# वार्षिक प्रतिवेदन
# Annual Report
## 2022-23

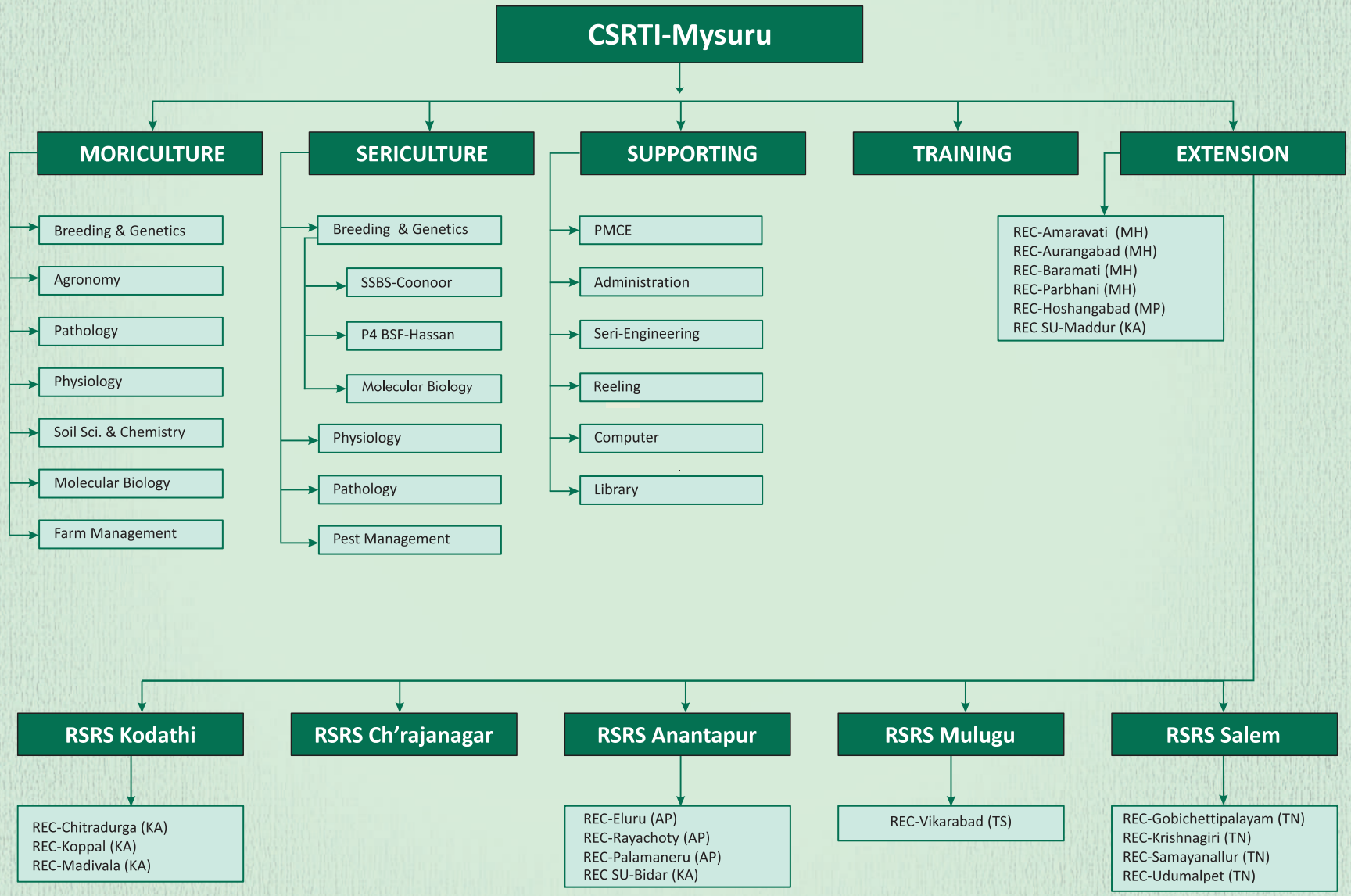

केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान

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

# CSRTI-Mysuru Organizational set-up-2022-23



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# ANNUAL REPORT

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***प्रकाशक***
डॉ. एस. गाँधी दास
निदेशक
केंरेअप्रसं, मैसूरु

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***हिंदी अनुवाद***
सुश्री शचि. के

***पुस्तक लेआउट और सज्जा***
श्री जस्टिन कुमार जे

***मुद्रण***
सर्वश्री गुप्ता ऑफसेट प्रिंट्रस
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## Content

# प्रस्तावना

केंद्रीय रेशम उत्पादन अनुसंधान और प्रशिक्षण संस्थान, मैसूरु रेशम उत्पादन अनुसंधान, विस्तार और मानव संसाधन विकास के क्षेत्र में उत्कृष्ट योगदान हेतु उपलब्ध संसाधनों को योजनाबद्ध तरीके से और प्रभावी ढंग से उपयोग करने हेतु प्रयासरत है । संस्थान द्वारा बनाए गए कार्यक्रम और संचालित परियोजनाएं उन आदर्शों के अनुरूप हैं जिनके आधार पर केंद्रीय रेशम बोर्ड ने राज्यों और देश के संभावित क्षेत्रों में उच्च गुणवत्ता वाले द्विप्रज रेशम उत्पादित करने के लक्ष्य निर्धारित किए हैं। हाल ही में, संस्थान ने विभिन्न कृषि-जलवायु और मृदा स्थितियों के लिए उपयुक्त शहतूत किस्में विकसित करने के उद्देश्य से परियोजनाएं प्रारंभ की है ताकि व्यवसाय के स्तर पर उत्पादकता बढ़ाई जा सके। शहतूत अनुसंधान क्षेत्र में, संस्थान उच्च उपज क्षमता वाले कुछ जीनोटाइप की पहचान करने में सक्षम रहा । पहली बार, शोधकर्ताओं ने वर्ष 1971-2021 की अवधि के लिए 20-वर्ष और 100-वर्ष के समय पैमाने, यानी, GTP20 और GTP100 के लिए भारतीय शहतूत उत्पादन प्रणाली के लिए वैश्विक तापमान परिवर्तन क्षमता का अनुमान लगाया। संस्थान द्वारा वृक्ष शहतूत कृषि के लिए एक उर्वरक खुराक विकसित की गई । मूल विगलन रोग के खिलाफ कवक और जीवाणु विरोधी सूक्ष्मजीव समुदाय ने रोग के प्रबंधन में सकारात्मक परिणाम दर्शाए हैं।

रेशमकीट विकास अनुसंधान परियोजनाएं "निम्न लागत पर उच्च आय" के विचार के साथ रेशम उत्पादन किसानों की आय बढ़ाने के लिए उच्च उत्पादकता पर जोर दे रही हैं। प्रजनकों ने बेहतर रेशम गुणवत्ता वाले छे बहुप्रज वंश विकसित किए हैं; उनमें से कुछ 3ए-ग्रेड रेशम उत्पादित करने में सक्षम हैं। नव विकसित द्विप्रज द्वि संकर बीएफसी1 x बीएफसी 10 आर्थिक विशेषताओं और गुणवत्ता प्राचलों के संबंध में काफी संभावनाएं दर्शाता है। बहु विषाणु सहनशील द्वि संकर आर.डी1एन1 अत्यधिक आशाजनक है, और द्विप्रज रेशम कोसा उत्पादन की समग्र उत्पादकता में सुधार किया जा सकता है। संस्थान फसल सुरक्षा उपायों पर भी जोर देता है क्योंकि अब तक गौण माने गए कई कीट प्रमुख कीट बनकर फसलों को क्षति पहुंचा रहे हैं । स्वस्थ रेशमकीट फसल उत्पादन सुनिश्चित करने की दृष्टि से प्रत्येक रसायन की प्रभावकारिता की जांच करके नए प्रभावशाली रसायनों और उत्पादों का चयन किया गया है।

संस्थान के विभिन्न बहुप्रशंसित प्रशिक्षण कार्यक्रमों के तहत 2262 व्यक्तियों को प्रशिक्षित करके इस उद्देश्य के लिए निर्धारित लक्ष्य से अधिक प्रशिक्षण देकर सराहनीय कार्य किया है। संस्थान द्वारा प्रतिष्ठित आईटीईसी प्रशिक्षण कार्यक्रम भी सफलतापूर्वक चलाया गया। समूह संवर्धन कार्यक्रम (सीपीपी), जो एक दशक से अधिक समय से चलाए जा रहे हैं, भारत में द्विप्रज कोसा उत्पादन के आंकड़ों में वृद्धि लाई। संस्थान ने क्षेरेअकें, अविकें और अविकें उप इकाइयों के माध्यम से विभिन्न राज्यों में कई विस्तार संचार कार्यक्रमों के अलावा, चार रेशम कृषि मेला, सेरि विज्ञान दिवस और राजभाषा तकनीकी सेमिनार आयोजित किया है।

जलमग्न किण्वन प्रोद्योगिकी का उपयोग करके कीट शल्कों से काइटिन निष्कर्षण की प्रक्रिया की खोज संस्थान को गौरवान्वित किया है जिसके लिए एकस्व (पेटेन्ट) प्राप्त करने हेतु आवेदन प्रस्तुत किया गया है । रेशमकीटों के झाडन हेतु एक डस्टिंग मशीन और रेशमकीटपालन हेतु ट्रे की सफाई और विसंक्रमण करने की मशीन के लिए दो एकस्व (पेटेंट) प्राप्त हुए। पोषण का व्यावसायीकरण कार्य दो और कंपनियों को सौंप दिया गया। इसके अलावा, रेशमकीट प्यूपा पृथक्करण के लिए स्व समायोजित अधिक कोण ऑटो-एडस्टेड ऑबट्यूस एंगल कोसा कर्तन मशीन का लाइसेंस तमिलनाडु के एक फर्म को दिया गया । मैं संस्थान के सभी शोधकर्ताओं को बधाई देता हूँ और उनकी सराहना करता हूँ जिन्होंने मानव संसाधन की कमी के बावजूद कई चुनौतियों का सामना करके संस्थान के लिए कई उपलब्धियां प्राप्त करने हेतु उत्कृष्ट योगदान दिए । मैं वैज्ञानिक समुदाय से आग्रह करता हूँ कि अनुसंधान के क्षेत्र में निरंतर प्रयास करते रहें ताकि संस्थान और ऊंचाइयों को छू सके ।

डॉ. एस. गाँधी दास
निदेशक

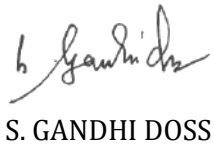
# Foreword

In pursuit of excellence in the field of sericulture research, extension, and human resources development, the Central Sericultural Research and Training Institute, Mysuru has been striving hard to channelize and effectively utilize the resources at its disposal. The Institute's programmes and projects do commensurate with the ideals on which the Central Silk Board has set the targets for achieving high-quality bivoltine sericulture across the states and potential areas of the country. In the recent past, the Institute has taken up a project with the aim of developing mulberry varieties suitable for different agro-climatic and soil conditions so as to increase the productivity of the avocation. In the mulberry research field, the Institute was able to identify certain genotypes with higher yield potential. For the first time, the researchers made an estimation of the global temperature change potential for the Indian mulberry production system for a 20-year and 100-year time scale, i.e., GTP20 and GTP100, for a period of 1971-2021. A fertilizer dose for tree mulberry cultivation was developed by the Institute. A fungal and bacterial antagonistic microbial consortium against root rot disease has shown positive results in managing the disease.

The research projects in the silkworm improvement programmes place emphasis on higher productivity to augment the income of sericulture farmers with lower input costs and higher returns. The breeders have developed six multivoltine lines with improved silk quality; some of them are capable of producing 3A-grade silk. The newly developed bivoltine double hybrid BFC1 x BFC10 shows great potential with respect to economic traits and quality parameters. The multi-viral-tolerant double hybrid RDIN1 is highly promising, and the overall productivity of bivoltine silk cocoon production could be improved. The Institute also gives thrust to crop protection measures as many pests, hitherto considered minor ones, have become major pests and are damaging crops. Many new chemicals and products are screened for their efficacy with the baseline concern of ensuring healthy silkworm crop production while probing the efficacy of each chemical.

The well-acclaimed training programmes of the Institute have done a commendable job by training 2262 persons under various programmes and in the process, exceeding the target set for the purpose. The prestigious ITEC training programme was also successfully carried out by the Institute. The CPP programmes, which have been carried out for over a decade, continue to inspire production figures with respect to bivoltine cocoon generation in India. The Institute has organized four Resham Krishimelas in different states, conducted a Seri Vigyan day, and conducted a Hindi seminar, apart from many extension communication programmes across the states through the RSRSs, RECs, and REC-sub units.

The Institute takes pride in filing an application for patenting a process for the extraction of chitin from moth scales using submerging fragmentation technology. Two patents were awarded for a dusting machine for silkworms and a machine for cleaning and disinfecting trays for rearing silkworms. The commercialization of Poshan was given to two more companies. Also, an auto-adjusted obtuse-angle cocoon machine for silkworm pupal separation was licenced to a firm in Tamil Nadu. It is my privilege to congratulate and appreciate the researchers involved in achieving many feats for the Institute, despite facing a lot of challenges amidst human resource constraints, and I call upon the scientific fraternity to strive for better heights in taking the Institute to higher levels of excellence.



S. GANDHI DOSS
DIRECTOR

# के रे अ प्र सं, मैसूरु के बारे में

केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, मैसूरु की स्थापना केंद्रीय रेशम बोर्ड, वस्त्र मंत्रालय, भारत सरकार के नियंत्रण में वर्ष 1961 में सर्वप्रथम चन्नपट्टणा में किया गया 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 (केंं रे अ प्र सं)** के रूप में पुनर्नामकरण किया गया । यह संस्थान देश में रेशम उद्योग के विकास के लिए पिछले 60 सालों से अनवरत सेवाएं समर्पित कर रहा है ।आज यह संस्थान अनुभवी वैज्ञानिकों, समस्त आधुनिक सुविधाओं एवं अवसंरचनायुक्त रेशम उत्पादन अनुसंधान के उत्कृष्ट प्रमुख संस्थान के रूप में विख्यात है । केंरेअप्रसं, मैसूरु उच्च अध्ययन एवं उन्नत प्रशिक्षण केंद्र के रूप में मान्यता प्राप्त है । यह संस्थान कर्नाटक, आंध्रप्रदेश, तमिलनाडु, तेलंगाना, केरल, महाराष्ट्र एवं मध्यप्रदेश में शहतूत रेशम उद्योग के क्षेत्र में अनुसंधान एवं विकास संबंधी समग्र आवश्यकताओं की पूर्ति करता है। अभी तक इस संस्थान ने रेशम उत्पादन प्रौद्योगिकी के विभिन्न पहलुओं में 800 विदेशियों सहित करीब 53,000 व्यक्तियों को प्रशिक्षित किया है । यह संस्थान अनुसंधान, प्रशिक्षण एवं विस्तारण कार्य संचालित करने के अलावा राष्ट्रीय एवं अंतर्राष्ट्रीय अभिकरणों को परामर्श एवं सलाहकारी सेवाएँ भी प्रदान करता है ।

## दृष्टि

ग्रामीण विकास एवं उन्नयन हेतु रेशम संवर्धन में अनुसंधान एवं विकास संबंधी सेवाएं प्रदान करने वाले आदर्श संगठन के रूप में कार्य करने के अलावा विशेषकर उष्णकटिबंधीय देशों को ध्यान में रखते हुए देशी और वैश्विक स्तर पर मानव संसाधन का सृजन ।

## लक्ष्य

- उत्पादन लागत कम करने के साथ-साथ उत्पादकता एवं गुणवत्ता मे वृद्धि ।
- संसाधन की प्रभावी उपयोगिता हेतु पर्यावरण अनुकूल और गरीबों एवं महिलाओं की हितैषी परियोजनाएं विकसित करना ।
- हितधारकों की सामाजिक आर्थिक स्थिति में सुधार हेतु कम लागत वाली-नई प्रौद्योगिकियां विकसित करना ।
- गुणवत्तापूर्ण रेशम के उत्पादन में वृद्धि हेतु क्षेत्र में प्रभावी प्रौद्योगिकियां विकसित करके उन्हें लोकप्रिय बनाना ।
- हर पहलू से सम्बंधित मानव-संसाधन के विकास हेतु गतिविधियां संचालित करना ।

## अधिदेश

- विभिन्न कृषि-जलवायु स्थितियों/क्षेत्रों के लिए उचित शहतूती रेशम उत्पादन प्रौद्योगिकियां विकसित करना ।
- विभिन्न विषयों पर आधारभूत एवं अनुप्रयुक्त अनुसंधान संचालित करना ताकि उपयुक्त प्रौद्योगिकियां विकसित की जा सके ।
- सिद्ध प्रौद्योगिकियों को क्षेत्र स्तर पर अपनाए जाने की क्षमता की जांच व सत्यापन करना ।
- विकसित प्रौद्योगिकियों का क्षेत्र स्तर पर प्रारंभिक प्रदर्शन ।
- मानव संसाधन विकास एवं प्रशिक्षण कार्यक्रम का संचालन ।
- शहतूत रेशम उत्पादन से संबंधित कीटपालन उपस्कर, मशीन, उत्पाद एवं केंरेबो के संस्थानों में विकसित या अन्य एजेंसियों द्वारा रेफर किए गए प्रौद्योगिकियों के परीक्षण केंद्र के रूप में कार्य करना ।
- सहयोगात्मक अनुसंधान एवं प्रौद्योगिकी स्थानांतरण हेतु राज्य सरकारों, स्वैच्छिक संगठनों, गैर सरकारी संगठनों, विश्वविद्यालयों और अन्य राष्ट्रीय संस्थानों से समन्वयन करना ।

## संगठनात्मक रचना

केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, मैसूरु, देश में रेशम उत्पादन अनुसंधान विकास कार्य में लगा हुआ सबसे बड़ा और अधिक वैविध्यपूर्ण संस्थान है जो कृषि इंजीनियरों, समाजशास्त्रियों एवं अर्थशास्त्रियों सहित करीब 80 वैज्ञानिकों से समर्थित है । 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 से कार्य कर रहे हैं । अनुसंधान व विकास कार्यकलाप और प्रौद्योगिकी विकास कार्य चार प्रमुख प्रभागों यथा परपोषी पादप उत्पादन एवं संरक्षण, रेशमकीट उत्पादन एवं संरक्षण, विस्तार एवं प्रशिक्षण 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 सेवा का भी उपयोग करता है । योजना, अनुवीक्षण, समन्वयन एवं मूल्यांकन कक्ष की सहायता से निदेशक, संस्थान और इसके संबद्ध एककों के अनुसंधान व विकास कार्यकलापों की प्रगति का अनुवीक्षण करते हैं । पी-4 मूल बीज फार्म, हासन एवं उप रेशमकीट प्रजनन केंद्र, कूनूर यथाक्रम प्रजनक स्टॉक एवं का प्रजनन स्टॉक का अनुरक्षण करते हुए रेशमकीट प्रजनन कार्यक्रमों में समर्थन दे रहे हैं । संस्थान को पीपीवी व एफआरए, नई दिल्ली द्वारा शहतूत उपजातियों के नोडल केंद्र के रूप में मान्यता प्राप्त हुई है । संस्थान द्वारा नियमित रूप से पुस्तकें, बुल्लेटिन, पुस्तिकाएं एवं तकनीकी पैम्फलेट और रेशम उत्पादन विज्ञान पर दस्तावेज़ी साहित्य सेरिडॉक प्रकाशित किए जा रहे हैं ।

**विस्तार कार्य-तंत्र**

प्रयोगशाला उपलब्धियों के मान्यकरण एवं उन्हें क्षेत्र में प्रभावी ढंग से स्थानांतरित करने को सुगम बनाने हेतु इस संस्थान के तीन स्तरीय विस्तारण कार्य-तंत्र हैं - क्षेत्रीय रेशम उत्पादन अनुसंधान केंद्र (क्षे रे अ कें), अनुसंधान विस्तारण केंद्र (अ वि कें) और उप एकक । दक्षिणी राज्यों के मुख्य रेशम उत्पादन अंचलों में स्थित क्षेत्रीय रेशम उत्पादन अनुसंधान केंद्र क्षेत्र विशेष के अनुकूल और प्रायोगिक अनुसंधान संचालित करते हैं । कृषकों को प्रशिक्षित करने और बुनियादी स्तर पर विस्तार सेवाएं उपलब्ध कराने के अतिरिक्त क्षेत्रीय आवश्यकताओं के लिए उपयुक्त प्रौद्योगिकियों की सिफारिश करने हेतु प्रौद्योगिकी परीक्षण किया जाता है । लाभार्थियों को प्रौद्योगिकी का स्थानांतरण करना और उनकी सहायता के लिए सभी प्रौद्योगिक निवेश देने का उत्तरदायित्व अनुसंधान विस्तारण केंद्र एवं उप-एककों का है । महाराष्ट्र एवं मध्यप्रदेश के साथ दक्षिण राज्यों में भी द्विप्रज रेशम उत्पादन को बढ़ावा देने हेतु कें रे अ प्र सं, मैसूरु, समूह संवर्धन कार्यक्रम (सीपीपी) और सं ग्रा सं का (आई.वी.एल.पी) केंद्रों का समन्वयन करता है । राज्य रेशम उत्पादन विभागों के पदधारियों के समन्वयन से संबंधित राज्यों में प्रौद्योगिकियों का प्रभावी स्थानांतरण किया जाता है ।

**प्रशिक्षण केंद्र**

इस संस्थान को उष्णकटिबंधीय रेशम उत्पादन के क्षेत्र में प्रशिक्षित मानव संसाधन विकसित करने हेतु अग्रगामी केंद्र के रूप में मान्यता प्राप्त है । यह राष्ट्रीय एवं अंतर्राष्ट्रीय स्तर पर उष्णकटिबंधीय रेशम उत्पादन में प्रशिक्षण देता 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 । यह संस्थान ग्रमीण गरीब लोगों, कमज़ोर वर्गों और महिला रेशम उत्पादकों के सामाजिक-आर्थिक विकास के लिए और प्रौद्योगिक सशक्तिकरण हेतु जैव प्रौद्योगिकी विभाग एवं विज्ञान व प्रौद्योगिकी विभाग, भारत सरकार द्वारा प्रायोजित विभिन्न प्रशिक्षण कार्यक्रम संचालित करते है। यह संस्थान राज्य रेशम उत्पादन विभागों की मानव संसाधन विकास आवश्यकताओं को पूरा करने के अलावा जापान अंतर्राष्ट्रीय सहकारिता अभिकरण(जाइका) और विदेश मंत्रालय, भारत सरकार(आईटीईसी) जैसे संगठनों के माध्यम से अंतर्राष्ट्रीय छात्रों/कर्मिकों को रेशम उत्पादन प्रशिक्षण कार्यक्रम संचालित कर रहा है । प्रशिक्षण स्कंध में दृश्य-श्रव्य शिक्षण उपस्करों से सुसज्जित कक्षाएँ और प्रशिक्षणार्थियों को ठहराने हेतु छात्रावास सुविधाएँ 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 की अभिकल्पना एवं विकास तथा मशीनों/उपस्करों की संरचना को समर्थित करने हेतु सभी सुविधाओं से युक्त रेशम उत्पादन अभियांत्रिकी प्रभाग ।
- संबद्ध एककों, रेशम उत्पादन विभागों और अन्य संगठनों के साथ तेजी से संप्रेषण सुनिश्चित करने हेतु विडियो सम्मेलन स्टुडियो ।
- कंप्यूटर सेन्टर द्वारा लान के माध्यम से प्रिंट / फाइल शेयर समर्थन सहित सभी को इन्टरनेट कनेक्शन दिया जाता है ।
- पुस्तकालय सेवाएँ (11335 पुस्तकें, 8239 वैज्ञानिक पत्रिकाओं का बंध खंड, 5 अंतर्राष्ट्रीय इलेक्ट्रॉनिक पत्रिकाएँ, 6 इंडियन एलेक्ट्रॉनिक पत्रिकाएं, 36 इंडियन एवं अंतर्राष्ट्रीय पत्रिकाओं की मुद्रित प्रतियां, 320 शोध पत्र, 55 पीएचडी प्रबंध; तकनीकी रिपोर्ट एवं सीडी रॉम डेटा बेस-एग्रिस ।

# ABOUT CSRTI-MYSURU

The Central Sericultural Research and 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 Mysuru province and later was shifted to Mysuru in the year 1963. With the inclusion of training component, the Institute was renamed as Central Sericultural Research & Training Institute (CSRTI), in the year 1965. The Institute has completed 60 years of dedicated service for the development of sericulture industry in the country and has the distinction of being the premier institution for tropical sericultural research par excellence with modern facilities and infrastructure including experienced scientific and technical personnel. CSRTI-Mysuru is recognized as a center for higher learning and advanced training. It caters to the need of on farm mulberry sericulture sector in Karnataka, Andhra Pradesh, Tamil Nadu, Telangana, Kerala, Maharashtra and Madhya Pradesh. CSRTI-Mysuru has imparted training to more than 53,000 persons including 800 foreign nationals in various aspects of sericulture technology. Besides conducting research, training and extension activities, the institute also offers consultancy and advisory services to national and international agencies.

**Vision**

To be a model organization for providing R&D services in sericulture for rural development and upliftment besides generation of human resources both at domestic and global level with special reference to tropical countries.

**Mission**

- To improve the productivity and quality of silk, besides reducing the cost of production
- To generate pro-environment, pro-poor and pro-women technologies for effective resource utilization
- To develop low cost innovative technologies for overall improvement of socio-economic condition of stakeholders
- To promote and popularize the cutting edge technologies in the field to increase production base of quality silk.
- To undertake Human Resource Development at all levels of operation

**Mandate**

- To develop mulberry sericultural technologies suitable to different agro-climatic conditions /zones.
- To conduct basic and applied research in various disciplines leading to the development of appropriate technologies
- To test verify the proven technologies at field level for their adoptability
- To conduct front-line demonstration of developed technologies in the field
- To conduct human resource development and training programmes
- To serve as a testing centre for mulberry sericulture related rearing equipments, machines, products and technologies evolved in CSB Institute or referred by other agencies
- To coordinate with State Govts., Voluntary organisations NGOs, universities and other National institutes for collaborative research and technology transfer.

**Organizational Setup**

CSRTI-Mysuru is the largest and most diversified institution engaged in sericulture R & D in the country, supported by 80 scientists of various disciplines including agricultural engineers, sociologists and economists. These personnel working in close coordination for the development of suitable technologies and its transfer through the main institute and its nested units 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 major divisions: Host Plant Production & Protection, Silkworm Production & Protection, Extension and Training. CSRTI-Mysuru has technical and administrative staff to undertake 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. The P4 BSF, Hassan and SSBS, Coonoor support in the silkworm breeding programmes by maintaining breeders stock. The institute is recognized as a nodal centre by PPV & FRA, New Delhi, for mulberry varieties. Institute regularly publishes books, bulletins, leaflets and technical pamphlets helpful for the stake holders. The institute publishes Seridoc a half yearly compilation, presenting the research papers published in sericulutral science across the world.

**Extension Network**

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

**Training Centre**

CSRTI-Mysuru is recognized as flagship centre for generation of trained human resource in tropical sericulture at national and international level. The institute also conducts training programmes sponsored by DBT, DST and Ministry of Textiles (Govt. of India) for socio-economic and technological empowerment of 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 candidates through various organizations such as JICA and Ministry of External Affairs, Govt. of India (ITEC). The training hub houses well-equipped classrooms with hostel facilities for the trainess.

**Infrastructure Facilities**

- Well-equipped laboratories, well maintained 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 demonstrate the concept of CRC
- Engineering Division with excellent facilities to support designing, development and fabrication of machines/equipments suitable for sericulture

- Video Conference facility ensure faster communication with nested units, DOSs and other organizations
- Computer center provides internet connectivity to all through LAN with print/file share support
- Library Services includes 11335 books; 8239 bound volumes of scientific journals; 5 Internationl Electronic journals; 6 Indian Electronic journals and 36 Indian & International print version journals; 320 dissertations; 55 Ph.D. theses; technical reports and CD-ROM database-AGRIS.

# मुख्यांश

**परपोषी पादप**

- झाडीनुमा पौधारोपण प्रणाली के अंतर्गत चयनित त्रिगुणित जीनोटाइप टी आर आई 10 और टी आर आई 8 ने मानक उपजातियों जी4 और विशाला की तुलना में अधिक पत्ती उपज दर्शाई ।
- अखिल भारतीय शहतूत समन्वित प्रयोग चरण IV के अंतर्गत शहतूत पत्ती उपज पर किए परीक्षण में सीएमवाई-01 का निष्पादन मानक उपजातियों की तुलना में बेहतर रहा ।
- मूल विगलन रोग पैदा करने वाले फफूंद फ्यूसेरियम सोलानी और लासियोडिप्लोइडिया थियोब्रोमे के प्रति मध्यम प्रतिरोधी जीनोटाइप, सीबीपी01 की पहचान की गई ।
- वर्ष 1971 से 2021 तक की अवधि के लिए भारतीय शहतूत उत्पादन प्रणाली के संबंध में वैश्विक तापमान परिवर्तन क्षमता जीटीपी 20 और जीटीपी 100 (समय मान 20-वर्ष और 100-वर्ष के लिए) का पहला आकलन किया गया ।
- वर्ष 1971-2021 की अवधि के लिए शहतूत उत्पादन प्रणाली में प्रतिक्रियाशील एन प्रजातियों के कुल तापन और शीतलन प्रभाव का आकलन किया गया ।
- वृक्ष शहतूत कृषि के लिए अनुशंसित उर्वरक की मात्रा एनपीके @ 258:103:103 ग्राम/पौधा/वर्ष+15 किलो गोबरखाद/ पौधा/ वर्ष है ।
- शहतूत पत्ती उत्पादन बढाने हेतु मान्यकृत ड्रिप फर्टिगेशन तकनीक द्वारा पारंपरिक विधि की तुलना में पत्ती उपज में 17% वृद्धि हुई और उर्वरक खुराक में 25% बचत हुई।
- मूल विगलन रोग उत्पन्न करने वाले फफूंदी रोगजनकों के विरुद्ध विकसित फफूंदी और जीवाणु विरोधी माइक्रोबियल कंसोर्टिया ने 68.89 से 88.89% तक मायसेलियल विकास अवरोध दर्शाया।
- शहतूत उपजातियों के मामले में असहमति होने की स्थिति में रेफरन्स और कैंन्डिडेट उपजातियों की आसान और तेज़ पहचान के लिए छह एसएसआर मार्करों यथामलएसएसआर26, एमओएसओ288, मुलएसएसआर96बी, एम2एसएसआर87, एम2एसएसआर68 और एमओएसओ340-2 का उपयोग करके कृषिजोपजाति (कल्टीवेर) पहचान आरेख की संरचना की ।
- पीपीवी व एफआर अधि नियम 2001 के अधीन पंजीकृत शहतूत उपजातियों के लिए पंजीकरण प्रमाणपत्र - जी-2: आरईजी/2021/0048; आरसी-1: आरईजी/2021/0051; एआर-12: आरईजी/2021/0052; सहाना: आरईजी /2021/0049 और एमएसजी-2: आरईजी /2021/0050 प्राप्त हुए ।
- हेक्साकोनोज़ोल 5% ईसी 1 एमएल/एल जल उपचार से यूरेडोस्पोर अंकुरण (शहतूत में पर्ण शीर्णता कारण) का प्रतिशत मानक (96.15) की तुलना में 3.37 तक कम हो गया और उपचार के पांच दिन बाद रेशमकीट के लिए सुरक्षित पाया गया।
- शहतूत के रसभक्षी कीटों के विरुद्ध जैविक कीटनाशक गियाजेन का 3 एमएल/एल पानी में उपचार करने के 5 दिन बाद सुरक्षित पाया गया।

- 3 एमएल/एल पानी में कार्बनिक माइटसाइड पावर प्लांट ऑर्गोमाइट को उपचार के 5 दिनों के बाद रेशम कीड़ों के लिए सुरक्षित पाया गया।
- कर्नाटक, तमिलनाडु और आंध्र प्रदेश के शहतूत किसानों को पत्ती रोलर, डायफेनिया पुलवेरुलेंटलिस के प्रबंधन के लिए अंडा परजीव्याभ, ट्राइकोग्रामा चिलोनिस की 16 यूनिटों और लार्वीय परजीव्याभ, ब्रैकोन ब्रेविकोर्निस की 4 यूनिटों की आपूर्ति की गई।
- कर्नाटक और तमिलनाडु के किसानों को शहतूत थ्रिप्स, स्यूडोडेंड्रोथ्रिप्स मोरी के जैविक नियंत्रण के लिए परभक्षी ब्लैप्टोस्टेथस पैलेसेन्स के 6 यूनिटों (1 यूनिट = 1000 ग्रब/वयस्क) की आपूर्ति की गई।

**रेशमकीट**

- बेहतर रेशम गुणवत्ता वाले छह बहुप्रज रेशमकीट वंश विकसित किए गए । एमएएस-3 x बीएम2 संयोजन से 3ए ग्रेड रेशम प्राप्ति दर्ज की गई । एमएएस-3 का जनक एमवी1 x एस8 है ।
- बहुप्रज द्विसंकर सीबीडीएच-4 (एचबी4 × एमओ6 × एफसी2) का निष्पादन बेहतर रहा, इसके बाद सीबीडीएच-1 (एनडी10 × पीएम × एफसी2) और सीबीडीएच-2 (पीएम × एनडी10 × एफसी2) का निष्पादन अच्छा रहा जिन्होंने अंड प्राप्ति में मानक (पीएम × सीएसआर2) की तुलना में 5-7% वृद्धि दर्शाई । बीजागार कार्यकलापों के दौरान कोसों के रंग में कोई भिन्नता और अंडों की शीतनिष्क्रियता प्रकट नहीं हुआ और बेहतर गुणवत्ता वाले 2ए ग्रेड के रेशम का उत्पादन किया ।
- दक्षिणी राज्यों में एक नए द्विप्रज द्विसंकर (बीएफसी1 x बीएफसी10) का मूल्यांकन करने पर 68-72 किलोग्राम/100 डीएफएलएस औसत कोसा उपज ; 23.4% कोसा कवच अनुपात ; 5.5 से 6.0 रेंडिटा और 2ए-3ए ग्रेड का रेशम दर्ज किया गया ।
- विषैले तत्वों और कीटनाशक अवशेषों से मुक्त कोसा, सेरिसिन और फ़ाइब्रोइन के जैविक उत्पादन के लिए मानक संचालन प्रक्रिया विकसित की गई ।
- विषालुता पर किए अध्ययन से पता चला कि 24 घंटे के ऊष्मायन के बाद सेरिसिन, फ़ाइब्रोइन और रेशम में एल-929 सेल लाइनों पर कोई विषालुता नहीं है।
- प्यूपा तेल निष्कर्षण हेतु एक प्रक्रिया विकसित की गई और आंशिक क्रिस्टलीकरण विधि द्वारा एएलए (α-लिनोलेनिक एसिड) की सांद्रता 48% तक बढ गई।
- किण्वन माध्यम में एक घटक के रूप में रेशमकीट प्यूपे का उपयोग करके प्रोटियेज़ एनजाइम का उत्पादन किया गया ।
- शहतूत रेशमकीट प्यूपा के प्रोटिओमिक्स अभिलक्षणन के तहत रेशमकीट प्यूपा में कुल 5882 प्रोटीन पाए गए।
- शहतूत रेशमकीट प्यूपा से मानव खाद्य उत्पाद पास्ता, कुकीज़, पेय मिश्रण और मेयोनेज़ तैयार किए गए । एरी प्यूपे से भुने और मसालेदार एरी प्यूपा और एरी अचार उत्पाद तैयार किए गए ।
- रेशमकीट प्यूपा आधारित मुर्गी और मछली आहार सूत्रीकरण तैयार किया गया और आहार संबंधी परीक्षण पूरा किया गया ।
- आंध्र प्रदेश, कर्नाटक और तमिलनाडु के वाणिज्यिक चॉकी पालन केंद्रों में चॉकी आहार पूरक सूत्रीकरण (सीएफएसएफ) का मूल्यांकन किया गया और लार्वा नष्ट में 3.97% से 1.56% तक एवं असमान लार्वा में 4.35% से 1.59% तक कमी हुई और कोसा उत्पादकता में 8.12% वृद्धि हुई ।
- पहचानी गई दवा (डेक्लाटासविर) रेशमकीट में बी एम एन पी वी के गुणन पर P13KAkt मार्ग को रोकती है।
- कुछ विशिष्ट जीन जो पी आई 3के-एकेटी मार्गे की अभिव्यक्ति में शामिल हैं, आरटीक़्यू-पीसीआर विश्लेषण में देखे गए।
- बहु विषाणु सहनशील द्वि संकर आर डी 1 ने सभी मौसम में एफ सी 1 × एफ सी 2 (91.4%) की तुलना में उच्च स्तरीय दर दर्शाई ।
- शहतूत पत्तों तथा मृदा में कीटनाशक संदूषण का पता लगाने के लिए एक पेपर स्ट्रिप विधि विकसित की गई ।
- रेशमकीट प्यूपा के लिंग वर्गीकरण और छँटाई के लिए एक ऑप्टिकल उपकरण विकसित किया गया और इसका प्रारंभिक परीक्षण पूरा कर लिया गया ।

- पीड़क प्रबंधन प्रयोगशाला (पीएमएल) ने रेशमकीट पीड़क, उजी मक्खी के प्रबंधन के लिए नेसोलिनक्स थाइमस के 1379 पाउच वितरित किए ।

**विस्तारण**

- आंध्र प्रदेश, कर्नाटक, केरल, तमिलनाडु, तेलंगाना, महाराष्ट्र के 26 मेगा क्लस्टरों से द्विप्रज समूह संवर्धन कार्यक्रम (सीपीपी) के अंतर्गत 6166.4 मीट्रिक टन द्विप्रज कच्चा रेशम उत्पादित किया गया और स्वतंत्र क्षेत्र (नॉन कैप्टीव) में 522 लाख रोग मुक्त बीज चकत्तों से 77.88 किग्रा/100 डीएफएल औसत कोसा उपज प्राप्त हुई ।
- 15,968 किसानों को सम्मिलित करते हुए 21,661 एकड़ में नया शहतूत पौधारोपण किया गया ।
- किसानों, छात्रों, विदेशी प्रतिनिधियों और अन्य लोगों सहित कुल 4824 आगंतुकों ने संस्थान का दौरा किया ।
- 15 दिसंबर 2022 को 'बदलती जलवायु परिस्थितियों में शहतूत और रेशमकीट रोग प्रबंधन' पर एक कार्यशाला का आयोजन किया गया ।
- आंध्र प्रदेश, कर्नाटक, तमिलनाडु और तेलंगाना राज्यों में 4 रेशम कृषि मेले का आयोजन किया ।
- संस्थान के कार्यकलापों से परिचित कराने हेतु 22 फरवरी 2023 को सेरी विज्ञान दिवस का आयोजन किया गया और 10 स्कूलों के छात्रों ने भाग लिया ।
- 23 फरवरी 2023 को हिंदी में एक तकनीकी सेमिनार आयोजित किया गया और संस्थान के वैज्ञानिकों द्वारा हिंदी में तेरह तकनीकी शोध पत्र प्रस्तुत किए गए ।

**प्रशिक्षण**

- क्षमता निर्माण एवं आवश्यकता आधारित प्रशिक्षण (सीबीटी) और (एनबीटी) (108% उपलब्धि) सहित विभिन्न प्रशिक्षण कार्यक्रमों के तहत 2262 व्यक्तियों को प्रशिक्षित किया गया।
- "शहतूत रेशमकीटपालन पर सेरीकल्चर और रेशम उद्योग" नामक एक आईटीईसी प्रशिक्षण, 10 देशों के 26 अंतरराष्ट्रीय प्रशिक्षणार्थियों के लिए केंरेअप्रसं, मैसूर में 6 नवंबर से 3 दिसंबर 2022 तक चार सप्ताह के लिए आयोजित किया गया ।
- विभिन्न विश्वविद्यालयों/कॉलेजों के 71 छात्रों को पंजीकृत किया गया और संस्थान के वैज्ञानिकों के मार्गदर्शन में उनकी स्नातकोत्तर उपाधि के एक भाग के रूप में परियोजना पूरी की ।

**एकस्व और वाणिज्यीकरण**

**एकस्व हेतु प्रस्तुत आवेदन**

- 'जलमग्न किण्वन प्रौद्योगिकी द्वारा शलभ के शल्क से काइटिन निकालने की प्रक्रिया' नामक अभिनवकरण हेतु एकस्व प्राप्त करने तथा वाणिज्यीकरण के लिए आवेदन दायर किया गया ।

**प्राप्त एकस्व**

- "रेशमकीटों के लिए डस्टिंग मशीन" और "रेशम कीटपालन में ट्रे की सफाई और विसंक्रमण हेतु एक मशीन" नामक अभिनवकरण हेतु एकस्व (यथाक्रम एकस्व सं 402483 और 394974) प्राप्त हुए ।

**वाणिज्यीकृत**

- पोषण - शहतूत में पोषक तत्वों की कमी दूर करने के लिए एक बहु-पोषक तत्व सूत्रीकरण हेतु दो फर्मों सर्वश्री आर.वी. सेरी एग्रोवेट, कोलार ( दिनांक: 13.06.2022 )और सर्वश्री सेरीकेयर, कोलार, (दि. 14.07.2022) को लाइसेंस दिया गया ।
- रेशमकीट प्यूपा पृथक्करण के लिए स्व समायोजित अधिक कोण (ऑटो-एडजस्टेड ऑबट्यूज़ एंगल) कोसा कर्तन मशीन का लाइसेंस (दिनांक: 22.11.2022) सर्वश्री एनएसटीजी इंडिया प्रा. लिमिटेड, कांचीपुरम, तमिलनाडु को दिया गया ।

## लाइसेंस का नवीकरण

- **पोषण:** शहतूत में पोषक तत्वों की कमी दूर करने के लिए एक बहु-पोषक तत्व सूत्रीकरण - के लिए मैसर्स सेरी-कॉन टेक्नोलॉजीज, बेंगलुरु को दिए लाइसेंस का राष्ट्रीय अनुसंधान विकास निगम नई दिल्ली के माध्यम से (दिनांक 20.09.2022) नवीकरण किया गया।

## SALIENT ACHIEVEMENTS

### HOST PLANT

- Identified triploid genotypes TRI-10 and TRI-8 show higher leaf yields than the check varieties G4 and Vishala under bush plantation systems.
- Under AICEM phase IV, genotype CMY-01 has outperformed check varieties for mulberry leaf yield.
- Identified one genotype, CBP01, which is moderately resistant to root rot causing fungi *Fusarium solani* and *Lasiodiploidea theobromae*.
- The first estimation of Global temperature change potential for the Indian mulberry production system for a 20-year and 100-year time scale, i.e., GTP20 and GTP100, has been done for a period of 1971-2021.
- Total warming and cooling effects of the reactive N species in the mulberry production system have been estimated for the period 1971-2021.
- Recommended fertilizer dose for tree mulberry cultivation as: NPK @ 258:103:103 g/plant/ year + 15 kg FYM/plant/year.
- Validated drip fertigation technology for the improvement of mulberry leaf production with an improvement of 17% leaf yield in comparison with conventional methods and saved 25% fertilizer dose.
- Fungal and bacterial antagonistic microbial consortia against root rot disease causing fungal pathogens, showed 68.89 to 88.89% mycelial growth inhibition.
- Generated cultivar identification diagram using six SSR markers *viz*., MulSSR26, MoSo288, MulSSR96B, M2SSR87, M2SSR68 and MoSo340-2 for easy and rapid identification of reference and candidate varieties in case of any conflict.
- Mulberry varieties registered under PPV & FR Act 2001 received the certificate of registration. G-2: REG/2021/0048; RC-1: REG/2021/0051; AR-12: REG/2021/0052; Sahana: REG/2021/0049 and MSG-2: REG/2021/0050.
- Hexaconozole 5% EC 1 mL/L of water treatment reduced the percentage of uredospore germination (causing leaf rust in mulberry) to 3.37 compared to control (96.15) and found to be safe to silkworm after 5 days of treatment.
- The organic insecticide Gaiagen against sap feeding pests of mulberry at 3 mL/L of water was found safe 5 days after treatment.
- The organic miticide Power Plant Orgomite at 3 mL/L of water was found safe for silkworms after 5 days of treatment.

- Supplied 16 units of egg parasitoid, *Trichogramma chilonis* and 4 units of larval parasitoid, *Bracon brevicornis* for the management of leaf roller, *Diaphania pulverulentalis* to mulberry farmers of Karnataka, Tamil Nadu and Andhra Pradesh.
- Supplied 6 units of (1 unit = 1000 grubs/adults) predator *Blaptostethus pallescens* for the biological control of mulberry thrips, *Pseudodendrothrips mori* to farmers of Karnataka and Tamil Nadu.

## SILKWORM

- Developed six multivoltine silkworm lines with improved silk quality. The combinations MAS-3 x BM2 showed 3A grade silk. The parentage of MAS-3 is MV1 x S8.
- The Multivoltine double hybrids CBDH-4 (HB4 × MO6 × FC2) performed better followed by CBDH-1 (ND10 × PM × FC2) and CBDH-2 (PM × ND10 × FC2) with an improvement in the egg recovery of 5-7% more over the ruling crossbreed (PM × CSR2). There is no cocoon colour variation and hibernation of eggs during grainage operations and has produced better quality silk with 2A grade.
- A new bivoltine double hybrid (BFC1 x BFC10) has been evaluated in Southern states, that showed an average cocoon yield of 68-72 kg/100 dfls; 23.4% shell ratio; 5.5 to 6.0 renditta and 2A-3A silk grade.
- Test hybrid TT21 x TT56 performed better in comparison with the ruling hybrids with 2A-3A grade silk.
- Developed Standard Operating Procedure for organic production of cocoon, sericin and fibroin free from toxic elements and pesticide residues.
- Toxicity studies revealed that Sericin, fibroin and silk had no toxicity on L-929 cell lines after 24 h incubation.
- A process was developed for extraction of pupae oil and concentration of ALA (α-Linolenic acid).
- Protease enzyme was produced using silkworm pupae as one of the ingredient in fermentation medium.
- Proteomics characterization of mulberry silkworm pupae was carried out.
- Human food products pasta, cookies, beverage mix and mayonnaise were prepared from mulberry silkworm pupae. Roasted and spiced eri pupae and eri pickle products were prepared using eri pupae.
- Silkworm pupae based poultry and fish feed formulations prepared and feeding trials completed.
- Chawki feed supplement formulation (CFSF) was evaluated in the commercial chawki rearing centres of Andhra Pradesh, Karnataka and Tamil Nadu and observed reduction in the missing larvae from 3.97% to 1.56%, the unequal larvae from 4.35% to 1.59% and cocoon productivity improved by 8.12%.
- Declatasvir inhibited the P13K-Akt pathway which support the BmNPV multiplication.
- In RT-qPCR analysis PI3K Gene expression was up regulated in the inoculated batch.
- The multi viral tolerant silkworm double hybrid RDIN1 has shown high pupation rate (97.4%) compared to FC1 x FC2 (91.4%) in all the seasons.
- Developed a paper strip method for the detection of pesticide contamination in mulberry leaf and soil.

- Developed an optical tool embedded silkworm pupal gender classification and sorting machine and completed the preliminary trials.
- The Pest Management Laboratory (PML) has distributed 1379 pouches of *Nesolynx thymus* for the management of silkworm pest, uzi fly.

## TRAINING

- Trained 2262 persons under various training programmes including CBT and NBT (108% achievement).
- An ITEC training entitled *Sericulture and Silk Industry* on mulberry silkworm rearing, was conducted for four weeks from 6th November to 3rd December 2022 at CSRTI, Mysuru to 26 international trainees from 10 countries.
- At the model commercial chawki rearing centre, 50,350 dfls were brushed and distributed to 395 farmers and recorded an average cocoon yield of 70 kgs/100 dfls.
- Registered 71 students from different universities/colleges and carried out their project work as a part of their masters' degree under the guide ship of scientists of the institute.

## EXTENSION

- Under Bivoltine Cluster Promotion Programme (CPP) 6166.4 MT bivoltine raw silk was produced from 26 Mega clusters in Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, Telangana, Maharashtra and non-captive area from 522 lakh dfls rearing with an average cocoon yield of 77.88 kg/100 dfls.
- New Mulberry plantation was taken up with 15,968 farmers covering 21,661 acres.
- Sensitized 23,683 sericulturists on new technologies through 283 extension communication programmes (ECP) in bivoltine rearing, mulberry and silkworm disease management.
- A total of 4824 visitors including farmers, students, foreign delegates and others visited the institute.
- Organized a workshop on *Mulberry and Silkworm Pest and Disease Management in Changing Climatic Conditions* on 15$^{th}$ December 2022.
- Conducted 4 *Resham Krishimelas* in Andhra Pradesh, Karnataka, Tamil Nadu and Telangana states.
- Conducted a *Seri Vigyan day* on 22$^{nd}$ February 2023 to enhance the visibility of the Institute and students from 10 schools participated.
- Conducted one technical seminar in Hindi on 23rd February 2023 and nine technical papers were presented in the seminar in Hindi.

## PATENTS AND COMMERCIALIZATION

### a. Patents filed

- Application filed for patenting and commercialization of innovation named Process for extraction of chitin from moth scales by submerging fragmentation technology.

### b. Patents Granted

- Two patents granted with Patent No. 394974 for the innovation "Dusting Machine for silkworms" and Patent No. 402483 for the innovation "A Machine for cleaning and disinfection of trays for rearing silkworms".

**c. Commercialized**

- Poshan - A multi-nutrient formulation for correcting the nutrient deficiencies in mulberry was licensed to two firms, 1. M/s. R.V. Seri Agrovet, Kolar - license date: 13.06.2022 & 2. M/s. Serio Care, Kolar - license date: 14.07.2022.
- Auto-adjusted obtuse angle cocoon cutting machine for silkworm pupal separation was licensed to M/S. NSTG India Pvt. Ltd., Kanchipuram, Tamilnadu - license date: 22.11.2022.

**d. License renewed**

- License was renewed for Poshan - A multi-nutrient formulation for correcting the nutrient deficiencies in mulberry through National Research Development Corporation New Delhi to M/s. Seri-Con Technologies, Bengaluru - date of license: 20.09.2022.

## राजभाषा कार्यान्वयन संबंधी गतिविधियाँ

केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, मैसूरु में वर्ष 2022-23 के दौरान राजभाषा नीति का पूर्णत: अनुपालन किया गया। राजभाषा अधिनियम की धारा3(3) का शत प्रतिशत अनुपालन सुनिश्चित किया गया । संस्थान में हर तिमाही में नियमित रूप से राजभाषा कार्यान्वयन समिति की बैठक का आयोजन कर राजभाषा प्रगति के बारे में समीक्षा की गई । हिंदी कार्यशालाओं का आयोजन, हिंदी दिवस/पखवाड़े का आयोजन,हिन्दी पत्रिका एवं तकनीकी साहित्य का प्रकाशन तथा हिंदी टिप्पण-आलेखन प्रोत्साहन योजना का कार्यान्वयन 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, लिफाफे, पहचान-पत्र, परिचय-पत्र आदि द्विभाषी में तैयार किए गए है इन्हें सुनिश्चित करने हेतु जाँचबिंदु (भंडार अनुभाग, प्रेषण कक्ष और संबंधित अधिकारी स्तर पर) बनाए गए हैं ।
3. **हिंदी पत्राचार:** वर्ष के दौरान क, ख तथा ग क्षेत्र स्थित केंद्रीय सरकारी कार्यालयों को क्रमश: 84%, 88 % और 86% पत्र हिंदी में भेज कर पत्राचार लक्ष्य से अधिक प्रतिशत प्राप्त किया है।
4. **राजभाषा कार्यान्वयन समिति की बैठकों का आयोजन:** संस्थान में हर तिमाही में राजभाषा कार्यान्वयन समिति की बैठक का आयोजन कर राजभाषा प्रगामी प्रयोग के बारे में समीक्षा की गई । वर्ष 2022-23 के दौरान दिनांक 18.05.2022, 22.09.2022, 29.12.2022 एवं 28.03.2023 को राजभाषा कार्यान्वयन समिति की बैठकें 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 के साथ-साथ वैज्ञानिकों के लिए भी इस वर्ष के दौरान दिनांक 19.05.2022, 24.09.2022, 07.12.2022 और 23.02.2023 को अलग-अलग एक दिवसीय हिंदी कार्यशाला का आयोजन कर कुल 42 अधिकारियों व 41 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 करने को प्रोत्साहित करने के लिए केंद्रीय रेशम बोर्ड की उधारीकृत टिप्पण-आलेखन प्रोत्साहन योजना लागू की गई है जिसके अंतर्गत निर्धारित शब्द लिखने पर नकद पुरस्कार दिया जाता है। इस वर्ष के दौरान इस

योजना के अंतर्गत संस्थान के 13 पदधारियों को दिनांक 30.09.2022 को आयोजित राजभाषा पखवाड़ा समापन समारोह में नकद पुरस्कार वितरित किए गए, उनके अलावा अधीनस्थ कार्यालयों के 9 पदधारियों को भी इस योजना के अंतर्गत पुरस्कार प्राप्त हुआ है।

7. **हिंदी प्रकाशन:** संस्थान की वार्षिक रिपोर्ट अंशत: द्विभाषी में प्रकाशित की गई । इसके अलावा राजभाषा गृह पत्रिका रेशम किरण का प्रकाशन किया गया ।

8. **राजभाषा नियम 10(4) के अंतर्गत अधीनस्थ कार्यालयों को अधिसूचित किया जाना:** जिन कार्यालयों में हिंदी में कार्यसाधक ज्ञान रखने वालों का प्रतिशत80 हो जाता है उन कार्यालयों को मंत्रालय द्वारा राजभाषा नियम10(4) के अधीन अधिसूचित किया जाता है । इस दिशा में इस संस्थान के अलावा 06 अधीनस्थ कार्यालयों को अधिसूचित कराया जा चुका है।

9. **हिंदी दिवस/ पखवाडे का आयोजन:** संस्थान में दिनांक 14.09.2022 से 30.09.2022 तक राजभाषा पखवाड़ा मनाया गया जिस दौरान 4 विभिन्न हिंदी प्रतियोगिताओं यथा सहीलेखन, श्रुतलेखन, स्मृति परीक्षण, शब्दावली, प्रतियोगिताओं का आयोजन किया गया । प्रत्येक प्रतियोगिता के विजेताओं को प्रथम, द्वितीय, तृतीय एवं सांत्वना पुरस्कार नकद रूप में दिया गया।

10. **राजभाषा शील्ड:** वैज्ञानिक/अधिकारी/कर्मचारी संवर्ग में श्रेष्ठ राजभाषा कार्य निष्पादन हेतु राजभाषा शील्ड वैयक्तिक स्तर पर प्रदान किया जाता है । यह शील्ड सर्वश्रेष्ठ कार्य निष्पादन करने वाले अनुभागों के अतिरिक्त दिया जाता है । इससे वैज्ञानिकों/अधिकारियों/कर्मचारियों में उत्साह का संचार हुआ है एवं बेहतर कार्यान्वयन एवं परिणाम सामने आए है ।

11. **कंप्यूटर पर हिंदी में कार्य:** धारा3(3) का अनुपालन, फार्म/प्रपत्र,मानक मसौदे, तिमाही रिपोर्ट तथा मूल्यांकन रिपोर्ट, बैठकों की कार्रवाई संबंधी कार्य कंप्यूटर पर सुचारू रूप से किया जा रहा है। संस्थान में सभी अभिकलित्रों में यूनिकोड की व्यवस्था है जिससे हिंदी,अंग्रेजी तथा अन्य भारतीय भाषाओं में काम करने में सुविधा हुई है।

12. **निरीक्षण:** अधीनस्थ कार्यालयों में राजभाषा कार्यान्वयन की प्रगति की समीक्षा करने और तदनुसार आवश्यक सुझाव और मार्गदर्शन देने के लिए उनका निरीक्षण किया जाता है। रिपोर्टाधीन वर्ष में कुल **6** कार्यालयों का निरीक्षण किया गया है।

13. **प्रशिक्षण:** रेशम उत्पादन से संबंधित कुल 10 तकनीकी प्रशिक्षण कार्यक्रम हिन्दी के माध्यम से आयोजित किया गया ।

14. **द्विभाषी मनक प्रपत्र:** हिन्दी पत्राचार में वृद्धि करने हेतु कुल 36 द्विभाषी मानक पत्र तैयार कर 12 अधीनस्थ कार्यालयों के उपयोगार्थ भेजे गए ।

15. **वेबसाइट का द्विभाषीकरण:** संस्थान का विबसाइट पूर्णत: द्विभाषी द्विभाषी में बनाई गई है ।

16. **राजभाषा तकनीकी सेमिनार:** संस्थान में दि.23.02.2023 को राजभाषा तकनीकी सेमिनार का आयोजन किया गया और 13 वैज्ञानिकों/परियोजना सहायकों द्वारा शोध पत्र प्रस्तुत किए गए । इसके अलावा केंरेतकें, रांची में आयोजित राष्ट्रीय तकनीकी सेमिनार में संस्थान के वैज्ञानिकों/परियोजना सहायकों ने भाग लिया और शोध पत्र/पोस्टर प्रस्तुत किए गए ।

17. **क्षेत्रीय राजभाषा पुरस्कार:** संस्थान को दक्षिण – पश्चिम एवं दक्षिणी क्षेत्र के केन्द्रीय सरकार के कार्यालयों में वर्ष 2021-22 के दौरान उत्कृष्ट राजभाषा कार्यान्वयन हेतु तृतीय क्षेत्रीय राजभाषा पुरस्कार से सम्मानित किया गया । यह पुरस्कार दि. 27.01.2023 को तिरुवनंतपुरम में आयोजित राजभाषा सम्मेलन के दौरान प्रदान किया गया ।

## ACTIVITIES REGARDING OFFICIAL LANGUAGE IMPLEMENTATION

During 2022-23 Official Language policy was implemented successfully at Central Sericultural Research and Training Institute, Mysuru. Compliance of section 3(3) of the Official Languages Act was ensured. The progress in implementation of Hindi was reviewed regularly by conducting quarterly meeting of the Official Language Implementation Committee. Organization of Hindi workshops, Hindi Day, Fortnight, Publication of Hindi magazine/Technical literature were carried out and Hindi Noting drafting scheme was

popularised and implemented in the Institute. The details of action taken on various items of Official Language Implementation during the period is as follows:

1. **Compliance of Section 3(3)**: All the papers coming 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, Sign Boards, Name plates, Envelopes, Identity Cards, Visiting cards etc are prepared in bilingual. Check points (at Stores Section, Despatch Section and at concerned officer level) have been devised to ensure issuance of the same in bilingual.
3. **Hindi Correspondence:** During the year prescribed targets for correspondence in Hindi were achieved by sending 84%, 88% and 86% letters in Hindi to Central Govt. Offices located in A, B and C regions respectively**.**
4. **Organization of meetings of the Official Language Implementation Committee:** The progress of implementation of the Official Language was reviewed regularly from time to time by conducting OLIC meeting in every quarter. During the year 2022-23 Official Language Implementation Committee meetings were organised on 18.05.2022, 22.09.2022, 29.12.2022, and 28.03.2023 and follow up action were taken on the decisions of the meeting.
5. **Organization 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 also to extend information about Official Language Policy. During the year, 40 Officers and 39 Staff have been trained in Hindi workshops organised on 19.05.2022, 24.09.2022, 07.12.2022 and 23.02.2023 separately for technical and administrative officials and scientists.
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. CSB's liberalised noting-drafting incentive scheme was implemented in which cash awards are given for writing prescribed words in Hindi. During the year cash awards were given to 13 officials on the valedictory function of Official Language fortnight held on 14-09-2022. Apart from this, 9 officials of subordinate offices were also awarded prizes under this scheme.
7. **Publications in Hindi:** Annual report of the Institute was published partly in bilingual and Official Language House magazine of the institute Resham kiran was published 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 are having working knowledge in Hindi are notified under 10(4) of the official languages rules. In this direction, apart from this office, 6 sub-ordinate offices have also been notified.
9. **Organisation of Hindi competitions:** Official Language Fortnight was organised from 14.09.2022 to 30.09.2022 during which 4 different Hindi competitions *viz*., 1. Correct writing 2. Dictation, 3. Memory test and 4. Glossary competitions were organised. The winners of the competitions were awarded with first, second, third and consolation prizes.
10. **Rajbhasha Shield:** Rajbhasha Shield is awarded at individual level in scientific/officer/employee cadre for their best performance in official language work. This shield is given in addition to the award

for the best performing sections which aroused enthusiasm among the scientists/officers/employees and resulted in better performance in implementation.

11. **Work on Computers in Hindi:** Compliance of Section 3(3), forms, standard drafts, quarterly progress report and evaluation report, work related to meetings are carried out smoothly on computers. Unicode system is activated in all computers which facilitates employees to do work in Hindi, English and other Indian languages.
12. **Training:** 11 Training programmes related to Sericulture were conducted through Hindi medium.
13. **Inspection:** Sub-ordinate offices are inspected for reviewing the progress made regarding implementation of Official Language Policy and extending necessary suggestions & guidance accordingly. During the year under report 2 offices have been inspected.
14. **Bilingual Standard forms:** 36 billingual standard drafts were prepared and sent to 12 different Sub-ordinate offices so as to increase Hindi correspondence.
15. **Website:** Website of the Institute has been rendered in bilingual cent percent.
16. **Official Language Technical Seminar:** Official Language Technical Seminar was organised at the Institute on 23.02.2023 and13 Scientists and Project Assistants presented research papers. Apart from this Scientists and Project Assistants of the Institute participated and presented papers and posters in the Technical Seminar organized at CTRTI-Ranchi.
17. **Regional Official Language Award:** Institute has been bestowed with the Regional official Language award (Third prize) for the year 2021-22 for excellent Official Language Implementation. The award was presented in the Regional Official Language Conference held at Thiruvananthapuram on 27.01.2023.

# 1. MULBERRY BREEDING AND GENETICS

## Ongoing Research Project

### PIB 3632: Evaluation of superior triploid mulberry genotypes for leaf yield under bush and tree planting system in different agro-climatic conditions (Mar. 2018-Feb. 2024)

M. K. Raghunath, Manjappa, Tanmoy Sarkar, G. S. Aruna Kumar, S. K. Hanumantharayappa (upto May 2022), S. B. Kulkarni (from June, 2022), K. P. Kiran Kumar, Babulal (upto Oct. 2022) and A. V. Mary Joespha Sherry (Co-Ordinator)

**Objective**

- Evaluation of superior triploid mulberry genotypes for leaf yield under bush plantation.
- Evaluation of superior triploid mulberry genotypes for leaf yield under tree plantation.

At CSRTI-Mysuru, five crops data (5 crops of the II year) pertaining to growth and yield for the bush planting system were recorded. Similarly, four crops data (1st to 4th crops of the II year) on growth and yield attributing characters were recorded for the tree planting system. Based on the pooled analysis of five crops, it was found that two triploid genotypes, Tri-10 and Tri-8 performed better than the check varieties (G4 and Vishala) under the bush and tree planting systems respectively (Table 1.1 & 1.2).

Whereas, at RSRS, Ananthapur, data from four crops (2nd to 5th crop of II year) for the bush planting system and (1st to 4th crop data of II year) for the tree plantation system were recorded on growth and yield parameters, respectively. Analysed data revealed that triploid genotypes Tri-10, followed by Tri-9 and Tri-8 outyielded the check varieties in bush planting system (Table 1.3). However, in the tree planting system, triploid genotypes Tri-9, followed by Tri-10 and Tri-8, performed on par with check varieties (Table 1.4). Whereas, at RSRS Kodathi, 5 crops were recorded (1st to 5th crop data of the II year) in both bush and tree planting systems. The pooled data of five crops revealed that triploid genotypes, *viz*., Tri-8, Tri-10 and Tri-9 out yielded the check varieties in the bush planting system (Table 1.5). Further, triploid genotypes Tri-10, Tri-8 and Tri-9 performed on par with check varieties for leaf yield under tree planting system (Table 1.6).

Table 1.1: Growth and yield parameters of triploid genotypes under bush planting system for the second year at CSRTI-Mysuru (pooled data of five crops)

| Genotype | No. of Shoots | Length of longest shoot (cm) | Total shoot length (cm) | Moisture content (%) | Moisture retention capacity (%) | Harvest Index (HI) | LY/plot (kg/48 plants) | Plot Biomass (kg) |
|---|---|---|---|---|---|---|---|---|
| Tri-1 | 13.2 | 139.9 | 1272 | 74.6 | 82.1 | 0.53 | 22.8 | 51.2 |
| Tri-5 | 11.2 | 142.9 | 1171 | 76.0 | 81.9 | 0.49 | 22.1 | 53.6 |
| Tri-6 | 18.1 | 149.9 | 1822 | 76.6 | 77.9 | 0.46 | 23.1 | 50.7 |
| Tri-8 | 12.2 | 138.4 | 1188 | 76.7 | 82.7 | 0.52 | 28.2 | 51.6 |
| Tri-9 | 11.8 | 141.8 | 1170 | 76.5 | 83.3 | 0.51 | 22.6 | 56.0 |
| Tri-10 | 17.6 | 156.2 | 1765 | 77.1 | 81.6 | 0.53 | 34.6 | 57.4 |
| G-4 | 12.3 | 148.8 | 1189 | 75.8 | 82.0 | 0.54 | 25.6 | 37.2 |
| Vishala | 12.2 | 159.9 | 1324 | 77.2 | 82.5 | 0.48 | 30.5 | 69.8 |
| CD at 5% | 1.3 | N/A | 197 | N/A | 1.9 | 0.02 | 3.5 | 15.7 |
| CV (%) | 5.2 | 8.1 | 8 | 1.5 | 1.3 | 1.80 | 7.6 | 16.6 |

Table 1.2: Growth and yield parameters of triploid genotypes under tree planting system for second year at CSRTI-Mysuru (pooled data of five crops)

| Genotype | No. of shoots | Length of longest shoot (cm) | Total shoot length (cm) | Moisture content (%) | Moisture retention capacity (%) | Harvest Index (HI) | LY (kg/ 12 plants) | Plot biomass (kg) |
|---|---|---|---|---|---|---|---|---|
| Tri-1 | 16.43 | 139.67 | 1926.67 | 75.07 | 84.03 | 0.52 | 19.0 | 36.10 |
| Tri-5 | 20.33 | 137.67 | 2163.33 | 75.70 | 83.10 | 0.50 | 19.2 | 39.60 |
| Tri-6 | 34.13 | 150.33 | 4153.33 | 75.27 | 80.43 | 0.42 | 22.5 | 53.00 |
| Tri-8 | 18.47 | 151.33 | 2506.33 | 76.90 | 83.87 | 0.52 | 30.4 | 58.00 |
| Tri-9 | 20.40 | 131.33 | 2700.33 | 73.63 | 83.47 | 0.49 | 18.0 | 33.80 |
| Tri-10 | 42.27 | 141.67 | 4957.33 | 76.10 | 84.20 | 0.48 | 35.8 | 72.50 |
| Vishala | 26.57 | 123.67 | 2113.67 | 75.13 | 83.23 | 0.51 | 26.6 | 54.10 |
| G4 | 26.77 | 129.67 | 2109.00 | 74.47 | 82.40 | 0.48 | 26.0 | 52.50 |
| CD at 5% | 6.72 | N/A | 825.85 | 1.30 | N/A | 0.03 | 2.9 | 4.70 |
| CV (%) | 14.81 | 7.87 | 16.51 | 0.97 | 2.18 | 3.44 | 6.6 | 5.30 |

Table 1.3: Growth and yield parameters of triploid genotypes under bush planting system for second year at RSRS, Ananthapur (pooled data of four crops)

| Genotype | No. of Shoots | Length of longest shoot (cm) | Total shoot length (cm) | Moisture content (%) | Moisture retention capacity (%) | Harvest Index (HI) | LY (kg/ 48 plants) | Plot Biomass (kg) |
|---|---|---|---|---|---|---|---|---|
| Tri-1 | 8.17 | 135.17 | 778.67 | 72.57 | 77.97 | 0.54 | 17.0 | 31.50 |
| Tri-5 | 9.57 | 133.97 | 830.83 | 72.70 | 78.23 | 0.55 | 16.9 | 30.70 |
| Tri-6 | 7.83 | 121.13 | 675.63 | 73.80 | 79.17 | 0.54 | 16.8 | 31.17 |
| Tri-8 | 10.73 | 129.50 | 878.30 | 76.20 | 78.93 | 0.56 | 20.5 | 36.47 |
| Tri-9 | 10.33 | 131.37 | 860.27 | 76.87 | 80.03 | 0.56 | 21.6 | 38.87 |
| Tri-10 | 11.70 | 139.20 | 1,001.10 | 80.83 | 82.63 | 0.60 | 25.6 | 42.53 |
| G4 | 8.60 | 125.97 | 733.53 | 73.80 | 79.47 | 0.54 | 18.9 | 34.97 |
| Vishala | 9.60 | 113.93 | 781.83 | 68.90 | 78.07 | 0.53 | 17.8 | 33.63 |
| CD at 5% | 1.04 | 3.67 | 55.07 | 3.08 | 2.05 | 0.02 | 0.4 | 2.98 |
| CV (%) | 6.14 | 1.61 | 3.81 | 2.34 | 1.46 | 2.26 | 5.3 | 4.82 |

Table 1.4: Growth and yield parameters of triploid genotypes under tree planting system for second year at RSRS, Ananthapur (pooled data of four crops)

| Genotype | No. of shoots | Length of longest shoot (cm) | Total shoot length (cm) | Moisture content (%) | Moisture retention capacity (%) | Harvest Index (HI) | LY (kg/ 12 plants) | Plot biomass (kg) |
|---|---|---|---|---|---|---|---|---|
| Tri-1 | 17 | 132.6 | 1810.63 | 72.57 | 79.2 | 0.54 | 19.00 | 38.14 |
| Tri-5 | 18 | 134.7 | 2101.00 | 72.70 | 79.4 | 0.55 | 23.20 | 47.76 |
| Tri-6 | 19 | 126.9 | 1917.40 | 73.80 | 79.8 | 0.54 | 27.40 | 59.32 |
| Tri-8 | 23 | 150.0 | 2662.15 | 76.20 | 81.1 | 0.56 | 31.50 | 64.48 |
| Tri-9 | 23 | 144.5 | 2844.68 | 76.87 | 80.4 | 0.56 | 32.60 | 67.10 |
| Tri-10 | 26 | 157.3 | 3584.08 | 80.83 | 83.1 | 0.60 | 34.00 | 64.24 |

| Genotype | No. of shoots | Length of longest shoot (cm) | Total shoot length (cm) | Moisture content (%) | Moisture retention capacity (%) | Harvest Index (HI) | LY (kg/ 12 plants) | Plot biomass (kg) |
|---|---|---|---|---|---|---|---|---|
| G4 | 22 | 144.3 | 2672.68 | 73.80 | 80.7 | 0.54 | 31.40 | 65.81 |
| Vishala | 21 | 135.7 | 2284.72 | 68.90 | 79.0 | 0.53 | 30.40 | 64.99 |
| CD at 5% | 2.11 | 6.06 | 121.09 | 3.08 | 1.0 | 0.02 | 3.80 | 6.88 |
| CV (%) | 5.56 | 2.44 | 2.76 | 2.34 | 0.7 | 2.26 | 7.41 | 6.60 |

Table 1.5: Growth and yield parameters of triploid genotypes under bush planting system for second year at RSRS, Kodathi (pooled data of five crops)

| Genotype | No. of shoots | Length of longest shoot (cm) | Total shoot length (cm) | Moisture content (%) | Moisture retention capacity (%) | Harvest Index (HI) | LY (kg/48 plants) | Plot biomass (kg) |
|---|---|---|---|---|---|---|---|---|
| Tri-1 | 4.85 | 129.74 | 462.87 | 72.30 | 83.00 | 0.60 | 19.56 | 29.71 |
| Tri-5 | 5.94 | 133.14 | 598.03 | 72.0 | 79.40 | 0.61 | 22.62 | 35.31 |
| Tri-6 | 6.04 | 137.74 | 628.75 | 72.90 | 81.80 | 0.55 | 19.79 | 33.94 |
| Tri-8 | 6.32 | 144.09 | 690.79 | 73.70 | 82.80 | 0.61 | 35.79 | 54.80 |
| Tri-9 | 6.48 | 139.51 | 677.40 | 73.00 | 83.00 | 0.63 | 30.34 | 43.67 |
| Tri-10 | 7.03 | 140.46 | 729.08 | 71.10 | 80.00 | 0.61 | 34.56 | 52.26 |
| G4 | 5.40 | 127.54 | 521.13 | 73.10 | 83.20 | 0.64 | 22.47 | 32.88 |
| Vishala | 4.98 | 149.52 | 553.93 | 70.80 | 81.50 | 0.60 | 25.04 | 37.99 |
| CD at 5% | 1.03 | 10.93 | 147.72 | NS | NS | NS | 7.69 | 8.60 |
| CV (%) | 11.7 | 5.2 | 16 | 2.4 | 4.5 | 6.57 | 16.73 | 16.57 |

Table 1.6: Growth and yield parameters of triploid genotypes under tree planting system for second year at RSRS, Kodathi (pooled data of five crops)

| Genotype | No. of shoots | Length of longest shoot (cm) | Total shoot length (cm) | Moisture content (%) | Moisture retention capacity (%) | Harvest Index (HI) | LY (kg/ 12 plants) | Plot biomass (kg) |
|---|---|---|---|---|---|---|---|---|
| TRI-1 | 12.42 | 120.92 | 1033.31 | 72.33 | 79.05 | 0.62 | 17.94 | 27.14 |
| TRI-5 | 14.00 | 130.86 | 1379.34 | 70.65 | 78.93 | 0.65 | 16.94 | 22.92 |
| TRI-6 | 18.84 | 115.27 | 1946.31 | 72.73 | 78.38 | 0.58 | 15.05 | 23.15 |
| TRI-8 | 16.50 | 127.96 | 1799.80 | 72.30 | 80.44 | 0.62 | 20.49 | 29.50 |
| TRI-9 | 18.93 | 135.73 | 2188.61 | 72.25 | 79.55 | 0.60 | 19.40 | 29.73 |
| TRI-10 | 22.56 | 129.56 | 2422.65 | 69.83 | 77.34 | 0.67 | 24.07 | 34.90 |
| G4 | 14.73 | 120.60 | 1495.13 | 71.15 | 77.70 | 0.63 | 16.09 | 23.38 |
| Vishala | 16.67 | 145.13 | 1949.74 | 69.63 | 77.16 | 0.60 | 25.53 | 30.59 |
| CD at 5% | 5.13 | NS | 594.30 | NS | 2.620 | NS | 4.14 | 5.1 |
| CV (%) | 15.1 | 13.7 | 17 | 2.7 | 1.98 | 7.69 | 16.45 | 14.22 |

**PIE13001 MI: All India Coordinated Experimental Trials for Mulberry (AICEM) Phase-IV (Apr. 2019-Mar. 2025)**

Zonal Coordinator: Babulal (till Oct. 2022), A. V. Mary Josepha Shery (from Nov. 2022)

Principal Investigator: Nazeer Ahmed Saheb

Co-PI: Manjappa

CI: S. K. Hanumantharayappa (till May, 2022), V. Laxmanan (from Jun. 2022), P. Sudhakar (till Jul. 2022), K. P. Kiran Kumar (from Aug. 2022), A. Venugopal (till Oct. 2022), M. Venkatachalapathy (from Nov. 2022), S. Rajadurai, J. B. Narendrakumar and K. Jhansilakshmi

Facilitators: M. K. Raghunath, G. S. Aruna Kumar, M. R. Bhavya, V. Shobana and K. Jhansilakshmi

**Objective**

- Identification of suitable mulberry variety for regional, zonal and national use based on their performance

During the progress period of one year, three test genotypes, *viz*., CMY 01, CBP 01 and CPP 01, have been evaluated for growth and leaf yield parameters along with checks (G4 and V1) for five crops at seven test centres in the South Zone. Analysis of the variance of pooled values over different crops revealed the prevalence of variation among test genotypes and checks for all the traits under study in most of the test centres. For leaf yield, CMY 01 has shown the highest leaf yield across test centres with an average of 42.5 MT/ha/year, which is 12% and 15% higher than G 4 (37.6 MT/ha/year) and V 1 (36.9 MT/ha/year). CBP 01 has shown a leaf yield of 37.9 MT/ha/year, which is on par with the checks and CPP 01 has shown the least yield of 30.6 MT/ha/year (Table 1.7). Among test genotypes, CBP 01 and CMY 01 have shown the highest number of shoots per plant and total shoot length per plant, while CMY 01 has shown the highest number of leaves per metre of shoot length, however, on par with the checks at most of the centres (Table 1.7). At all test centres, CMY 01 and CPP 01 showed the highest harvest index, and all the genotypes showed leaf moisture content and leaf moisture retention after 6 hours of preservation on par with checks, except in a few centres.

Table 1.7: Average performance of test genotypes for growth and leaf yield over five crops (crop 4 – crop 8) during the year 2022-23 at seven test centres of South Zone

| Genotype | No. of shoots/ plant | Total shoot length (cm) | No. of leaves/m shoot | Harvest Index | Leaf moisture content (%) | Leaf moisture after 6 h | Net plot leaf yield (kg/49 plants | Leaf yield MT/ha/ year |
|---|---|---|---|---|---|---|---|---|
| CSRTI Mysuru (Crop 4 – Crop 8) | | | | | | | | |
| CMY01 | 14.1$^{ab}$ | 1304$^{a}$ | 19.6$^{a}$ | 0.59$^{b}$ | 76.7$^{a}$ | 75.0$^{a}$ | 37.9$^{a}$ | 46.2$^{a}$ |
| CBP01 | 13.7$^{b}$ | 1400$^{a}$ | 16.8$^{b}$ | 0.55$^{c}$ | 75.9$^{a}$ | 74.1$^{a}$ | 30.1$^{b}$ | 36.7$^{b}$ |
| CPP01 | 9.7$^{c}$ | 824$^{b}$ | 15.9$^{b}$ | 0.60$^{b}$ | 75.0$^{a}$ | 73.1$^{a}$ | 20.3$^{c}$ | 24.8$^{c}$ |
| G4 | 15.2$^{ab}$ | 1287$^{a}$ | 19.5$^{a}$ | 0.62$^{a}$ | 76.1$^{a}$ | 73.7$^{a}$ | 28.6$^{b}$ | 35.0$^{b}$ |
| V1 | 15.7$^{a}$ | 1463$^{a}$ | 19.7$^{a}$ | 0.57$^{c}$ | 75.9$^{a}$ | 74.0$^{a}$ | 29.0$^{b}$ | 35.4$^{b}$ |
| CV (%) | 7.6 | 8.8 | 3.2 | 1.1 | 1.5 | 1.6 | 6.6 | 6.6 |
| REC Krishnagiri (Crop 4 – Crop 8) | | | | | | | | |
| CMY01 | 12.0$^{ab}$ | 1379$^{bc}$ | 21.2$^{a}$ | 0.60$^{b}$ | 74.2$^{a}$ | 64.9$^{a}$ | 49.7$^{a}$ | 60.7$^{a}$ |
| CBP01 | 12.8$^{a}$ | 1739$^{a}$ | 15.5$^{c}$ | 0.54$^{d}$ | 74.5$^{a}$ | 64.6$^{a}$ | 46.1$^{b}$ | 56.3$^{b}$ |
| CPP01 | 9.2$^{c}$ | 980$^{d}$ | 15.4$^{c}$ | 0.59$^{b}$ | 73.4$^{a}$ | 64.1$^{a}$ | 35.0$^{d}$ | 42.7$^{d}$ |

| Genotype | No. of shoots/ plant | Total shoot length (cm) | No. of leaves/m shoot | Harvest Index | Leaf moisture content (%) | Leaf moisture after 6 h | Net plot leaf yield (kg/49 plants | Leaf yield MT/ha/ year |
|---|---|---|---|---|---|---|---|---|
| G4 | 11.0$^{b}$ | 1261$^{c}$ | 21.2$^{a}$ | 0.61$^{a}$ | 73.7$^{a}$ | 62.7$^{a}$ | 42.0$^{c}$ | 51.3$^{c}$ |
| V1 | 11.2$^{b}$ | 1547.8$^{b}$ | 19.2$^{b}$ | 0.55$^{c}$ | 74.2$^{a}$ | 64.1$^{a}$ | 41.4$^{c}$ | 50.5$^{c}$ |
| CV (%) | 4.9 | 6.0 | 1.5 | 6.6 | 1.0 | 2.3 | 3.4 | 3.4 |
| REC Madiwala (Crop 4 – Crop 8) | | | | | | | | |
| CMY01 | 8.1$^{a}$ | 822$^{b}$ | 20.8$^{a}$ | 0.54$^{b}$ | 75.2$^{b}$ | 69.1$^{a}$ | 24.1$^{a}$ | 29.4$^{a}$ |
| CBP01 | 8.7$^{a}$ | 986$^{ab}$ | 16.2$^{d}$ | 0.51$^{d}$ | 76.2$^{a}$ | 68.1$^{a}$ | 20.9$^{a}$ | 25.5$^{a}$ |
| CPP01 | 5.8$^{b}$ | 532$^{c}$ | 17.8$^{c}$ | 0.58$^{a}$ | 73.3$^{c}$ | 67.6$^{a}$ | 12.4$^{b}$ | 15.1$^{b}$ |
| G4 | 8.8$^{a}$ | 918$^{ab}$ | 21.0$^{a}$ | 0.55$^{b}$ | 76.1$^{a}$ | 67.5$^{a}$ | 23.0$^{a}$ | 28.1$^{a}$ |
| V1 | 9.3$^{a}$ | 1088$^{a}$ | 19.4$^{b}$ | 0.53$^{c}$ | 74.9$^{b}$ | 67.9$^{a}$ | 22.0$^{a}$ | 26.9$^{a}$ |
| CV(%) | 11.9 | 15.5 | 3.6 | 1.8 | 2.1 | 2.5 | 20.4 | 20.4 |
| REC Vikarabad (Crop 4 – Crop 7) | | | | | | | | |
| CMY01 | - | 1955$^{a}$ | 19.6$^{a}$ | 0.58$^{a}$ | 76.9$^{a}$ | 73.7$^{a}$ | 42.8$^{a}$ | 52.2$^{a}$ |
| CBP01 | - | 1838$^{b}$ | 19.0$^{ab}$ | 0.58$^{ab}$ | 75.4$^{b}$ | 71.6$^{b}$ | 36.0$^{b}$ | 44.0$^{b}$ |
| CPP01 | - | 1875$^{b}$ | 15.2$^{c}$ | 0.57$^{b}$ | 75.4$^{b}$ | 71.7$^{b}$ | 34.1$^{c}$ | 41.6$^{c}$ |
| G4 | - | 1960$^{a}$ | 18.7$^{b}$ | 0.57$^{b}$ | 76.9$^{a}$ | 73.2$^{a}$ | 42.5$^{a}$ | 51.8$^{a}$ |
| V1 | - | 1966$^{a}$ | 18.5$^{b}$ | 0.57$^{b}$ | 77.4$^{a}$ | 73.8$^{a}$ | 42.7$^{a}$ | 52.1$^{a}$ |
| CV (%) | | 1.6 | 2.6 | 1.0 | 0.8 | 1.2 | 2.3 | 2.3 |
| RSRS Kodathi (Crop 4 – Crop 7) | | | | | | | | |
| CMY 01 | 7.1$^{a}$ | 759$^{ab}$ | 20.0$^{b}$ | 0.61$^{a}$ | 75.6$^{a}$ | 73.8$^{a}$ | 27.1$^{a}$ | 33.1$^{a}$ |
| CBP 01 | 6.1$^{bc}$ | 791$^{a}$ | 18.3$^{c}$ | 0.56$^{c}$ | 74.1$^{a}$ | 72.7$^{a}$ | 25.6$^{a}$ | 31.2$^{a}$ |
| CPP 01 | 5.6$^{c}$ | 588$^{c}$ | 17.7$^{c}$ | 0.59$^{ab}$ | 74.2$^{a}$ | 71.9$^{a}$ | 18.5$^{b}$ | 22.6$^{b}$ |
| G 4 | 6.3$^{b}$ | 612$^{c}$ | 21.5$^{a}$ | 0.61$^{a}$ | 74.7$^{a}$ | 73.3$^{a}$ | 21.1$^{b}$ | 25.8$^{b}$ |
| V 1 | 5.5$^{c}$ | 671$^{bc}$ | 19.7$^{b}$ | 0.58$^{bc}$ | 75.1$^{a}$ | 73.0$^{a}$ | 19.7$^{b}$ | 24.1$^{b}$ |
| CV (%) | 6.4 | 7.9 | 1.9 | 2.7 | 1.4 | 1.6 | 10.5 | 10.5 |
| RSRS Ananthapur (Crop 4 – Crop 7) | | | | | | | | |
| CMY 01 | 6.8$^{a}$ | 835$^{a}$ | 20.4$^{a}$ | 0.62$^{a}$ | 79.3$^{a}$ | 76.6$^{a}$ | 24.9$^{a}$ | 30.4$^{a}$ |
| CBP 01 | 6.0$^{b}$ | 808$^{a}$ | 19.0$^{a}$ | 0.55$^{d}$ | 76.3$^{b}$ | 73.3$^{b}$ | 22.3$^{b}$ | 27.2$^{b}$ |
| CPP 01 | 5.1$^{c}$ | 665$^{c}$ | 17.6$^{c}$ | 0.59$^{b}$ | 75.8$^{bc}$ | 72.4$^{bc}$ | 21.4$^{b}$ | 26.1$^{b}$ |
| G 4 | 6.3$^{a}$ | 726$^{b}$ | 18.7$^{b}$ | 0.61$^{a}$ | 75.0$^{bc}$ | 71.9$^{bc}$ | 20.5$^{b}$ | 25.0$^{b}$ |
| V 1 | 6.7$^{a}$ | 887$^{a}$ | 18.4$^{b}$ | 0.57$^{c}$ | 74.2$^{c}$ | 70.9$^{c}$ | 21.4$^{b}$ | 26.1$^{b}$ |
| CV (%) | 7.5 | 10.8 | 6.5 | 2.3 | 2.3 | 2.4 | 10.0 | 10.0 |
| REC Rayachoty (Crop 4 – Crop 6) | | | | | | | | |
| CMY 01 | 6.7$^{b}$ | 953$^{b}$ | 20.2$^{a}$ | 0.56$^{a}$ | 76.9$^{a}$ | 73.9$^{a}$ | 37.1$^{a}$ | 45.2$^{a}$ |
| CBP 01 | 7.7$^{a}$ | 1264$^{a}$ | 16.7$^{b}$ | 0.54$^{a}$ | 75.5$^{b}$ | 72.6$^{b}$ | 36.6$^{a}$ | 44.6$^{a}$ |
| CPP 01 | 6.3$^{b}$ | 823$^{b}$ | 16.9$^{b}$ | 0.53$^{b}$ | 75.0$^{b}$ | 72.0$^{b}$ | 33.9$^{b}$ | 41.4$^{b}$ |
| G 4 | 7.5$^{a}$ | 1145$^{a}$ | 19.6$^{a}$ | 0.57$^{a}$ | 74.6$^{c}$ | 71.7$^{b}$ | 37.8$^{a}$ | 46.1$^{a}$ |
| V 1 | 8.0$^{a}$ | 1251$^{a}$ | 20.3$^{a}$ | 0.53$^{b}$ | 74.3$^{c}$ | 71.8$^{b}$ | 35.6$^{ab}$ | 43.4$^{ab}$ |
| CV (%) | 7.5 | 11.1 | 4.1 | 5.1 | 1.2 | 1.5 | 13.3 | 13.3 |

Values with same letters are not significantly different. CV (%), Coefficient of variation

**PIE 01022 SI: Evaluation of promising mulberry genotypes for higher leaf yield and resistance to root rot and root knot diseases in primary yield trial (Dec. 2021-May 2026)**

Manjappa, G. S. Arunakumar and M.K. Raghunath

**Objectives**

- Identification of superior genotypes with higher yield, quality and resistance to Root rot & Root knot nematode diseases.
- Confirmation of resistance levels in superior genotypes under artificial inoculation conditions.

Twenty two selected genotypes and three checks (V1, G4 and BR8) were multiplied twice through stem cuttings in the nursery beds to evaluate them for leaf yield in the experimental plot. Fifteen high leaf-yielding genotypes evaluated for growth and yield parameters in a previous project were not screened against root rot and root knot nematodes. Hence, in the present study, these genotypes were inoculated with root rot pathogens, *viz*., *Lasiodiplodia theobromae*, *Fusarium solani* and the root knot nematode *Meloidegynae incognita*, in pots with three replications. Plants were maintained in the glasshouse with regular watering. Four genotypes were found to be moderately resistant to root rot pathogens and root knot nematodes.

## Continuous/Other activities

**Maintenance of mulberry germplasm, mother culture and demonstration plot**

Manjappa, M.K. Raghunath, Tanmoy Sarkar, Babulal (upto Oct. 2022) and A. V. Mary Joesph (Sherry)

A working germplasm with 28 mulberry accessions was maintained for carrying out hybridization programmes. Nineteen elite varieties were also maintained in the demonstration plot for the benefit of sericulturists, students and other stakeholders. Breeders seed plots of six mulberry varieties, viz., G4 (late age silkworm rearing), G2 (young age silkworm rearing), MSG2 (soil moisture stress environments), AGB8 (sub-optimal irrigated conditions), AR-12 (alkaline soil resistant) and Sahana (Shade tolerance), were maintained for seed cutting supply.

**Meteorological Observatory**

Honorary Superintendent : M. K. Raghunath, Sci-D

Observers : Muthappa, STA

: Ramesh, AT

The Part-time observatory of the India Meteorological Department [IMD] has been functioning at the Institute and keeping records and communicating with IMD, Bengaluru. The data on various meteorological observations, viz., temperature, humidity, pressure, dew point, vapour pressure, cloud types and quantum, wind direction and speed and rainfall, are recorded every day at 08:30 and 17:30 h and communicated to IMD (Table 1.8). The meteorological data is utilized by the scientists of the Institute as well as other national institutes, viz., CFTRI, the University of Mysore, *etc*., on a regular basis.

Table 1.8: Meteorological data for the year 2022

| Month | Temperature [°C] | | | Humidity [%] | | | Rainfall [mm] | No of rainy days (d) |
|---|---|---|---|---|---|---|---|---|
| | Max. | Min. | Mean | Max. | Min. | Mean | | |
| Januray | 33.00 | 14.00 | 23.50 | 93.00 | 33.00 | 63.00 | 0 | 0 |
| February | 33.20 | 16.00 | 24.60 | 96.00 | 24.00 | 60.00 | 0 | 0 |
| March | 35.20 | 16.00 | 25.60 | 91.00 | 22.00 | 56.50 | 43 | 1 |
| April | 37.00 | 19.20 | 28.10 | 95.00 | 30.00 | 62.50 | 55 | 4 |
| May | 37.00 | 18.00 | 27.50 | 98.00 | 45.00 | 71.50 | 297 | 12 |
| June | 33.20 | 18.00 | 25.60 | 98.00 | 51.00 | 74.50 | 128 | 6 |
| July | 32.00 | 18.00 | 25.00 | 98.00 | 47.00 | 72.50 | 211 | 19 |
| August | 33.00 | 18.00 | 25.50 | 98.00 | 65.00 | 81.50 | 418 | 19 |
| September | 32.00 | 18.00 | 25.00 | 100.00 | 62.00 | 81.00 | 124 | 8 |
| October | 31.60 | 15.20 | 23.40 | 96.00 | 66.00 | 81.00 | 209 | 6 |
| November | 30.40 | 15.00 | 22.70 | 93.00 | 59.00 | 76.00 | 44.00 | 4.00 |
| December | 30.80 | 13.00 | 21.90 | 93.00 | 56.00 | 74.50 | 42.00 | 5.00 |
| Mean | 33.20 | 16.53 | | 95.75 | 46.67 | | | |
| Extm.High | 37.00 | 19.20 | | 100.00 | 66.00 | | | |
| Extm.Low | 30.40 | 13.00 | | 91.00 | 22.00 | | | |
| | | | | | | Total rainfall (mm) | | 1571.00 |
| | | | | | | No. of rainy days (d) | | 84 |

# 2. MULBERRY MOLECULAR BIOLOGY

## Concluded Research Projects

### PIE 01014 SI: Development of Distinctiveness, Uniformity and Stability (DUS) Descriptors for Mulberry (*Morus* spp.) and their Validation - Phase III (Apr. 2020 – Mar. 2023)

M. R. Bhavya (01.04.2020 to 31.03.2023), R. Mahesh (12.07.2021 to 31.03.2023), Pankaj Tewary (01.04.2020 to 31.12.2020), Babulal (15.01.2021 to 31.10.2022), A. V. Mary Josepha (Shery), (01.11.2022 to 19.03.2023), S. Gandhi Doss (20.03.2023 to 31.03.2023) and P. Sowbhagya

**Objectives**

- Establishment and maintenance of example and reference varieties in DUS test plot.
- Morphological and molecular characterization of example and reference varieties using DUS descriptors and SNPs/SSRs, respectively and generation of manual cultivar identification diagram.
- DUS testing and registration of mulberry varieties (G-2, AR-12, Sahana, RC-1 and MSG-2) under PPV & FRA.
- Collect and characterize mulberry varieties (other than CSB released varieties) of South India (from State Research Institutes like KSSRDI, Universities, *etc*.).
- Establishment of Co-nodal DUS test centre at CSRTI-Berhampore.

**Establishment and maintenance of example and reference varieties in DUS test plot**

Established six candidate and 15 example varieties in the DUS test plot and maintained a total of 50 mulberry genotypes, which include example genotypes, reference genotypes, and candidate varieties in the DUS test plot.

**Morphological and molecular characterization of mulberry varieties**

Morphological characterization of example genotypes was carried out for 35 DUS characteristics. In the present study, all the example genotypes showed variation with respect to all the characteristics examined. Among the 35 assessed characteristics, 6 were dimorphic, 23 were trimorphic, and 6 were polymorphic, indicating their potential for varietal characterization, establishment of distinctiveness and identification of genotypes or varieties.

The dendrogram was constructed using DARwin 6.0 software from morphological characters for 31 genotypes. Based on the cluster analysis, the 31 genotypes were grouped into eight major clusters at a distance coefficient of 0 to 1. The distribution of genotypes into different clusters indicates the presence of diversity and distinctiveness among the thirty-one genotypes (Fig. 2.1). Cluster analysis indicates that genotypes grouped into the same cluster are more similar to each other, and genotypes grouped into different clusters are more diverse. These results can provide a useful guide for selecting specific germplasm with distinct genetic backgrounds in mulberry breeding programmes.

Morphological characterization of nineteen varieties (reference and candidate) was carried out for 35 DUS characteristics. Cultivar Identification Diagram (CID) was generated for reference and candidate varieties based on seven morphological characters viz., sex, mature fruit colour, leaf size, leaf base, leaf margin, shoot type and internodal distance. These characters clearly separated and identified all nineteen mulberry varieties (Fig. 2.2). This cultivar identification diagram is highly usable for the identification of mulberry varieties at the field level.

Though the CID based on morphological characters is useful, the expression of morphological characters is stage-specific and may vary with environmental conditions. Therefore, molecular markers can be employed for easy and rapid identification of varieties during any conflict. In the present study, twenty-one mulberry varieties (13 Reference, 6 candidate, AGB-8 and Mysore local) were molecularly characterized with 33 SSR markers. Among 33 SSR markers, twenty-five were found to be polymorphic, and they are useful in knowing genetic diversity in mulberry and identifying mulberry varieties. Out of the 25 polymorphic markers, six, viz., MulSSR26, MoSo288, MulSSR96B, M2SSR87, M2SSR68 and MoSo340-2 were further utilised in the identification of the mulberry cultivars. SSR marker MulSSR26 separated 21 mulberry cultivars into 2 groups by the presence of different allele sizes. Group I for 180 bp has S-146, RFS-135, S-36, MR-2, S-13, RFS-175, S-1635, Vishala, V-1, RC-1, G-2, Sahana, AR-12, MSG-2, AGB-8, RC-2; Group II for 210 bp and 180 bp have K-2, S-34, AR-11, G-4 and Mysore local. Similarly, other five markers were differentiated the mulberry cultivars step by step until full separation was achieved as shown in Fig. 2.3. Utilizing 6 SSR markers, all 21 mulberry varieties were eventually differentiated from each other.

**DUS testing and registration of mulberry varieties under PPV & FRA**

Two cycles of DUS testing of candidate varieties (G-4, G-2, RC-1, AR-12, Sahana and MSG2) along with reference varieties were carried out. The difference in some of the characters between candidate varieties and the nearest reference varieties is given in Fig. 2.4 to 2.8. G-4, G-2, RC-1, AR-12, Sahana and MSG-2 were protected by PPV & FRA during 2023 and issued the certificate of registration with registration numbers,

REG/2019/117 (G-4), REG/2021/0048 (G-2), REG/2021/0051 (RC-1), REG/2021/0052 (AR-12), REG/2021/0049 (Sahana) and REG/2021/0050 (MSG-2).

**Collection and characterization of mulberry varieties (other than CSB released varieties) of South India**

Mulberry varieties, Vishwa (DD), Thlaghattapura (TG), Suvarna-1, Suvarna-2, and Suvarna-3, were procured from KSSRDI, Thalagattapura, Bengaluru, to increase the reference collection of the mulberry genotypes and characterized with 19 morphological DUS characters. Morphological data showed that Vishwa is the nearest variety to MR-2 and RC-2 with a difference of six characters; TG is more similar to S-13 with a difference of five characters; Suvarna-1 is closest to MR-2 with a difference of four characters; Suvarna-2 is nearest to S-1635 and AR-12 with a difference of six characters; and Suvarna-3 is more similar to Kanva-2 and S-146 with a difference of six characters. This shows that the KSSRDI mulberry varieties are distinct from the existing reference collection.

**Establishment of Co-nodal DUS test centre at CSRTI-Berhampore**

Saplings of 51 genotypes, which include example genotypes and reference varieties, were supplied to establish the DUS test plot at CSRTI-Berhampore, West Bengal.

**Conclusion**

- Generated cultivar identification diagram using seven DUS characters, viz., sex, mature fruit colour, leaf size, leaf base, leaf margin, shoot type, and internodal distance, which is highly useful for identification of mulberry varieties at field level.
- A cultivar identification diagram generated based on six SSR markers, viz., MulSSR26, MoSo288, MulSSR96B, M2SSR87, M2SSR68, and MoSo340-2, will be available for easy and rapid identification of varieties during any conflict.
- G-4, G-2, RC-1, AR-12, Sahana and MSG-2 were protected by PPV&FRA during 2023 and issued the registration certificate. Registration of mulberry varieties under the PPV&FR Act, 2001, provided dual proprietorship of IP on the variety and its denomination to prevent infringement.

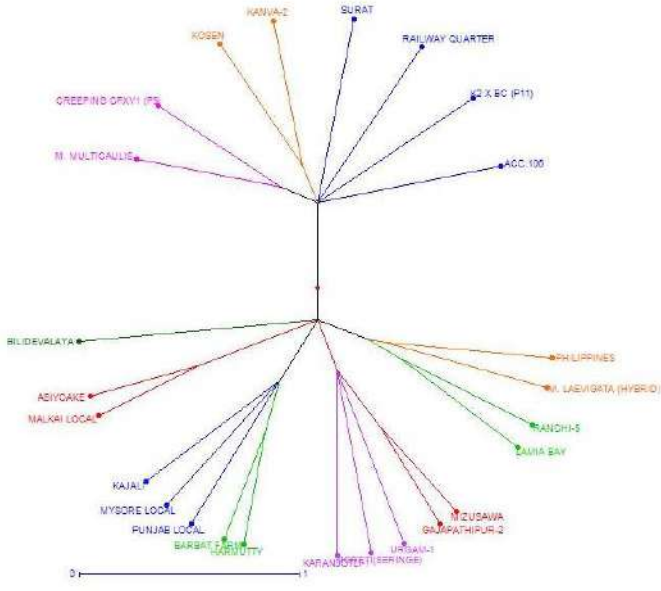



Fig. 2.1: Dendrogram of example genotypes, generated in DARwin software by neighbor joining method

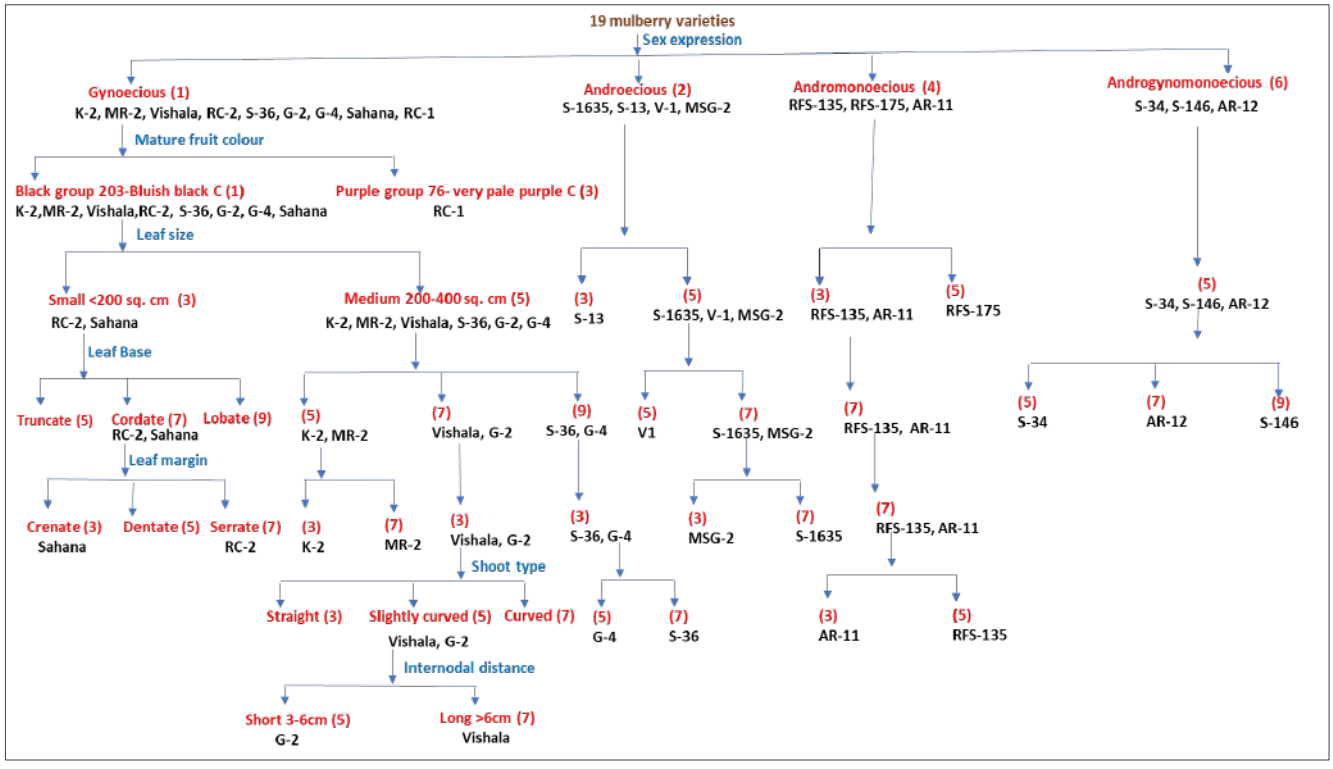



Fig. 2.2: Cultivar identification diagram of 19 mulberry genotypes using seven morphological characters. Name of the character is given in blue and state of the character is given in red

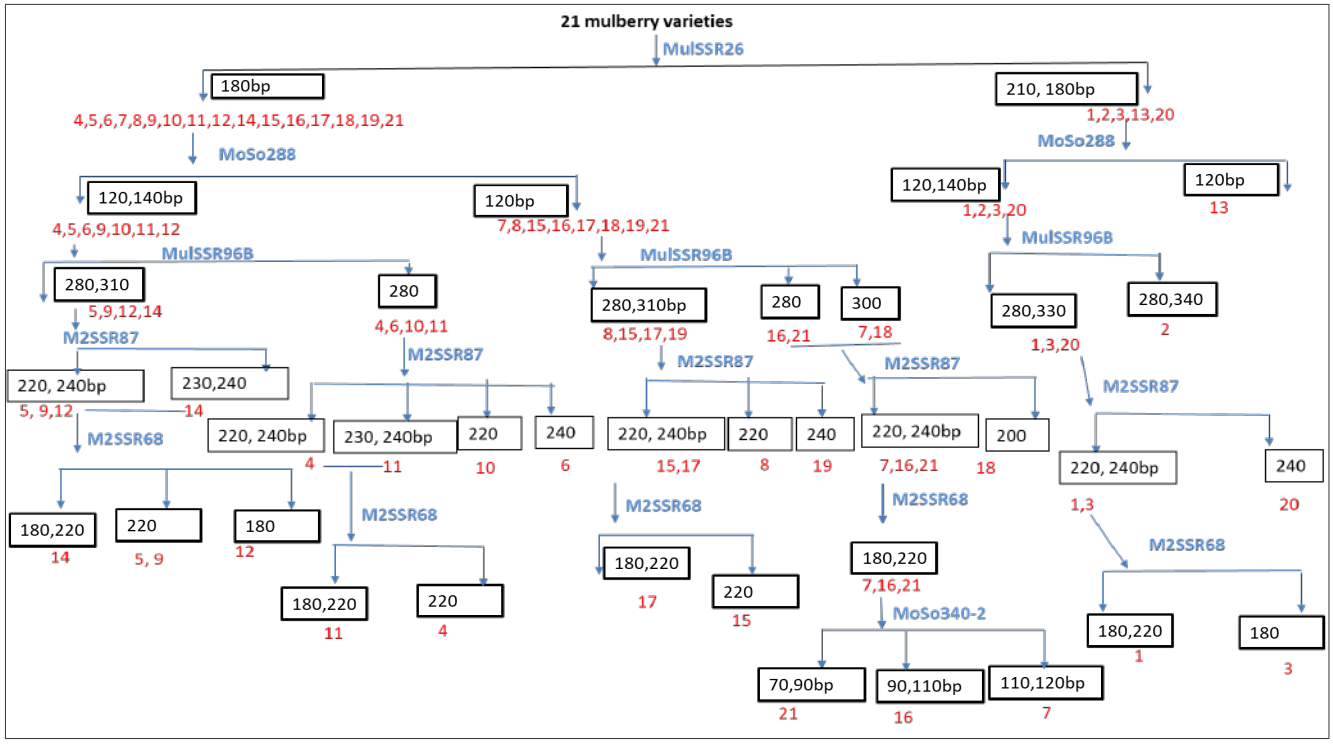



Fig. 2.3: Cultivar identification diagram of 21 mulberry genotypes by 6 SSR markers

The numbers in red are genotype number (1: K-2, 2:S-34, 3:AR-11, 4:S-146, 5: RFS-135, 6:S-36, 7:MR-2, 8:S-13, 9: RFS-175, 10:S-1635, 11: Vishala, 12: V-1, 13: G-4, 14:RC-1, 15: G-2, 16: Sahana, 17:AR-12, 18:MSG-2, 19: AGB-8, 20: Mysore local, 21:RC-2) and allele size in bp for a marker was given in rectangular box. Marker names are given in Blue. **Note:** Fora marker MulSSR96B the allele size difference of 16$^{th}$and 21$^{th}$ genotypes with 7$^{th}$ and 18$^{th}$ and for a marker M2SSR87 the allele size difference of 5$^{th}$, 9$^{th}$, 12$^{th}$ genotype with 14$^{th}$ genotype and 4$^{th}$ with 11$^{th}$ genotype is very less. Therefore, these genotypes are again differentiated using marker M2SSR87 and M2SSR68, respectively. Fifth and Ninth genotypes are not differentiated using markers indicate they are more similar to each other.

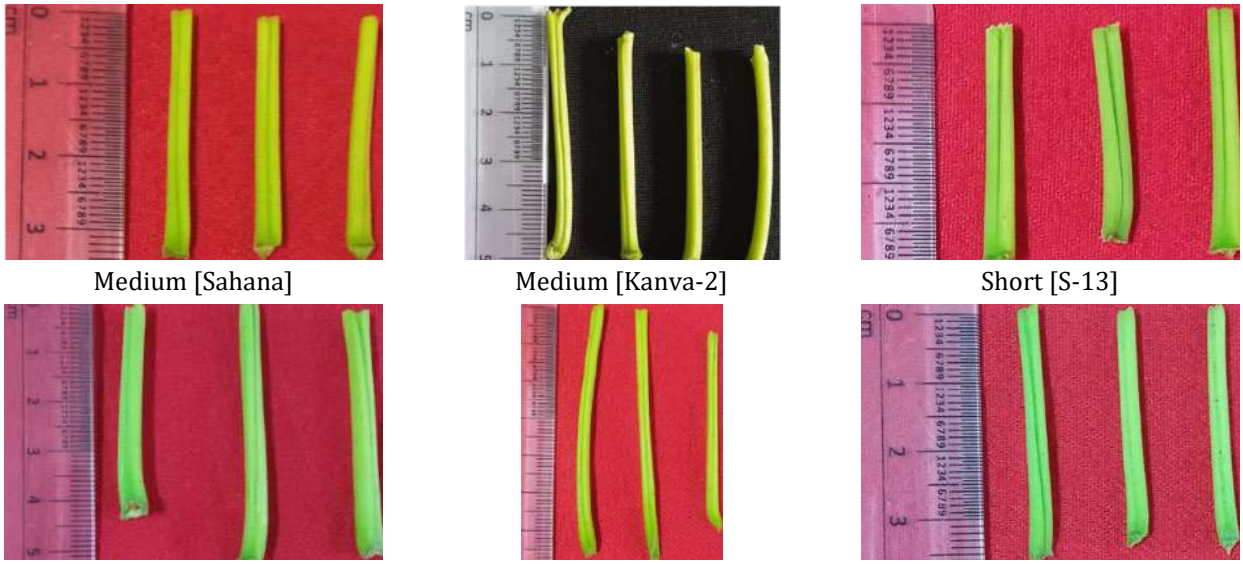

Lobate [G-4] Truncate [V-1] Cordate [Vishala]

Fig. 2.4: Distinctiveness in leaf base

Purple group 76
Very pale purple colour RC-1

Black group 203
Bluish black S-36

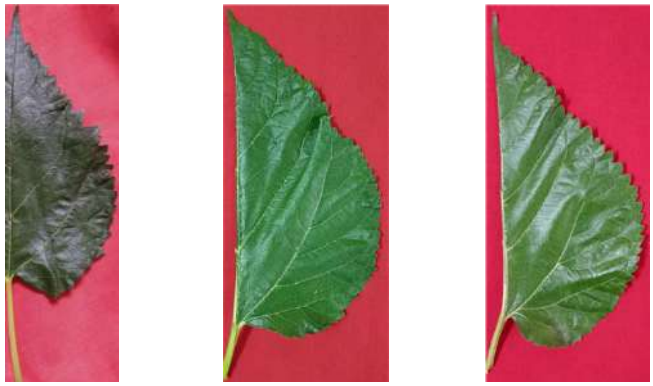
Fig. 2.5: Distinctiveness in fruit colour



Medium [Sahana] Medium [Kanva-2] Short [S-13]

Medium [G-2] Long [MR-2] Medium [RC-2]

Fig. 2.6: Distinctiveness in Petiole length



Dentate [AR-12] Crenate [Vishala] Serrate [S-1635]

Fig. 2.7: Distinctiveness in leaf margin

Androecious [MSG-2] Androecious [V-1] Andromonoecious [RFS-135]

Androgynomonoecious [AR-12] Androecious [S-1635] Gynoecious [Vishala]

Fig. 2.8: Distinctiveness in sex

## On-going Research Projects

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

G.S. Arunakumar and M.R. Bhavya

**Objectives**

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

**Field experiments**

In total, 2179 F1 hybrid seedlings pertaining to different cross combinations were established and maintained in the experimental plot for recording observations (Table 2.1). Recorded first, second and third crop data on hybrids of G2 x Thailand male (171), V1 x Laevigata hybrid (51), V1 x *M. multicaulis* (40) G4 OPH (114) and G2 OPH (187). Selected superior hybrids in each cross and OPH based on growth and yield parameters, pest and disease data (Table 2.2).

Prepared the cuttings of selected $F_1$ progenies from five crosses (*Morus multicaulis* x Thailand male, BR8 x ERRC103, Hosur C3 x V1, G2 x Thailand Male and Punjab local x Cathayana Hybrid) one OPH (G4) and planted in the nursery beds for multiplication of saplings for Primary yield trial (PYT). Saplings of 45 selected hybrids of different cross combinations are ready for transplantation to PYT experimental field. Survivability of each hybrid has been assessed (Table 2.3).

Table 2.1: Details of the crosses and OPH established in the experimental field

| Cross | Cross code | No. of seeds | No. of seedlings | Germination % | Estd. in field |
|---|---|---|---|---|---|
| *M. multicaulis* × Thailand male | MMTM | 2800 | 350 | 12.5 | 288 |
| Punjab local × Cathayana hybrid | PLCH | 510 | 55 | 10.78 | 55 |
| G2 × Thailand male | G2TM | 1694 | 646 | 38.13 | 326 |
| BR-8 × ERRC-103 | BRER | 1142 | 227 | 19.88 | 99 |
| Hosur-C3 × V1 | HC3V1 | 201 | 108 | 53.73 | 76 |
| G4 OPH | G4OPH | 2071 | 910 | 43.94 | 748 |
| *M. multicaulis* × V1 | MMV1 | 805 | 310 | 38.51 | 40 |
| English Black OPH | EBOPH | 2675 | 300 | 11.21 | 240 |
| G2 OPH | G2OPH | 1680 | 210 | 12.5 | 187 |
| *Morus multicaulis* | MMOPH | 1500 | 170 | 11.33 | 120 |

Table 2.2: Details of progenies selected from crosses and OPH based on growth and yield parameters

| Growth and yield Parameters | Cross 6 hybrids (*M. multicaulis* × V1) | G2 OPH | Cross 5 hybrids (Hosur C3 x V1) | G4 OPH |
|---|---|---|---|---|
| Length of longest shoot (cm) | 40, 13, 25, 30, 3, 12, 32, 8, 5, 9 | 59, 16, 172, 41, 74, 17, 115, 74, 116, 164, 153 | 44, 33, 35, 21, 1, 31, 45, 63, 49, 41 | 112, 114, 113, 97, 108, 111, 105, 100, 115, 62 |
| No. of leaves in longest shoot | 24, 13, 30, 3, 4, 27, 31, 38, 19, 5 | 129, 59, 131, 53, 153, 158, 167, 17, 136, 164 | 69, 44, 33, 49, 28, 39, 53, 73, 35, 31, | 100, 97, 108, 48, 50, 42, 90, 93, 114, 67 |
| Shoot weight (g) | 8, 1, 5, 26, 36, 37, 22, 10, 13, 38 | 59, 140, 61, 2,3, 175, 158, 41, 153, 131 | 37, 35, 1, 41, 25, 50, 39, 49, 71, 57 | 108, 100, 48, 50, 97, 114, 67, 96, 105, 88 |
| Stem weight (g) | 5, 1, 8, 9, 37, 13, 36, 21, 26, 38 | 59, 17, 140, 2, 3, 41, 55, 61, 95, 131 | 37, 35, 1, 41, 44, 39, 49, 19, 33, 57 | 108, 97, 48, 100, 50, 67, 96, 90, 105, 44 |
| No. Branches | 25, 20, 18, 35, 19, 21, 28, 9, 13, 37 | 161, 154, 175, 163, 177, 28, 19, 47, 49, 169 | 16, 37, 19, 36, 64, 9, 1, 11, 41, 58 | 44, 112, 16, 78, 108, 109, 113, 2, 32, 41 |

Table 2.3: Survival percentage of selected hybrids in nursery condition

| Sl. No. | Cross /OPH name | Survival % | Sl. No. | Cross /OPH name | Survival % | Sl. No. | Cross /OPH name | Survival % |
|---|---|---|---|---|---|---|---|---|
| 1 | G2 x TM51 | 3.0 | 22 | MM168 x TM103 | 50.0 | 43 | BR8 x ERRC01 | 93.0 |
| 2 | G2 x TM53 | 41.0 | 23 | MM168 x TM105 | 43.0 | 44 | BR8 x ERRC02 | 67.0 |
| 3 | G2 x TM54 | 29.0 | 24 | MM168 x TM109 | 42.0 | 45 | BR8 x ERRC16 | 56.0 |
| 4 | G2 x TM55 | 10.0 | 25 | MM168 x TM110 | 51.0 | 46 | BR8 x ERRC17 | 52.0 |
| 5 | G2 x TM76 | 9.0 | 26 | MM168 x TM111 | 56.0 | 47 | BR8 x ERRC28 | 56.0 |
| 6 | G2 x TM100 | 15.0 | 27 | MM168 x TM112 | 33.0 | 48 | BR8 x ERRC70 | 56.0 |
| 7 | G2 x TM103 | 9.0 | 28 | MM168 x TM140 | 10.0 | 49 | PL x CH04 | 48.0 |
| 8 | G2 x TM104 | 5.0 | 29 | MM6 x TM67 | 56.0 | 50 | PL x CH09 | 54.0 |
| 9 | G2 x TM105 | 16.0 | 30 | MM6 x TM68 | 16.0 | 51 | PL x CH10 | 52.0 |
| 10 | G2 x TM106 | 6.0 | 31 | MM6 x TM71 | 53.0 | 52 | PL x CH12 | 54.0 |
| 11 | G2 x TM114 | 6.0 | 32 | MM6 x TM72 | 69.0 | 53 | PL x CH13 | 41.0 |
| 12 | MM168 x TM02 | 30.0 | 33 | MM6 x TM101 | 46.0 | 54 | Hosur C3 x V1-1 | 57.0 |
| 13 | MM168 x TM06 | 53.0 | 34 | MM6 x TM104 | 80.0 | 55 | Hosur C3 x V1-25 | 30.0 |
| 14 | MM168 x TM08 | 67.0 | 35 | MM6 x TM106 | 21.0 | 56 | Hosur C3 x V1-35 | 57.0 |
| 15 | MM168 x TM10 | 45.0 | 36 | MM6 x TM143 | 57.0 | 57 | Hosur C3 x V1-41 | 34.0 |
| 16 | MM168 x TM13 | 29.0 | 37 | MM6 x TM153 | 37.0 | 58 | Hosur C3 x V1-47 | 14.0 |
| 17 | MM168 x TM18 | 44.0 | 38 | MM6 x TM172 | 56.0 | 59 | Hosur C3 x V1-71 | 45.0 |
| 18 | MM168 x TM25 | 59.0 | 39 | MM6 x TM173 | 46.0 | 60 | G4 OPH 48 | 13.0 |
| 19 | MM168 x TM48 | 33.0 | 40 | MM6 x TM174 | 26.0 | 61 | G4 OPH 50 | 15.0 |
| 20 | MM168 x TM55 | 47.0 | 41 | MM6 x TM175 | 36.0 | 62 | G4 OPH 100 | 10.0 |
| 21 | MM168 x TM58 | 50.0 | 42 | MM6 x TM177 | 61.0 | 63 | G4 OPH 108 | 3.0 |

## Continuous/Other Activities

- Regular maintenance of 400 Panel of Diverse Germplasm.
- Development and maintenance of mapping resources.

# 3. SOIL SCIENCE & CHEMISTRY

## Concluded Research Project

### PIC 01007 SI: Development of protocol for production of medically fit silk (sericin, fibroin, cocoon) for clinical purposes (Feb. 2020 to Jan. 2023)

Ravindra, Dhaneshwar Padhan, Divya Singh, Y. Thirupathaiah, V. Sobhana, T. Gayathri and S. M. Hukkeri

**Objectives**

- Production of mulberry leaf through organic cultivation practices/hydroponics/sand culture
- Rearing of silkworm by using the leaf produced under such system and production of organic cocoons and silk
- Development of protocol for production of heavy metal and other toxic free/permissible limit in cocoon/silk.

**Specific Objective**

- Purification and characterization of sericin and fibroin from organic cocoon.

**Production of cocoon through organic cultivation practices**

During the period of report, silkworm rearing was conducted using organically produced leaf in Jul – Aug. 2022, Oct-Nov. 2022 and Jan-Feb 2023. Cocoon, Sericin and fibroin were tested for heavy metals, pesticide residues formaldehyde, chlorine and aflatoxins if any. The results showed that heavy metals are within the permissible limit whereas pesticides, formaldehyde, chlorine and aflatoxin were below detection limit

**Hydroponic Nutrient Flow Technique (NFT)**

Mulberry plants (120) of V1 variety were grown through hydroponic method and maintained in the polyhouse condition. The hydroponically grown mulberry leaf and cocoon were tested for heavy metals and pesticide residues and it was found that Pb, Cd, As, Hg and Co, Ni, Cr and Cu are within limit. Similarly, it was also observed that pesticides such as organophosphates, carbamates and organochlorines were not detected in hydroponically grown leaf.

**Sand bed culture**

Mulberry plants (280) of V1 variety grown in sand culture technique was maintained in polyhouse conditions. Heavy metals and pesticide residues were analysed in mulberry leaf produced and cocoon shell it was observed that heavy metals are within the permissible limit and pesticides are not detected.

**Cytotoxicity assay**

In this study, sericin (10-1000µg), fibroin (10-400µg) and silk (0.1g) samples were tested for cytotoxicity assay on L-929 cell lines it was observed that all these samples were not showed toxicity effect on cell lines at lower concentrations.

**Bioburden test of silk**

Microorganisms on a product, raw material, or surface are referred to as bioburden. The quality control of pharmaceutical items, medical equipment, and their components heavily relies on bioburden testing. This analysis, which complies with ISO 11737-1, finds populations of live microorganisms on a product before sterilisation, demonstrating the product's microbiological cleanliness. Silk sample (0.1 g) is tested for the presence of microbial load and it was observed that microbial load on silk (bacteria 0-10 CFU/g and fungi 0-60 CFU/g) are within the permissible limit (100 CFU/g) as per ISO 13485 medical device guidelines.

**Removal of heavy metals from sericin solutions using alginate beads**

The adsorption approach was used to eliminate the heavy metals from the cocoon extract. In a brief, sodium calcium alginate beads prepared were placed in a glass column, and loaded with cocoon extract solution. The filtrate solution examined for the presence of heavy metals. The results show that heavy metals, such as Pb, Cr, Cu, Fe, and Zn, were successfully removed from the sericin solution.

**Removal of heavy metals by using activated mulberry leaf powder**

The V1 mulberry leaf samples was collected, shade dried and made powder and activated the leaf powder by treating with alkali solution. The activated leaf powder was filled in glass column and washed the column with milliq water then loaded the sericin solution and kept it for 2-3h. Heavy metals such as Cu,

Fe, Zn and Mn were analysed before and after the filtration of sericin solution. The metals ions adsorb by activated mulberry leaf by 70-80% from the sericin solution.

**Antioxidant activity**

The sericin and fibroin solution was used for the antioxidant activity and the results shows that sericin was more effective antioxidant than fibroin.

## On-going Research Projects

### MTL 01025 MI: Life cycle assessment of mulberry silk: A National Assessment (Feb. 2022-Jan. 2025)

Amit Kumar, V. Sobhana, K. Alam[1], R. Kiran[2], R. Mondal[3], G. R. Manjunatha[4], and S. Nivedita[5]

[1]CSRTI-Berhampore; [2]CSRTI-Pampore; [3]CSGRC-Hosur; [4]CO-Bengaluru; [5]CSTRI-Bengaluru

**Objective**

- To assess GHGs emission, GWP, C, N, water and energy footprints in the life cycle of Mulberry silk systems.
- To prepare life cycle Inventory of Mulberry silk and its products
- To identify alternative practices to mitigate GHGs emission and minimize the C, N, energy and water footprints in mulberry silk production system along with their socio-economic implication.

Experimental plots have been identified at all three study locations, *i.e*., temperate, sub-tropical, and tropical. The initial calculation of global temperature change potential for the Indian mulberry at the 20-year ($GTP_{20}$) and 100-year ($GTP_{100}$) scales has been completed by taking the base data from 1971-2021. The first estimation of Total $N_2O$, Direct $N_2O$, $N_2O$ from nitrate leaching, N induced $CH_4$ influx, and total warming from Indian mulberry sericulture since 1971-2021 has been done. The indirect $CO_2$ efflux by pesticides, fertilisers, irrigation, and tillage has been estimated for the first crop. The questionnaire and pre-test have been completed for consumers. Levels of $PM_{2.5}$, $PM_{10}$, $SO_2$, CO, $NO_2$, CO and $O_3$, along with the prevailing temperature and relative humidity conditions of various sericultural districts of tropical, sub-tropical and temperate climates covered under the study (Dec. 2022 to Mar. 2023), have been recorded. The environmental variables such as temperature, dewpoint, specific humidity, relative humidity, rainfall, wind speed, surface pressure and wind direction of the experimental plots have been collected and processed for all the plots. The silk saree consumer survey has been conducted in Tropical [Kolar (N = 66), Mysuru (N = 211), and Chitradurga (80)]; temperate (N = 50) and sub-tropical (N = 50) areas for the period under report.

## Continuous/Other activites

### Quality Analysis and Sample Testing

Commercialized products developed by CSRTI-Mysuru were analysed in the laboratory to check the quality parameters. Samples of water, soil and FYM were also tested for macronutrients. Based on the test results, technical guidance was provided to the farmers and stakeholder groups.

Table 3.1: Analysis of products or samples and revenue generated

| Products/samples | No. of samples | Revenue generated (Rs.) |
|---|---|---|
| Soil | 326* | 8048 |
| Water | 46* | 1526 |
| Leaf | 28* | 354 |
| FYM | 02 | 1416 |

| Products/samples | No. of samples | Revenue generated (Rs.) |
|---|---|---|
| Asthra | 19 | 17936 |
| Vijetha | 04 | 14160 |
| Vijetha supplement | 16 | 18880 |
| Sanitech | 01 | 944 |
| Ankush | 06 | 24780 |
| Amruth | 03 | 3540 |
| Poshan | 10 | 35400 |
| Dr. Soil | 01 | 3540 |
| Serichlore | 01 | 944 |
| Total | 463 | 131468 |

* 44 soil, 16 water and 2 leaf samples were tested against payment

# 4. AGRONOMY

## Concluded Research Project

### PPA 01016 SI: Development of an agronomical package for tree mulberry cultivation for wide acceptance among the seri-farmers of Southern India (Nov. 2020 - Feb. 2023)

Dhaneshwar Padhan, C.M. Babu, V. Sobhana, J.B. Narendra Kumar, T. Sivasubramonian and D. Guruswamy (up to May 2022)

**Objectives**

- To evaluate the optimum requirement of nutrients for mulberry under tree cultivation.
- To work out the techno-economics of the mulberry under tree cultivation.

The experiment was conducted with farmer's participatory mode in three locations *viz*., Maddur, Chamarajanagar and Kolar areas to optimize the nutrient requirement for mulberry under tree cultivation. Four treatments *viz.,* $T_1$: NPK @ 207:83:83 g + 15 kg FYM/plant/year; $T_2$: NPK @ 155:62:62 g + 15 kg FYM/plant/year; $T_3$: NPK @ 258:103:103 g + 15kg FYM/plant/year; $T_4$: NPK @ 103:83:83 g + 15 kg FYM/plant/year + Green manuring along with farmer's adopted practice as control ($T_5$) were tested over a period of two years.

Eight crop data on the growth and yield parameters of mulberry under different fertilizer treatments revealed that the growth and yield were significantly influenced by the nutrient management practices in all three experimental sites (Table 4.1, 4.2 and 4.3). It was observed that treatment $T_3$ recorded the highest leaf yield in all the experimental sites as compared to other treatments (Fig. 4.1). However, in Kolar experimental area, the farmer's adopted practice ($T_5$) recorded the leaf yield at par with $T_3$ treatment. The economics of tree mulberry cultivation was also worked out and it was found that $T_3$ treatment showed higher B:C ratio (2.95:1) compared to the farmers' adopted practice (2.49:1).

**Conclusion**

The fertilizer dose with NPK @ 258:103:103 g + 15 kg FYM/plant/year may be recommended to farmers for obtaining quality mulberry leaf with higher yield under tree cultivation.

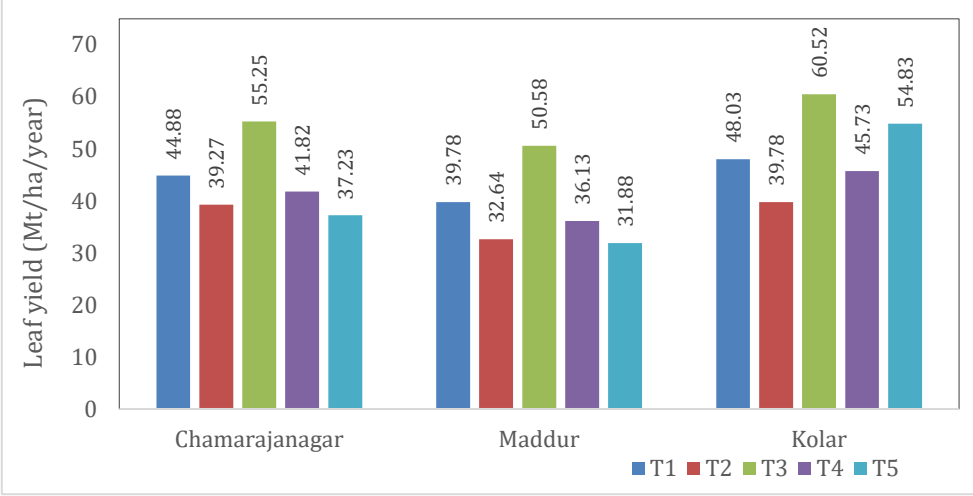



Fig. 4.1: Leaf yield of mulberry under different treatments at experimental sites

Table 4.1: Effect of different doses of fertilizers on growth and yield of mulberry (Location: Maddur)

| Treatments | Longest shoot length (cm) | No. of shoots /plant | No. of leaves /shoot | Leaf weight (kg)/plant | Shoot weight (kg)/plant |
|---|---|---|---|---|---|
| $T_1$ | 184$^{b}$ | 27$^{b}$ | 36$^{a}$ | 3.97$^{ab}$ | 3.00$^{b}$ |
| $T_2$ | 169$^{d}$ | 24$^{c}$ | 30$^{b}$ | 3.31$^{c}$ | 2.44$^{c}$ |
| $T_3$ | 194$^{a}$ | 31$^{a}$ | 39$^{a}$ | 4.51$^{a}$ | 3.41$^{a}$ |
| $T_4$ | 177$^{c}$ | 26$^{bc}$ | 32$^{b}$ | 3.54$^{bc}$ | 2.56$^{c}$ |
| $T_5$ | 169$^{d}$ | 23$^{c}$ | 29$^{b}$ | 3.20$^{c}$ | 2.35$^{c}$ |

Different letters (a-d) in each column indicate significant differences between the treatments according to Duncan's multiple range test (P< 0.05)

Table 4.2: Effect of different doses of fertilizers on growth and yield of mulberry (Location: Chamarajnagar)

| Treatments | Longest shoot length (cm) | No. shoots/plant | No. leaves/shoot | Leaf weight (kg)/plant | Shoot weight (kg)/plant |
|---|---|---|---|---|---|
| $T_1$ | 194$^{a}$ | 29$^{ab}$ | 37$^{ab}$ | 4.26$^{ab}$ | 3.19$^{b}$ |
| $T_2$ | 179$^{b}$ | 26$^{c}$ | 33$^{c}$ | 3.64$^{b}$ | 2.66$^{c}$ |
| $T_3$ | 200$^{a}$ | 32$^{a}$ | 38$^{a}$ | 4.74$^{a}$ | 3.58$^{a}$ |
| $T_4$ | 179$^{b}$ | 27$^{bc}$ | 34$^{bc}$ | 3.91$^{b}$ | 2.96$^{bc}$ |
| $T_5$ | 176$^{b}$ | 25$^{c}$ | 33$^{c}$ | 3.46$^{b}$ | 2.61$^{c}$ |

Different letters (a-c) in each column indicate significant differences between the treatments according to Duncan's multiple range test (P< 0.05)

Table 4.3: Effect of different doses of fertilizers on growth and yield of mulberry (Location: Kolar)

| Treatments | Longest shoot length (cm) | No. of shoots /plant | No. of leaves /shoot | Leaf weight (kg)/plant | Shoot weight (kg)/plant |
|---|---|---|---|---|---|
| $T_1$ | 182$^{b}$ | 30$^{ab}$ | 34$^{bc}$ | 4.71$^{b}$ | 3.40$^{b}$ |
| $T_2$ | 176$^{b}$ | 27$^{b}$ | 33$^{c}$ | 4.21$^{c}$ | 3.03$^{c}$ |
| $T_3$ | 198$^{a}$ | 35$^{a}$ | 41$^{a}$ | 5.55$^{a}$ | 3.97$^{a}$ |

| Treatments | Longest shoot length (cm) | No. of shoots /plant | No. of leaves /shoot | Leaf weight (kg)/plant | Shoot weight (kg)/plant |
|---|---|---|---|---|---|
| $T_4$ | 179[b] | 29[b] | 35[bc] | 4.61[b] | 3.32[b] |
| $T_5$ | 194[a] | 32[ab] | 38[ab] | 5.01[ab] | 3.56[ab] |

Different letters (a-c) in each column indicate significant differences between the treatments according to Duncan's multiple range test (P< 0.05)

## Ongoing Research Projects

**MOE 01021SI: Evaluation and popularization of improved technologies developed in the field of mulberry sector for South India (Nov. 2021-Oct. 2023)**

**Component 9: Impact of drip fertigation on mulberry productivity**

M. Muthulakshmi (Overall PI), R. Mahesh (Component 9 PI), T. Sivasubramonian, S. B. Kulkarni, K. Jhanshi Lakshmi, P. Sudhakar (upto Jul. 2022) and P. Kiran Kumar (from Aug. 2022)

**Objectives**

- To validate the drip fertigation technology for mulberry at different locations.

Efficient use of water and nutrients is the principal factor in determining optimum mulberry leaf productivity. Hence, drip fertigation technology was developed to enhance the efficiency of water and nutrients for mulberry. Drip fertigation with a 75% recommended dose was found to be the optimum requirement for sustainable mulberry leaf production. As such, the technology validation trial was conducted at different locations in the southern zone, *viz*., CSRTI-Mysuru, RSRS-Kodathi and Anantapur with V1 variety under PRS plantation; RSRS-Chamrajanagara with AGB8 variety under high bush plantation (6' x 3' spacing) and REC-Krishnagiri with G4 variety under PRS plantation. The average leaf yield recorded under the drip fertigation system vis-a-vis the conventional package was 995 and 789 g/plant, respectively. Thus, the drip fertigation system yielded an average improvement of 26% in leaf yield against the conventional package. The results indicated that drip fertigation technology is an efficient system for water and nutrient management in mulberry cultivation (Table 4.4).

Table 4.4: Impact of drip fertigation on leaf yield (g/plant)

| Station | Drip Fertigation | Conventional practice | % Improvement |
|---|---|---|---|
| CSRTI-Mysore | 817 | 642 | 26 |
| RSRS-Chamrajanagara | 1920 | 1420 | 35 |
| RSRS-Kodathi | 565 | 505 | 12 |
| REC-Krishnagiri | 680 | 590 | 15 |
| Average | 995 | 789 | 26 |

## Continuous/Other activites

- Engaged classes for trainees and students under different training programmes.
- Maintained 2 acre seed mulberry garden with G4 variety.
- Maintained the seri-compost and vermicompost units for demonstration.

# 5. MULBERRY PHYSIOLOGY

## Ongoing Research Projects

**Pilot Study: Isolation, identification and characterization of drought tolerant plant growth promoting microbes (Feb. 2023 to Jul. 2023)**

Divya Singh, T. Gayathri and L. Satish

**Objective**

- To isolate, identify and characterize plant growth promoting microbes from the rhizosphere of mulberry under drought condition.

Soil samples were collected from drought affected farmers' fields from the rhizospheric region (three replications each) of the mulberry gardens of Jalna, Beed (Maharashtra) and Kolar (Karnataka) districts. Soil samples from the same farmer's field were pooled and processed for soil analysis for different parameters such as pH, organic carbon, phosphorus and potassium. The soil analysis was done according to the modified methods of Jackson (1973), Walkley and Black (1934), Olsen *et al*., (1954) and Hanway and Heidal (1952). Isolation of microbes and soil data analysis are in progress.

Fig. 5.1: Drought tolerant bacterial colonies isolated from the soil of Jalna district

# 6. MULBERRY PATHOLOGY

## Ongoing Research Project

**PRP 01015 SI: Identification, evaluation and inclusion of potential antagonistic microbes in Integrated Root Rot Disease Management in Mulberry (Nov. 2020 - Oct. 2023)**

G. S. Arunakumar, L. Satish, N. Dhahira Beevi, Vinod Kumar Yadav, P.M. Nisarga

**Objectives**

- Collection, isolation, identification and characterization of potential biocontrol agents available at rhizosphere of mulberry.
- *In-vitro* evaluation of potential bio-control agents available at rhizosphere of mulberry against root rot causing pathogens.
- To study compatibility of potential bio-control agent for development of antagonistic microbial consortia and *in-vivo* evaluation against root rot pathogens.
- *In-vivo* evaluation of compatible potential bio-control agents' integration with existing best management practices for formulation of integrated root rot disease management packages.

A total of 120 soil samples were collected from healthy mulberry gardens in southern Indian states. Different isolates of bacterial and fungal organisms were isolated from these soil samples. Molecular, morpho-cultural, and microscopic characterizations of 17 bacterial isolates and three fungal isolates were carried out. These isolates showed antagonistic effects on four root rot causing fungal pathogens (*Fusarium solani*, *F. oxysporum*, *Rhizopus oryzae* and *Lasiodiplodia theobromae*). Antagonism was confirmed against these pathogens using the dual culture technique (Table 6.1). The compatibility of these isolates with eight contact and systemic fungicides was studied, the majority of the bacterial isolates were compatible with fungicides, whereas only one fungal isolate was observed to be compatible with fungicide (mancozeb @ 0.1 %). Twelve effective bacterial and fungal isolates were selected based on their fungicidal compatibility and their percent inhibition of fungal mycelial growth. These isolates were used to develop different microbial consortia or formulations based on their compatibility with each other. Suitable carrier (liquid or solid) materials have been identified to prepare different formulations. Effective formulations of microbial consortia against the root rot pathogens were selected based on an *in-vitro* study. Root rot disease was created artificially by inoculating pathogenic isolates on highly susceptible plants. The efficacy of selected formulations on diseased plants was evaluated under glasshouse conditions. Eight treatments were selected based on the results of the *in-vitro* study; these treatments were imposed on root rot diseased V1 and Thailand male mulberry varieties (highly susceptible to root rot disease) under glasshouse conditions. Data on the number of bud breaks in each treatment was recorded to study the effect of bio-stimulation by microbial consortia (Fig. 6.1). Out of eight treatments, five formulations showed 100% and 92.31 to 95.24% bud sprouting on mulberry plants upon exposure to *Lasiodiploidia theobromae* and *Fusarium solani*, respectively (Table 6.2). The treatment effects were assessed by recording the number of healthy and wilted shoots and leaves and the height of the plants.

Table 6.1: Per cent inhibition of root rot causing pathogens by antagonistic microbial isolates

| Isolate name | Per cent mycelial growth inhibition | | | | |
|---|---|---|---|---|---|
| | *F. solani* | *R. oryzae* | *F. oxysporum* | *L. theobromae* | Average |
| TN006.2 | 77.78 | 88.89 | 88.89 | 73.33 | 82.22 |
| TN010.2 | 88.89 | 88.89 | 88.89 | 77.78 | 86.11 |
| TS001.1 | 88.89 | 88.89 | 71.11 | 73.33 | 80.56 |
| TS001.2 | 88.89 | 88.89 | 64.44 | 75.56 | 79.44 |
| TN006.5 | 88.89 | 88.89 | 77.78 | 37.78 | 73.33 |
| TS003.1 | 88.89 | 88.89 | 77.78 | 28.89 | 71.11 |
| AP001.4 | 11.11 | 77.78 | 88.89 | 33.33 | 52.78 |
| AP014.2 | 88.89 | 77.78 | 88.89 | 31.11 | 71.67 |
| KA004 | 46.67 | 33.33 | 28.89 | 4.44 | 28.33 |

Table 6.2: Details of treatments and their effect on buds sprouting

| Treat-ment | Details of Treatment | *Lasiodiplodia theobromae* | | | *Fusarium solani* | | |
|---|---|---|---|---|---|---|---|
| | | NB @9 | S @15 | | NB @9 | S @15 | |
| | | Total | Total | % | Total | Total | % |
| T1 | Rotfix: 5g per liter of water | 17 | 11 | 64.71 | 15 | 10 | 66.67 |
| T2 | SAAF: 2g per liter of water | 13 | 9 | 69.23 | 09 | 5 | 55.56 |
| T3 | LF1: 5ml per liter of water | 16 | 16 | 100.00 | 13 | 12 | 92.31 |
| T4 | LF3: 5ml per liter of water | 14 | 14 | 100.00 | 13 | 12 | 92.31 |
| T5 | SF2: 5g per liter of water | 18 | 18 | 100.00 | 21 | 20 | 95.24 |

| Treat-ment | Details of Treatment | *Lasiodiplodia theobromae* | | | *Fusarium solani* | | |
|---|---|---|---|---|---|---|---|
| | | NB @9 | S @15 | | NB @9 | S @15 | |
| | | Total | Total | % | Total | Total | % |
| T6 | NB2: 5ml per liter of water | 11 | 11 | 100.00 | 26 | 24 | 92.31 |
| T7 | Roco+SF2: (2g+5g) per liter of water | 10 | 10 | 100.00 | 15 | 15 | 100.00 |
| T8 | SAAF+SF2: (2g+5g) per liter of water | 12 | 11 | 91.67 | 20 | 19 | 95.00 |
| T9 | Control | 13 | 6 | 46.15 | 15 | 8 | 53.33 |

NB @9: Number of buds @ 9 days after treatment; Sprouting @ 15 days after treatment.

Fig. 6.1: Bud sprouting after 10 days of exposure to various treatments under glasshouse condition

## Other activities

- Maintenance of different bacterial and fungal cultures in the section.
- Evaluation of commercialized products (*Navinya* and Rot fix) and issue of test report if found effective under lab conditions.
- Addressed mulberry disease problems of South Indian Seri-farmers with suitable management practices as and when required.

# 7. FARM MANAGEMENT

Y. N. Sanath Kumar

## Continuous/Routine activities

- Maintained 20 acres of mulberry garden including 2 acres of *chawki* garden with improved cultivation practices for the production and supply of quality leaf to different rearing programmes of the Institute. Maintained 3 acres of demonstration plot for tree mulberry cultivation.
- Supplied 58,135 kg of mulberry leaf and 10,450 kg of mulberry shoot to different rearing programmes under various projects, experiments, and race maintenance activities.
- Supplied 16,625 kg of mulberry chawki leaf to the Commercial Chawki Rearing Centre to undertake the chawki rearing of 44,610 dfls.
- Maintained 5 acres of V1 mulberry garden for the production and supply of seed cuttings.
- Supplied 35.257 MT of V1 mulberry seed cuttings to 104 farmers for horizontal expansion of about 141 acres.
- A total of Rs. 6,11,078/- was generated as income through the sale of mulberry seed cuttings, the auctioning of coconut trees, green grass, *etc*.

# 8. BIVOLTINE BREEDING LABORATORY

## Ongoing Research Project

### AIB 01009 MI: Evaluation of new bivoltine silkworm double hybrid TT21 x TT56 at farmers level for authorization and commercial exploitation (Apr. 2020-Mar. 2024)

K. N. Madhusudhan (From Jun. 2021), L. Kusuma, M. S. Ranjini, M. N. Chandrasekar, S. B. Kulkarni[1], K. P. Kiran Kumar[2], N. Dhahira Beevi[3], T. Sivasubramaniam[4], K. Praveen Kumar[5], M. B. Radha[6], N. Chandrakanth[7], K.P. Sivakumar[8], Rita Singh[9] and R. P. Singh[10]

[1]RSRS-Kodathi, [2]RSRS-Ananthapur, [3]RSRS-Salem, [4]RSRS-Chamarajanagar, [5]RSRS-Mulugu, [6]SSPC-Ramanagaram, [7]CSRTI-Berhampore, [8]CSTRI-Bengaluru, [9]RSRS-Jammu, [10]RSRS-Sahaspur

**Objective**

- To evaluate the performance of bivoltine hybrid, TT21 x TT56 in field for productivity and silk quality

The continuous maintenance of Parents of TT21 (N1 & N2) and TT 56 (N5 & N6) were carried out at BBL, CSRTI-Mysuru. The disease free layings of foundation crosses of TT21 and TT56 were prepared and supplied to identify ASRs with help of NSSO through SSPC, Ramanagaram, Mysuru and Bengaluru. Till date, 4,01,450 hybrid dfls were prepared by NSSO and handed over to CSRTI, Mysuru for distribution and evaluation at farmers field. So far, 2,48,000 dfls were supplied to different agro-climatic regions which includes south, norh, east and western states of India. A total of 1,53,450 dfls are kept under 3 and 4 months hibernation schedule. Based on the results from the farmers, TT21 x TT56 showed better performance, in comparison to the ruling hybrids. Futher, subjecting the cocoons of TT21 x TT56 collected from different farmers for post cocoon parameters evaluation produced 2A-3A grade silk.

Table 8.1: Comparative evaluation of TT21 x TT56 with existing hybrid in different states

| State | Dfls | Yield range/100 dfls | |
|---|---|---|---|
| | | TT21 x TT56 | Control |
| Karnataka | 80,200 | 65-80 (73) | 66-78 (69) |
| Tamil Nadu | 62,550 | 59-80 (71) | 60-78 (68) |
| Andhra Pradesh | 29,000 | 60-80 (72) | 58-78 (67) |
| West Bengal | 29,000 | 45-80 (57) | 40-55 (48) |
| Uttarakhand | 11,500 | 46-56 (51) | 35-40 (38) |
| Jammu & Kashmir | 9,800 | | |
| Maharasthra | 5,500 | 65-79 (72) | 66-78 (68) |
| Telangana | 7,600 | 64-78 (70) | 65-75 (66) |
| Tripura | 6,100 | 35-55 (43) | 30-45 (38) |
| Odisha | 500 | 27-47 (37) | 25-45 (35) |
| Assam | 6350 | 35-45 | - |
| Total | 2,48,000 | - | - |

Values in the bracket indicate the average yield

Table 8.2: Reeling performance of TT21 x TT56 cocoons

| **A. Basic Information** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Lot No. | RST/22-23/SR-104 | | RST/22-23/SR-106 | | RST/22-23/SR-113 | | RST/22-23/SR-136 | | RST/22-23/SR- 137 | |
| 2. Name of farmer | Farmer 1 | | Farmer III | | GT Reddy | | Selvam | | Manikandan | |
| 3. Quantity (kgs) | 3.23 | | 2.72 | | 3.00 | | 3.50 | | 3.50 | |
| **B. Cocoon Characters** | | | | | | | | | | |
| 1. SCW (g) | 1.581 | | 1.603 | | 2.128 | | 1.585 | | 1.395 | |
| 2. SSW (g) | 0.380 | | 0.387 | | 0.496 | | 0.320 | | 0.267 | |
| 3. Shell Ratio (%) | 24.04 | | 24.14 | | 23.30 | | 20.2 | | 19.1 | |
| 4. Defective cocoons | 14.0 | | 13.4 | | 17.0 | | 8.4 | | 11.0 | |
| 5. Avg. fil. length (m) | 928 | | 992 | | 936 | | 975 | | 763 | |
| 6. NBFL (m) | 615 | | 484 | | 485 | | 877 | | 661 | |
| 7. Denier | 2.86 | | 2.70 | | 3.02 | | 2.64 | | 2.37 | |
| **C. Reeling Performance** | | | | | | | | | | |
| 1. Reelability | 55.2 | | 81.2 | | 80.0 | | 90.4 | | 87.0 | |
| 2. Rendita | 6.2 | | 6.5 | | 6.6 | | 6.1 | | 7.3 | |
| 3. Silk Recovery | 67.2 | | 63.7 | | 65.1 | | 76.0 | | 76.7 | |
| 4. Raw silk % | 16.2 | | 15.4 | | 15.2 | | 16.3 | | 13.7 | |
| 5. Silk waste % | 18.2 | | 19.9 | | 20.4 | | 10.0 | | 10.4 | |
| **D. Characters of raw silk** | Value | Grade | Value | Grade | Value | Grade | Value | Grade | Value | Grade |
| 1. Average size | 20.5 | | 22.9 | | 20.0 | | 19.8 | | 19.6 | |
| ***Major Tests*** | | | | | | | | | | |
| 1. Standard size deviation | 1.48 | 2A | 1.32 | 3A | 1.60 | 2A | 1.52 | 2A | 1.6 | 2A |
| 2. Evenness variation I | 30 | 4A | 28 | 4A | 24 | 4A | 30 | 4A | 28 | 4A |
| 3. Evenness variation II | 4 | 2A | 2 | 4A | 2 | 4A | 2 | 4A | 2 | 4A |
| 4. Cleanness | 97 | 4A | 98 | 4A | 97 | 4A | 94 | 2A | 96 | 3A |
| 5. Average neatness | 95 | 4A | 95 | 4A | 99 | 4A | 93 | 3A | 95 | 4A |
| 6. Low neatness | 93 | 4A | 90 | 4A | 95 | 4A | 90 | 4A | 93 | 4A |
| ***Auxillary tests*** | | | | | | | | | | |
| 1. Maximum deviation | 2.3 | 1 | 3.4 | 1 | 2.4 | 1 | 3.5 | 2 | 3.6 | 2 |
| 2. Evenness variation III | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| 3. Winding br./10 skeins/h | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 |
| 4. Tenacity | 3.7 | 1 | 3.7 | 1 | 3.7 | 1 | 3.9 | 1 | 3.9 | 1 |
| 5. Elongation | 21 | 1 | 22 | 1 | 20 | 1 | 19 | 1 | 19 | 1 |
| 6. Cohesion | 109 | 1 | 122 | 1 | 80 | 1 | 86 | 1 | 92 | 1 |
| Overall Grade | | 2A | | 3A | | 2A | | 2A | | 2A |

## BPS 01 0027 CN: Immunomodulatory and adjuvant effects of chitosan nanoparticles extracted from *Bombyx mori* (May. 2022-Apr. 2024)

K. N. Madhusudhan, K. Byrappa[1], G. Mallikarjuna, T. Narasaraju[1] and Pandareesh[1]

[1]Adichunchanagiri University, BG Nagara, Mandya district

### Objectives

- Preparation and characterization of chitosan-based nanoparticles.
- Studying the immunomodulatory role of chitosan-based nanoparticles against pathogens infections in *Bombyx mori* and experimental mice model.

- Determining the adjuvant efficacy of chitosan nanoparticles in mucosal immunity using intranasal SARS-COV-2 Spike vaccine

Mass extraction of chitin and chitosan was carried out using chemical extraction method (3 kg of chitin and 750 g of chitosan). Further, extraction procedure of chitosan from moths and diseased larvae were standardized. Dissolution of chitosan (100%) was achieved through different chemicals. The process for microbial extraction of chitin/chitosan from moths and diseased larvae were standardized. The silkworm pathogens *viz*., bacteria, BmNPV and Pebrine were maintained for evaluation of synthesized nanoparticles. Diversified products from chitosan *viz*., thin film, chitosan-ZnO Nanoparticles, drug encapsulated chitosan microspheres were developed.

### BPS 010028 CN: Value addition of cellulose and chitin from sericulture waste in advanced packaging applications (May. 2022-Apr. 2024)

K. N. Madhusudhan, K. Byrappa[1], V. Sobhana, K. Prashantha[1], M. A. Babu[1] and H. K. Vivek[1]
[1]Adichunchanagiri University, BG Nagara, Mandya district

**Objectives**

- Biohydrothermal processing of biocompatible and non-toxic heterogenous metals and metal oxides nanoparticles and quantum dots for advanced packaging films.
- Standardization of Dissolution of Chitin/ Chitosan and Cellulose.
- Preparation of chitin/ chitosan, cellulose based nanoparticles and quantum dots based advanced biodegradable packaging materials, their characterization and evaluation for various advanced packaging applications.

Chemical extraction method of cellulose from mulberry twigs were standardized using different chemical combinations. Further, the chemically extracted cellulose, chitin and chitosan were characterized using XRD and FTIR. The dissolution of cellulose and chitin were standardized by using ionic liquids. Synthesis and standardization of colourless-chitin and chitin microsphere. Development of diversified products. The X-ray pattern of the cellulose exhibits the typical diffraction peaks of the crystalline structure of cellulose at 2θ=16.3° and 22.5°.

Chemical extraction method of cellulose from mulberry twigs were standardized using different chemical combinations. Further, the chemically extracted cellulose, chitin and chitosan were characterized using XRD and FTIR. The dissolution of cellulose and chitin were standardized by using ionic liquids. Synthesis and standardization of colourless-chitin and chitin microsphere. The X-ray pattern of the cellulose exhibits the typical diffraction peaks of the crystalline structure of cellulose at 2θ=16.3° and 22.5°.

### AIB 01024 MI: Development of productive, autosexing silkworm breeds/ hybrids of *Bombyx mori* L. in egg stage and separation of male silkworm population by optical sorting method for commercial exploitation (Dec. 2021- Mar. 2024)

L. Kusuma, S. Manthira Moorthy, M. S. Ranjini, S. M. Hukkeri

**Objective**

- Development of viable bivoltine sex-limited strains at egg stage.
- To develop appropriate automated technology to sort male silkworm eggs by optical sorting method

- Development of productive sex limited bivoltine hybrid and evaluation of male population for important commercial traits

Presently, commercial cocoons reeled are made from a mixed population of male and female cocoons and produce up to 4A grade silk. Generally, the silk obtained from male silkworms is finer and has greater elasticity when compared to that obtained from female silkworms. Hence, it is imperative to develop a male-only breed or hybrid that yields internationally graded silk. Accordingly, parental resource materials were screened and selected, crosses were set up, and new hybrid combinations were made. Rearing of egg color-sex-limited parental breeds, derived lines, FCs, and backcrosses was carried out for successive filial generations. Dfls were prepared for 8 sex-limited parental breeds (CAO, CAO1, CBO, CBO1, CBO2, CBO-HF, CAD, CBD), 6 derived lines (ESLFCO2, ESLFC08, ESLFCO52, ESLFCD26, 2ECO17, 2EV252), 24 FC combinations along with their backcrosses (22) and were consigned under a 3 month and 4 month schedule. A few layings were acid treated and used for next generation rearing. Layings of egg sex limited parental lines, derived lines (F5) and developed lines (F4), along with the FCs and hybrids, were sorted based on the egg colour and brushed. The cocoon weight of these lines ranged from 1.294 to 1.356 and the shell percentage from 20.45 to 21.32. The expression or occurrence of the egg-sex-limited character varied among the hybrid combinations, which was documented accordingly. Further loose eggs were prepared for use in the optical sorting machine. The donor parent was crossed with elite breeds like CSR2, CSR4, S8, D2, CSR6, CSR16, CSR27, CSR52, CSR53, 2C, GEN1, 4S, 4D, SK6, BMV2, BMD3A, BMFD, S8N, CSR16N, CSR26N, CSR50N, CSR52N, N1, N2, N6, SSBS5, SSBS7, and D16. Only a few breeds expressed SL character. Male population numbers varied between breeds. A few selected oval and dumbbell breeds were crossed with donor parents. The inheritance of sex-limited characters in progeny and performance studies is in progress. Further, breeds with more male preferences based on egg colour were screened and selected for next-generation rearing. Currently, the batches are in the F4 and F5 generations.

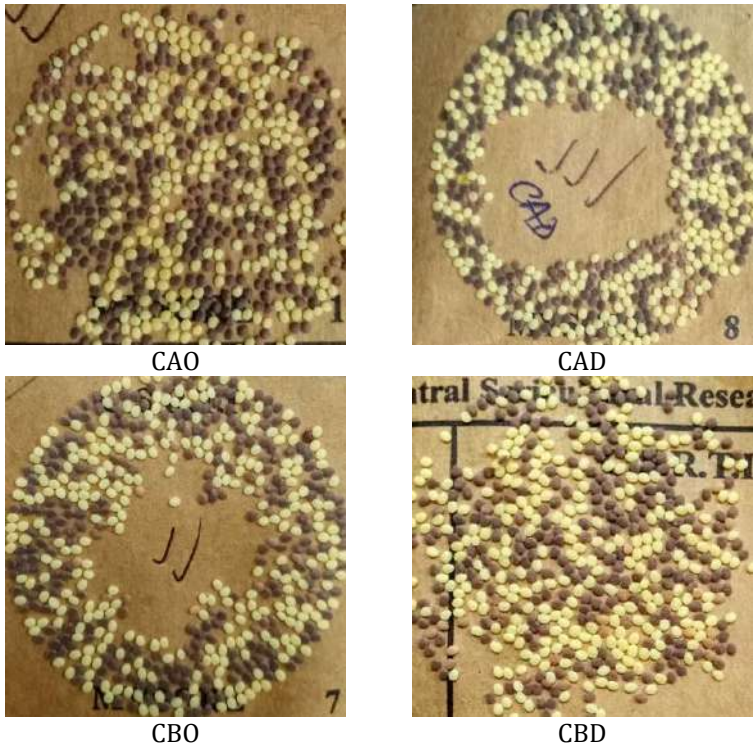



Fig. 8.1: Egg sex-limited lines – Oval lines: CAO, CBO; Dumbbell lines: CAD, CBD. Yellow colour eggs represent males and grey represent females

## AIE 01026 MI: Evaluation of new bivoltine double hybrid, BFC1 x BFC10 at farmers' level for authorization for commercial exploitation (Feb. 2022-Jan. 2025)

K. B. Chandrashekar, S. Manthira Moorthy[1], L. Kusuma, M. S. Ranjini, S. Anand Kumar, N. Chandrakanth[2], V. Lakshmanan[3], T. Sivasubramaniam[4], M. Venkatachalapathy[5], V. K. Harlapur[6], M. H. Shanbhogue[7], M. B. Radha[8], Pramod Sasvihalli[9], Y. Srinivasulu[10] and A. Umesha[11]

[1]CO-Bengaluru, [2]CSRTI-Berhampore, [3]RSRS-Kodathi, [4]RSRS-Chamarajanagar, [5]REC-Palamaneru, [6]NSSO-Bengaluru, [7]SSPC-Mysuru, [8]SSPC-Ramanagara, [9]SSPC-Malavalli, [10]REC-Chitradurga, [11]REC-Koppal

### Objective

- To evaluate the performance of bivoltine double hybrid, BFC1 x BFC10 in field for high silk content and silk quality

Basic seed of parental stocks *viz*., BMV1, BMO10, BMD3, BMFD were reared and maintained. Preparation of FCs (BFC1: BMV1XBMO10A, BFC10: BMD3XBMFD) was carried out and supplied to NSSO for seed cocoon generation of double hybrids (BFC1 x BFC10). A total of 63,800 dfls of double hybrid BFC1 x BFC10 was supplied to farmers through nested units of CSB (Table 8.3) for field evaluation. The yield ranged between 70-75 kgs/100 dfls. Disinfectants and bed disinfectants (Asthra and Vijetha) were also supplied to the farmers through the respective subunits. The cocoon samples were collected from the farmers by the subunits and sent for evaluation of reeling performance at CSTRI-Bengaluru. Further, a total of 79,000 dfls of double hybrid was prepared by NSSO (51,000 at SSPC - Palakkad, 28,000 at SSPC-Malavalli) and were consigned under 4 months and 6 months schedules respectively for supply to farmers under hybrid authorization trials.

Table 8.3: Details of BFC1 x BFC10 double hybrid dfls supplied

| State | Dfls supplied |
|---|---|
| Karnataka | 17,900 |
| Tamil Nadu | 26,900 |
| Andhra pradesh | 13,000 |
| Maharashtra | 3,000 |
| Telangana | 3,000 |
| Total | 63,800 |

## AIB 01032 SI: Validation of silk regulators - ubiquitin and mannosidase among silkworm breeds (Feb. 2023–Jan. 2025)

L. Kusuma and L. Satish

### Objective

- To carry out validation of identified silk fibroin regulators - ubiquitin and mannosidase among bivoltine and multivoltine silkworm breeds.
- Correlation of genotype to phenotype for trait mapping.

Selection of silkworm breeds with trait specific characters and phenotyping under the project was initiated.

## Collaborative Research Project

### AIT 08005 MI: Development and Evaluation of Bidensovirus resistant silkworm hybrids developed from marker assisted breeding lines - Phase II [in collaboration with SBRL-Bengaluru] (Mar. 2020 - Feb. 2023)

K.S. Tulsi Naik[1], A. Ramesha[1], M. S. Ranjini[2], M. N Chandrashekar[2], K. Rahul[3] and Mihir Rabha[3]
[1]SBRL-Bengaluru, [2]CSRTI-Mysuru, [3]CSRTI-Berhampore

**Objectives**

- To develop bivoltine silkworm hybrids among marker assisted breeding lines and evaluate for *Bm*BDV resistance.
- To identify suitable multivoltine/bivoltine parents in the pipeline carrying *Bm*BDV resistance and develop and evaluate cross breed hybrids for *Bm*BDV resistance.

The four bivoltine breeds (CSR2R, CSR27R, CSR6R and CSR26R) of silkworm *Bombyx mori* L. developed at SBRL-Bengaluru for BmBDV resistance utilizing nsd-2 marker assisted selection were reared at CSRTI-Mysuru and combination of dumbbell [CSR6R × CSR26R] and oval [CSR2R × CSR27R] foundation crosses were prepared. The FCs produced were utilized for the preparation of BmBDV resistant double hybrid FC1R x FC2R [CSR6R × CSR26R] × [CSR2R × CSR27R] for conducting On-station trials. Accordingly, 10 dfls of both *Bm*BDV resistant and control FC1 x FC2 double hybrid dfls were distributed and evaluated at four RSRSs stations namely, RSRS Chamarajanagar, RSRS Kodathi, RSRS Salem (REC Samanayallur) and RSRS Ananthapur during three seasons i.e., rainy (July-Oct), winter/autumn (Dec-Feb) & summer/Spring (March-May) seasons. The performance data with 67.67-84.58kgs/100 dfls yield was recorded in the test hybrid. The average cocoon weight of 1.624-1.818 g, shell weight of 0.34-0.41 g and SR% with 20.56-22.65 was recorded in the test hybrid. Whereas, in control 60.40-88.35 kgs/100 dfls yield, 1.744-1.871g of average cocoon weight, 0.35-0.40 g of shell weight and SR% of 19.33-21.72 was recorded (Table 8.4). There was no significant difference between the test hybrid and control. However, when survival was analysed there was an improvement with 3.25-16.2% in the test hybrid over the control, which is promising and through the On-Farm trials, the potential of test hybrid would be evaluated.

Table 8.4: Performance of *Bm*BDV resistant double hybrid FC1R x FC2R and the control FC1 x FC2

| RSRS | Race | Egg/dfl | Survi-val % | Yield/10000 larvae | | Yield/ 100 dfls | SCW (g) | SSW (g) | Shell ratio (%) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | By No. | By wt. (kg) | | | | |
| Anantapur | FC1R x FC2R | 518 | 85.56 | 8560 | 15.56 | 77.65 | 1.818 | 0.41 | 22.65 |
| | FC1 x FC2 (C) | 485 | 73.61 | 6945 | 12.10 | 60.40 | 1.744 | 0.37 | 21.67 |
| Salem | FC1R x FC2R | 566 | 96.75 | 9650 | 16.19 | 84.58 | 1.624 | 0.34 | 21.07 |
| | FC1 x FC2 (C) | 523 | 93.70 | 9377 | 17.08 | 88.35 | 1.871 | 0.40 | 21.72 |
| Kodathi | FC1R x FC2R | 526 | 90.46 | 8961 | 15.18 | 75.90 | 1.750 | 0.36 | 20.56 |
| | FC1 x FC2 (C) | 479 | 86.46 | 8488 | 14.20 | 71.00 | 1.810 | 0.35 | 19.33 |
| Ch'nagar | FC1R x FC2R | 551 | 81.31 | 8133 | 13.53 | 67.67 | 1.664 | 0.35 | 21.11 |
| | FC1 x FC2 (C) | 558 | 81.59 | 8131 | 14.41 | 72.02 | 1.771 | 0.38 | 21.49 |

## Concluded Pilot Study

**Identification of candidate gene markers for the development of silkworm hybrids with longevity associated stress tolerance and productive trait. [As per approval No. CSB/CSRTI/PMCE/Pilot studies/2020-21/217, dated 31.12.2020] (Dec. 2020 - Sep. 2022)**

M. S. Ranjini, L. Kusuma, S. Manthira Moorthy (Upto May 2021)

**Objective**

- Assessment of lifespan and screening for stress tolerance in selected silkworm breeds.
- Identification and characterization of candidate genes.
- To develop bivoltine silkworm breeds/hybrids with better longevity associated with stress tolerance and productive trait.

Life-history trait longevity (adult lifespan) is broadly considered as important index for breeding, as it is associated with stress tolerance. The trait was assessed in selected bivoltine silkworm races. Substantially, shortest lifespan and longest lifespan was recorded in S8, CSR17 and CSR51 races respectively.

The expression levels of *Thioredoxin peroxidase* gene in the fat body and midgut tissues of oxidative stress tolerant (LL CSR51) and oxidative stress susceptible (SL CSR17) bivoltine silkworm was evaluated through qPCR after exposure to paraquat (oxidative stress inducer). Total RNA was extracted from the fat body and midgut tissues of stress tolerant and stress susceptible bivoltine silkworm breeds after exposure to 10mM paraquat induction into the 3 day old $5^{th}$ instar larvae. The control larvae of both the breeds were exposed to PBS. First strand complementary DNA (cDNA) was synthesized by PrimeScript RT Takara using *B. mori* GAPDH as an internal control to normalize the expression of target genes. *Thioredoxin peroxidase* gene was used as a target gene of interest. qPCR was performed using a Takara RT PCR Kit with the Real-Time PCR Detection System (Bio-Rad). qPCR was performed using an initial denaturation at 95°C for 1 min, followed by 35 cycles of amplification (95°C for 30s, 55°C for 30s, and 72°C for 30s), and the melting curve analysis was performed from 65 to 95°C. The relative expression levels of target genes were analyzed using the $2^{-\Delta\Delta CT}$ method.

The fold difference was observed and elucidated the role of *Thioredoxin peroxidase* gene in antioxidant defense by expression analysis through qPCR in the paraquat exposed fat body and midgut tissue of short-listed Short-lived and Long-lived silkworm bivoltine breeds when compared to control (Fig. 8.2 & 8.3). The data suggest that *BmTrx* is a *B. mori* antioxidant protein, which is ubiquitously expressed and functions in antioxidant defense. The fact that the *BmTrx* in the long-lived breed CSR51 was upregulated by paraquat, and suggests that it has an important role in the protection against oxidative stress caused by various stress conditions and supports that it has better longevity than CSR17.

The identified gene specific marker can be utilised for the development of longevity associated with oxidative stress tolerance breeding lines to produce hybrid, which can cope up better with unpredictable climatic variations.

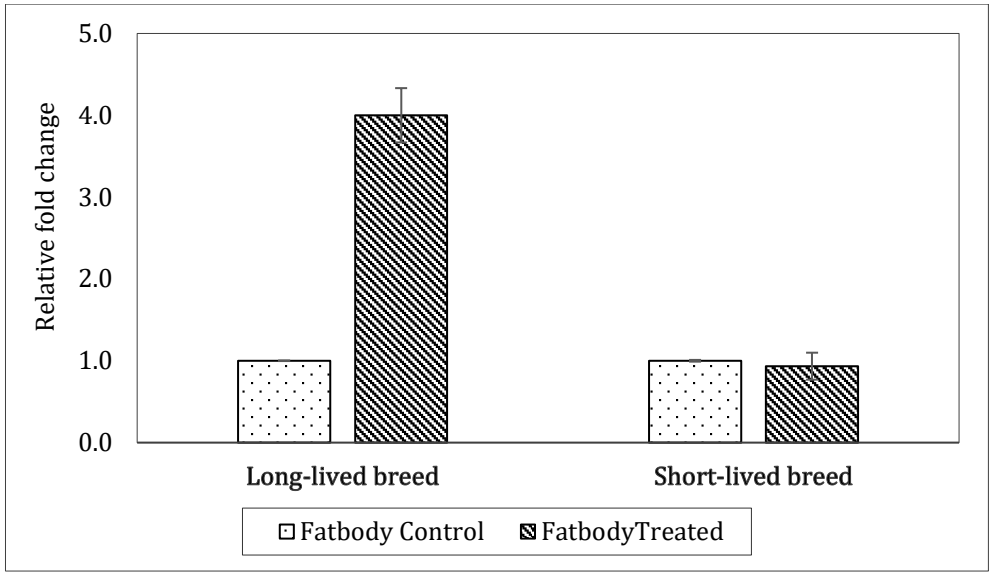



Fig. 8.2: Relative expression levels of *Thioredoxin peroxidase* gene as determined by qPCR. The fold increase in expression of the targe gene in control and Paraquat treated fat body tissue of long-lived and short-lived breeds with fold change

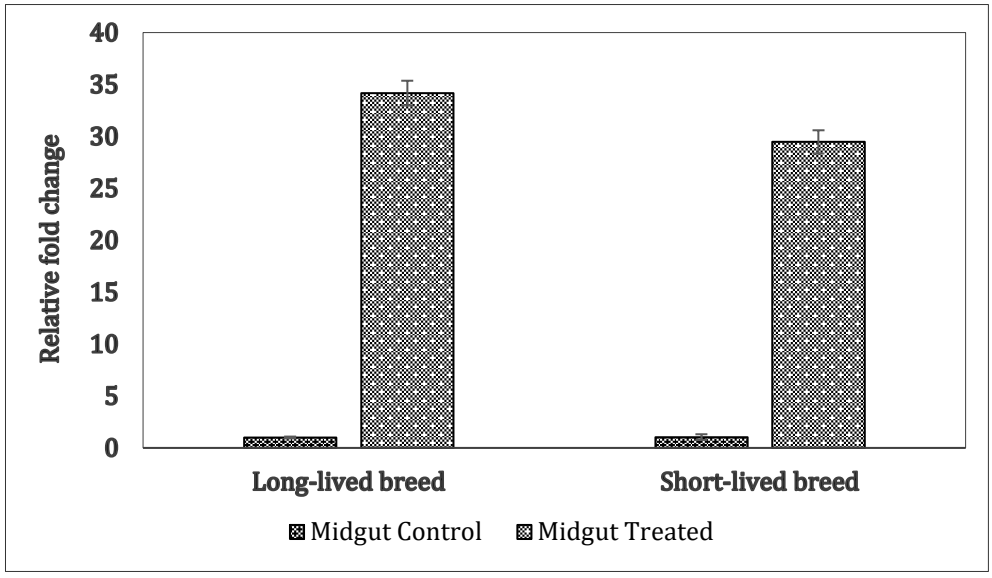



Fig. 8.3: Relative expression levels of *Thioredoxin peroxidase* gene as determined by qPCR. The fold increase in expression of the targe gene in control and Paraquat treated midgut tissue of long-lived and short-lived breeds with fold change

## Concluded TOTs

**MOE 01021 SI: Evaluation and Popularization of improved technologies developed in the field of mulberry sector for South India (Apr. 2021 – Mar. 2023)**

**Component 2: Popularization of G11 x G19 double hybrid in Kolar region of Karnataka**

K. N. Madhusudhan, L. Satish, Pramod Sasvihalli[1], J. B. Narendra Kumar[2] and and Kariyappa[3]

[1]SSPC-Malavalli, [2]REC-Madivala, [3]CSTRI-Bengaluru

**Objective**

- To popularize new double hybrid G11 x G19 in rainy seasons in Kolar region of Karnataka

Parents of G11 x G19 double hybrid were maintained at CSRTI-Mysuru. Foundation crosses were prepared and supplied to Adopted Seed Rearers of SSPC, Malavalli. Against the target of 1,20,000 dfls, 40,000 dfls were produced by SSPC, Malavalli. 12,000 dfls were distributed to CRCs of Kolar Region. Remaining 28,000 dfls were distributed to CRCs of Maharashtra with the help of NSSO, Bengaluru. An average of 70 kgs/100 dfls were harvested from Kolar and Maharastra farmers. The CRCs and farmers of Kolar region were inclined towards marked larvae (G11 x G19 is plain in nature).

**Utility of the project**

As per the advice of Hybrid authorization committee meeting held on 11.11.2022, the parents of G11 x G19 were introduced into seed multiplication channel and the maintanance is being carried out at P4 Basic Seed Farm, Hassan. Based on the demand from the CRCs and farmers, the foundation crosses will be prepared and supplied to NSSO for popularization in any region of India (preferably in Maharashtra).

## MOE 01021 SI: Popularization of improved breeds and technologies for Southern India (on farm/on station trials of CSRTI-Mysuru)

## Component-3: Evaluation of productive double hybrid, DHP5 at farmers' level. (Apr. 2021 – Mar. 2023)

R. Meenal, K. N. Madhusudhan, M. S. Ranjini, P. Samuthiravelu[1], Y. Srinivasulu[2], Y. Humayun Sharief[3] and Kariyappa[4]

[1]REC-Udumalpet, [2]REC-Chitradurga, [3]REC-Baramati, [4]CSTRI-Bengaluru

**Objective**

- To evaluate the newly developed bivoltine silkworm double hybrid, DHP5 at farmers' field through On Farm Trials.

**At CSRTI, Mysore:** The identified parental breeds *viz*., S8, D2, CSR16 and CSR51 were reared at bivoltine rearing house and seed cocoons were generated. Cocoons conforming to the original traits were selected and the required foundation cross dfls *viz*., S8 x D2 and CSR16 x CSR51 were prepared. FC dfls were reared and DHP5 dfls were produced and supplied to farmers.

**At Field:** A total of 20050 dfls were distributed to 112 farmers in Salem, Udumalpet, Krishnagiri, Chitradurga, Mysore, Eluru and Mulugu area. Free disinfectants *viz*., Vijetha and Asthra were supplied to the farmers. The data revealed an average cocoon yield of 74.48 kg/100 dfls with 1.852 g single cocoon wt., 0.415 g single shell wt with 22.34% shell ratio. Average rate fetched per kg of cocoons was Rs.560/-

**At CSRTI-Bengaluru:** Three kg of cocoon samples from all places were sent to CSTRI-Bengaluru for reeling analysis. Reeling data revealed that the cocoons showed an AFL of 974.25 m, 2.69 denier, 77.4% reelability, 6.33 Renditta and 73.3 % raw silk recovery. Overall the silk obtained was graded as 2A.

As control, the performance data of 7685 dfls of FC1 x FC2 was collected, which showed an average cocoon yield of 68.47 kg/100 dfls with 1.751 g SCW, 0.385 g SSW and 21.96% shell ratio. Average rate fetched per kg of cocoons was Rs. 485/-.

Table 8.5: Performance of DHP5 with existing hybrid FC1 x FC2 in different states

| State | No.of dfls | No.of farmers | Actual yield (kg) | Yld/100 dfls (kg) | SCW (g) | SSW (g) | Shell Ratio (%) | Rate/kg (Rs.) |
|---|---|---|---|---|---|---|---|---|
| DHP5 | | | | | | | | |
| TamilNadu | 12290 | 70 | 9174.89 | 76.58 | 1.886 | 0.419 | 22.18 | 581.60 |
| Andhra Pradesh | 3700 | 18 | 2501.50 | 67.39 | 1.844 | 0.436 | 23.64 | 416.50 |
| Karnataka | 3210 | 21 | 2276.20 | 71.50 | 1.756 | 0.388 | 22.11 | 541.90 |
| Telangana | 850 | 3 | 670.00 | 78.84 | 1.804 | 0.412 | 22.84 | 504.00 |
| Total/avg | 20050 | 112 | 13952.6 | 74.48 | 1.852 | 0.415 | 22.34 | 559.50 |
| FC1 x FC2 (Control) | | | | | | | | |
| TamilNadu | 5695 | 32 | 3217.15 | 72.51 | 1.773 | 0.383 | 21.53 | 562.50 |
| Andhra Pradesh | 650 | 4 | 464.00 | 70.67 | 1.753 | 0.398 | 22.70 | 385.00 |
| Karnataka | 1340 | 10 | 838.00 | 62.25 | 1.728 | 0.375 | 21.65 | 506.83 |
| Total/avg | 7685 | 46 | 4519.15 | 68.47 | 1.751 | 0.385 | 21.96 | 484.77 |

## Continuous/ Other activities

### Maintenance of bivoltine Genetic Resources

K. B. Chandrashekar, R. Meenal, K.N. Madhusudan, M. S. Ranjini, L. Kusuma

Productive bivoltine breeds, robust bivoltine breeds , thin denier bivoltine breeds, sex limited breeds, amylase marker assisted selection breeds , NPV tolerant breeds and morphological mutants were maintained for conservation through four crop rearing during the period 2022-2023. The values obtained for the traits were in conformity with the original breed characteristics.

| Breed Category | Breeds | | Fecu-ndity (Nos) | Pupa-tion Rate (%) | Cocoon wt. (g) | Shell (%) | Fil. Length (m) | Raw Silk (%) | Denier |
|---|---|---|---|---|---|---|---|---|---|
| Productive | CSR2<br>CSR4<br>CSR5<br>CSR6 | CSR16<br>CSR17<br>CSR26<br>CSR27 | >500 | >85 | >1.70-1.80 | >22-24 | >900 | >17.0 | 2.7-3.0 |
| Robust | CSR18<br>CSR19<br>CSR46<br>CSR47<br>CSR50<br>CSR51 | CSR52<br>CSR53<br>S8<br>D2<br>RD1 | >500 | >90 | >1.60-1.80 | >22-23 | >900 | >15.0 | 2.7-3.0 |
| Thin Denier | CSR48<br>JPN7 | | >500 | >85 | >1.60-1.80 | >22-23 | >1200 | >15.0 | 2.2-2.4 |
| Sex-Limited | CSR2 (SL)<br>CSR4 (SL)<br>CSR8 (SL) | CSR12 (SL)<br>CSR27 (SL)<br>CSR202 (SL) | >400 | >85 | >1.50-1.70 | >20-21 | >700 | >13.0 | 2.6-2.9 |

| Breed Category | Breeds | | Fecu-ndity (Nos) | Pupa-tion Rate (%) | Cocoon wt. (g) | Shell (%) | Fil. Length (m) | Raw Silk (%) | Denier |
|---|---|---|---|---|---|---|---|---|---|
| Amylase Marker assited selection | GEN1<br>GEN2<br>GEN3<br>2C<br>2S<br>3C<br>3D | 4D<br>4S<br>4C<br>6P<br>6C | >450 | >85 | >1.50-1.70 | >20-21 | >800 | >14.0 | 2.7-3.0 |
| NPV Tolerant | S8N<br>52N | 16N<br>26N | >500 | >85 | >1.40-1.60 | >20-21 | >700 | >13.0 | 2.6-2.9 |
| Morphol-ogical mutants | TMS 18<br>TMS 40 | TMS 52<br>TMS 59<br>TMS KNOB | >300 | >80 | >0.90-1.30 | >13-16 | >350 | >10.0 | 2.1-2.5 |

# 9. MULTIVOLTINE BREEDING LABORATORY

## Concluded Research Project

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

K. B. Chandrashekar, K. M. Ponnuvel[1], S. M. Moorthy (upto May 2021), S. M. Hukkeri, S.B. Kulkarni (upto Jun. 2019), P. V. Soudaminy (upto Mar. 2020) and L. Kusuma

[1]SBRL-Bengaluru

**Objectives**

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

Multivoltines are usually of low fibre quality, which can be improved by introgressing bivoltine blood. In the process, the major hindrance is the occurrence of hibernation eggs in the subsequent generations. In the present study, exotic (BM2) and indigenous (S8) bivoltine silkworm breeds were utilised and six multivoltine silkworm breeds or lines were developed with improved silk quality. The integrated approach of conventional breeding and marker-assisted selection through RT-PCR-based screening of diapause and non-diapause genes was undertaken. The gene expression patterns in eggs of stabilised lines and parental breed Silkworms *Bombyx mori* L. with respect to diapause and non-diapause characteristics were studied (Fig. 9.1). Among the 6 lines, 2 better performing lines were taken forward for on station trials at RSRS Chamarajanagara and Kodathi through OST (On Station Trials). The testing of post-cocoon parameters of these developed multivoltine crossbreeds was undertaken at CSTRI, Bangaluru, and the combinations recorded 2A grade silk in one of the combinations MAS-3 x BM2 showed 3A grade silk (MAS-3 (MV1x S8) (Table 9.1). Overall, the new crossbreeds showed improved silk quality and productivity over PM x CSR2, the ruling crossbreed, which is usually ungraded. The major constraint in improving cross breed silk, which is the occurrence of hibernation eggs, has been addressed through marker assistant selection.

Table 9.1: The laboratory rearing performance of the stabilized lines with 3 bivoltine silkworm breeds

| # | Lines | Fec. | ERR | | SCW (g) | SSW (g) | Shell % | AEI |
|---|---|---|---|---|---|---|---|---|
| | | | Nos. | Wt. | | | | |
| 1 | MAS1 × S8 | 511 (51.12) | 8310 (44.93) | 15.59 (62.86) | 2.666 (63.38) | 0.534 (63.38) | 20.44 (65.62) | 57.32 |
| 2 | MAS1×BM2 | 516 (53.21) | 8590 (52.18) | 15.28 (60.62) | 2.641 (62.44) | 0.549 (62.44) | 20.79 (68.60) | 59.52 |
| 3 | MAS1 × CSR2 | 518 (53.84) | 8900 (60.21) | 15.98 (65.62) | 2.513 (57.66) | 0.507 (57.66) | 20.43 (60.20) | 58.91 |
| 4 | MAS2 × S8 | 496 (44.82) | 7830 (32.50) | 14.01 (51.60) | 2.712 (65.11) | 0.519 (65.11) | 19.50 (62.66) | 50.34 |
| 5 | MAS2 × BM2 | 484 (39.58) | 8590 (52.18) | 14.01 (51.58) | 2.539 (58.64) | 0.500 (58.64) | 19.97 (58.73) | 51.90 |
| 6 | MAS2 × CSR2 | 459 (29.09) | 8730 (55.81) | 15.51 (62.26) | 2.571 (59.84) | 0.491 (59.84) | 19.20 (57.03) | 51.00 |
| 7 | MAS3 × S8 | 522 (55.73) | 9280 (70.05) | 14.11 (52.31) | 2.106 (42.46) | 0.439 (42.46) | 20.83 (46.65) | 54.61 |
| 8 | MAS3 × BM2 | 538 (62.44) | 8620 (52.96) | 12.76 (42.67) | 2.059 (40.70) | 0.421 (40.70) | 20.37 (43.10) | 49.52 |
| 9 | MAS3 × CSR2 | 529 (58.46) | 8400 (47.26) | 13.03 (44.58) | 2.109 (42.57) | 0.435 (42.57) | 20.63 (45.75) | 49.46 |
| 10 | MAS4 × S8 | 537 (61.81) | 8320 (45.19) | 11.95 (36.93) | 1.967 (37.25) | 0.381 (37.25) | 19.36 (35.01) | 43.33 |
| 11 | MAS4 × BM2 | 512 (51.32) | 7760 (30.69) | 11.27 (32.04) | 1.990 (38.13) | 0.381 (38.13) | 19.16 (34.99) | 38.13 |
| 12 | MAS4 × CSR2 | 510 (50.70) | 8760 (56.59) | 12.35 (39.78) | 2.027 (39.51) | 0.425 (39.51) | 20.94 (43.82) | 48.69 |
| 13 | MAS5 × S8 | 494 (43.98) | 8120 (40.01) | 13.54 (48.21) | 2.531 (58.33) | 0.465 (58.33) | 18.76 (51.75) | 46.55 |
| 14 | MAS5 × BM2 | 482 (38.74) | 8120 (40.01) | 14.17 (52.72) | 2.603 (61.03) | 0.477 (61.03) | 18.36 (54.18) | 46.53 |
| 15 | MAS5 × CSR2 | 467 (32.66) | 8780 (57.10) | 16.17 (66.95) | 2.332 (50.91) | 0.452 (50.91) | 19.56 (49.26) | 50.50 |
| 16 | MAS6 × S8 | 505 (48.39) | 8680 (54.51) | 13.28 (46.36) | 2.094 (41.99) | 0.425 (41.99) | 20.33 (43.86) | 48.32 |
| 17 | MAS6 × BM2 | 551 (67.69) | 8740 (56.07) | 13.55 (48.30) | 2.129 (43.30) | 0.432 (43.30) | 20.42 (45.27) | 52.74 |
| 18 | MAS6 × CSR2 | 515 (52.79) | 8200 (42.08) | 12.52 (40.98) | 2.080 (41.49) | 0.437 (41.49) | 21.00 (46.17) | 47.65 |
| | Average | 508 | 8506 | 13.79 | 2.308 | 0.456 | 19.91 | |
| | SD | 23.837 | 386.14 | 1.403 | 0.268 | 0.050 | 0.882 | |

*Note: Values in parentheses indicates SD; p<0.05 indicates significant at 5%*

Four parents and their derived lines/hybrid combinations were analysed through RT-PCR for all 20 genes which are responsible for the diapause and non-diapause character. These genes include: diapause – *Trehalose transporter*, *Sorbitol dehydrogenase*, *Cytochrome b5*, *Methyltransferase*, *DnaJ (Hsp40) homolog 5*, *Paralytic peptide binding protein*, *Hsp 70*, *Spatzle*, *Serotonin receptor*, *Dopamine receptor* for diapause and

*Pseudouridine synthase, Chitinase A precursor, Polyubiquitin 4 UBQ4, Acyl-coenzyme A dehydrogenase, Profilin protein, 40S ribosomal protein S5, Nuclosome assembly protein, Kruppel, Bm period, Bm relish* for Non-diapause. Among 20 genes, 3 genes were associated with parental breeds *viz.,* Diapause gene - *Methyl transferase,* Non-diapause genes - *Acyl coenzyme A dehydrogenase* and *Nucleosome assembly protein*. Stabilized lines were analysed through RT-PCR for relative gene expression using these three associated genes against control (parental breeds). Crossbreed dfls with 3 bivoltine breeds - CSR2, S8, BM2E were utilised to prepare 18 different combinations of hybids.

Based on the RT-PCR results six stabilized lines were maintained *viz*., MAS1, MAS2, MAS3, MAS4, MAS5 and MAS6 and their rearing performance is given in Table 9.2. Among the 6 lines, better performing lines were taken forward for further trials. From the selected three lines - hybrids were prepared using the bivoltine parents BM2 (Exotic), S8 (Indigenous) and CSR2 (Table 9.3). Based on the phenotypic characters of cocoons, fecundity, hibernation character and post cocoon characters, short listing of the lines was carried out and OST was taken up. MAS1, MAS3 and MAS6 performed better among the combinations and yielded improved silk quality with 2A to 3A grade.

Table 9.2: Rearing performance of the stabilized lines

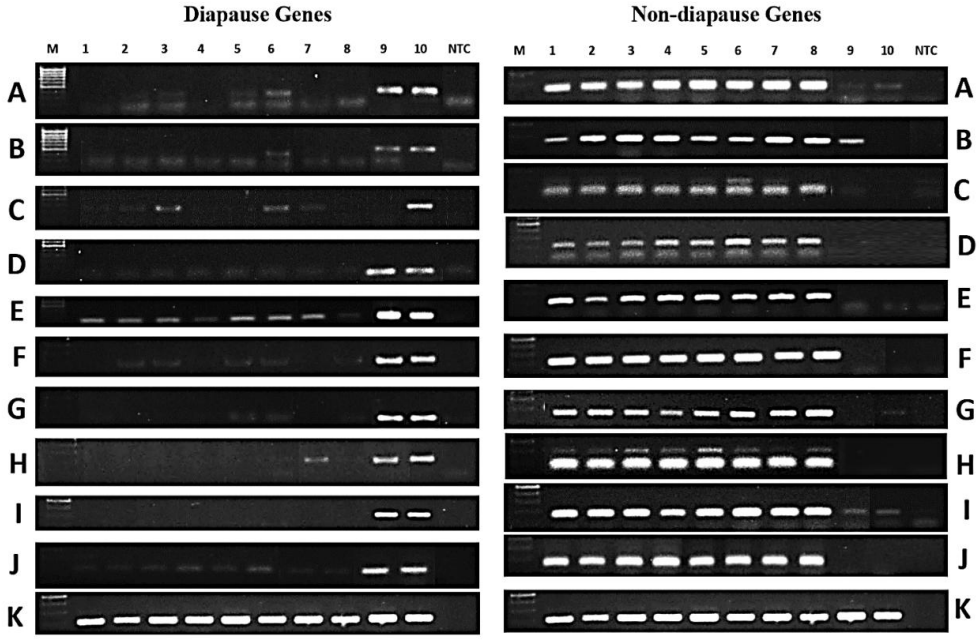
| Lines | Fec | ERR | | SCW (g) | SSW (g) | SR % | AEI |
|---|---|---|---|---|---|---|---|
| | | Nos. | Wt. | | | | |
| MV1 (Parent) | 460 (42.38) | 7633 (41.15) | 12.96 (57.08) | 2.060 (52.05) | 0.351 (49.07) | 17.16 (44.81) | 47.76 |
| MAS-1 (MV1S6AB × BM2) | 502 (52.73) | 8393 (56.33) | 12.71 (53.77) | 2.090 (53.12) | 0.357 (50.02) | 17.26 (45.69) | 51.94 |
| MAS-2 (MV1B × MBV1) | 495 (50.84) | 7720 (42.88) | 11.69 (39.99) | 2.061 (52.10) | 0.363 (50.97) | 17.44 (47.29) | 47.35 |
| MAS- 3 (MV1 × S8) | 503 (52.97) | 8024 (48.96) | 11.79 (41.24) | 2.174 (56.13) | 0.402 (57.19) | 18.67 (58.20) | 52.45 |
| HB4 (Parent) | 481 (47.55) | 7860 (45.68) | 13.69 (67.01) | 2.247 (58.70) | 0.402 (57.17) | 18.06 (52.80) | 54.82 |
| MAS-4 (HB4 × BM2) | 510 (54.53) | 8560 (59.66) | 13.28 (61.37) | 1.936 (47.68) | 0.375 (52.95) | 19.15 (62.43) | 56.44 |
| MAS-5 (HB4 × BMV1) | 532 (60.04) | 7476 (38.00) | 11.92 (43.02) | 2.095 (53.31) | 0.380 (53.64) | 17.94 (51.66) | 49.95 |
| MAS-6 (HB4 × S8) | 535 (60.86) | 7980 (48.08) | 11.94 (43.29) | 2.068 (52.34) | 0.385 (54.54) | 18.68 (58.25) | 52.89 |
| PM (Control) | 402 (28.09) | 9040 (69.25) | 11.93 (43.22) | 1.284 (24.57) | 0.197 (24.46) | 15.36 (28.86) | 36.41 |
| Avg. | 491 | 8076 | 12.43 | 2.002 | 0.357 | 17.75 | |
| Std | 40.595 | 500.750 | 0.739 | 0.282 | 0.062 | 1.129 | |

Table 9.3: Tukey's Multiple mean comparison test for the rearing parameters of OST batch reared at RSRS

| Hybrids | Fec. (Nos) | Hatching % | ERR No. | ERR Wt. | Yield / 100 dfls |
|---|---|---|---|---|---|
| MAS1 × S8 | $490.0^{bcd}$ | 94.2 | $8620.8^{bc}$ | $12.6^{ab}$ | $60.2^{cde}$ |
| MAS1 × BM2 | $498.3^{abcd}$ | 92.5 | $7888.2^{c}$ | $12.7^{ab}$ | $65.2^{bc}$ |
| MAS1 × CSR2 | $497.0^{abcd}$ | 94.8 | $8554.2^{bc}$ | $12.9^{ab}$ | $60.5^{cd}$ |
| MAS3 × S8 | $483.0^{cd}$ | 93.3 | $8089.3^{c}$ | $11.3^{b}$ | $49.9^{ef}$ |

| Hybrids | Fec. (Nos) | Hatching % | ERR No. | ERR Wt. | Yield / 100 dfls |
|---|---|---|---|---|---|
| MAS3 × BM2 | 489.3$^{bcd}$ | 92.8 | 8967.7$^{ab}$ | 13.7$^{a}$ | 65.8$^{a}$ |
| MAS3 × CSR2 | 481.3$^{cd}$ | 94.6 | 9429.3$^{ab}$ | 12.6$^{ab}$ | 58.4$^{cde}$ |
| MAS5 × S8 | 515.3$^{ab}$ | 93.3 | 7937.2$^{c}$ | 12.5$^{ab}$ | 65.0$^{ab}$ |
| MAS5 × BM2 | 522.7$^{a}$ | 94.8 | 8002.8$^{c}$ | 12.4$^{ab}$ | 64.5$^{a}$ |
| MAS5 × CSR2 | 505.0$^{abcd}$ | 93.4 | 7977.0$^{c}$ | 12.2$^{ab}$ | 51.0$^{def}$ |
| PM × CSR2 | 511.7$^{ab}$ | 94.0 | 7981.3$^{c}$ | 11.3$^{b}$ | 49.4$^{g}$ |
| MV1 × S8 | 474.0$^{d}$ | 93.8 | 8302.3$^{bc}$ | 11.6$^{b}$ | 48.2$^{fg}$ |
| p-value | *** | - | *** | ** | *** |
| CV | 1.9 | 1.4 | 3.2 | 5.7 | 6.2 |

*Note: Values with similar letter are non-significant*




| | Diapause Genes | Non-diapause Genes | |
|---|---|---|---|
| A | Trehalose transporter | Pseudouridine synthase | A |
| B | Sorbitol dehydrogenase | Chitinase A precursor | B |
| C | Cytochrome b5 | Polyubiquitin 4 UBQ4 | C |
| D | Methyl transferase | Acyl-coenzyme A dehydrogenase | D |
| E | DnaJ (Hsp40) homolog 5 | Profilin protein | E |
| F | Paralytic peptide binding protein | 40S ribosomal proteinS5 | F |
| G | Hsp 70 | Nuclosome assembly protein | G |
| H | Spatzle | Kruppel | H |
| I | Serotonin receptor | Bm period | I |
| J | Dopamine receptor | Bm relish | J |
| K | $\beta$ – actin | $\beta$ – actin | K |

Fig. 9.1: Gene expression patterns in stabilized lines and parental breed eggs of silkworm *Bombyx mori* L. with respect to diapause and non-diapause character (1:MV1, 2:MV1×BM2, 3:MV1×BMV1, 4:MV1×S8, 5:HB4, 6:HB4×BM2, 7:HB4×BMV1, 8:HB4×S8, 9:S8, 10:BM2, 11:NTC)

Further, based on the results of the RT-PCR analysis, Ct values and variations in copy number were recorded with *β-actin* as an internal standard. The experiment was performed in triplicates and results were standardized to the expression level of the constitutive *β*-actin gene. A Non-template control (NTC) sample was also run to detect contamination if any. Accordingly, genes related to non-diapause were identified utilizing Marker Assisted Selection (MAS) and correlated among the developed hybrid lines in comparison to parental lines (Fig. 9.1).

In conclusion, this is the first study which has integrated conventional and marker assisted selection for multivoltine/cross breed oriented studies. From the present work six multivoltine silkworm breeds/ lines with improved silk quality utilizing Exotic (BM2) and indigenous (S8) bivoltine silkworm breeds were developed through RT-PCR based screening of diapause and non-diapause genes. Among the 6 lines, 2 better performing lines were taken forward for on station trials. The developed lines have yielded 2A-3A graded silk. The other promising lines are being maintained for utilization in the future breeding programs.

**MOE 01021 SI: Evaluation of improved Technologies of Mulberry Sericulture in South India**

**Component-6: Evaluation of Improved Pure Mysore-PM-4 (Apr. 2021-Mar. 2022)**

K. B. Chandrashekar

**Objective**

- To evaluate the improved Pure Mysore lines - PM 4 at P3 farm, DOS Bilidevalaya, Kunigal and its crossbreed at farmers' level.

In co-ordination with DOS Karnataka 5 rearings of PM-4 were undertaken with 50 dfls of improved Pure Mysore (PM-4) at P3 GSF Bilidevalaya Kunigal and 2000 crossbreed dfls (PM-4 x CSR2) were prepared. 50 dfls were distributed to 40 farmers. The performance of improved PM-4 at farm and cross breeds at farmers level was evaluated for both pre and post cocoon parameters. The improved Pure Mysore was found to be superior to the control.

Table 9.4: Performance of Improved Pure Mysore at P3 Bilidevalaya Kunigal

| Breed Source | Fec. (Nos) | ERR | | SCW (g) | SSW (g) | Shell % |
|---|---|---|---|---|---|---|
| | | Nos. | Wt. (kg) | | | |
| PM-4 | 515.40 (10.22) | 9176.26 (208.59) | 13.11 (0.47) | 1.42 (0.08) | 0.21 (0.02) | 14.88 (0.84) |
| PM | 490.80 (7.25) | 9098.27 (105.58) | 12.48 (0.46) | 1.31 (0.09) | 0.19 (0.01) | 14.26 (0.60) |
| % Imp. | 5% | 1% | 5% | 8% | 12% | 4% |
| t-test (p value) | 0.000 | 0.417 | 0.006 | 0.006 | 0.007 | 0.113 |

*Note: Values in parentheses indicates SD; p<0.05 indicates significant at 5%*

Table 9.5: Rearing performance of PM4 × CSR2 at farmer's level

| Breed Source | Fec. (Nos) | Hatch. % | ERR | | SCW (g) | SSW (g) | Shell % | Yld/100 dfls (kg) | Pupation (%) |
|---|---|---|---|---|---|---|---|---|---|
| | | | Nos. | Wt (kg) | | | | | |
| PM-4x CSR2 | 505.65 (12.61) | 92.51 (1.07) | 9022.43 (118.37) | 15.36 (0.47) | 1.80 (0.06) | 0.35 (0.02) | 19.58 (0.59) | 71.49 (1.32) | 90.22 (1.18) |
| PM x CSR2 | 493.35 (12.64) | 92.94 (1.12) | 8930.94 (158.11) | 14.83 (0.52) | 1.73 (0.05) | 0.33 (0.02) | 19.06 (0.89) | 67.27 (1.55) | 89.31 (1.58) |
| % Imp. | 2% | 0% | 1% | 4% | 4% | 7% | 3% | 6% | 1% |
| t-test (p value) | 0.000 | 0.087 | 0.004 | 0.000 | 0.000 | 0.000 | 0.003 | 0.000 | 0.004 |

*Note: Values in parentheses indicates SD; p<0.05 indicates significant at 5%*

## 10. SATELLITE SILKWORM BREEDING STATION-COONOOR

**V. Vijay**

### Maintenance of Bivoltine Silkworm Germplasm Stocks

During the reporting year, one conservation rearing and subsequent grainage operations were taken up for 26 breeders' stock, *viz*., CNR3, CNR4, CNR5, SLD1, SLD8, SLD9, SSBS2, SSB3, SSBS4, SSBS5, SSBS6, SSBS7, SSBS9, SSBS10, SSBS11, SSBS12, SSBS16, SSBS17, D1, D11, D13, D15, D17, MASN4, MASN6 and MASN7 during April 2022. A total of 1133 dfls were produced and are preserved in three schedules at SSPC, Mysuru cold storage.

Table 10.1: Rearing performance of SSBS germplasm

| # | Race | Larval Marking | Hat-ching % | Av. SR Female | Av. SR Male | Av SCWT | Av SSWT | Av SR | ERR No. |
|---|---|---|---|---|---|---|---|---|---|
| 1 | CNR3 | Marked | 95.0 | 19.7 | 23.6 | 1.87 | 0.40 | 21.5 | 8575 |
| 2 | CNR4 | Plain | 97.0 | 19.3 | 23.0 | 2.20 | 0.46 | 21.0 | 7825 |
| 3 | CNR5 | Plain | 91.3 | 20.0 | 23.4 | 1.99 | 0.43 | 21.5 | 6150 |
| 4 | SLD1 | Plain | 94.3 | 19.1 | 24.7 | 2.12 | 0.46 | 21.5 | 9550 |
| 5 | SLD8 | Marked | 91.9 | 19.9 | 22.2 | 2.00 | 0.42 | 21.0 | 9500 |
| 6 | SLD9 | Marked | 97.0 | 20.2 | 22.8 | 1.92 | 0.41 | 21.3 | 8675 |
| 7 | SSBS2 | Plain | 95.1 | 19.9 | 23.5 | 2.17 | 0.47 | 21.5 | 8575 |
| 8 | SSBS3 | Plain | 96.5 | 20.5 | 25.2 | 1.89 | 0.43 | 22.6 | 9625 |
| 9 | SSBS4 | Plain | 92.9 | 19.4 | 23.4 | 2.18 | 0.46 | 21.1 | 9650 |
| 10 | SSBS5 | Plain | 96.7 | 21.1 | 24.8 | 2.00 | 0.46 | 22.7 | 9650 |
| 11 | SSBS6 | Marked | 92.4 | 19.6 | 23.2 | 2.04 | 0.43 | 21.2 | 9775 |
| 12 | SSBS7 | Plain | 94.8 | 20.9 | 25.0 | 1.88 | 0.43 | 22.7 | 8825 |
| 13 | SSBS9 | Plain | 95.6 | 19.9 | 23.7 | 2.06 | 0.45 | 21.6 | 9650 |
| 14 | SSBS10 | Plain | 96.3 | 20.0 | 23.6 | 2.17 | 0.47 | 21.6 | 9675 |
| 15 | SSBS11 | Plain | 96.9 | 19.0 | 22.2 | 2.29 | 0.47 | 20.4 | 9775 |
| 16 | SSBS12 | Plain | 94.3 | 20.8 | 24.4 | 1.94 | 0.43 | 22.4 | 9675 |
| 17 | SSBS16 | Plain | 94.7 | 20.2 | 24.3 | 2.05 | 0.45 | 22.0 | 8050 |
| 18 | SSBS17 | Plain | 91.2 | 20.2 | 24.3 | 1.99 | 0.44 | 22.0 | 7475 |
| 19 | D1 | Plain | 95.7 | 21.1 | 25.9 | 1.93 | 0.45 | 23.1 | 8750 |
| 20 | D11 | Marked | 94.1 | 19.1 | 22.8 | 1.85 | 0.38 | 20.8 | 9325 |
| 21 | D13 | Marked | 94.9 | 18.7 | 22.1 | 2.10 | 0.43 | 20.2 | 8925 |
| 22 | D15 | Plain | 94.0 | 22.2 | 25.0 | 1.84 | 0.43 | 23.5 | 7800 |
| 23 | D17 | Marked | 96.0 | 21.2 | 24.6 | 1.88 | 0.43 | 22.8 | 8500 |
| 24 | MASN4 | Plain | 96.1 | 18.0 | 21.8 | 2.05 | 0.40 | 19.7 | 9575 |
| 25 | MASN6 | Plain | 97.1 | 18.6 | 22.8 | 2.04 | 0.42 | 20.4 | 8400 |
| 26 | MASN7 | Plain | 95.3 | 18.8 | 22.4 | 2.00 | 0.41 | 20.4 | 9075 |

### Production and supply of dfls to Bivoltine Breeding Laboratory (BBL), CSRTI-Mysuru

Reared 38 dfls of two pure race (S8 & CSR16) and two FCs (D2 x S8, & CSR16 x CSR51) supplied by BBL during Sept.-Oct., 2022. Produced dfls of the Pure Races & Double Hybrids and supplied 1690 dfls of S8 (315 dfls), CSR16 (110), DHP5 (480) and DHP5R (785) to BBL, CSRTI, Mysore.

Table 10.2: Rearing performance of SSBS germplasm

| # | Races | Hatching % | Av SCWT | Av SSWT | Av SR% | ERR No. |
|---|---|---|---|---|---|---|
| 1 | S8 | 95.7 ± 1.28 | 1.60 ± 0.04 | 0.32 ± 0.01 | 19.8 ± 0.44 | 8665 ± 419 |
| 2 | CSR16 | 73.3 ± 17.1 | 1.33 ± 0.07 | 0.25 ± 0.02 | 19.1 ± 0.89 | 4745 ± 2602 |
| 3 | D2xS8 | 94.8 ± 1.66 | 1.79 ± 0.08 | 0.36 ± 0.01 | 20.2 ± 0.38 | 6480 ± 1693 |
| 4 | CSR16xCSR51 | 93.9 ± 1.14 | 1.68 ± 0.09 | 0.33 ± 0.02 | 19.3 ± 0.55 | 8556 ± 1115 |

**Visitor Services**

Table 10.3: Details of visitors at Sericulture Information Centre/Museum

| # | Organisation | Staff | Students |
|---|---|---|---|
| 1 | FCRR, Dept. of Sericulture, Metupalayam, TN | 2 | 20 |
| 2 | Palar Agricultural College, Ambur, Vellore, TN | 2 | 48 |
| 3 | ICAR-CPRI, RS, Ooty, The Nilgiris, TN | 2 | 5 |
| 4 | Yuvaraja's College, Mysore, KA | 3 | 50 |
| 5 | H M CS Academy, Coimbatore, TN | 6 | 100 |
| 6 | Sree Narayana College, Kozhikode, KL | 2 | 23 |
| 7 | Vidhya Niketan Public School, Coimbatore, TN | 5 | 120 |
| 8 | University of Jammu, M.Sc., Department of Sericulture, Jammu, J&K | 2 | 12 |
| 9 | St. Antony's Govt. aided Primary School, Ooty, TN | 3 | 118 |
| 10 | Vidhya Niketan Public School, Coimbatore, TN | 5 | 100 |
| 11 | Providence College, Dept. of Commerce, Coonoor | 3 | 50 |
| Total | | 35 | 646 |

Table 4: Revenue generated

| # | Particular / Head | Amount |
|---|---|---|
| 1 | House Rent + Licence fee + Water Charges | 3,92,989 |
| 2 | Guest House Charges | 37,700 |
| 3 | Visitors fee | 6,000 |
| 4 | Disposal of Unserviceable items | 18,100 |
| Total | | 4,54,789 |

# 11. P4 BASIC SEED FARM, HASSAN

Dayananda

**SIM 0015: Bivoltine silkworm breeds maintenance and multiplication**

**Objectives**

- Maintain required area of mulberry as per the recommended package of practices set for basic Seed farms for the production and supply of quality mulberry leaf for breed maintenance rearing's.
- Maintain authorized and popular bivoltine breeds as per the breed maintenance procedure set for P4 level.

- Prepare, preserve and supply of quality P3 stock to P3 centers of south India (P3 farms of NSSO and DoS, Karnataka) for downstream multiplication.

Maintained 1.08 Acres of mulberry (block plantation) with the V1 variety as per the recommended package of practises set for Basic Seed Farms. Another 1.21 acres of tree mulberry (Under establishment) have also been maintained as per the general package of practises. Eight authorised/popular bivoltine breeds, including four oval types (CSR2, CSR17, CSR27, and S8) and four dumbbell types (CSR4, CSR6, CSR16, and CSR26), were maintained true to the original breed characteristics for four rearing cycles in a year (May-June 2022, Aug-Sep 2022, Nov-Dec 2022, and Feb-Mar 2023). Meticulous testing at every stage was carried out to keep the crop free from diseases in general and Pebrine in particular. The mean rearing performance during the year is presented below:

Table 11.1: Performance of bivoltine breeds (Mean of 4 rearing cycles)

| Breed | ERR by No. | ERR by wt. (kg) | SCW (g) | SSW (g) | Shell percent |
|---|---|---|---|---|---|
| CSR2 | 9409±435 | 16.525±1.132 | 1.820±0.109 | 0.408±0.026 | 22.41±0.55 |
| CSR17 | 9677±137 | 17.443±1.552 | 1.846±0.179 | 0.383±0.035 | 20.81±1.07 |
| CSR27 | 9469±404 | 16.008±1.399 | 1.755±0.145 | 0.397±0.034 | 22.62±0.97 |
| S8 | 9605±216 | 16.826±1.171 | 1.788±0.141 | 0.395±0.032 | 22.10±0.91 |
| Mean of oval | 9540±298 | 16700±1.313 | 1.802±0.144 | 0.396±0.032 | 21.96±0.87 |
| CSR4 | 9636±194 | 16.464±0.934 | 1.692±0.149 | 0.362±0.040 | 21.36±0.87 |
| CSR6 | 9465±456 | 16.768±1.372 | 1.765±0.082 | 0.376±0.022 | 21.31±0.80 |
| CSR16 | 9646±188 | 16.420±1.102 | 1.707±0.113 | 0.373±0.030 | 21.84±0.78 |
| CSR26 | 9401±556 | 15.521±2.187 | 1.715±0.145 | 0.348±0.045 | 20.25±1.14 |
| Mean of Dumbbells | 9537±349 | 16.293±1.398 | 1.720±1.122 | 0.365±0.034 | 21.19±0.90 |
| Overall | 9539±328 | 16.497±1.356 | 1.761±0.133 | 0.380±0.033 | 21.59±0.89 |

Table 11.2: Production, utilization and disposal of cocoons

| Crop No | Cocoon production (kg) | Cocoons utilized or disposed (kg) | | | | |
|---|---|---|---|---|---|---|
| | | Assessment/ Sample | Grainage | Others | Marketed * | Revenue (Rs.) |
| 1 | 91.700 | 3.750 | 8.750 | - | 79.200 | 65240.00 |
| 2 | 48.176 | 8.587 | 5.500 | - | 34.089 | 25827.00 |
| 3 | 70.300 | 3.500 | 4.500 | - | 62.300 | 56992.00 |
| 4 | 49.700 | 2.500 | 4.200 | - | 43.000 | 45156.00 |
| Total | 259.876 | 18.337 | 22.950 | - | 218.589 | 193215.00 |

* Excess cocoons

During rearing, a total of 259.876 kg of P3 cocoons were generated. In coordination with NSSO, most of the excess cocoons were sold to P3 BSF Mysuru and SSPC, KR Nagara to prepare pure stock dfls instead of disposing of them for reeling. The cocoon production, utilisation and disposal during the year is presented in the table 11.2.

A total of 22.950 kg of seed cocoons (14,115 by number) were processed as per the set procedure and produced 5395 P4/P3 dfls, indicating an egg recovery of 38.22%. The dfls produced were preserved under a 4 and 6 month hibernation schedule and utilised as required. The summary of dfls produced is presented in Table 11.3.

Table 11.3: Summary of dfls production

| Crop No. | Month | Qty. of Seed Cocoon utilized | | Qty. of Seed produced (nos.) | Egg recovery (%) | Pebrine Incidence (%) |
|---|---|---|---|---|---|---|
| | | kg | No. | | | |
| 1 | Jun. 2022 | 8.750 | 4860 | 1723 | 35.45 | 0.00 |
| 2 | Sep. 2022 | 5.500 | 3055 | 1004 | 32.86 | 0.30 |
| 3 | Dec. 2022 | 4.500 | 2800 | 1009 | 36.04 | 1.09 |
| 4 | Mar. 2023 | 4.200 | 3400 | 1659 | 48.79 | 0.12 |
| | Total | 22.950 | 14115 | 5395 | 38.22 | 0.38 |

During the period, 1,077 P3 dfls were supplied in 24 splits at black box stage to P3 multiplication centers of DoS, Karnataka and NSSO for downstream multiplication.

Table 11.4: Revenue generation

| # | Particulars | Amount (Rs.) |
|---|---|---|
| 1 | Sale proceeds of excess cocoons | 2,10,179.00 |
| 2 | Sale proceeds of P3 Dfls | 2,15,400.00 |
| 3 | Sale of Excess Leaf | 2,500.00 |
| 4 | Disposal of Unserviceable articles | 40,000.00 |
| | Total | 4,68,079.00 |

# 12. SILKWORM PHYSIOLOGY LABORATORY

## Concluded Collaborative Research Project

### BPS 01013 CN: Utilization and diversification of silkworm pupae products for human & animal consumption and composting (Sep. 2020-Mar. 2023)

CSRTI-Mysuru: Y. Thirupathaih, Ravindra, Y. N. Sanath Kumar and S. M. Hukkeri

CFTRI-Mysuru: B. Sathyndra Rao, S. Shinde Vijay, Sridevi A Singh

CIFRI-Barrackpore: B. K. Das, D. K. Meena and M. A. Hassan

**CSRTI-Mysuru**

**Bacterial metagenomic analysis of spent silkworm pupae**

The microbiome of silkworm pupae was profiled through Illumina Miseq sequencing of the 16S rRNA gene. The taxonomic abundance of bacteria present in spent silkworm pupae before drying or after reeling (SP1) and spent silkworm pupae after sundrying (SP2) was classified at phylum level. *Firmicutes* were predominant in SP1, followed by *Actinobacteria*, while *Proteobacteria* were predominant in SP2 samples (Fig. 12.1). Species level classification indicates that the predominance of *Bacillus* spp., followed by *Streptococcus luteciae*, *Staphylococcus* spp., and *Macrococcus caseolyticus*, was present, whereas in sundried pupae samples (SP2), the predominance of *Enterococcus cecorum*, followed by *Acinetobacter* spp., *Prevotella* spp., *Streptococcus luteciae*, *Macrococcus caseolyticus*, and *Peptostreptococcus anaerobius*, was present (Table 12.1). The results have indicated that bacterial diversity in sundried spent silkworm pupae is higher and is associated with pathogenic bacterial species. Therefore, it is advisable to collect spent pupae immediately after reeling and drying by using a hot air oven or a microwave oven.

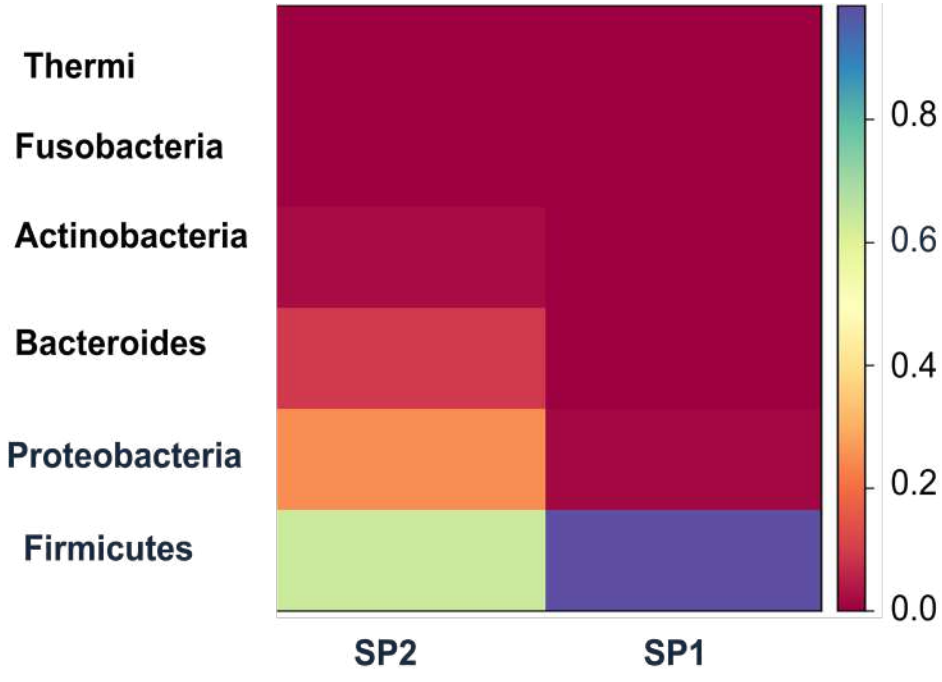



Fig 12.1: Heatmap representing bacterial phyla found in mulberry silkworm *B. mori* spent pupae. A darker colour represents the presence of a particular phylum, and a lighter colour indicates less abundance of that particular phylum. Spent silkworm pupae before drying (SP1) and after sun drying (SP2) had different bacterial phyla.

Table 12.1: Major bacterial species in silkworm, *Bombyx mori* spent pupae:

| Name of species | SP1 (%) | SP2 (%) |
|---|---|---|
| *Enterococcus cecorum* | 0.1 | 14.30 |
| *Streptococcus luteciae* | 5.97 | 4.96 |
| *Macrococcus caseolyticus* | 1.18 | 4.82 |
| *Peptostreptococcus anaerobius* | - | 1.18 |
| Unclassified *Bacillus* species | 73.9 | 2.30 |
| Un identified/un classified spp. | 13 | 63 |
| unclassified *Acinetobacter* spp. | - | 14.30 |
| *Prevotella* spp. | - | 8.30 |
| *Staphylococcus* unclassified spp. | 4.83 | - |

**Extraction of pupae oil and concentration of ALA by different extraction methods**

Silkworm pupae oil was extracted by different extraction methods, *i.e.*, organic solvents, conventional method, supercritical carbon dioxide ($CO_2$), and oil presses. The highest yield of oil recovery is obtained through organic solvent extraction from silkworm pupae powder (25-32%), followed by enzymatic or conventional (8-12%), supercritical carbon dioxide (1%) and oil press (1%) processes. The omega-3 fatty acid α-linolenic acid (ALA) was quantified in pupae oil extracted through each method, and the highest level of ALA was detected in supercritical $CO_2$ (44.6%), followed by conventional (37.2%), solvent extraction method (29%), and oil press method (20.8). The results have indicated that the ALA content in silkworm pupae oil is influenced by extraction method (Table 12.2).

Table 12.2: Silkworm pupae oil extraction methods and ALA quantification.

| Extraction Method | Oil recovery (%) | ALA concn. (%) |
|---|---|---|
| Solvent | 25-32 | 29.4 |
| Conventional | 8-12 | 37.2 |
| Super critical $CO_2$ | 1.0 | 44.6 |
| Oil press | 1.0 | 20.8 |

**Bacterial protease production with pupae powder as an ingredient in fermentation media.**

The submerged fermentation process with *Bacillus* sp. was carried out to produce protease enzyme by incorporating silkworm pupae powder as an ingredient in the fermentation medium at 1 to 2% levels. After fermentation, the crude protein activity was found to be high in live silkworm pupae powder at 2% (6.21±0.55) followed by spent pupae powder at 2% (4.57±0.98), live silkworm pupae powder at 1% (3.36±0.44), spent silkworm pupae at 1% (2.23±0.99). The results have indicated that silkworm pupae at 2% level in fermentation had higher protease activity than at 1% level, and at 2% level, protease activity was significantly higher than control (Table 12.3). Therefore, silkworm pupae powder could be incorporated into fermentation medium in place of casein powder for the commercial production of protease enzyme.

Table 12.3: Submerged fermentation of protease production with silkworm pupae powder based medium

| Type of pupae | Pupae powder (%) | Enzyme activity (Units/ml) |
|---|---|---|
| Green/live/fresh | 1 | 3.36±0.44 |
| | 2 | 6.21±0.55* |
| Spent | 1 | 2.23±0.99 |
| | 2 | 4.57±0.98* |
| Control (casein) | 1 | 1.47±0.10 |
| | 2 | 2.14±0.07 |

** p<0.01 significant*

**Proteomics of silkworm pupae**

SDS Page analysis indicates that live silkworm pupae have a 115 KDa (approx.) protein, which is absent in spent silkworm pupae proteins. The absence of this protein in the spent pupae could be due to microbial spoilage or denaturation during the reeling process (Fig. 12.2). The LC/MC analysis has indicated the presence of 5882 proteins, the majority of them uncharacterized proteins, followed by enzymes, mitochondrial proteins, silk gland factors, silk proteins, DNA binding proteins, transcriptional or translational factors, transporter proteins, and membrane-bound proteins (Fig. 12.3).

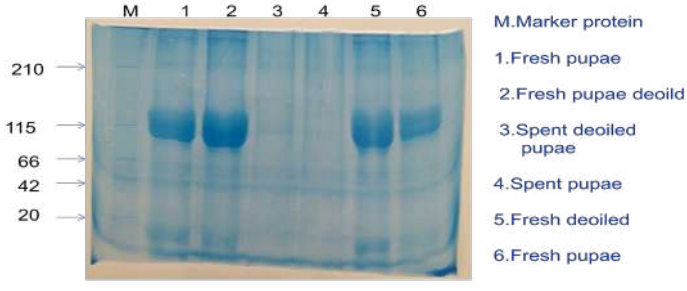



Fig. 12.2: SDS Page analysis of silkworm pupae proteins

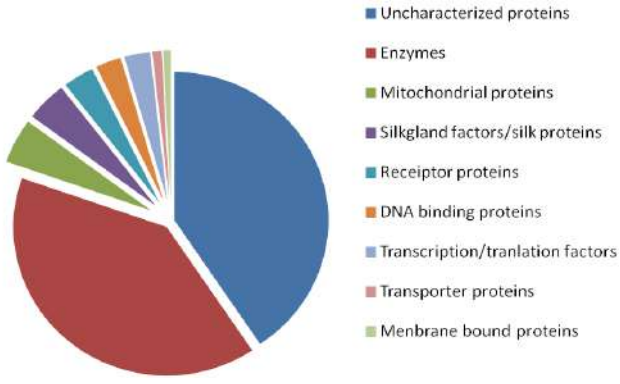



Fig.12.3: Proteomics analysis indicated that 5882 proteins were detected in silkworm pupae, majority of them are uncharacterized proteins followed by enzymes

**CFTRI-Mysuru**

**Preparation of food products from fresh mulberry silkworm pupae**

The freeze-dried, drum-dried, and tray-dried powders were incorporated separately into pasta and cookies at 5%, 10%, and 15% levels, and the pasta and cookies samples were analysed for quality parameters. Pasta and cookies prepared from trays dried showed minimal cooking loss, better firmness, and better colour and textural properties. The spray-dried powder was incorporated into beverage mixes at 10%, 20%, and 30% levels, and at 2.5%, 5%, and 10% levels for mayonnaise, and the samples were analysed for quality parameters. Beverage mix and mayonnaise incorporated at 10% and 2.5%, respectively, showed better physicochemical and rheological properties. Samples of pasta using silkworm pupae, cookies using silkworm pupae, silkworm pupae protein-rich beverage mix, silkworm pupae-based mayonnaise, and dried roasted spiced silkworm pupae were studied for sensory analysis in the non-traditional area of Karnataka and the traditional consumption area of Assam. Pasta (10% SP), Cookies (10% SP), Beverage mix (10% SP), and Mayonnaise (2.5% SP) were highly acceptable sensorially.


Fig. 12.4: Pasta, cookies, beverage mix and mayonnaise.

**Evaluation of mulberry silkworm spent pupae (SWP) as an ingredient in poultry feed**

For the evaluation of SWP in poultry feed for broilers, whole SWP (WSWP), defatted WSWP, cuticle-free SWP (CSWP), and defatted CSWP were used. The treatments were categorised into 9 groups (n = 11). Group I: control feed with soy meal as a source of protein, groups II & III: partial replacement of soymeal with SWP 8% and 15%, group IV & V: partial and complete replacement of soymeal with defatted SWP 50% and 100%, group VI & VII: fed with partial replacement of soymeal with CSWP 8% and 15%, group VIII & IX: fed with partial and complete replacement of soy meal with defatted CSWP 50% and 100%. The animals

were fed with the stipulated feed formulations for six weeks. Weekly body weight, feed intake, and body temperature were observed. At the end of 6 weeks, animals were euthanized and assessed for carcass yield, clinical chemistry, hematology, and histopathology assays. The Feed Conversion ratio per unit gain in bodyweight per unit feed consumed for the different groups was studied. There was no significant change in the body temperature, which was at an average of 39.15±0.46°C across the groups. The average carcass yield (% live weight) was 63.72±2.36 with no significant difference within the groups. The average percent carcass weight of meat (66±1.51) and bone (32±1.32) ratio was 2.1±0.21. Based on the in-live (bodyweight, feed conversion ratio), meat (Carcass weight and Yield) and intestine histopathological evaluation, partial replacement of soymeal with cuticle free SWP (8 -15 %) and defatted CSWP (up to 50%) is found suitable.

A similar grouping was done for studies with the layers, and the animals were divided into 9 groups (n=11) for the study. Group I: control feed with soy meal as a source of protein; groups II & III: partial replacement of soymeal with SWP 14% and 23%; group IV & V: partial and complete replacement of soymeal with defatted SWP 50% and 100%, group VI & VII: partial replacement of soymeal with CSWP 14% and 23%; group VIII & IX: partial and complete replacement of soy meal with defatted CSWP 50% and 100%. Feeding trials were conducted for eleven weeks. Weekly feed intake, number of eggs laid, and egg weight were observed. Egg quality evaluations for the laid eggs were carried out every week. At the end of 12 weeks, the animals were euthanized. The feed conversion ratios for the different groups were studied. Apart from these, shell thickness, air cell, and egg shape index were also evaluated. However, there was no significant difference across the groups. Based on the average number of eggs per week, feed conversion ratio, average egg weight per kg of feed, and with no significant difference in the egg quality, replacement of soymeal with defatted WSWP 50% and 100% cuticle-free SWP 14 -23 % and defatted CSWP 50% and 100% are found suitable.

**CIFRI, Barrackpore**

**Indoor feeding trial using mixed *Antheraea mylitta* and *Bombyx mori* pupae meal**

**a. *Labeo rohita* (fingerling)**

The experiment was conducted for 7 weeks in the wet-lab of ICAR, CIFRI-Barrackpore, India, to understand the optimum combination of *A. mylitta* and *B. mori* pupae meal in practical fish feed for fingerlings of *Labeo rohita*. Three experimental diets were formulated using various ingredients with sequential replacement of combination of *A. mylitta* and *B. mori* pupae meal. *L. rohita* fingerlings (10.36±0.01 g) were arbitrarily dispensed into three dietary treatment groups *viz*., 25:75 (AM:DBM), 50:50 (AM:DBM), and 75:25 (AM:DBM) [where NDAM = Non-defatted *A. mylitta*, and DBM = defatted *B. mori*] in duplicate by keeping 15 fish per 500L fibre-reinforced plastic circular experimental tanks with round the clock aeration. Each fish group was fed with respective experimental diets on satiation basis thrice daily at 09:30, 13:00, and 17:00 h, respectively. All the experimental tanks were cleaned manually at an interval of 3 days and excreta was siphoned out followed by replacing the same volume of water to maintain the water volume in all experimental units. After 45 days of feeding trial, it was noticed that the experimental group fed diet containing 50:50 non-defatted *A. mylitta* and defatted *B. mori* pupae meal as a major protein source, yields significantly better nutrient conversion and growth performances compared to the other treatment groups.

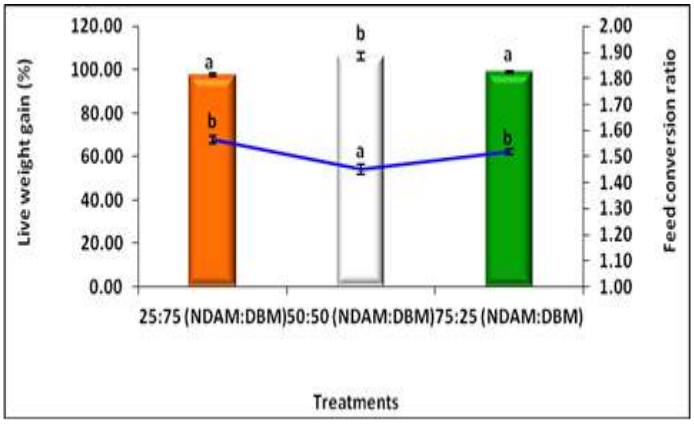



Fig. 12.5: Live weight gain (%) [bars] and feed conversion ratio [line] of *L. rohita* fingerlings; Data are presented as Mean±SE (n=2); Bars and Line with different superscripts differ significantly ($p<0.05$)

**b. *Oreochromis niloticus* (fingerlings)**

Another experiment was conducted for 45 days in the wet-lab of ICAR, CIFRI-Barrackpore, India was to obtain an optimum combination of *A. mylitta* and *B. mori* pupae meal in practical fish feed for fingerlings of *Oreochromis niloticus*. Three experimental diets were formulated with sequential replacement of one pupae meal with other involving *A. mylitta* and *B. mori*. Fingerlings of *O. niloticus* (4.65±0.02g) were arbitrarily dispensed into three dietary treatment groups *viz*., 25:75 (AM:DBM), 50:50 (AM:DBM), and 75:25 (AM:DBM) [where NDAM = Non-defatted *A. mylitta*, and DBM = defatted *B. mori*] in duplicate by keeping 15 fish per 150 L fibre-reinforced plastic circular experimental tanks with round the clock aeration. Each fish group was fed with respective experimental diets on satiation basis thrice daily at 09:30, 13:00, and 17:00 h, respectively. All the experimental tanks were cleaned manually at an interval of 3 days and excreta was siphoned out followed by replacing the same volume of water to maintain the water volume in all experimental units.

After 45 days of feeding trial, no significant differences were noticed in both live weight gain and feed conversion ratio among the three dietary treatment groups. The study reveals any combination of the meals is acceptable for the fish.

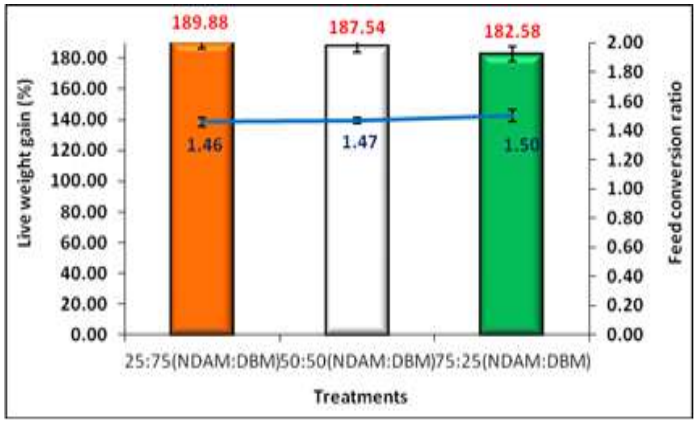
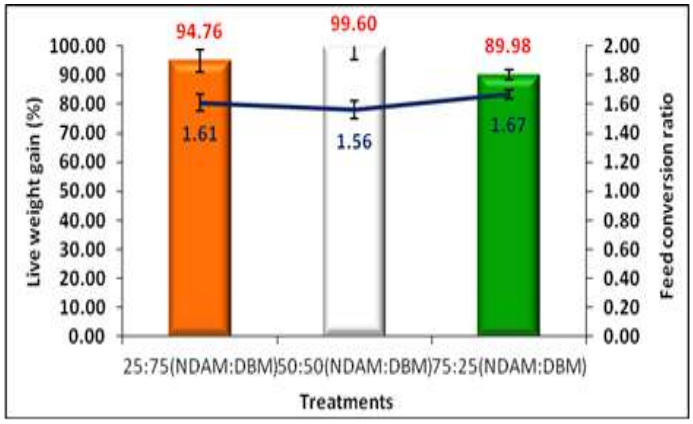



Fig. 12.6: Live weight gain (%) [bars] and Feed conversion ratio [line] of *O. niloticus fingerlings*; Data are presented as Mean ± SE (n=2); Bars and Line with different superscripts differ significantly ($p<0.05$)

**c. *Pangasianodon hypophthalmus* (fingerlings)**

Similarly, three experimental diets were formulated using various ingredients with sequential replacement of *A. mylitta* and *B. mori* pupae meal. *P. hypophthalmus* fingerlings (24.93±0.09 g) were arbitrarily dispensed into three dietary groups viz. 25:75 (AM:DBM), 50:50 (AM:DBM), and 75:25 (AM:DBM) [where NDAM = Non-defatted *A. mylitta* , and DBM = defatted *B. mori*] in duplicate groups by keeping 10 fish per 500L fibre-reinforced plastic circular experimental tanks with round the clock aeration. Each fish group was fed with respective experimental diets on satiation basis thrice daily at 09:30, 13:00, and 17:00 h, respectively. All the experimental tanks were cleaned manually at an interval of 3 days and excreta was siphoned out followed by replacing the same volume of water to maintain the water volume in all experimental units. After 45 days of feeding trial, it was noticed that all the three dietary experimental groups showed similar growth performances and nutrient utilization efficiencies among themselves. The study indicated that any of the combination is equally effective in supporting growth and nutrient conversion of this species.



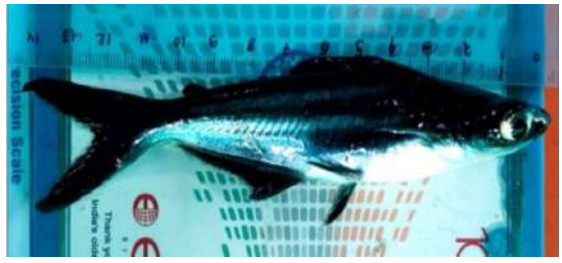



Fig. 12.7: Live weight gain (%) [bars] and Feed conversion ratio [line] of *P. hypophthalmus* fingerlings; Data are presented as Mean ± SE (n=2); Bars and Line with different superscripts differ significantly ($p<0.05$)

## Concluded Research Project

**MOE 01021 SI: Evaluation and popularization of improved technologies developed in the field of mulberry sector for South India (Apr. 2021-Mar. 2023).**

**Component 1: Evaluation of *Chawki* feed supplement formulation in commercial chawki rearing centers**

E Bhuvaneswari (PI), M Muthulakshmi, Y Thirupathaiah, JB Narendrakumar, M. Venkatachalapathi and N. Dhahira Beevi.

**Objective**

- To popularize chawki feed supplement formulation at commercial chawki rearing centers of Andhra Pradesh, Karnataka and Tamil Nadu

On-farm trials have been conducted for the evaluation of chawki feed supplement formulation (CFSF) in the commercial chawki rearing centres during the rainy, winter, and summer seasons with FC1 x FC2 silkworms in Andhra Pradesh, Karnataka, and Tamil Nadu. At each trial location, the treated batch was supplemented in I instar for the first three days @10 ml for 100 dfls, one feed per day. The CFSF was

sprinkled on mulberry leaves and left for 15 minutes for the absorption of nutrients into the chopped mulberry leaves. For the control batch, regular, untreated leaves were fed and tested for chawki parameters during the second moult. The growth of the larvae (weight of 100 nos.), percentage of missing and unequal larvae, and disease incidence were noted under chawki performance. Further, late-age growth and other cocoon parameters are compared and presented in Table 12.6.

During the rainy season (Jun. to Sep. 2022), the CFSF were evaluated for 9,200 dfls. The difference was noted in the control and CFSF-treated group in respect of larvae weight, single cocoon weight, shell weight, pupation rate, and found significant improvement in the cocoon yield of 8.86% over the control. During winter season (Oct. to Dec. 2022), CFSF were evaluated for 1500 dfls of CFSF in comparison with control. The CFSF-treated batches have shown an improvement in cocoon yield of 8.83% over the control. The study continued in the summer season (Jan. to Mar. 2023), and a similar trend was observed with a 14.09% improvement in cocoon yield in the CFSF-treated batches over the control.

Table 12.6: Evaluation of CFSF in commercial CRCs of AP, KA and TN (Average of 3 trial locations)

| Para-meter | Chawki performance | | | Late age and cocoon parameters | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Larval growth (g/100 L) | Missing Larvae % | Under sized larvae % | Weight of 10 larvae (g) | SCW (g) | SSW (g) | SR (%) | Pupn. rate (%) | Yield (kg/ 100 dfls) | Cocoon rate in Rs./kg |
| Rainy season | | | | | | | | | | |
| Control | 3.284 (±0.21) | 4.340 (±0.19) | 4.77 (±0.34) | 44.33 (±5.31) | 1.853 (±0.08) | 0.381 (±0.01) | 20.615 (±0.62) | 83.56 (±8.45) | 78.13 (±7.481) | 631.0 (±43.75) |
| CFSF treated | 3.651 (±0.09) NS | 2.220 (±0.24) * | 1.876 (±0.15) * | 46.574 (±4.23) NS | 1.924 (±0.03) * | 0.407 (±0.01) * | 21.175 (±0.91) NS | 88.96 (±2.72) * | 85.06 (±4.56) * | 645.66 (±46.12) NS |
| Winter season | | | | | | | | | | |
| Control | 3.393 (±0.07) | 4.202 (±0.72) | 4.950 (±0.73) | 47.178 (±5.05) | 1.830 (±0.10) | 0.387 (±0.15) | 21.164 (±0.44) | 89.537 (±2.17) | 70.396 (±4.71) | 698.33 (±38.21) |
| CFSF treated | 3.576 (±0.11) NS | 1.77 (±0.21) * | 1.647 (±0.33) * | 48.66 (±5.47) NS | 1.883 (±0.08) NS | 0.401 (±0.009) * | 21.352 (±0.50) NS | 93.629 (±1.47) * | 76.61 (±1.32) * | 705.08 (±39.41) NS |
| Summer season | | | | | | | | | | |
| Control | 3.308 (±0.23) | 4.984 (±0.37) | 6.424 (±1.11) | 41.838 (±2.11) | 1.736 (±0.08) | 0.364 (±0.04) | 21.057 (±0.20) | 90.97 (±2.79) | 68.87 (±0.17) | 578.50 (±10.60) |
| CFSF treated | 3.431 (±0.303) NS | 1.744 (±0.17) * | 2.383 (±1.38) * | 43.306 (±2.59) NS | 1.792 (±0.03) * | 0.380 (±0.003) * | 21.221 (±0.21) * | 93.265 (±2.49) * | 78.57 (±1.22) * | 578.34 (±32.10) NS |

Each value is the mean±SD of 16 separate observations; *Significant at 0.05% level (P value <0.05); NS- Non-significant

# 13. PEST MANAGEMENT LABORATORY

## Ongoing Research Project

### ARE 01029 MI: Recommendation of novel fungicidal and insecticidal applications for mulberry (May 2022 - Apr. 2025).

S. Mahiba Helen, G. S. Arunakumar, G. Mallikarjuna, Khasru Alam[1], V. S. Raviraj[1], Pawan Saini[2] and Chattar Pal[2]

[1]CSRTI-Berhampore, [2]CSRTI-Pampore

**Objectives**

- To identify suitable novel fungicide, nematicide and insecticide molecule under *in vitro* studies against mulberry pathogens and pests.
- *In vivo* evaluation of identified novel fungicide, nematicide and insecticide molecule against mulberry pathogens.
- To study the safety of novel fungicide, nematicide and insecticides on silkworm.

Thirteen fungicides have been evaluated in vitro against mulberry diseases such as powdery mildew, leaf spot, leaf blight and leaf rust. Out of thirteen Hexaconozole 5% EC 1ml/l of water treatment, the percentage uredospore germination reduced to 3.37% compared to control 96.15%. The safety testing against silkworm showed that it is safe 5 days after treatment.

Velum prime a nematicide tested against mulberry root knot nematode in the laboratory showed that, the percentage juvenile mortality 97.6 compared in treatment compared to control 20.5 after 6 hours of treatment. Its found safe 15 days after treatment to silkworm.

$LC_{50}$ of Fluxametamide an isoxazoline compound (Gracia), Emamectin Benzoate 5% SG (Gold), Betacyfluthrin 8.49% w/w + Imidacloprid 19.81 % w/w (Solomon) against *Spilosoma obliqa* fifth instar larvae is 0.104, 0.018 and 0.126 respectively.

Safety testing of organic insecticide Gaiagen for sap feeding pests 3ml and 5ml/litre of water found safe 5 days after treatment.

**PRE 01030 CN: Development of an integrated management package for the broad mite, *Polyphagotarsonemus latus* (Acari: Tarsonemidae), in mulberry (Aug. 2022 - Jul. 2024)**

S. Mahiba Helen, Prakya Sreerama Kumar[1], G .Mallikarjuna, Richa Varshney[1], K. Jhansi Lakshmi[2] and Shivkumar

[1]ICAR-NBAIR, Bengaluru, [2]REC-Krishnagiri

**Objectives**

- To evaluate biocontrol agents (*Hirsutella thompsonii*, *Blapthethus pallescens*, *Neoseiulus indicus* and *Typhlodromus* (*Anthoseius*) *transvaalensis*), chemicals and botanicals against the broad mite.
- To develop an integrated management package for the broad mite.
- To generate toxicological data for *Hirsutella thompsonii* [ICAR–NBAIR–MF(Ag)66] and its formulation.

An MoU was signed between Central Sericultural Research and Training Institute (CSRTI-Mysuru) and the Indian Council of Agricultural Research – National Bureau of Agricultural Insect Resources (NBAIR, Bengaluru) on 03 November 2022. Safety testing of organic miticide power plant Orgomite against silkworm found that 3 ml and 6 ml/litre of water found safe 5 days after treatment.

## Continuous/Other activities

Maintenance of mother cultures for mass production and supply to stakeholders of recommended bio-control agents of major silkworm and mulberry pests.

S. Mahiba Helen

**Objective**

- To maintain host cultures of bio-control agents for mass production, release and supply to stakeholders.

Under Biological control programme, 1379 pouches of *Nesolynx thymus* was supplied to cover 689.5 thousand dfls rearing for the management of silkworm uzi fly. For the management of leaf roller (*Diaphania pulverulentalis*) 16 units of egg parasitoid (*Trichogramma chilonis*) and 4 units of larval parasitoid (*Bracon brevicornis*) was supplied to farmers from Karnataka, Tamil Nadu and Andhra Pradesh. For the biological control of mulberry thrips (*Pseudodendrothrips mori*) supplied a predator and 6 units of (1 unit= 1000 grubs/adults) *Blaptostethus pallescens* to Karnataka and Tamil Nadu farmers.

- Maintained laboratory host cultures of house fly, *N. thymus*, *Corcyra cephalonica*, pink mealybug, *Diaphania pulverulentalis* for the mass production of natural enemies.
- Maintained laboratory cultures of *Scymnus coccivora* and *Cryptolaemus montrouzieri*, beetles for the management of pink hibiscus mealybug in mulberry.
- Maintained laboratory cultures of egg larval parasitoid *Phanerotoma* sp. and larval parasitois *Dolichogenidea* sp. and pupal parasitoid *Tetrastichus howardi* (Hymenoptera: Eulophidae) for the management of *D. pulverulentalis*.

# 14. SILKWORM PATHOLOGY LABORATORY

## Concluded Research Project

### MOE 01021 SI: Evaluation and popularization of improved technologies developed in the field of mulberry sector for South India

### Component 4: Evaluation of newly developed multiviral diseases tolerant bivoltine hybrid RDIN1 (Apr. 2021-Mar. 2023)

L. Satish, L. Kusuma, K. N. Madhusudan, H. R. Raveendranath, A.V. Mary Josepha Shery

**Objective**

- To evaluate the newly identified multi-viral disease tolerant (DNV1, IFV & NPV) hybrid (RDIN1) at farmers' level

One hundred larvae of HBM10 and PAM117 were inoculated with each virus separately, and the survival percentage was calculated until moth emergence. SSR marker screening was performed on each moth that survived. The moth with all eight SSR markers ((Isocitrate dehydrogenase (IDH216), Glucose dehydrogenase (GDH306), Lipase (LIP283), Protein tyrosine phosphatase (PTP284), Attacin (ATT), Ankyrin (ANK165), Alkaline tyrosine kinase (ATK285) and Dipeptidyl peptidase (DPP150)) was selected (Fig. 14.1) and layings of that moth were selected for the next generation. Whereas, CSR52 and CSR27 were kept uninoculated and the layings were selected based on the productive characteristics of the breed. After the breed character selection process, the breeding programme included crossing the females of the HBM10 with males of PAM117 and the females of the CSR52 with males of CSR27. The multi-viral-tolerant foundation cross (HBM10 x PAM117) and the productive foundation cross (CSR52 x CSR27) were taken forward for next generation rearing. The next generation rearing of the foundation crosses follows normal rearing protocol with the production of RDIN1 double hybrid layings by crossing females of CSR52 x CSR27 with those of males of HBM10 x PAM117.

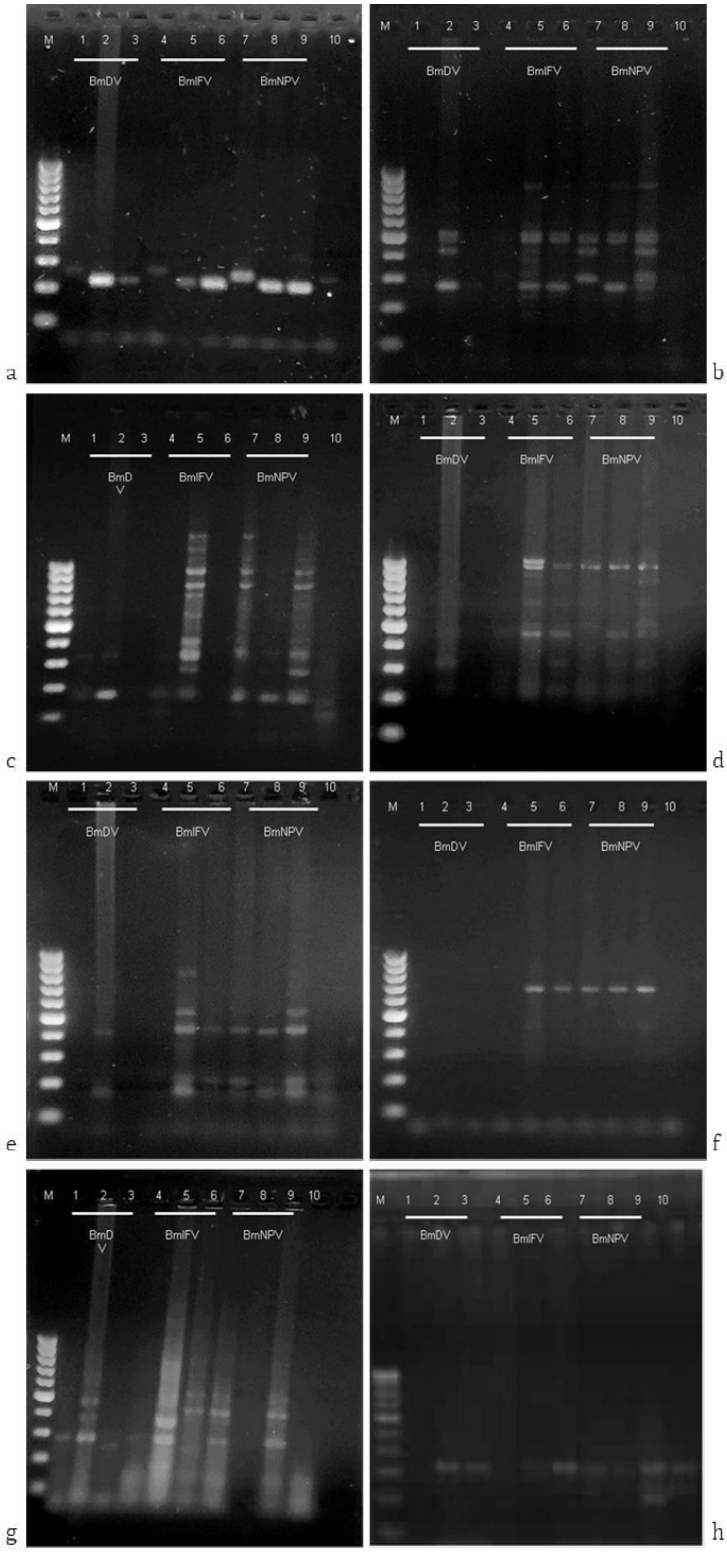



Fig. 14.1: Agarose gel profile of PCR amplicons for 8 SSR marker genes of multi-viral tolerant silkworm breeds
a. IDH216, b. PTP284, c. DPP150, d. ATK285, e. ANK165, f. ATT700, g. LIP285, h. GDH306
M. 100 bp ladder; 1. ♀ HBM10-MVT; 2. ♂ PAM117-MVT; 3. ♀ HBM10-MVT x ♂ PAM117-MVT; 4. ♀ HBM10-MVT;
5. ♂ PAM117-MVT; 6. ♀ HBM10-MVT x ♂ PAM117-MVT; 7. ♀ HBM10-MVT; 8. ♂ PAM117-MVT;
9. ♀ HBM10-MVT x ♂ PAM117-MVT; 10. Double Hybrid RDIN1

**Field evaluation of RDIN1**

A total of 20,000 dfls were prepared and supplied to farmers during the period of April 2021 to March 2023, free of cost. The rearings were monitored up to the cocooning stage to assess the health of the larvae. One kg of cocoon was collected from farmers for assessing the pupation percentage and post cocoon parameters. The comparison with FC1 x FC2 was done for evaluating the test hybrid. The pupation of RDIN1 was found to be 94.8%, compared to 91.4% of FC1 x FC2 with a 4% significant improvement over control (Table 14.1). Though there was improvements in cocoon yield, cocoon weight, shell weight, shell %, reelability, filament length, raw silk %, denier, neatness, etc., over the control, these were statistically non significant.

The RDIN1 performed significantly well, with 95.5% pupation (Table 14.2) in the summer and 93.8% pupation (Table 14.3) in the rainy season, indicating a 4% improvement in the summer and a 3% improvement in the rainy season over the control. The cocoon weight of the control was significantly higher in summer than the test, but all other parameters remained statistically non-significant. In the rainy season, cocoon weight, shell weight, shell percentage, and reelability were found to be significant in the test compared to the control, but all other parameters remained non-significant. Similarly, the pupation rate in Karnataka (95.1%) was better in comparison to Andhra Pradesh (93.2%), as represented in Table 14.3.

Table 14.1: Overall rearing and reeling performances of RDIN1 & FC1 x FC2 at farmers' field

| Hybrid | Pupa-tion (%) | Cocoon Yield (kg/ 100 dfls) | SCW (g) | SSW (g) | SR (%) | Reel (%) | AFL (m) | RS (%) | Den (d) | Neat (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Rainy | | | | | | | | | | |
| RDIN1 | 94.06 | 71.26 | 1.872 | 0.405 | 21.63 | 86.64 | 882.78 | 17.00 | 2.84 | 94.43 |
| FC1xFC2 | 92.33 | 69.32 | 1.659 | 0.356 | 21.45 | 86.47 | 865.43 | 17.02 | 2.81 | 94.14 |
| CD @ 5% | 0.35 | 0.25 | 0.007 | 0.001 | NS | NS | 3.22 | NS | 0.01 | N/A |
| SEm± | 0.13 | 0.09 | 0.002 | 0.001 | 0.03 | 0.12 | 1.15 | 0.02 | 0.00 | 0.13 |
| Summer | | | | | | | | | | |
| RDIN1 | 94.87 | 71.23 | 1.794 | 0.388 | 21.62 | 87.17 | 881.29 | 17.02 | 2.84 | 94.44 |
| FC1xFC2 | 91.52 | 69.35 | 1.707 | 0.354 | 20.71 | 85.94 | 866.94 | 17.00 | 2.81 | 94.13 |
| CD @ 5% | 0.35 | 0.25 | 0.007 | 0.001 | NS | NS | 3.22 | NS | 0.01 | N/A |
| SEm± | 0.18 | 0.13 | 0.003 | 0.001 | 0.04 | 0.17 | 1.63 | 0.03 | 0.01 | 0.18 |

SCW: Single cocoon weight; SSW: Single shell weight; SR: Shell ratio; Reel: Reelability: AFL: Average filament length; RS: Raw silk; Den: Denier; Neat: Neatness; SE(m±): Standard error mean; CD @5%: Critical difference at 5% level of significance

Table 14.2: Overall rearing and reeling performances of RDIN1 & FC1 x FC2 from Karnataka farmers

| Particulars | Pupa-tion (%) | Cocoon yield (kg) | SCW (g) | SSW (g) | SR (%) | Reel (%) | AFL (m) | RS (%) | Den (d) | Neat (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| RDIN1 | 95.18 | 71.55 | 1.70 | 0.36 | 21.39 | 87.66 | 863.64 | 16.91 | 2.84 | 94.44 |
| ±SD | 0.96 | 2.14 | 0.09 | 0.01 | 0.58 | 1.60 | 17.00 | 0.69 | 0.05 | 0.50 |
| FC1 x FC2 | 92.15 | 71.33 | 1.65 | 0.37 | 22.20 | 85.50 | 897.25 | 17.05 | 2.87 | 94.00 |
| ±SD | 1.47 | 2.27 | 0.19 | 0.04 | 0.35 | 0.50 | 71.77 | 0.57 | 0.21 | 0.00 |
| PIOC | 3% | 0% | 3% | 0% | -4% | 3% | -4% | -1% | -1% | 0% |
| P value of t stat | 0.03 | 0.89 | 0.67 | 0.95 | 0.02 | 0.01 | 0.48 | 0.75 | 0.83 | 0.04 |
| Sig @ 5% | ** | NS | NS | NS | ** | ** | NS | NS | NS | NS |

Table 14.3: Overall rearing and reeling performances of RDIN1 & FC1xFC2 from Andhra Pradesh farmers

| Particulars | Pupa-tion (%) | Cocoon yield (kg) | SCW (g) | SSW (g) | SR (%) | Reel (%) | AFL (m) | RS (%) | Den (d) | Neat (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| RDIN1 | 93.27 | 66.37 | 1.72 | 0.38 | 22.19 | 85.83 | 896.17 | 17.37 | 2.83 | 94.33 |
| ±SD | 0.98 | 3.74 | 0.07 | 0.02 | 0.42 | 0.85 | 55.75 | 0.68 | 0.05 | 0.47 |
| FC1XFC2 | 91.57 | 68.23 | 1.77 | 0.40 | 22.33 | 86.33 | 972.00 | 18.23 | 2.92 | 94.33 |
| ±SD | 2.64 | 3.91 | 0.14 | 0.04 | 0.86 | 0.47 | 73.11 | 0.25 | 0.16 | 0.47 |
| PIOC | 2% | -3% | -3% | -4% | -1% | -1% | -8% | -5% | -3% | 0% |
| P value of t stat | 0.47 | 0.65 | 0.65 | 0.68 | 0.85 | 0.52 | 0.31 | 0.21 | 0.54 | 1.00 |
| Sig @ 5% | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |

## AIT 01019 SI: Screening of Drugs/Inhibitors to inhibit the PI3K-Akt pathway in *Bombyx mori* for controlling Nuclear polyhedrosis Virus Infection (Nov. 2020-Oct. 2023)

G. Mallikarjuna and K. N. Madhusudhan

### Objectives

- To screen different commercial drugs and their anologues against BmNPV infection targeting PI3K-Akt pathway.
- To study the impact of potential drugs on differential expression of genes involved in PI3K-Akt pathway by real-time qPCR.
- To identify the transcripts in control as well as drug treated samples.
- To evaluate the effect of PI3K inhibitors in BmN cell lines.
- To develop an effective drug for controlling the viral infection.

The assay was conducted for the previously screened drugs, *ie*, Ritinovir, Daclatasvir, Indinavir, GSK-1059615, and PTP inhibitor. The viral load concentration was $2x10^6$ concentrations. The treatment of healthy silkworms with drugs showed no adverse effect on the test animal. Treatment of virus-inoculated silkworms with drugs shows very promising results in comparison with virus-inoculated controls. The maximum survival was noticed with Daclatasvir and PTP inhibitors. Further, a study was conducted by combining two drugs in combination (Daclatasvir and a PTP inhibitor), and the survival percentage and toxicity of the combinational drugs were studied. Ritonavir and Daclatasvir drugs were also given to the 3rd instar of double hybrid silkworms (100 worms per drug concentration). Daclatasvir has not shown any toxicity in drug-treated silkworms. PIK-249, GSK-1059615, PTP inhibitors, and Tipronavir drugs are showing low toxicity in the silkworm. In order to identify genes involved in viral replication, genomic DNA was extracted from uninoculated control silkworms, inoculated BmNPV silkworms, drug-treated silkworms, and treated silkworms inoculated with BmNPV. PCR was conducted to check for specific primer amplification, and the amplified samples were sequenced. RNA isolation was carried out at SBRL, Kodathi. cDNA synthesis and RT-qPCR were also conducted in SBRL, Kodathi, in order to determine the viral action in the test silkworm samples. RT-qPCR results showed prominent changes in viral replication and fold changes in treated samples compared to drug-treated and NPV-infected samples.

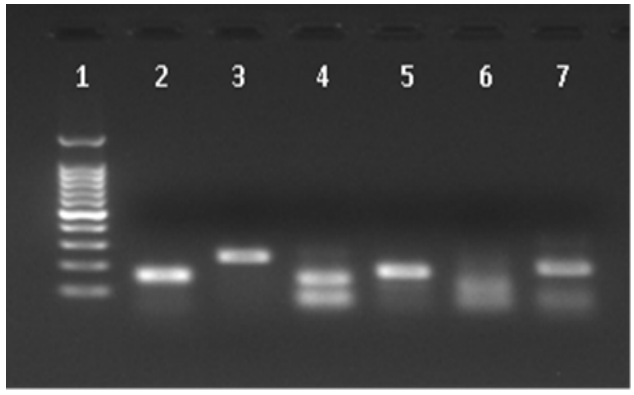



Fig. 14.2: cDNA analysis with qPCR primers. 1. Ladder (100bp to 1000bp) 2. AKT (150bp), 3. BmSTAT (250bp), 4. mTOR (150bp), 5. PI3K (200bp), 6. RTK (100bp) and 7. VATP (300bp)

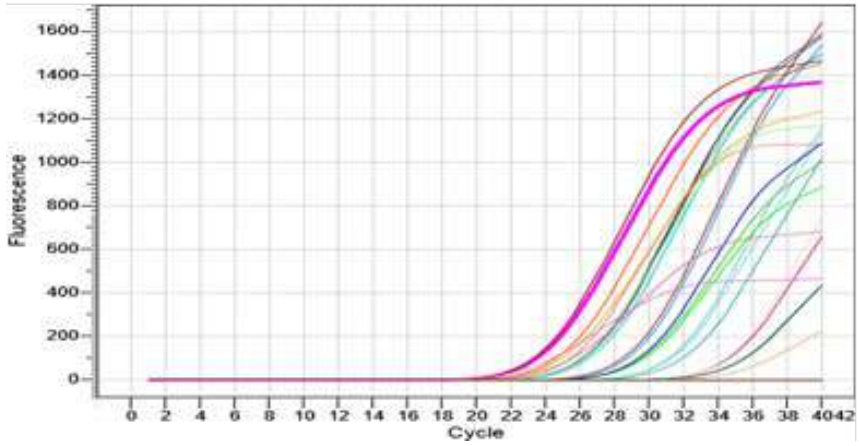



Fig. 14.3: Amplification curve of the the identified genes

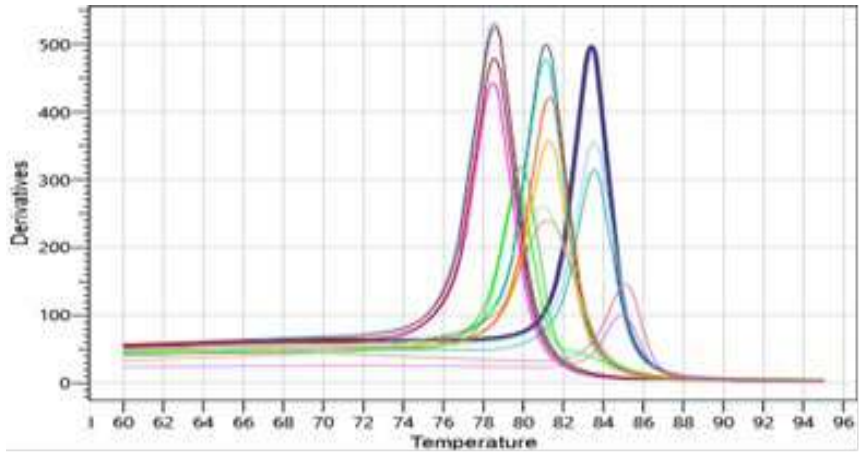



Fig. 14.4: Melting curve of the all identified genes

**ARP 01033 CN: Mulberry silkworm disease monitoring and management in southern states of India (Feb. 2023 to Jan. 2028)**

G. Mallikarjuna and H. M. Shanbogue (SSPC-Mysuru)

**Objectives**

- To monitor and estimate the prevalence of the 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 outbreaks.

Collecting information from the chosen BSF of DoS and clusters on all silkworm diseases and causes of crop loss. Collected data from various clusters through the data uploading website.

**AIC 01023 SI: Development of Spectroscopic tests for insecticide resistant biomarkers in silkworm, *Bombyx mori* (Jan.2022-Dec. 2023)**

L. Satish, S. Mahiba Helen

**Objectives**

- Screening and evaluation of insecticide resistant biomarkers in silkworm
- Development of spectroscopic tests for insecticide resistant biomarkers

A rapid visual screening paper-strip method for the detection of pesticide contamination in sericultural field was standardised. The visual screening is based on blue colour appearance during the hydrolysis of indoxyl acetate catalysed by acetylcholinesterase and remains colourless when acetylcholinesterase is inhibited by pesticides. The pesticides spiked with mulberry leaf were also standardised for the limit of detection on the paper-strip method. The limit of detection between pure pesticides (0.1-10 µl) and field recommended pesticides (10-40 µl) were evaluated using acetylcholinesterase and bacteria. The limit of detection of field recommended pesticides were evaluated up to 15 days sprayed on mulberry leaf under field condition. This was measured between samples for inhibition, uninhibition and partial inhibited pesticides. The shelf life of the paper-strip with enzyme and bacteria were also conducted and found to be 48 h. The economics of method was also worked out and whatman filter paper 1 was found to be affordable. The bioassay for pesticides was also conducted that resulted in vomiting on day 1, further inactive and mortality in the following days.

Bioassay for pesticides namely Bifenthrin 10% EC (1ml/L) and Flubendiamide 39.35% SC (0.25ml/L) were evaluated at ten different concentrations ranging from 0.5ml/L to 0.001ml/L (superstar) and 0.12ml/L to 0.00015ml/L below the field recommended concentration. The initial results showed vomiting, flaccid condition, anal protrusion and finally mortality of silkworm larvae. Bioassay for Chlorantraniprole was also performed after 2 months and the results were observed to be the same symptoms as above.

Chlorantraniprole

Bifenthrin

Flubendiamide

Fig. 14.5: Larval symptoms observed after treatment

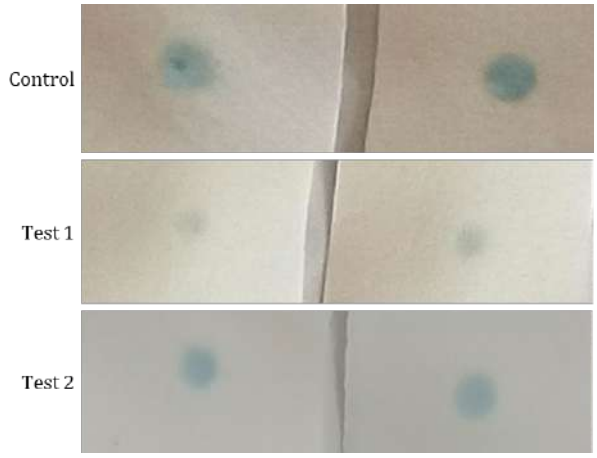



Fig. 14.6: Paper strip method conducted for various field samples for detection of Pesticides

**BPC 07022 MI: Regeneration of silk filaments from silk waste material (Mar.2021-Feb. 2024) (In collaboration with CSTRI, Bangalore)**

K. Jaganathan[1], K.M.A. Kadhar[1], L. Satish, H. R. Raveendranath [**Mar.2021-Feb. 2024**]
[1]CSTRI-Bengaluru

**Objectives**

- Development of protocol to dissolve silk waste/cocoons and regeneration of silk
- Characterization of the silk filament
- Development of products from regenerated silk

**Degumming of Mulberry cocoons**

Degumming of mulberry cocoons was carried out using different chemicals *viz*., 0.5% Calcium carbonate, 3% Anhydrous Sodium Bicarbonate and 0.3% Sodium carbonate and Sodium dodecyl Sulfate (SDS). The degummed cocoons were washed, dried and then used for dissolution purpose.

**Dissolution trials**

The degummed cocoons were dissolved in different chemicals, namely Calcium chloride (10M), Zinc chloride (8M), Calcium Nitrate (5M), Lithium bromide (9M) at 90°C and a combination of LiBr with $CaNO_3$, Calcium chloride at 90°C and fibres were also dissolved in Formic acid and Formic acid with Lithium bromide, Formic acid with Calcium chloride, Formic acid with calcium chloride and PEG, Polyethylene glycol, and a combination of PEG and lithium bromide. Cocoons degummed using 3% anhydrous Sodium Bicarbonate and 0.3% SDS were dissolved using 9M Lithium Bromide at 90°C (15% silk fibroin content), which gave better dissolution without any jelly mass.

**Spinning trials**

The spinning trials using coagulants such as Ethanol, Methanol, Ammonium sulphate, Methanol, Isoamyl alcohol, n-Butanol and combinations of Ethanol and Methanol were conducted. Fibroin dissolved using LiBr and CaNO3 and a combination of Formic acid with Calcium chloride and PEG dissolves the fibre well, and dissolved silk produces good quality fibres in a coagulation bath containing Methanol: Ethanol (1:1), Ethanol, Methanol individually. The same coagulation mixture was used to spin fibroin dissolved in a

combination of Poly Ethylene Glycol (PEG), formic acid, and Formic acid and Calcium chloride, resulting in better fibre spinning. All dissolved fibroin samples and regenerated fibres were prepared and sent for biophysical analysis to characterise the secondary protein structure using FTIR, XRD and Raman spectroscopy and the results were analysed based on the literature and found to have secondary protein structure structurally similar with better quality silk of CSR2 and JPN7.

Table 14.4: Raman, FTIR, and XRD data of five regenerated fiber prepared with different dissolution and coagulant solutions

| Sample Name | Raman Spectra $cm^{-1}$ | FT-IR $cm^{-1}$ | XRD | |
|---|---|---|---|---|
| | | | 2-θ (deg) | D (ang.) |
| L1 | 1494.41, 1829.90 | 3289, 2977, 1624, 1523, 1446, 1237, 1165, 1045, 879, 639, 3287, 1624, 1525, 1446, 1236, 1016, 634 | 11.4133 | 7.74671 |
| | | | 29.0499 | 3.07134 |
| L2 | 319.61, 1609.46, 3335.67 | 3286, 1624, 1520, 1234 | 10.6116 | 8.33008 |
| L3 | 153.35, 905.78 , 1120.35, 1326.88, 1809.15, 2084.47, 2450.16, 3013.66 | 3289, 2977, 1624, 1523, 1446, 1237, 1165, 1045, 879, 639 | 11.4133 | 7.74671 |
| | | | 28.875 | 3.08954 |
| | | | 33.2249 | 2.69432 |
| BFCM | 155.80, 1448.79, 2423.52, 2567.34, 2980.59 | 3286, 1623, 1528, 1446, 1240, 641 | 20.9442 | 4.23807 |
| | | | 25.8432 | 3.4447 |
| BFCPE | 163, 397, 3581, 4029 | 3286, 1623, 1528, 1446, 1240, 641 | 11.2352 | 7.86914 |
| | | | 20.5879 | 4.3106 |
| | | | 28.7827 | 3.09924 |

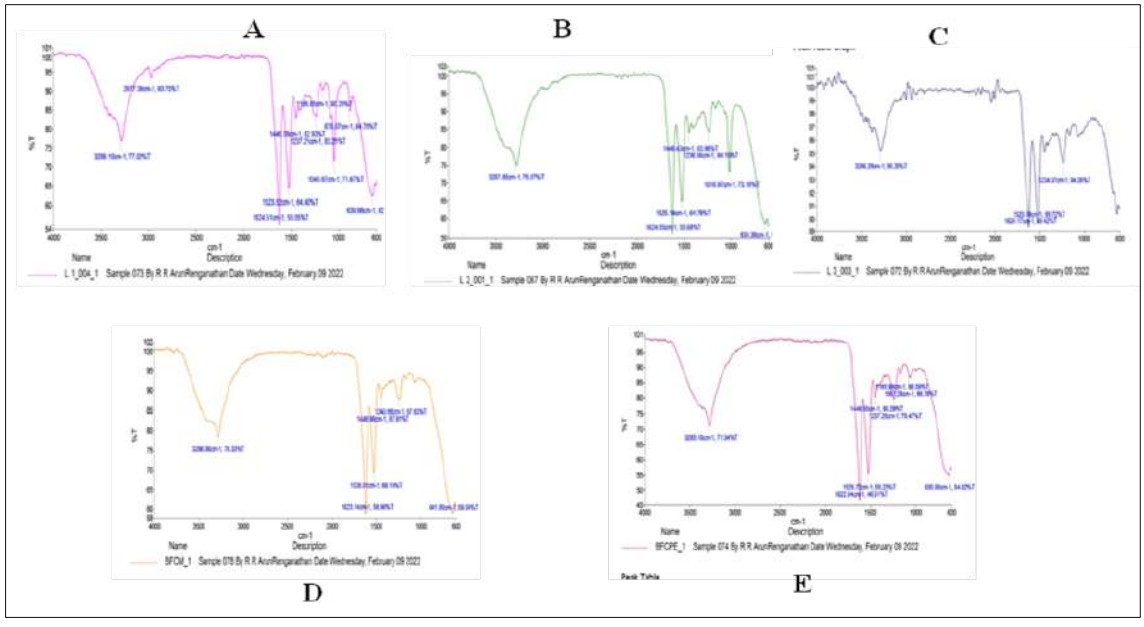



Fig. 14.7: FTIR Spectra Regenerated fibres L1, L2, L3, BFCM and BFCPE 1514–1517 $cm^{-1}$ (amide II), corresponding to the _beta sheet conformation, and 1639–1640 $cm^{-1}$ (amide I), 1528–1530 $cm^{-1}$ (amide II), and 1236–1237 $cm^{-1}$ (amide III), corresponding to the random coil conformation

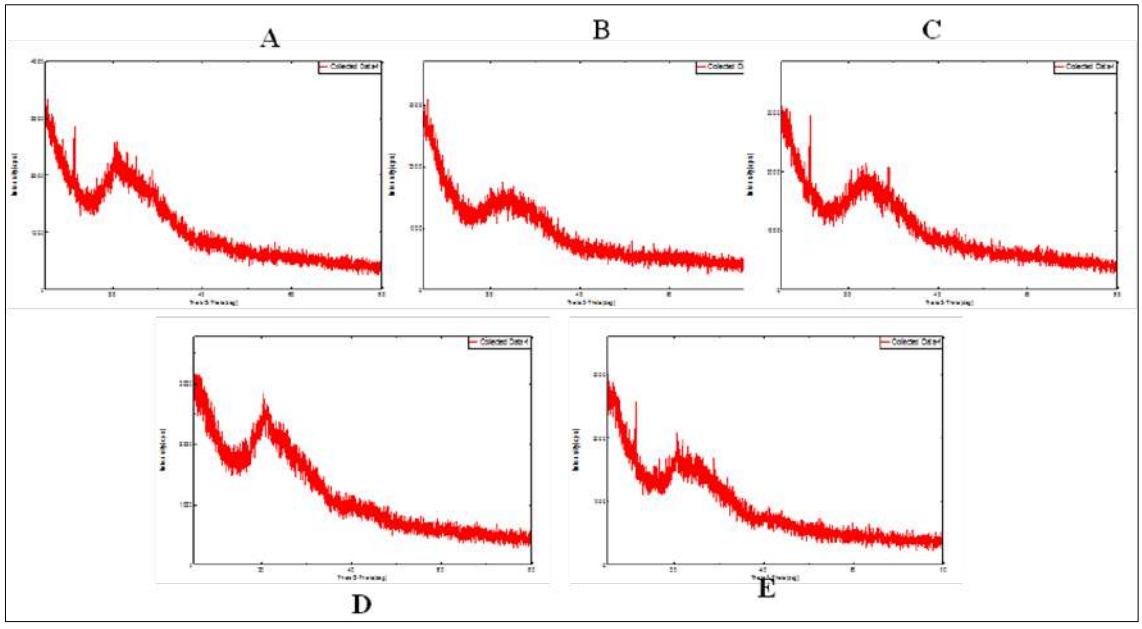



Fig. 14.8: XRD Spectra of Regenerated Fibres L1, L2, L3, BFCM and BFCPE

The diffraction angle of Regenerated fibers in the range of 16.4° and 20.9° for intense β sheets.

## Continuous/other activities

### Maintenance of Silkworm Pathogens

Maintained the BmNPV, BmIFV and BmDNV virus stocks, pathogenic bacteria, *viz*., *Staphylococcus aureus*, *Streptococcus faecalis*, *Bacillus thuringiensis* and *Serratia marcescens* and fungal pathogens, *Beauveria bassiana* and different microsporidian strains. Sub-culturing of all bacterial and fungal pathogens and reinoculation of the viral pathogens and microsporidia were done periodically. The virulence of all the pathogens is tested periodically as per the standard procedure.

### Field problems resolved

Resolved 20 field problems related to silkworm diseases and gave guidance to the farmers for proper disease management. Follow up action also done by contacting the farmers.

### Pebrine monitoring

The scientists carried out Pebrine monitoring at bivoltine and multivoltine breeding laboratories, P4 BSF Hassan, P3 BSF Mysuru and P2 BSF Ambuga (DoS).

### Quality analysis

Issued 44 quality analysis reports for different room and bed disinfectants developed by the silkworm pathology section.

# 15. POST COCOON EVALUATION

Shivakumar M. Hukkeri and M. N. Chandrashekar

The cocoons received from different sections and nested units of the institute were assessed for the quality. The other activities are human resource development in post cocoon technology, demonstration of technologies, transfer of technologies and complete knowledge transfer about new start ups. The section is involved with different research projects of the institute.

Table 15.1: Cocoon lots received from CSRTI-Mysuru and other units

| # | Section/Unit | Cocoon Lots BV |
|---|---|---|
| 1 | Multivoltine Breeding Lab | 91* |
| 2 | Silkworm Pathology | 9 |
| 3 | Soil Science & Chemistry | 15 |
| 4 | RSRS-Kodathi | 20 |
| 5 | RSRS-Anathapur | 20 |
| 6 | RSRS-Chamarajanagar | 20 |
| 7 | REC-Samayanallur | 20 |
| | Total | 195 |

* Combination of BV & CB; all others are bivoltine lots

# 16. SERICULTURE ENGINEERING DIVISION

## Concluded Research Project

### MFM 01020 CN: Development of artificial intelligence empowered multisensory approach for gender classification and separation of silkworm cocoons (Dec. 2020-Nov. 2021 & extended up to Apr. 2022))

Shivakumar M. Hukkeri, K. N. Madhusudhan, K. S. Nitin[1], M. H. Shanbhogue[2], G.R. Manjunath[3]

[1]NIE College-Mysuru, [2]SSPC-Mysuru, [3]CO-Bengaluru

**Objectives**

- Design and development of working prototype of gender classification and separation of silk worms in pupal stage for drudgery reduction in grainages and better seed production
- Design and development of working prototype of gender classification and separation of silk worms in cocoon stage (non-destructive)

**Work done**

- Modified the feeding system of pupae in the machine as advised by the authority
- Developed two machines under this project in collaboration with NIE, Mysuru
- Auto-adjusted obtuse angle cocoon cutting machine for silkworm pupal separation (Provisional patent number received & commercialization done through NRDC to NSTG India Pvt. Ltd., Kanchipuram, Tamilnadu)
- An optical tool embedded silkworm gender classification and sorting machine
- Filed patent for two technologies for commercialization through NRDC
- Demonstrated the cocoon cutting machine to Dr. S. Ayyappan, RCC chairman, Shri. Rajit Ranjan Okhandiar, Member Secretary, Director Tech and other officials.

**Advantages of new machine**

- A relatively simple and differential light emission based automated tool for gender classification.

- An automated machine to classify and sort the silkworm pupae into male, female, and unrecognized collector bins.
- High separation accuracy (95%) and higher speed of separation.
- Less drudgery and manpower requirements.
- A single machine, with two channels can separate more than 50,000 pupae in 8 hours of operation.

**Launch of the machine**

- Launched the **Cocoon Cutting Machine** by Shri Rajit Ranjan Okhandiar, Member Secretary, CSB, Bangaluru during the inaugural session of the National Seminar on ***Climate smart sericulture***, held at NIFT Campus on 6th Oct. 2022.
- Released the pamphlet for technology on "Cocoon cutting machine "during the launch of machine on 6th Oct. 2022.
- An Appreciation Certificate was received by the team members of this project

**Output utilization**

- A meeting was held at CO, CSB-Bangaluru under the Chairmanship of Shri. Rajit Ranjan Okhandiar, Member Secretary, CSB on 01.08.2022 to review the status of developing the equipment under the project MFM 01020 CN and a decision was taken to supply 20 cocoon cutting machines (10 automatic & 10 semiautomatic) with >99% accuracy to NSSO units by following required official procedures.
- Many demonstrations were carried out to dignitaries and SSPCs on the efficacy of the cocoon cutting machine.




## Pilot Study

### Design and Development of 3-D fabric based mountages suitable for silkworm rearing (Nov. 2021 – Jan. 2022 & extended up to Jun. 2022)

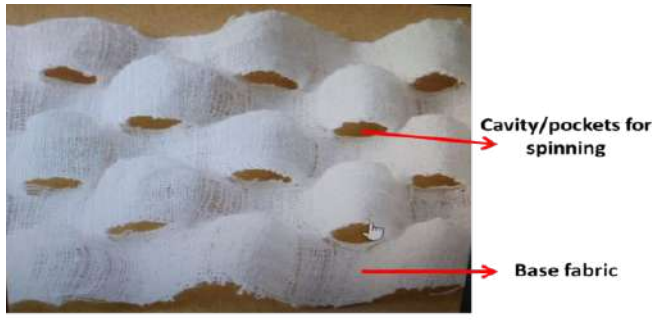
Shivakumar M Hukkeri, K.N. Madhusudhan and M.N. Chandrasekar

**Objectives**

- Development of low cost fabric based mountage for the production of cocoons with less defective %.
- To analyze the impact of such fabric based mountages on silkworm spinning, cocoon quality and ease of maintenance during and post spinning activities

**Brief work done**

- Developed a 3-D fabric based mountages with pockets towards proper anchor for spinning cocoons.




Schematic prototype of proposed fabric based mountage

**Advantages**

- Provides sufficient and equal space for the larvae to spin their cocoons;
- To make easy the silkworm larvae crawling on them
- Maintains microclimatic conditions for larvae by absorbing the extra moisture
- Low cost with more shelf life
- Facilitates convenient for handling and usage
- Saves labour
- Amenable for disinfection.
- Easy for cleaning and storage after use.
- easy for cocoon harvesting

**Other developments**

- Developed of new room Heaters (with Twin Coils fitted with fan and Thermostat) and low-cost wall mounting fan based humidifier

**Demonstration of sericulture engineering technologies**

As a part of the mandate of the SED, displayed all the developed sericulture machines, equipments and tools in the demonstration hall and demonstrated the sericulture engineering technologies to visitors *viz.,* international officials, national officials, farmers, students, entrepreneurs, *etc*. A total of 1200 persons have visited the Sericulture Engineering Division during 2022-23.

| # | State | Visitors (no.) |
|---|---|---|
| | National | |
| 1. | Tamil Nadu | 1350 |
| 2. | Karnataka | 911 |
| 3. | Maharatra | 557 |
| 4. | Andhra Pradesh | 339 |
| 5. | Kerala | 89 |
| 6. | Uttar Pradesh | 48 |
| 7. | Bihar | 60 |
| 8. | Jammu & Kashmir | 14 |
| 9. | Delhi | 54 |
| | International | |
| 1. | Japan | 01 |
| 2. | ITEC participants | 16 |
| | Total | 3401 |


# 17. CAPACITY BUILDING AND TRAINING

R. Meenal (from Feb. 23), G. S. Geetha, Anuradha H. Jingade (Upto Jan. 23), S. Purushotham (up to May 22)

Under Capacity Building and Training, a total of 2262 persons were trained under various training programmes, including CBT and NBT, for the year 2022–23, against the target of 2100. The trainees were from various backgrounds, such as officers, officials from DoS, practicing sericulture farmers across different States, young entrepreneurs, sericulture start-up trainees, researchers, employment seekers on compassionate grounds, and students pursuing long- and short-term projects and internships as a part of their Master's degree.

Table 17.1: Details of Capacity Building and Training (CBT) programmes conducted at CSRTI Mysuru and its nested units

| # | Particulars | Target | | Achievement | |
|---|---|---|---|---|---|
| | | Physical (Nos.) | Beneficia-ries (No.) | Physical (Nos.) | Beneficia-ries (No.) |
| 1 | Structured Training Course* | | | | |
| 1.1 | Intensive Bivoltine Training | 5 | 100 | - | - |
| 1.2 | Farmers Skill Training | 57 | 1145 | 57 | 1183 |
| 1.3 | MDP under STEP | 2 | 30 | 1 | 27 |
| 1.4 | Technology Orientation Programme | 2 | 30 | 2 | 32 |
| 1.5 | Sericulture Resource Centres (SRCs)<br>Establishment of New SRC | 30<br>01 | 600 | 26 | 614 |
| 1.6 | Other Need Based Training | - | - | 6 | 58 |

| # | Particulars | Target | | Achievement | |
|---|---|---|---|---|---|
| | | Physical (Nos.) | Beneficia-ries (No.) | Physical (Nos.) | Beneficia-ries (No.) |
| 2 | Non-CBT # | - | - | | |
| 2.1 | Awareness Programme | - | - | 22 | 316 |
| 2.2 | Training on Seed Act | - | - | 3 | 32 |
| | Total | 97 | 2100 | 117 | 2262 |

# Training programme funded by agencies other than CSB

During the year, CSRTI-Mysuru trained 72 officers and officials under CBT in four batches and 393 farmers and entrepreneurs in 32 batches under the Need Based Training (NBT) programme. Similarly, 32 private entrepreneurs were trained for the establishment of the Commercial Chawki Rearing Centre (CRC) and 45 CRC entrepreneurs under the Refresher Training Programme for the renewal of the CRC licence (Table 17.2). The nested units (RSRSs and RECs) of the CSRTI, Mysuru, trained 1183 farmers under the Farmers Training Programme (FST). The four Sericulture Resource Centres (SRC) operating in the states of Tamil Nadu and Karnataka trained 614 sericulture farmers on different sericulture technologies (Table 17.3). Besides this, the division has facilitated 74 students from different universities and colleges to carry out their project or internship as a part of their Masters Degree under the guidance of CSRTI-Mysuru Scientists at different laboratories (Table 17.7).

Table 17.2: Details of training programmes conducted at CSRTI-Mysuru

| # | Name of training | Area of training | No of days | No of batches | Date | | No of trainees | Total |
|---|---|---|---|---|---|---|---|---|
| | | | | | From | To | | |
| 1 | CBT | STEP | 2 | 1 | 18.08.2022 | 19.08.2022 | 27 | 27 |
| 2 | | TOP | 5 | 2 | 13.09.2022 | 17.09.2022 | 14 | 32 |
| 3 | | TOP | | | 10.10.2022 | 14.10.2022 | 18 | |
| 4 | | Foundation Training | 6 | 1 | 13.03.2023 | 18.03.2023 | 13 | 13 |
| 5 | NBT | Awareness programme for Farmers | 5 | 17 | 23.04.2022 | 27.04.2022 | 19 | 271 |
| 2 | | | | | 05.05.2022 | 09.05.2022 | 2 | |
| 3 | | | | | 21.05.2022 | 25.05.2022 | 20 | |
| 4 | | | | | 23.05.2022 | 27.05.2022 | 12 | |
| 5 | | | | | 23.05.2022 | 27.05.2022 | 15 | |
| 6 | | | | | 19.07.2022 | 23.07.2022 | 1 | |
| 7 | | | | | 05.09.2022 | 09.09.2022 | 24 | |
| 8 | | | | | 01.11.2022 | 05.11.2022 | 10 | |
| 9 | | | | | 01.11.2022 | 05.11.2022 | 12 | |
| 10 | | | | | 14.11.2022 | 18.11.2022 | 18 | |
| 11 | | | | | 28.11.2022 | 02.12.2022 | 18 | |
| 12 | | | | | 28.11.2022 | 02.12.2022 | 8 | |
| 13 | | | | | 05.12.2022 | 09.12.2022 | 23 | |
| 14 | | | | | 06.02.2323 | 10.02.2023 | 25 | |
| 15 | | | | | 14.02.2023 | 18.02.2023 | 21 | |
| 16 | | | | | 21.02.2023 | 25.02.2023 | 27 | |
| 17 | | | | | 28.02.2023 | 04.03.2023 | 16 | |

| # | Name of training | Area of training | No of days | No of batches | Date | | No of trainees | Total |
|---|---|---|---|---|---|---|---|---|
| | | | | | From | To | | |
| 18 | NBT | Commercial Chawki Rearing (CCRC) | 90 | 3 | 05.05.2022 | 02.08.2022 | 11 | 32 |
| 19 | | | | | 20.08.2022 | 17.11.2022 | 12 | |
| 20 | | | | | 30.01.2023 | 29.04.2023 | 9 | |
| 21 | NBT | Intensive Bivoltine Training (IBT) | 35 | 1 | 05.05.2022 | 08.06.2022 | 1 | 1 |
| 23 | NBT | Industrial Training (PG students) | 28 | 1 | 04.07.2022 | 24.07.2022 | 11 | 11 |
| 24 | NBT | Intensive Training in Bivoltine sericulture (ITBS) | 90 | 4 | 19.04.2022 | 17.07.2022 | 1 | 5 |
| 25 | | | | | 22.08.2022 | 19.11.2022 | 1 | |
| 26 | | | | | 09.01.2023 | 08.04.2023 | 1 | |
| 27 | | | | | 01.03.2023 | 29.05.2023 | 2 | |
| 28 | NBT | ITEC training | 21 | 1 | 06.11.2022 | 03.12.2022 | 26 | 26 |
| 29 | NBT | Refresher Training for Licence Renewal | 5 | 5 | 17.06.2022 | 23.06.2022 | 9 | 45 |
| 30 | | | | | 27.06.2022 | 03.07.2022 | 9 | |
| 31 | | | | | 20.08.2022 | 26.08.2022 | 10 | |
| 32 | | | | | 17.10.2022 | 23.10.2022 | 5 | |
| 33 | | | | | 14.03.2023 | 21.03.2023 | 12 | |
| Total | | | | | | | | 463 |

**Indian Technical and Economical Co-operation (ITEC) Training**

An ITEC training entitled ***Sericulture and Silk Industry*** on mulberry silkworm rearing, was conducted for four weeks from 6th Nov. to 3rd Dec. 2022 at CSRTI-Mysuru. A total of 26 participants from ten countries including the officials in Government, Public and Private Sectors, Universities, Chambers of Commerce and Industry, *etc*., attended the training. The trainees were taught in detail on sericulture aspects such as Mulberry cultivation, Silkworm rearing (Young age and late age), Silkworm seed production technology, Extension management, Transfer of technology and Post cocoon technology. They also visited Cold Storage plant, P3 and P4 stations, RSRS Chamarajanagar, Ramnagaram cocoon market, Kollegala cocoon market, weaving, dyeing and silk testing units located in and around Kollegala, Silkworm Seed Production Centre (SSPC) Mysuru, Karnataka Silk Industries Corporation Limited (KSIC) , Mysuru, large scale commercial chawki production centre at Keeranagere, CSTRI, P3D cell, Office of ISC Bangalore and progressive farmers.

**Foundation Training Programme for the newly inducted Scientists of CSTRI, Bangalore**

Besides conducting regular structured trainings, the institute had also conducted adhoc Foundation Training for the newly inducted Scientists-B (Post Cocoon) from CSTRI, Bangalore for 6 days from 13-18th March 2023. A total of 13 scientists from post cocoon discipline underwent class room training on pre cocoon aspects such as mulberry cultivation and its maintenance, recommended mulberry varieties, hygiene & disinfection of rearing house, present ruling bivoltine and multivoltine hybrids, silkworm rearing technologies for production of quality cocoons and economics of silkworm rearing. They were also taken on study tour to KSIC Factory, Mysuru and Kollegal Cocoon Market and other PCT units *viz.,* reeling, weaving, spinning and silk testing.

Table 17.3: Unit wise details of Farmers Skill Training (FST) and SRC Training

| # | Name of unit | Annual Target 22-23 | | | | Achievement during 22-23 | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | FST | | SRC | | FST | | SRC | |
| | | Physical (no) | Bene-ficiaries (no) | Physical (no) | Bene-ficiaries (no) | Physical (no) | Bene-ficiaries (no) | Physical (no) | Bene-ficiaries (no) |
| 1 | RSRS Salem | 13 | 250 | 15 | 300 | 13 | 251 | 12 | 314 |
| 2 | RSRS Kodathi | 5 | 100 | 15 | 300 | 5 | 100 | 14 | 300 |
| 3 | RSRS Ananthapur | 12 | 250 | - | - | 10 | 255 | - | - |
| 4 | RSRS Ch'nagar | 2 | 40 | - | - | 2 | 42 | - | - |
| 5 | RSRS Mulugu | 12 | 250 | - | - | 12 | 251 | - | - |
| 7 | REC Parbhani | 2 | 40 | - | - | 03 | 51 | - | - |
| 8 | REC Baramathi | 2 | 40 | - | - | 03 | 50 | - | - |
| 9 | REC Aurangabad | 3 | 60 | - | - | 03 | 62 | - | - |
| 10 | REC Amaravathi | 3 | 55 | - | - | 03 | 61 | - | - |
| 11 | REC Hoshangabad | 3 | 60 | - | - | 03 | 60 | - | - |
| Total | | 57 | 1145 | 30 | 600 | 57 | 1183 | 26 | 614 |

Table 17.4: State wise details of CBT and NBT trainings conducted during 22-23

| # | State | Structured Training (CBT) (Nos) | NON-CBT (Nos) |
|---|---|---|---|
| 1 | Tamil Nadu | 566 | - |
| 2 | Karnataka | 473 | 87 |
| 3 | Telangana | 251 | - |
| 4 | Andhra pradesh | 289 | 11 |
| 5 | Maharashtra | 228 | 142 |
| 6 | Madhya Pradesh | 62 | - |
| 7 | Uttarapradesh | - | 126 |
| 8 | Bihar | - | 1 |
| 9 | Other countries | - | 26 |
| Total | | 1869 | 393 |

**Commercial Chawki Rearing Activity**

During the year 22-23, a total of 48150 dfls were chawki reared and distributed among 390 rearers and generated revenue of Rs 10.02. The farmers recorded an average cocoon yield of 74.92 kgs /100 dfls. The brushing and distribution of chawki worms are shown in table 17.5.

Table 17.5: Brushing details of CRC during 2022-23

| Month | No.of dfls | No.of farmers | Amount (Rs.) | Yield/100 dfls (kg) |
|---|---|---|---|---|
| Apr. '22 | 3850 | 26 | 78925 | 64.0 |
| May | 4050 | 31 | 83025 | 75.0 |
| Jun. | 4400 | 38 | 90200 | 76.0 |
| Jul. | 4550 | 35 | 93275 | 77.0 |

| Month | No.of dfls | No.of farmers | Amount (Rs.) | Yield/100 dfls (kg) |
|---|---|---|---|---|
| Aug. | 4250 | 38 | 87125 | 64.0 |
| Sep. | 2850 | 25 | 58425 | 75.0 |
| Oct. | 4300 | 37 | 88150 | 82.0 |
| Nov. | 3200 | 26 | 65600 | 78.0 |
| Dec. | 4750 | 43 | 97375 | 80.0 |
| Jan. '23 | 5000 | 46 | 102500 | 81.0 |
| Feb. | 3350 | 24 | 73625 | 72.54 |
| Mar. | 3600 | 21 | 84600 | 74.46 |
| Total | 48150 | 390 | 1002825 | 74.92 |

**Feedback evaluation**

Feedback evaluation was conducted for a few training programmes after completion of the training through a questionnaire. The course-wise feedback of the same is presented in table 17.6.

Table 17.6: Feedback evaluation of training programmes

| Course | Training Utility Index | Training Efficiency Index | Training Facilities Index | Course Coverage Index | Training Management Index | Variance |
|---|---|---|---|---|---|---|
| STEP | 83.62 | 84.66 | 82.33 | 86.90 | 84.38 | 19.38 |
| TOP Batch 1 | 86.17 | 81.02 | 76.09 | 81.07 | 81.10 | 16.10 |
| TOP Batch 2 | 84.56 | 84.19 | 84.42 | 90.00 | 85.28 | 20.28 |
| Foundation Training | 88.77 | 84.31 | 71.98 | 91.54 | 90.98 | 25.98 |
| ITEC Training | 95.23 | 91.60 | 92.69 | 90.77 | 92.57 | 27.57 |
| NBT | 88.73 | 95.24 | 91.69 | 100.00 | 93.91 | 28.91 |

The overall training Management Index for the training program (TMI) ranged from 81.10 to 93.91 against 65% required indicating 16.10 to 28.91 % above the ISO standard. This shows a very positive opinion of the trainees about the program. The overall opinion by the trainees regarding the faculty, knowledge level of faculty, study tour, co-ordination & cooperation and efforts of faculty/ staff were most appreciated.

**Dissertations Submitted**

In addition to the regular training programmes the institute facilitated students from different universities and colleges to do their project as a part of their Masters Degree under the guidance of Scientists at different laboratories.

Table 17.7: Student Project/Dissertations carried out during 2022-23

| # | Name of the student | Title | University/Institution to which submitted | Name of the guide/co-guide |
|---|---|---|---|---|
| 1 | S. D. Manoj | Assessment of soil fertility, water and leaf quality parameters of mulberry sericulture in Nanjangud Taluk | JSS Academy of Higher Education & Research, Mysuru | Amit Kumar |
| 2 | N. A. Shreyas | Assessment of soil fertility, water quality and leaf quality parameters of mulberry sericulture in H. D .Kote | JSS Academy of Higher Education & Research, Mysuru | Amit Kumar |
| 3 | A. M. Anuja | Isolation, identification of actinomycetes and their efficacy aganist root rot causing pathogens of mulberry | JSS Academy of Higher Education & Research, Mysuru | Arunakumar GS |
| 4 | N. Anusha | Biosynthesis of Zinc nano particles from *Trichoderma harzianum* and its efficacy aganist root rot causing pathogens in mulberry | JSS Academy of Higher Education & Research, Mysuru | Arunakumar GS |
| 5 | Dolma Chhuden Sherpa | Extraction of secondary metabolites from biocontrol agents isolated from mulberry | JSS Academy of Higher Education & Research, Mysuru | Arunakumar GS |
| 6 | G. P. Lakshmishree | Studies on leaf spot and leaf blight diseases of mulberry | Maharani's Science College for Women, Mysuru | Bhavya MR |
| 7 | N. Priyanka | Isolation and Identification of bacteria associated with the rhizosphere of moderately yielding mulberry genotypes | Maharani's Science College for Women, Mysuru | Bhavya MR |
| 8 | B. V. Harini | Isolation and Identification of bacteria associated with the rhizosphere of low yielding mulberry genotypes | Maharani's Science College for Women, Mysuru | Bhavya MR |
| 9 | C. Jayashree | Studies on die back disease of mulberry | Maharani's Science College for Women, Mysuru | Bhavya MR |
| 10 | C. K. Narmadha | Isolation and Identification of bacteria associated with the rhizosphere of high yielding mulberry genotypes | Maharani's Science College for Women, Mysuru | Bhavya MR |
| 11 | Rochita Jayaraj | Assessment of genetic diversity among 10 (S-1635, Vishala, V-1, G-4, RC-1, G-2, Sahana, AR-12, MSG-2, AGB-8) mulberry varieties using SSR markers of *Morus alba* | Sri. Krishna Arts & Science College Coimbatore | Bhavya MR |
| 12 | B. Nisha | Molecular characterization of 11 (Kanva-2, S-34, AR-11, S-146, RFS-135, S-36, MR-2, S-13, RFS-175, Mysore local, RC-2) mulberry varieties using SSR markers of *Morus alba* | Sri. Krishna Arts & Science College Coimbatore | Bhavya MR |
| 13 | D. Devika | Molecular characterization of selected *M. indica* genotypes used as example genotypes in mulberry DUS guidelines using SSR markers | Sri. Krishna Arts & Science College Coimbatore | Bhavya MR |
| 14 | S. Kavya | Study of genetic diversity among selected mulberry genotypes of *M. latifolia and M. alba* included as example genotypes in mulberry DUS guidelines using SSR markers | Sri. Krishna Arts & Science College Coimbatore | Bhavya MR |

| | | | | |
|---|---|---|---|---|
| 15 | J. Sneha | Identification of polymorphic markers and genetic diversity using selected mulberry genotypes of *M. laevigata, M. serrata and M. bombycis* used as example genotypes in mulberry DUS guidelines | Sri. Krishna Arts & Science College Coimbatore | Bhavya MR |
| 16 | G. Kavyashree | Fortification of *Ageratum houstonianum* on the biochemical constituents and cocoon traits of mulberry silkworm *Bombyx mori* | JSS Academy of Higher Education & Research, Mysuru | Bhuvaneshwari E |
| 17 | S. Apoorva | Biochemical studies on white fly, *Pealius mori* infected mulberry leaves and its impact on silkworm's biochemical constituents and cocoon parameters | JSS Academy of Higher Education & Research, Mysuru | Bhuvaneshwari E |
| 18 | D. S. Keerthana | Qualitative and Quantitative assessment of Quercetin and Rutin in the mulberry leaves and silkworm excrement and its possible exploitation | JSS Academy of Higher Education & Research, Mysuru | Bhuvaneshwari E |
| 19 | M. M. Anusha | Sulphate sorption and desorption characteristics of soils under different aged mulberry plantations | JSS Science and Technology University, Mysuru | Dr. Dhaneshwar Padhan |
| 20 | M. Basavaraj | Extraction and Estimation of Bioactive Compounds from Silkworm *Bombyx mori* Cocoon Shell | JSS Academy of Higher Education & Research, Mysuru | Dhaneshwar Padhan |
| 21 | D. E. Anusha | Adsorption-desorption kinetics of potassium in soils of different aged mulberry plantations | JSS Science and Technology University, Mysuru | Dhaneshwar Padhan |
| 22 | S. P. Bharath Kumar | Phosphate sorption and desorption characteristics of soils under different aged mulberry plantations | JSS Science and Technology University, Mysuru | Dhaneshwar Padhan |
| 23 | G. M. Pooja | The stoichiometry of microbial biomass carbon, nitrogen and enzyme activities in rhizosphere soil of different aged mulberry plantations | Maharani's Science College for Women, Mysuru | Dhaneshwar Padhan |
| 24 | R. D. Kavya | Studies on soil respiration, microbial biomass nitrogen and its associated enzymatic activity in mulberry rhizosphere | Maharani's Science College for Women, Mysuru | Dhaneshwar Padhan |
| 25 | M. Prema | Assessment of soil microbial biomass sulphur and arylsulphatase activity in rhizosphere zone of different aged mulberry plantations | Maharani's Science College for Women, Mysuru | Dhaneshwar Padhan |
| 26 | M. C. Sneha | Assessment of soil microbial biomass sulphur and arylsulphatase activity in rhizosphere zone of different aged mulberry plantations | Maharani's Science College for Women, Mysuru | Dhaneshwar Padhan |
| 27 | P. J. Yashvanth | Evaluation of mulberry varieties for accumulation of antioxidants and variation in root traits under water logging stress. | JSS Academy of Higher Education & Research, Mysuru | Gayathri T |
| 28 | M. T. Chaitra | Studies on changes in osmolytes and growth responses in mulberry varieties under water logging stress. | JSS Academy of Higher Education & Research, Mysuru | Gayathri T |

| | | | | |
|---|---|---|---|---|
| 29 | B. M. Supriya | Development and characterization of silkworm chitosan-sericin hydrogel | Dept. of Biotechnology, Manasagangotri University of Mysuru, Mysuru | Madhusudhan KN |
| 30 | H. M. Santhosh Kumar | Development and characterization of silkworm chitosan-sericin hydrogel | Dept. of Biotechnology, Manasagangotri University of Mysuru, Mysuru | Madhusudhan KN |
| 31 | M. N. Indushree | Isolation and Characterization of secondary metabolites from gut microbiota of silkworm | Dept. of Biotechnology, Manasagangotri University of Mysuru, Mysuru | Madhusudhan KN |
| 32 | Tejaswini | Isolation and Characterization of secondary metabolites from gut microbiota of silkworm | Dept. of Biotechnology, Manasagangotri University of Mysuru, Mysuru | Madhusudhan KN |
| 33 | M. Chandana | *In Silico* Screening of Antiviral Drugs against Protein Pathway of JAK-STAT & ERK as a Primary Approach To Design New Generation Drugs | JSS College of Arts, Commerce and Science (Autonomous), Mysuru | Madhusudhan KN |
| 34 | Sushmanjali | *In silico* screening of different antiprotozoal drugs against proteins of ppo pathway and designing of new generation drugs | JSS College of Arts, Commerce and Science (Autonomous), Mysuru | Madhusudhan KN |
| 35 | G. Pramitha | *In silico* screening of antibiotic and antifungal drugs against protein pathway of TOLL and IMD for new generation drug designing | JSS College of Arts, Commerce and Science (Autonomous), Mysuru | Madhusudhan KN |
| 36 | Tanya Ahmed | Isolation, identification & characterization of secondary metabolites producing endophytes from *Morus alba L.* | Manasagangotri University of Mysuru, Mysuru | Madhusudhan KN |
| 37 | S. Mallikarjuna | A Study on Bio-synthesis and Characterization of Zinc Oxide Nanoparticles synthesized using *Syzygium jambos* (L) Leaf extract and its Antimicrobial activity | Davangere University, Davanagere | Madhusudhan KN |
| 38 | G. C. Kotresh Yadaw | A Study on Bio-synthesis and Characterization of Zinc Oxide Nanoparticles synthesized using *Tabernaemontana divaricata* Leaf extract and its Antimicrobial activity | Davangere University, Davanagere | Madhusudhan KN |
| 39 | B. S. Nikhil | A Study on Bio-synthesis and Characterization of Zinc Oxide Nanoparticles synthesized using *Ocimum sanctum* leaf extract and its Antimicrobial activity | Davangere University, Davanagere | Madhusudhan KN |

| | | | | |
|---|---|---|---|---|
| 40 | S. Sushmitha | Proteomic analysis of bacterial infected midgut from silkworm *Bombyx mori* | Maharani's Science College for Women, Mysuru | Mallikarjuna G |
| 41 | A. R. Simpana | Isolation and characterization of serine protease from the digestive Juice of silkworm against *Bombyx mori* Nucleopolyhedrosis virus (BmNPV) | Maharani's Science College for Women, Mysuru | Mallikarjuna G |
| 42 | M. Thanmaya | Isolation and characterization of lipase from the silkworm *Bombyx mori* against Nucleopolyhedro virus | Maharani's Science College for Women, Mysuru | Mallikarjuna G |
| 43 | Sonal V. Gowda | Purification of antiviral red fluorescent protein from infected silkworm fecal matter | Maharani's Science College for Women, Mysuru | Mallikarjuna G |
| 44 | C. R. Shilpa | Identification of different gene expression in silkworm *Bombyx mori* during *Bombyx mori* nucleopolyhedro virus infection | Maharani's Science College for Women, Mysuru | Mallikarjuna G |
| 45 | R. Sindhu | Evaluation of protein regulation and genomic studies in non – spinning larvae | JSS Academy of Higher Education & Research, Mysore | Mallikarjuna G |
| 46 | T. R. Megha | Isolation of Protease producing bacteria from soil: Extraction and characterization of amylase | Maharani's Science College for Women, Mysuru | Ravindra |
| 47 | Annapoorneshwari | Isolation of Protease producing bacteria from soil: Extraction and characterization of protease | Maharani's Science College for Women, Mysuru | Ravindra |
| 48 | B. Bhavana | Isolation of Cellulase producing bacteria from soil: Extraction and characterization of cellulose | Maharani's Science College for Women, Mysuru | Ravindra |
| 49 | Bushra Shabnam Shaik | Biochemical studies on removal of elements and Phytochemicals from aqueous extract of cocoon shell by using mulberry and alginate beads | St. Philomena's College, Mysuru | Ravindra |
| 50 | R. Lakshmi | Biochemical studies on removal of elements and phytochemicals from aqueous extract of cocoon shell by using mulberry and alginate beads | St. Philomena's College, Mysuru | Ravindra |
| 51 | E. Pavithra | Isolation of amylase producing bacteria from soil and partial characterization of amylase | Davangere University, Davanagere | Ravindra |
| 52 | S. H. Sushmitha | Isolation of amylase producing bacteria from soil and partial characterization of amylase | Davangere University, Davanagere | Ravindra |
| 53 | R. Deekshita | Biochemical Studies on Protease of Silkworm (*Bombyx mori*) | JSS Academy of Higher Education & Research, Mysore | Ravindra |
| 54 | S. S. Jayanth | Extraction and estimation of biochemical of mulberry leaf and silkworm *bombyx mori* cocoon shell | JSS Academy of Higher Education & Research, Mysore | Ravindra |
| 55 | N. K. Shivakumar | Extraction and identification of biochemical composition of mulberry leaf and silkworm cocoon | JSS Academy of Higher Education & Research, Mysore | Ravindra |
| 56 | G. U. Manushree | Extraction and identification of biochemical composition of mulberry leaf and silkworm cocoon | JSS Academy of Higher Education & Research, Mysore | Ravindra |

| | | | | |
|---|---|---|---|---|
| 57 | H. S. Hemanth Kumar | Effect of aqueous extract of cocoon shell on the enhancement of fruit shelf life and inhibition of tyrosinase activity | JSS Academy of Higher Education & Research, Mysore | Ravindra |
| 58 | A. Madiha Manal | Biochemical studies on Amylase from haemolymph and Gut of silkworm (*Bombyx mori*) | JSS Academy of Higher Education & Research, Mysore | Ravindra |
| 59 | T.K. Varun | Extraction of bioactive compounds from silkworm cocoon shell by different chemicals | JSS Academy of Higher Education & Research, Mysore | Ravindra |
| 60 | K. Sufaid | Extraction and estimation of bio active compounds from silkworm, cocoon shell by using different salt chemicals | JSS Academy of Higher Education & Research, Mysore | Ravindra |
| 61 | M. Manasa | Comparison of organic and organic nutrient management on soil physico-chemical properties and microbial activity under tree mulberry cultivation | Maharani's Science College for Women, Mysuru | Sobhana V |
| 62 | Vaishali. S | Comparative analysis of physio-chemical parameters and microbial properties of Sericompost and Farmyard manure | Maharani's Science College for Women, Mysuru | Sobhana V |
| 63 | H. M. Sujatha | Effect of organic and inorganic nutrient management on soil microbial population and phosphatase activity under tree mulberry cultivation | Maharani's Science College for Women, Mysuru | Sobhana V |
| 64 | B. V. Bhoomika | *In vitro* regeneration of shoots from nodal explants of mulberry (*Morus indica* l.) Cv. AGB8 | JSS College of Arts, Commerce and Science (Autono-mous), Mysuru | Tanmoy Sarkar |
| 65 | S. Mamatha | Effect of plant growth regulators on *Invitro* regeneration of shoots in mulberry (*Morus indica* cv. AGB8) from shoot tip explants | JSS College of Arts, Commerce and Science (Autono-mous), Mysuru | Tanmoy Sarkar |
| 66 | V. Manoj | Extraction and characterization of silkworm pupae proteins for antibacterial activity | Mahajana Edu. Society (R) Pooja Bhagavat Memorial, Mahajana Education Centre, Mysuru | Thirupathaiah Y |
| 67 | Hajrathul Anjoom | Pre treatment and production of bio ethanol from silkworm excreta | JSS Academy of Higher Education & Research, Mysore | Thirupathaiah Y |
| 68 | Amina Arfa | Pretreatment and production of bio ethanol from mulberry shoot | JSS Academy of Higher Education & Research, Mysore | Thirupathaiah Y |
| 69 | S. K. Jaya Sounder | Extraction and characterization of silkworm pupae proteins for bacteria and silk binding assay | Mahajana Edu. Society (R) Pooja Bhagavat Memorial, Mahajana Education Centre, Mysuru | Thirupathaiah Y |
| 70 | V. Shilpashree | Extraction & Characterization of Pupa Oil using Fermentation with *Bacillus* sp. | Maharani's Science College for Women, Mysuru | Thirupathaiah Y |
| 71 | T. P. Varshitha | Extraction & Characterization of Pupa Oil using Fermentation with *Lactobacillus* | Maharani's Science College for Women, Mysuru | Thirupathaiah Y |

# 18. SERICULTURAL EXTENSION, ECONOMICS AND MANAGEMENT

R. Bhagya, M. Muthulakshmi, Raveendra M. Mattigatti and N. G. Selvaraju (upto June 2022)

## Concluded Research Project

### PPF 01017 SI: Economics of Mulberry Sericulture in South India (Nov. 2020-Mar. 2023)

Raveendra M Mattigatti, Joycy Rani Dasari (upto Feb. 2021), Amit Saha (upto Nov.2022), M. Muthulakshmi (from Mar. 2021)

**Objectives**

- Scientific estimation of state-wise cost of mulberry cultivation and cocoon production in silkworm rearing and cost of cultivation of major crops
- Development and updating of optimum and financially feasible farm models for sericulture
- To study the resource use efficiency in sericulture

Data was collected from sericulture and non-sericulture farmers across the states of Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Maharashtra and Madhya Pradesh. A total of 1240 farmers were covered across the 31 clusters in the southern states.

**Cost of cocoon production in southern states**

Table 18.1: State-wise cost of cocoon production during 2021-22 (Rs. per acre/annum)

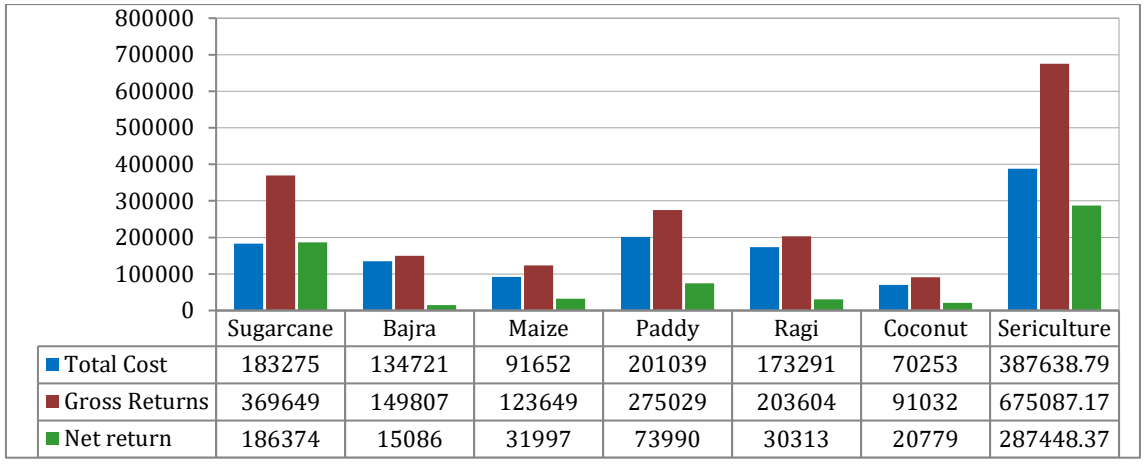
| Particulars | KA | TN | AP | TS | MH | MP | Overall |
|---|---|---|---|---|---|---|---|
| Sample Size | 220 | 120 | 60 | 100 | 120 | 20 | 640 |
| **A. Variable costs** | | | | | | | |
| Animal labour (PD) | 2895.80 | 0.00 | 3452.51 | 3377.65 | 6211.54 | 5147.62 | 3514.19 |
| Machine labour (h) | 3317.70 | 12520.50 | 8799.75 | 8332.57 | 5623.08 | 2971.43 | 6927.51 |
| Human Labour (MD) | 126662.46 | 155168.11 | 139563.36 | 180548.05 | 113303.35 | 52513.47 | 127959.80 |
| FYM (MT) | 17875.11 | 12781.19 | 17171.63 | 20581.45 | 21665.19 | 10380.95 | 16742.59 |
| Chemical Fertilizers (kg) | 7376.22 | 2479.88 | 10242.02 | 17986.94 | 8977.31 | 6222.22 | 8880.76 |
| Crop Prot. Chem.(Rs.) | 22638.79 | 21847.44 | 13786.65 | 11937.08 | 18115.50 | 18628.05 | 17825.58 |
| Irrigation costs (Rs.) | 1893.38 | 1560.60 | 4759.46 | 4554.41 | 7957.31 | 2482.35 | 3867.92 |
| Other Costs * (Rs.) | 20970.72 | 9859.10 | 12390.26 | 8532.17 | 42546.17 | 38795.27 | 22182.28 |
| Int. on WC (10% pa) | 32649.89 | 35431.99 | 23974.82 | 28158.12 | 31805.91 | 16183.86 | 28257.23 |
| Chawki Charges (Rs.)# | 43062.35 | 45646.19 | 22661.52 | 20683.28 | 25430.20 | 5776.19 | 27209.96 |
| **Total variable cost §** | **2.79** | **2.97** | **2.56** | **3.04** | **2.81** | **1.59** | **2.63** |
| **B. Fixed costs** | | | | | | | |
| Apportioned cost ◆(Rs.) | 15712.51 | 18016.44 | 3701.75 | 3689.06 | 9437.96 | 4044.54 | 9100.38 |
| Depreciation cost ◆(Rs.) | 92583.86 | 117703.70 | 38160.68 | 40812.37 | 65829.38 | 20099.57 | 62531.60 |
| **Total Fixed costs §** | **1.08** | **1.35** | **0.41** | **0.44** | **0.75** | **0.24** | **0.71** |
| **C. Total cost (A+B)§** | 3.87 | 4.33 | 2.98 | 3.49 | 3.56 | 1.83 | 3.34 |
| Cost/kg cocoon (Rs.) | 354.45 | 354.85 | 315.21 | 310.35 | 262.49 | 287.98 | 319.75 |
| **D. Revenue** | | | | | | | |
| No. of Crops/year | 7 | 10 | 6 | 8 | 8 | 5 | 7 |
| Cocoon yield/100 dfls (kg) | 85.09 | 84.54 | 77.82 | 85.00 | 83.54 | 68.53 | 81.54 |

| Particulars | KA | TN | AP | TS | MH | MP | Overall |
|---|---|---|---|---|---|---|---|
| Avg. cocoon Rate (Rs.) | 609.64 | 615.67 | 522.22 | 496.54 | 426.88 | 417.23 | 514.70 |
| Income from cocoons (Rs.)§ | 6.66 | 7.51 | 4.94 | 5.58 | 5.80 | 2.68 | 5.48 |
| By-products income (Rs) | 8366.83 | 10034.15 | 2131.92 | 5025.88 | 14345.00 | 6345.00 | 7708.13 |
| Total returns(Rs.)§ | 6.75 | 7.61 | 4.96 | 5.63 | 5.94 | 2.74 | 5.55 |
| Net returns(Rs.)§ | 2.87 | 3.28 | 1.98 | 2.14 | 2.37 | 0.91 | 2.20 |
| Returns per rupee of investment | 1.74 | 1.76 | 1.66 | 1.61 | 1.67 | 1.50 | 1.66 |

KA-Karnataka; TN-Tamil Nadu; AP-Andhra Pradesh; TS-Telangana; MH-Maharashtra; MP-Madhya Pradesh; PD-Pair Days; MD-Mandays; * transportation & marketing; Int. on WC – Interest on Working Capital # No. of dfls; § Rs. in lakhs; Apportioned cost ◆-establishment of mulberry garden; Depreciation cost ◆-rearing building, equipments, machinery, *etc*.

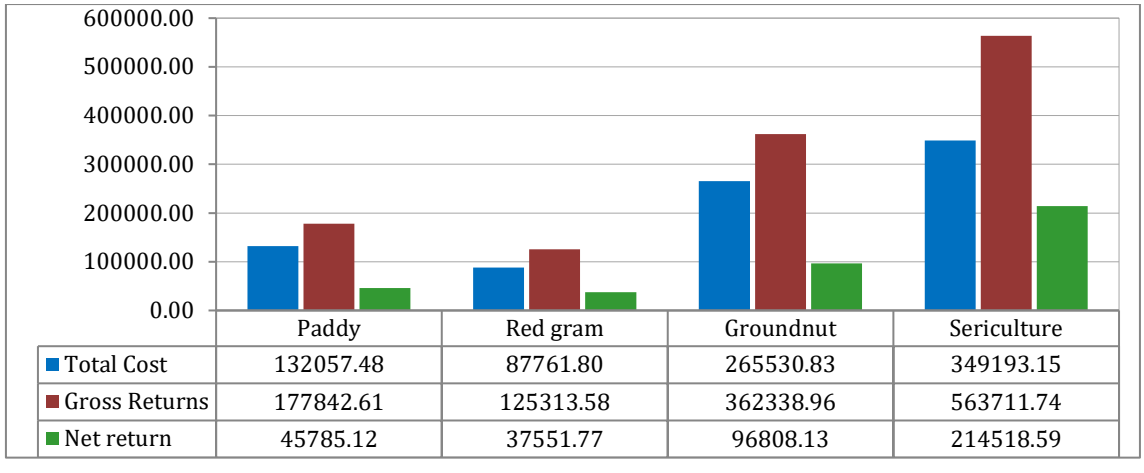
**Comparative economics of sericulture and agricultural crops in southern states:**

In Karnataka state, the agricultural crops cultivated by the sample farmers are,sugarcane, bajra, maize, paddy, ragi, coconut, *etc*. The economics of selected agriculture crops revealed that the net-profit/acre/year for sugarcane is Rs. 1,86,374, for paddy Rs.73,990, for maize Rs. 31,997, for Ragi Rs. 30,313, for coconut Rs. 20,779 and for bajraRs. 15,086. The BC ratio which indicates that the profitability is higher forsugarcane (2.02), which is higher than that of sericulture (1.74). Agriculture crops cultivated by the sampled farmers in Tamil Nadu are, maize, paddy, ragi and coconut. The net profits realized per acre/year for coconut is Rs.1,19,328.16, paddy Rs. 28,149.56), ragi Rs. 9,373.49 and maize Rs. 4,749.68. The BC ratio indicates that the profitability is higher in sericulture (1.74) followed by coconut crop with a BC ratio of 1.44. Agriculture crops cultivated by the sample farmers in the Andhra Pradesh are, paddy, red gram and groundnut. The net-profit/acre/year obtained for groundnut is Rs. 96,808.13/-, for paddy Rs. 45,785.12 and for redgram Rs. 37,551.77. The BC ratio indicates that the profitability is higher for redgram (1.43) than to Sericulture (1.61). Agriculture crops cultivated by the sample farmers in Telangana are,paddy and cotton. The net profits/acre/year forpaddy is Rs. 59222.34 and for cotton Rs. 52418.24. The BC ratio indicates that the profitability is higher in paddy (1.51) than in sericulture (1.67). The agriculture crops that are cultivated by the sample farmers in the Maharashtra are, sugarcane, redgram, maize and green chilli. The net profits/acre/year for sugarcane is Rs. 60,949.67, redgram Rs. 6,036.32, maize Rs. 13,944.00 and green chilli Rs. 7,507.20. The BC ratio indicates that the profitability is higher in sugarcane (2.86) higher than Sericulture (1.67) but the returns are higher in sericulture (Fig. 18.1). Agriculture crop that are cultivated by the sample farmers in the Madhya Pradesh is wheat. The net-profit/acre/year from wheat isRs. 18841.26 which is much lower than sericulture (Rs. 91,321.65). BC ratio of wheat is 1.39 which is slightly lower than that of sericulture (1.50).



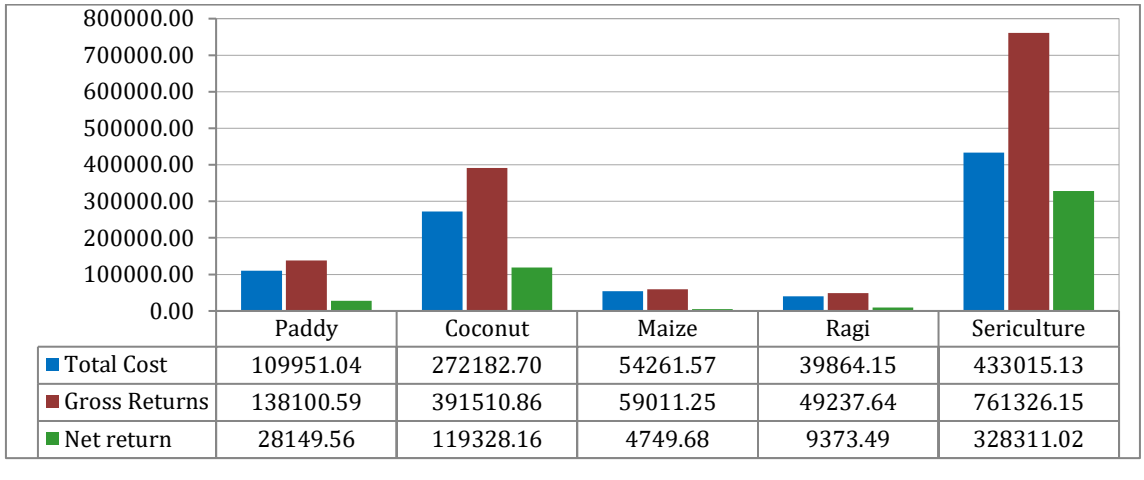

| | Sugarcane | Bajra | Maize | Paddy | Ragi | Coconut | Sericulture |
|---|---|---|---|---|---|---|---|
| Total Cost | 183275 | 134721 | 91652 | 201039 | 173291 | 70253 | 387638.79 |
| Gross Returns | 369649 | 149807 | 123649 | 275029 | 203604 | 91032 | 675087.17 |
| Net return | 186374 | 15086 | 31997 | 73990 | 30313 | 20779 | 287448.37 |

Fig. 18.1: Comparative economics of sericulture with other agriculture crops in Karnataka (Rs./acre/year)



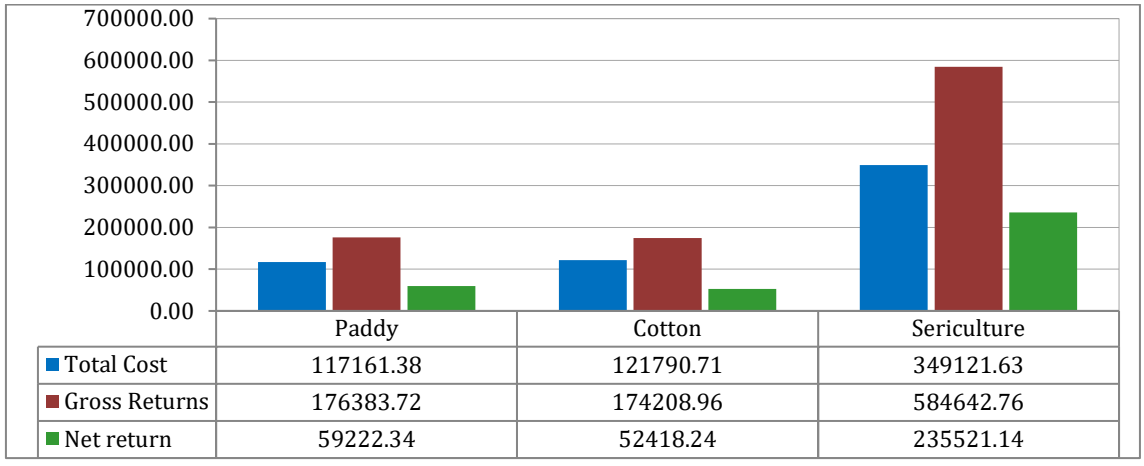

| | Paddy | Red gram | Groundnut | Sericulture |
|---|---|---|---|---|
| Total Cost | 132057.48 | 87761.80 | 265530.83 | 349193.15 |
| Gross Returns | 177842.61 | 125313.58 | 362338.96 | 563711.74 |
| Net return | 45785.12 | 37551.77 | 96808.13 | 214518.59 |

Fig. 18.2: Comparative economics of sericulture with other agriculture crops in Andhra Pradesh (Rs./acre/year)



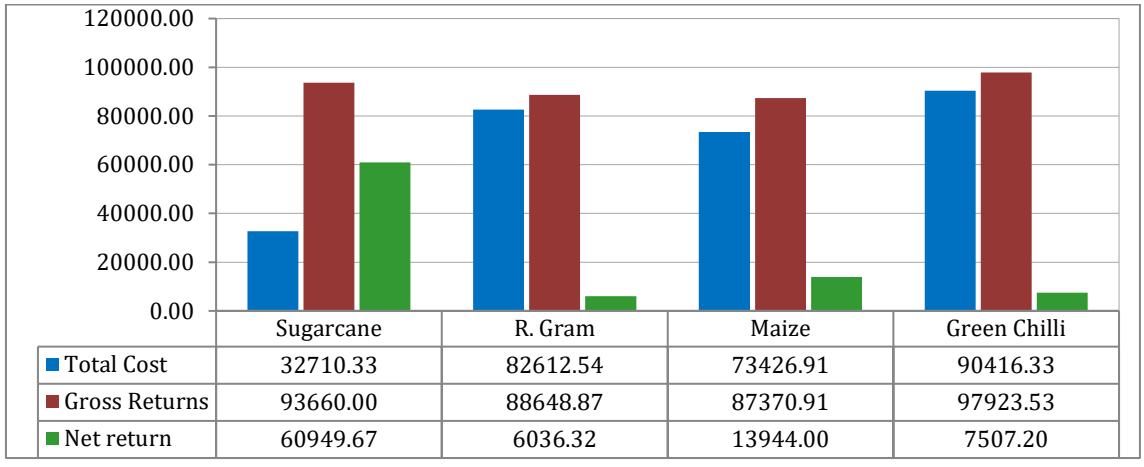

| | Paddy | Coconut | Maize | Ragi | Sericulture |
|---|---|---|---|---|---|
| Total Cost | 109951.04 | 272182.70 | 54261.57 | 39864.15 | 433015.13 |
| Gross Returns | 138100.59 | 391510.86 | 59011.25 | 49237.64 | 761326.15 |
| Net return | 28149.56 | 119328.16 | 4749.68 | 9373.49 | 328311.02 |

Fig. 18.3: Comparative economics of sericulture with other agriculture crops in Tamil Nadu (Rs./acre/year)



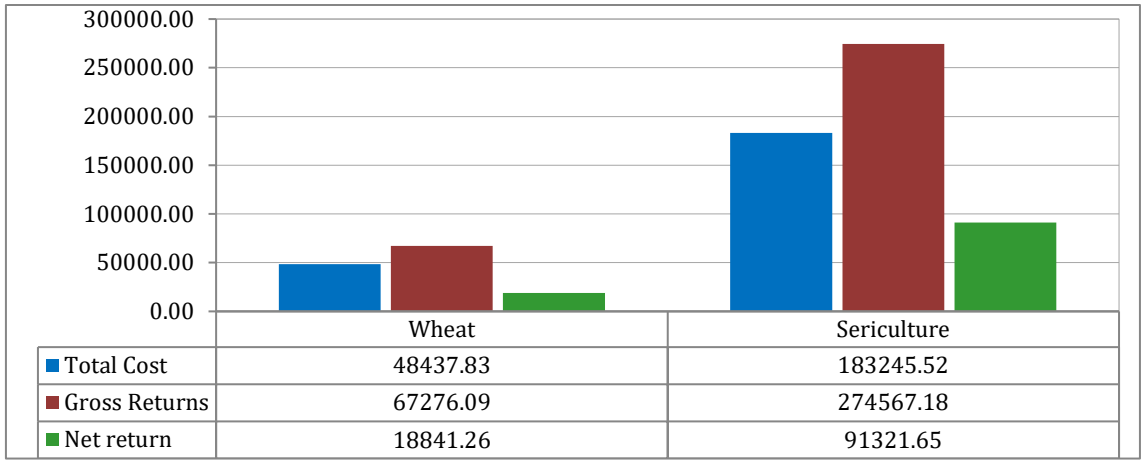

| | Paddy | Cotton | Sericulture |
|---|---|---|---|
| Total Cost | 117161.38 | 121790.71 | 349121.63 |
| Gross Returns | 176383.72 | 174208.96 | 584642.76 |
| Net return | 59222.34 | 52418.24 | 235521.14 |

Fig. 18.4: Comparative economics of sericulture with other agriculture crops in Telangana (Rs./acre/year)




| | Sugarcane | R. Gram | Maize | Green Chilli |
|---|---|---|---|---|
| Total Cost | 32710.33 | 82612.54 | 73426.91 | 90416.33 |
| Gross Returns | 93660.00 | 88648.87 | 87370.91 | 97923.53 |
| Net return | 60949.67 | 6036.32 | 13944.00 | 7507.20 |

Fig. 18.5: Comparative economics of sericulture with other agriculture crops in Maharashtra (Rs./acre/year)




| | Wheat | Sericulture |
|---|---|---|
| Total Cost | 48437.83 | 183245.52 |
| Gross Returns | 67276.09 | 274567.18 |
| Net return | 18841.26 | 91321.65 |

Fig. 18.6: Comparative economics of sericulture with other agriculture crops in Madhya Pradesh (Rs./acre/year)

## Optimum sericulture farm for different States

The financially feasible optimum sericulture farm for Karnataka state is worked out to be 5.17 acres, which indicates that the farmer can get higher profits up to 5.17 acres and beyond it will be a marginal loss. Similarly, optimum land holding was found to be 6.33 acres, 4.72 acres, 4.21 acres, 4.91 acres in Tamil Nadu, Andhra Pradesh, Telangana and Maharashtra states respectively. Optimum Farm Size and Resource Use Efficiency (Cobb Douglas production function and MVP) could not be worked out for Madhya Pradesh state as the sample size was small (20 only).

Table 18.2: State-wise estimated optimum sericulture farm size

| State | Optimum Seri. Farm (acres) |
|---|---|
| Karnataka | 5.17 |
| Andhra Pradesh | 4.72 |
| Tamil Nadu | 6.33 |
| Telangana | 4.21 |
| Maharashtra | 4.91 |

### Resource Use Efficiency in Sericulture

Cobb-Douglas production function was fitted to analyse the resource use efficiency, and the coefficients of the function were estimated for different resources ($X_1$ to $X_6$). Further the Marginal Value Product (MVP) were also worked out and presented in the Table 18.3. MVP, is the marginal revenue created due to an addition of one unit of resource. The marginal revenue product is calculated by multiplying the marginal physical product (MPP) of the resource by the marginal revenue (MR) generated.

In Karnataka, AP and TN states, all the resources were used efficiently leaving scope for the additional use of these resources would add positively to additional income (MVP>1). In Karnataka, additional one rupee investment in fertilisers would result in Rs. 8.35 in the total returns as indicated by the MVP. Similarly, additional one rupee investment in FYM, crop protection chemicals and labour would result in Rs. 9.12, 2.43 and 2.49 respectively in the total returns as indicated by their respective MVPs. In Andhra Pradesh, additional one rupee investment in fertilisers would result in Rs. 2.79 in the total returns as indicated by the MVP. Similarly, additional one rupee investment in FYM, Crop Protection Chemicals and labour would result in Rs. 3.71, 3.89 and 3.16 respectively in the total returns as indicated by their respective MVPs. In Tamil Nadu, an additional one rupee investment in fertilizers would result in Rs. 34.58 in the total returns as indicated by the MVP. Similarly, additional one rupee investment in FYM, crop protection chemicals and labour would result in Rs. 2.19, 1.34 and 3.33 respectively in the total returns as indicated by their respective MVPs. In Telangana and Maharashtra states, all the resources are used efficiently leaving scope for the additional use of these resources would add positively to additional income (MVP>1) except the cost of chemicals ($X_3$) with non-significant coefficient. Additional one rupee investment in fertilisers would result in Rs. 6.42 in the total returns as indicated by the MVP. Similarly, additional one rupee investment in FYM and labour would result in Rs. 10.65 and 3.43 respectively in the total returns as indicated by their respective MVPs.

Table 18.3: State-wise resource use efficiency in sericulture

| Vari-able | KA | | TN | | AP | | TS | | MH | | Overall | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coeff | MVP | Coeff | MVP | Coeff | MVP | Coeff | MVP | Coeff | MVP | Coeff | MVP |
| Inter-cept | 1.80 | | 2.76 | | 2.53 | | 4.77 | | 3.96 | | 1.67 | |
| $X_1$ | 0.09 | 8.35 | 0.11 | 34.58 | 0.13 | 6.42 | 0.09 | 2.79 | 0.16 | 10.68 | 0.16 | 10.01 |
| $X_2$ | 0.24 | 9.12 | 0.06 | 2.19 | 0.37 | 10.65 | 0.14 | 3.71 | 0.07 | 1.83 | 0.6 | 19.92 |
| $X_3$ | 0.08 | 2.43 | 0.06 | 1.34 | 0.01 | 0.44 | 0.08 | 3.89 | -0.04 | -1.22 | 0.58 | 18.08 |
| $X_4$ | 0.47 | 2.49 | 1.04 | 3.33 | 0.96 | 3.43 | 1.01 | 3.16 | 1.34 | 7.05 | 1.03 | 4.47 |
| $X_5$ | 0.01 | 783.60 | 0.00 | 162.87 | 0.01 | 540.54 | 0.01 | 377.48 | 0.01 | 463.91 | 0.03 | 3134.13 |
| $X_6$ | 0.93 | 490.62 | 0.88 | 303.37 | 0.65 | 265.78 | 0.56 | 238.47 | 0.61 | 224.24 | 0.08 | 34.05 |
| $X_7$ | 0.57 | 632.69 | 0.46 | 369.63 | 0.51 | 484.70 | 0.39 | 447.89 | 0.29 | 410.77 | 0.57 | 615.50 |
| $R^2$ | 0.73 | | 0.66 | | 0.53 | | 0.68 | | 0.61 | | 0.68 | |
| F-test (5%) | S | | S | | S | | S | | S | | S | |

KA-Karnataka; TN-Tamil Nadu; AP-Andhra Pradesh; TS-Telangana; MH-Maharashtra; MP-Madhya Pradesh; ($X_1$)Cost of fertilisers in Rs.;($X_2$) Cost of FYM in Rs.; ($X_3$)Cost of Chemicals in Rs.; ($X_4$)Cost of Labour in Rs.; ($X_5$) No. of Crops /year; ($X_6$) No. of dfls /ac/yr ; ($X_7$)Price in Rs.

**Salient Achievements**

The cost of mulberry cocoon production and other agricultural crops were worked out for 6 southern states. The optimum seri-farm size was worked out for 5 states which ranged from 4.21 to 6.33 acres. The resource use efficiency (MVP) showed that almost all states were used efficiently in all the 5 states under consideration except the cost of crop protection chemicals in two states viz; Telangana and Maharashtra.

## Cluster Promotion Programme (CPP)

Central Silk Board in collaboration with the Departments of Sericulture (DoS) implemented Cluster Promotion Programme under (CPP)-XII plan (2012-2017) in southern states, was extended and continued in 2022-23 also. The CPP clusters in the southern zone were monitored by CSRTI-Mysuru. The southern zone includes 26 Mega clusters (Karnataka - 11, Andhra Pradesh - 5, Telangana - 2, Tamil Nadu - 6 and Maharashtra - 2 clusters and six under non-captive area).

The Director, CSRTI-Mysuru is the south zone Coordinator; the head of SEEM division and state-wise 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. Targets of the clusters for 2022-23 were fixed based on the farmers profile and potentiality. The name and designation of the CDFs are given in Table 18.4 & 18.5.

Table 18.4: CDFs of Cluster Promotion Programme in the Captive area for 2022-23

| Clusters | CSB | DoS |
|---|---|---|
| **ANDRA PRADESH** | | |
| **1. Atmakuru (MC)** | | |
| 1. Atmakuru | K. P. Kiran Kumar, Sci-D, RSRS-Anantapur | K. Raju SO, Atmakuru |
| 2. Pattikonda | | K. Shoba Rani SO, Pattikonda |
| 3. Giddaluru | M. Venkatachalapathy, Sci-D, REC-Palamaner | A. Balasubramanyam SO, G'luru |
| **2. Chebrole (MC)** | | |
| 1. Bhimadole | K. P. Kiran Kumar, Sci-D, RSRS-Anantapur | D. Vani, DSO, Eluru |
| 2. Chebrole | | BMV Ramaraju, DSO, Kakinada |
| 3. Vijayawada | | N. Satyanaraya, DSO, VIjayawada |

| Clusters | CSB | DoS |
|---|---|---|
| **3. Hindupur (MC)** | | |
| 1. Hindupur | K. P. Kiran Kumar, Sci-D, RSRS-Anantapur | M. Suresh, ADS, Hindupur |
| 2. Madakasira | | K. Raju, ADS, Madakasira |
| **4. Kalyandurg (MC)** | | |
| 1. Kalyandurg | K. P. Kiran Kumar, Sci-D, RSRS-Anantapur | K. Naveen Kumar, SO, Kalyandurg |
| 2. Penukonda | | A. Ratnam, ADS, Penukonda |
| **5. Palamaner(MC)** | | |
| 1. Chittoor | M. Venkatachalapathy, Sci-D, REC-Palamaner | G. Babu, ADS, Gangasagaram (Apr. 22 to May 22)<br>K. Geetha, ADS, Gangasagaram (Jun. 22 to Mar. 23) |
| 2. Palamaner | | K. Kishore Naik, ADS, Palamaner |
| 3. Venkatagiri Kota | | H.HanumanthaNaik, ADS, Kuppam |
| **KARNATAKA** | | |
| **1. Bangalore rural (MC)** | | Prabhakar, DD |
| 1. Andarlahalli | S.B. Kulakarni, Sci-D, RSRS-Kodathi | Anjaneyagowda, DD, Chikballapura |
| 2. Channarayapatna | | T. R. Narendrababu, ADS, Devanhalli |
| 3. Gowribidanur | | Kantharaj, ADS, Gowribidanur |
| 4. Harohalli (B) | | C. L. Sateesha, ADS, Hosakote |
| 5. Tubugere | | Smt. Girijamba, ADS, Doddaballapur |
| **2. Bidar (MC)** | | |
| 1. Aurad | V. NishitaNaik, Sci-D, REC SU-Bidar | B. G. Shelke, Sericulture Inspector, Aurad |
| 2. Gulbarga | | S. Prakash Babu, ADS, Gulbarga |
| 3. Humnabad | | JaganathPalapure, ADS, Humnabad |
| **3. Chitradurga (MC)** | | |
| 1. Challakere | Y. Srinivasulu, Sci-D, REC-Chitradurga | K. Kenchojirao, ADS, Challakere |
| 2. HB Hally | NiranjanMurthy, STA, REC-Chitradurga | Laxman Reddy, SEO, TSC, HB Halli |
| 3. Hiryur | K. B.Shivanna, STA, REC-Chitradurga | C. D. Usha, ADS, Chitradurga |
| 4. Kudiligi | NiranjanMurthy, STA, REC-Chitradurga | Pranesh Rao, ADS, Kudligi |
| **4. Haveri (MC)** | | |
| 1. Davanagere | Y. Srinivasulu, Sci-D, REC-Chitradurga | A. Sreeharsha, ADS, Davanagere |
| 2. Haveri | G. Papaiah, STA, REC-Chitradurga | B. K. Chandrappa, SEO, TSC, Rannebennur |
| 3. Rannebennur | G. Papaiah, STA, REC-Chitradurga | B. K. Chandrappa, SEO, TSC, Rannebennur |
| **5. Jamakhandi (MC)** | | |
| 1. Bijapur | J. Vasanthi, STA, REC-Koppal | B.Y. Biradar, ADS, DoS, Bijapur |
| 2. Jamakhandi | | S.M. Dheshpande, ADS, Jamakhandi |
| 3. Belagavi | A. Umesha, Sci-C, REC-Koppal | G. B. Mallannavara, ADS, Belagavi |
| **6. Kolar (MC)** | | |
| 1. Ithandahalli | J.B. Narendra Kumar, Sci-D, REC-Madivala | Sreenivasa Murthy, ADS, Bangarpet |
| 2. Kurudumalai | | B. C. Venkateshappa, ADS, Mulabagal |
| 3. Shapur (Kolar) | | Manjunath, ADS, Kolar |
| 4. Sidlaghatta | | K. Thimmaraju, ADS, Sidlaghatta |
| 5. Tekal | | Ravichandra, ADS, Malur |
| 6. Yeldur | | Krishnappa, ADS, Srinivasapura |
| **7. Koppal (MC)** | | |
| 1. Yelburga | A. Umesha, Sci-C, REC-Koppal | C. Anjanamurthy, DDS, Kushtagi |
| 2. Shirahatti | | C. H. Mudagal, ADS, Gadag |
| 3. Lingasugur | J. Justin Kumar, STA, REC-Koppal | S. Rajendra Kumar, ADS, Lingasugur |
| **8. Maddur (MC)** | | |
| 1. Bevuru | D. Guruswamy, Sci-D, REC SU-Maddur | K. C. Bheemappa, ADS, Channapattana |

| | | |
|---|---|---|
| 2. Bidarakote | (Up to May 2022)<br>C. Shivkumar, Sci-C, REC SU-Maddur<br>(From Sep. 2022) | H. C. Suresh, ADS, Maddur |
| 3. D Halasahalli | | Swamivivekananda, ADS, Malavalli |
| 4. Gajanuru | | Swamivivekananda, ADS, Malavalli |
| 5. Toresettahalli | | H. C. Suresh, ADS, Maddur |
| **9. Mysuru (MC)** | | |
| 1. Srirangapatna | Mallikarjuna, G, Sci-C, CSRTI-Mysuru | Mahadeva, ADS, Srirangapattana |
| 2. HD Kote | | Manjunatha, ADS, HD Kote |
| 3. KR Nagara | | Sivamoorthy, ADS, KR Nagara |
| 4. T Narsipura | | C. R. Krishna, ADS, T. Narsipura |
| **10. Ramanagara (MC)** | | C.D. Basavaraju, DDS, Ramanagaram |
| 1. Banniguppe | S.B. Kulkarni, Sci-D, RSRS-Kodathi | M.P. Umesh, ADS, Ramangara |
| 2. Kanakapura | | Muthuraj, ADS, Kanakapura |
| 3. Harohalli (KKP) | | |
| 4. Doddalahalli | | |
| **11. Tumakur (MC)** | | Balakrishna, DDS, Tumkur |
| 1. Tumakur | V. Lakshmanan, Sci-D, RSRS-Kodathi | Narsimhaswamy, ADS, Tumkur |
| 2. Sira | | Rajgopal, ADS, Sira |
| 3. Y.N. Hosakote | | Nagaraj, ADS, Pavagada |
| **MAHARASHTRA** | | |
| **1. Aurangabad (MC)** | | |
| 1. Beed | RamprakashSci-D, REC-Aurangabad | VinitPawar, SDO, Beed |
| 2. Jalna | | Ajay P. Mohite, SDO, Jalna |
| **2. Satara (MC)** | | |
| 1. Satara | Y. HumayunSharief, Sci-D, REC-Baramati | Pyaresinh. S. Padvi, SDO, Grade-I, Wai |
| **3.Amravati** | | |
| 1. Akola | R. V. Kushwaha, Sci-D, REC-Amravati | P.B. Narwade , SDO, Akola |
| 2. Buldana | | S. P. Phadke, SDO, Buldana |
| 3. Wardha | | Aadesh S. Waghmare, SDO, Wardha |
| **TAMIL NADU** | | |
| **1. Alangeyam (MC)** | | |
| 1. Alangeyam | S.Kamaraj, Sci-C, RSRS-Salem | A. MeenakshiSundari, AIS, Alangeyam |
| **2. Dindigul (MC)** | | |
| 1. Keeranur | A. MahimaSanthi, Sci-D. REC-S'nallur | S. Mekala, ADS, Dindigul |
| 2. Palani | | |
| 3. Oddanchatiram | | |
| 4. Sanarpatty | | |
| 5. Alangudi | | S. Rengapappa, ADS, Trichy |
| **3. Gobichettipalayam (MC)** | | |
| 1. Gobi | E. Rajalakshmi, Sci-D, REC-G'palayam (UptoFeb. 2023)<br>T. Sivasubramonian, Sci-D, REC-G'palayam (From Mar. 2023) | M. Sangavi, IS, TSC-North Gobi |
| 2. Pitchandampalayam | | Rajeswari, AIS, TSC-Gobi |
| 3. Bhavani | | K. M. Sathya, AIS, TSC-Bhavani |
| 4. Anthiyur | | K. M. Sathya, AIS, TSC-Bhavani |
| 5. Annur | | Chandran, AIS, TSC-Annur |
| 6. Dharapuram | | S. Muneeswaran, AIS, TSC-Dharapuram |
| 7. Manurpalayam | | Mythili, AIS, TSC-Dharapuram |
| **4. Krishnagiri (MC)** | | |
| 1. Bagalur | K. Jhansilakshmi, Sci-D, REC-Krishnagairi | S. Hemanandini, AIS, TSC, Bagalur |
| 2. Kodiyalam | | S. Hemanandini, AIS, TSC, Bagalur |
| 3. Berigai | | Karpagam AIS, TSC, Berigai |
| 4. Krishnagiri | | R. Ashok, ADS, Krishnagiri |
| 5. Dharmapuri | | Leela Devi TA, ADS, Dharmapuri |
| **5. Tenkasi (MC)** | | |
| 1. Srivilliputtur | A. MahimaSanthi, Sci-D. REC-S'nallur | K. Nishanthi, ADS, Melagaram |

| | | |
|---|---|---|
| 2. Adaikalapattinam | | K. Nishanthi, ADS, Melagaram |
| **6. Udumalpet (MC)** | | |
| 1. Udumalpet | P. Samuthiravelu, Sci-D, REC-Udumalpet | P. Karthika, AIS, TSC-Udumalpet |
| 2. Gudimangalam | | P. Geethapriya, AIS, TSC-Gudimangalam |
| 3. Pollachi | | R. Shobana, AIS, TSC-Pollachi |
| 4. Pongalur | | R.Ramesh, AIS, TSC-Pongalur |
| **TELANGANA** | | |
| **1. Karimnagar (MC)** | | |
| 1. Karimnagar | K. Praveen Kumar, Sci-D, RSRS-Mulugu (Upto Nov. 22)<br>Vinod Kumar Yadav, Sci-C, RSRS-Mulugu<br>N. K. Tuyamani, STA, RSRS-Mulugu | Muralidhar Reddy, DDS-Warangal<br>Yethinder, ADS, Karimnagar<br>Anasuya, DDS-Khammam |
| **2. Siddipet (MC)** | | |
| 1. Siddipet | K. Praveen Kumar, Sci-D, RSRS-Mulugu (Up to Nov. 22)<br>Vinod Kumar Yadav, Sci-C, RSRS-Mulugu | Indrasena Reddy, ADS-Siddipet<br>Venkateswarlu, SO-Janagoan<br>K. Laxmaiah, ADS-Nalgonda<br>Veera Kumar, ADS-Suryapet |

Table 18.5: Particulars of CPP CDFs of NonCaptive Clusters for the year 2022-23

| Clusters | CSB | DoS |
|---|---|---|
| | **MADHYA PRADESH** | |
| 1. Hosahangabad | A. G. K. Daniel, Scit-D, REC-Hoshangabad | Lal Singh Narganwa, Field Officer<br>NavneetGour, Jr Seri. Insp., H'gabad<br>JagdishVishwakarma, FO, Hoshangabad |
| 2. Betul | | |
| | **TELANGANA** | |
| 3. Zaheerabad | S. Rajadurai, Sci-D, REC-Vikarabad | Vijayakumar, SO, DHSO, Sanga Reddy Dist |

### Cluster Performance over the Years

During this year, south zone clusters recorded 6166.37 MT of bivoltine raw silk production (102.89%) against the target of 5993.14 MT. Raw silk produced in the clusters from 2013 to 2023 is presented in Table 18.6 and state wise bivoltine raw silk production for the year 2022-23 is presented in Table 18.7.

Table 18.6: Raw Silk Production in south zone clusters - 2013 to 2023

| Year | Target (MT) | Production (MT) | Achv. (%) |
|---|---|---|---|
| 2013-14 | 1400.00 | 1420.90 | 101.49 |
| 2014-15 | 1944.00 | 2241.15 | 115.29 |
| 2015-16 | 2491.50 | 2772.09 | 111.26 |
| 2016-17 | 3100.00 | 3786.27 | 122.14 |
| 2017-18 | 3800.00 | 3905.35 | 102.77 |
| 2018-19 | 4560.00 | 4781.21 | 104.85 |
| 2019-20 | 5300.29 | 5054.50 | 95.36 |
| 2020-21 | 5819.94 | 5006.60 | 86.02 |
| 2021-22 | 5777.54 | 5832.82 | 100.96 |
| 2022-23 | 5993.14 | 6166.37 | 102.89 |
| Total | 40186.41 | 40967.26 | 101.94 |

Table 18.7: State wise bivoltine raw silk production for 2022-23

| State | Raw Silk | | |
|---|---|---|---|
| | Target (MT) | Est. Production (MT) | Achievement (%) |
| 1. Andhra Pradesh | 1507.74 | 1811.72 | 120.16 |
| 2. Karnataka | 2327.23 | 2037.29 | 87.54 |
| 3. Maharashtra | 251.46 | 332.51 | 132.23 |
| 4. Tamil Nadu | 1607.31 | 1693.20 | 105.34 |
| 5. Telangana | 142.15 | 165.06 | 116.12 |
| 6. Non-captive | 157.25 | 126.59 | 80.50 |
| Total/Avg. | 5993.14 | 6166.37 | 102.89 |

**Crop Performance**

A total of 522 lakh dfls were distributed to the farmers, against the target of 544 lakh, achieving 96% of the target. A total of 40081.40 MT bivoltine cocoons were produced with an average cocoon yield of 77.88 kg/100 dfls. Maharashtra mega clusters have a remarkable achievement of 123.59%dfls target. The state wise performance is presented in Table 18.8.

Table 18.8: State wise performance as per dfls targets and achievements for the year 2022-23

| State | Dfls target (lakh) | No. of crops | Dfls brushed (lakh) | Achievement (%) | Yield/100 dfls (kg) |
|---|---|---|---|---|---|
| 1. Andhra Pradesh | 140 | 66204 | 152 | 108 | 78.55 |
| 2. Karnataka | 215 | 103859 | 181 | 84 | 73.76 |
| 3. Maharashtra | 23 | 11072 | 29 | 123 | 80.01 |
| 4. Tamil Nadu | 139 | 68809 | 135 | 97 | 81.85 |
| 5. Telangana | 13 | 5622 | 14 | 107 | 85.54 |
| 6. Non-captive | 13 | 5915 | 11 | 86 | 73.69 |
| Total/Avg. | 544 | 261481 | 522 | 96 | 77.88 |

Table 18.9: Average cocoon yield/100 dfls (kg) in captive and Non-Captive (N-C) clusters

| # | State | XI Plan | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 2017-18 | 2018-19 | 2019-20 | 2020-21 | 2021-22 | 2022-23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | AP | 61.56 | 66.69 | 66.68 | 69.93 | 70.68 | 73.47 | 76.38 | 75.46 | 74.76 | 76.70 | 78.6 |
| 2 | KA | 62.73 | 65.83 | 65.23 | 66.74 | 67.49 | 67.62 | 66.05 | 66.37 | 68.68 | 71.83 | 73.8 |
| 3 | KL | - | 76.45 | 75.88 | 75.69 | 81.68 | 84.05 | 86.13 | - | - | - | - |
| 4 | MP | - | 52.93 | 53.93 | 47.66 | 49.12 | 51.68 | 46.08 | - | - | - | - |
| 5 | MH | 60.73 | 63.26 | 63.49 | 62.51 | 65.47 | 66.07 | 66.45 | 71.08 | 78.44 | 83.01 | 80.0 |
| 6 | TN | 71.13 | 74.46 | 75.54 | 77.86 | 78.33 | 80.32 | 79.59 | 79.78 | 80.94 | 81.89 | 81.9 |
| 7 | TS | - | - | 65.08 | 66.11 | 70.62 | 70.89 | 68.08 | 67.35 | 71.65 | 79.97 | 85.5 |
| 8 | N-C | - | - | - | - | - | - | - | 68.79 | 66.32 | 70.42 | 73.7 |
| Average | | 64.98 | 68.45 | 68.27 | 70.16 | 71.33 | 72.15 | 71.79 | 72.62 | 73.83 | 77.30 | 77.9 |

Table 18.10: Cluster Performance of Andhra Pradesh for the year 2022-23

| Mega cluster | Dfls target | Dfls distri-buted | Achieve-ment (%) | No. of crops | Dfls harvested | Cocoon yield (kg) | Yield/ 100 dfls (kg) | Rate/ kg (Rs.) |
|---|---|---|---|---|---|---|---|---|
| 1. Atmakur | 1560000 | 1340800 | 85.95 | 6672 | 1328400 | 954076.10 | 71.16 | 555.00 |
| 2. Chebrolu | 1390000 | 1128450 | 81.18 | 4006 | 1184350 | 894086.00 | 79.23 | 511.00 |
| 3. Hindupur | 3710000 | 4104250 | 110.63 | 17236 | 4059050 | 3088238.80 | 75.24 | 643.00 |
| 4. K'durgam | 1870000 | 2080800 | 111.27 | 9327 | 2025300 | 1534885.00 | 73.76 | 616.00 |
| 5. Palamaner | 5470000 | 6530588 | 119.39 | 28963 | 6394105 | 5304923.00 | 81.23 | 581.00 |
| Total/Avg. | 14000000 | 15184888 | 108.44 | 66204 | 14991205 | 11776208.90 | 77.55 | 581.00 |

Table 18.11: Cluster Performance of Karnataka for the year 2022-23

| Mega cluster | Dfls target | Dfls distri-buted | Achieve-ment (%) | No. of crops | Dfls harvested | Cocoon yield (kg) | Yield/ 100 dfls (kg) | Rate/ kg (Rs.) |
|---|---|---|---|---|---|---|---|---|
| 1. B'lore Rural | 1180115 | 820789 | 69.55 | 5659 | 818198 | 557204 | 67.89 | 631.00 |
| 2. Bidar | 1000000 | 696152 | 69.62 | 3717 | 680662 | 485322 | 69.71 | 526.00 |
| 3. Ch'durga | 3505000 | 2960759 | 84.47 | 11801 | 2970502 | 2265951 | 76.53 | 660.00 |
| 4. Haveri | 2505000 | 2318297 | 92.55 | 11065 | 2319052 | 1786852 | 77.08 | 528.00 |
| 5. Jamkandi | 1960000 | 1393810 | 71.11 | 9702 | 1368637 | 1009643 | 72.44 | 595.00 |
| 6. Kolar | 2939390 | 2198465 | 74.79 | 11402 | 2128817 | 1440753 | 65.53 | 579.00 |
| 7. Koppal | 1325000 | 1138666 | 85.94 | 6488 | 1129346 | 815622 | 71.63 | 585.00 |
| 8. Maddur | 1335000 | 1250465 | 93.67 | 10254 | 1257059 | 957622 | 76.58 | 614.00 |
| 9. Mysuru | 1221600 | 1550130 | 126.89 | 8427 | 1524074 | 1153777 | 74.43 | 522.00 |
| 10. Ra'nagara | 1349600 | 1322581 | 98.00 | 13446 | 1316261 | 1022364 | 77.30 | 648.00 |
| 11. Tumkur | 3133000 | 2464871 | 78.67 | 11898 | 2441387 | 1747270 | 70.89 | 614.00 |
| Total/Avg. | 21453705 | 18114985 | 84.44 | 103859 | 17953995 | 13242378 | 73.10 | 591.00 |

Table 18.12: Cluster Performance of Maharashtra for the year 2022-23

| Mega cluster | Dfls target | Dfls distri-buted | Achieve-ment (%) | No. of crops | Dfls harvested | Cocoon yield (kg) | Yield/ 100 dfls (kg) | Rate/ kg (Rs.) |
|---|---|---|---|---|---|---|---|---|
| 1. Aurangabad | 1735000 | 2220000 | 127.95 | 7983 | 2057600 | 1667289 | 75.10 | 640.00 |
| 2. Satara | 600000 | 642050 | 107.01 | 3089 | 643800 | 493999 | 76.94 | 584.00 |
| Total/Avg. | 2335000 | 2862050 | 122.57 | 11072 | 2701400 | 2161288 | 75.52 | 612.00 |

Table 18.13: Cluster Performance of Tamil Nadu for the year 2022-23

| Mega cluster | Dfls target | Dfls distri-buted | Achieve-ment (%) | No. of crops | Dfls harvested | Cocoon yield (kg) | Yield/ 100 dfls (kg) | Rate/ kg (Rs.) |
|---|---|---|---|---|---|---|---|---|
| 1. Alangayam | 1060000 | 1155740 | 109.03 | 7254 | 1155715 | 910306 | 78.76 | 640.00 |
| 2. Dindigul | 2230000 | 2355549 | 105.63 | 11430 | 2351553 | 1966881 | 83.50 | 591.00 |
| 3. Gobi | 3280000 | 3175007 | 96.80 | 18824 | 3160271 | 2572352 | 81.02 | 594.00 |
| 4. Krishnagiri | 3025000 | 3053142 | 100.93 | 16797 | 3025415 | 2498693 | 81.84 | 575.00 |
| 5. Tenkasi | 1035000 | 1063980 | 102.80 | 6339 | 1054530 | 853806 | 80.25 | 584.00 |
| 6. Udumalpet | 3300000 | 2648125 | 80.25 | 8165 | 2698380 | 2203789 | 83.22 | 640.00 |
| Total/Avg. | 13930000 | 13451543 | 96.57 | 68809 | 13445864 | 11005827 | 81.82 | 604.00 |

Table 18.14: Cluster Performance of Telangana for the year 2022-23

| Mega cluster | Dfls target | Dfls distri-buted | Achieve-ment (%) | No. of crops | Dfls harvested | Cocoon yield (kg) | Yield/ 100 dfls (kg) | Rate/ kg (Rs.) |
|---|---|---|---|---|---|---|---|---|
| 1. Karimnagar | 660000 | 700135 | 106.08 | 2812 | 624077 | 532547 | 76.06 | 596.00 |
| 2. Siddipet | 660000 | 707812 | 107.24 | 2810 | 630223 | 540346 | 76.34 | 601.00 |
| Total/Avg. | 1320000 | 1407947 | 106.66 | 5622 | 1254300 | 1072893 | 76.20 | 598.00 |

Table 18.15: Performance of Non-captive clusters for the year 2022-23

| Cluster | Dfls target | Dfls distri-buted | Achieve-ment (%) | No. of crops | Dfls harvested | Cocoon yield (kg) | Yield/ 100 dfls (kg) | Rate/ kg (Rs.) |
|---|---|---|---|---|---|---|---|---|
| Hoshangabad[1] | 115000 | 104250 | 90.65 | 598 | 98250 | 52384 | 50.25 | 319.00 |
| Akola, Buldana, Wardha[2] | 500000 | 413500 | 82.70 | 2249 | 397250 | 288529 | 69.78 | 527.00 |
| Nanded[2] | 300000 | 198750 | 66.25 | 949 | 197850 | 143233 | 72.07 | 547.00 |
| Zaheerabad[3] | 400000 | 420050 | 105.01 | 2119 | 423200 | 338667 | 80.63 | 698.00 |
| Total/Avg. | 1315000 | 1136550 | 86.43 | 5915 | 1116550 | 822813 | 72.40 | 523.00 |

[1]Madhya Pradesh; [2]Maharashtra; [3]Telangana

**Mulberry plantation**

In order to increase the silk production in the clusters, 15968 farmers were motivated to plant improved mulberry varieties to the extent of 21661 acres in the 26 mega clusters along with non-captive areas. The Plantation details are presented in Table 18.16.

Table 18.16: Mulberry plantation in clusters for the year 2022-23

| State | New plantation | |
|---|---|---|
| | No. of Farmers | Area (acres) |
| 1. Andhra Pradesh | 3523 | 5299 |
| 2. Karnataka | 9213 | 10978 |
| 3. Maharashtra | 1708 | 3109 |
| 4. Tamil Nadu | 538 | 595 |
| 5. Telangana | 432 | 1031 |
| 6. Non-Captive | 554 | 649 |
| Total | 15968 | 21661 |

**Extension Communication programmes (ECP)**

In order to transfer the technologies to the field and make farmers aware of new sericulture technologies, various extension communication programmes, such as farmers field days, awareness programmes, technology demonstrations, enlightenment programmes, farmers sericulture workshops, seminars and workshops, Reshme Krishimela, and exhibitions, were organised by the institute and nested units. During 2022-23 a total of 283 extension communication programmes were conducted and sensitised 23683 farmers. The farmers were sensitised on mulberry cultivation practices, silkworm rearing techniques, mites and thrips management, advantages of wider spacing in mulberry cultivation, technologies for tree mulberry cultivation, management of leaf roller and its control measures, awareness on the use of *Rot fix*, soil testing and its importance in mulberry cultivation, integrated pest and disease management practices, disinfection and hygiene in silkworm rearing, popularisation of new silkworm hybrids, demonstration of rotary mountages, mounting and spinning care, *etc*.

Table 18.17: Extension Communication Programmes conducted

| Programmes | Target | | Achievement | |
|---|---|---|---|---|
| | Physical (No.) | Beneficiaries (No.) | Physical (No.) | Beneficiaries (No.) |
| 1.*ReshmeKrishimela* cum Exhibition | 4 | 1400 | 4 | 2145 |
| 2. Farmers Field day | 30 | 3000 | 27 | 2804 |
| 3. Awareness programme | 82 | 8200 | 87 | 7562 |
| 4. Technology demonstration / Enlightenment programmes | 82 | 1640 | 96 | 2603 |
| 5. Workshop, Seminars & Conferences | 1 | 100 | 1 | 100 |
| 6. Technical Workshop for CRCs | 10 | 200 | 9 | 1100 |
| 7. Other activities | 0 | 0 | 59 | 7369 |
| Total | 209 | 14540 | 283 | 23683 |

***Resham Krishimela***

*Reshmam Krishimela* cum farmers' workshops in coordination with Department of Sericulture covering 2145 farmers was conducted during 2022-23.

Table 18.18: Details of ReshmeKrishiMelas conducted

| Name of the centre | Date | Venue | No. of participants |
|---|---|---|---|
| CSRTI-Mysuru | 03.03.2023 | Mandya, Karnataka | 750 |
| RSRS-Ananthapur | 17.02.2023 | Hindupur, Puttaparthy district, Andhra Pradesh | 550 |
| RSRS-Mulugu | 24.03.2023 | Jangaondistrict, Telangana | 535 |
| RSRS-Salem | 21.03.2023 | Shoolagiri, Hosur, Tamil Nadu | 310 |

**Workshop**

Scientific workshop on **Mulberry and Silkworm pest and disease management with changing climatic conditions,** was held on 15thDecember 2022 at CSRTI-Mysuru with an aim of exchanging ideas on management of pests and diseases and in mulberry and silkworms with scientific communities belonging to CSB, DoS and other research institutes. The workshop was attended by experts from various fields, scientists of CSRTI-Mysuru, Central Office, Bengaluru and nested units of CSRTI-Mysuru. DoS officials and State Sericulture Research Institutes also participated in the workshop. Four research papers covering latest scientific technologies useful for extension officers were presented.

**Social media as an Extension Communication Tool**

A total of 429 messages related to Research projects, Cluster promotion programmes and extension programmes of CSRTI-Mysuru and nested units were uploaded in social media platforms like Facebook, Twitter and Instagram, apart from Whats App messages. The digital media is a fast and effective communication platform for easy and quick transmission of messages to the target group.

**Visitors' Service**

A total of 4824 personnel including farmers, students, entrepreneurs, foreign delegates and departmental staff visited the Institute. Need based services were rendered to the farmers during their visit. They were sensitized on various aspects of sericulture. Students of varied disciplines *viz*., Agriculture, Life sciences, Textiles, Horticulture, Biotechnology, *etc*., were explained about the activities of Institute and also

on entrepreneurship opportunities in Sericulture. Women farmers were encouraged to take up sericulture for their livelihood by highlighting the importance of skill required for sericulture activities to enhance income from sericulture.

| Category | Visitors (No.) |
|---|---|
| Farmers | 1147 |
| Students | 3330 |
| Foreigners | 57 |
| Others | 290 |
| Total | 4824 |

# 19. REGIONAL SERICULTURAL RESEARCH STATION (RSRS) - ANANTAPUR

| | |
|---|---|
| In-Charge officer | P. Sudhakar (upto 31.07.22)<br>K. P. Kiran Kumar (from 01.08.22 to 12.03.23)<br>B. Srinath (from 13.03.23) |
| Scientists | 07 |
| Technical staff | 11 |
| Administrative & Supporting staff | 05 |

| Units | Total area (acres) | Mulberry acreage |
|---|---|---|
| RSRS-Anantapur | 40.73 | 4.00 |
| REC-Rayachoti | 5.00 | 2.50 |
| RECSU-Bidar (KA) | 11.33 | 4.00 |

## Collaborative Research Projects/Programmes

RSRS Ananthapur and its nested units are involved in the following collaborative projects with the main institute.

| Project/Programme | Unit |
|---|---|
| PIB 3632: Evaluation of superior triploid genotypes for yield and adaptability under varied agro-climatic conditions (Mar. 2018-Feb. 2024) | RSRS-Ananathpur |
| PIE 13001 MI (AICEM Phase-IV): All India Coordinated Experimental Trial in Mulberry Phase-IV (Apr.2019-Mar. 2025) | RSRS-Ananathpur & REC-Rayachoti |
| AIB 01009 MI: Evaluation of new bivoltine silkworm hybrid TT21 x TT56 at farmers level for authorization and commercial exploitation (Apr. 20-Mar. 24) | RSRS-Ananathpur |
| MOE 01021 SI: Evaluation of improved technologies of mulberry sericulture in South India<br>Component 3: Evaluation of productive double hybrid DHP5 at farmers' level (Apr. 2021-Mar. 2023)<br>Component 7: Evaluation of robust bivoltine silkworm hybrids suitable for different regions of high temperature and high humidity conditions (Apr. 2021-Mar. 2023) | RSRS-Ananathpur |
| AIT 08005 MI: Development and Evaluation of Bidensovirus resistant silkworm hybrids developed from marker assisted breeding lines Phase-II. (Mar. 2020-Feb. 2023) | RSRS-Ananathpur |

## Continuous/Other activities

### Cluster Promotion Programme (CPP)

Bivoltine sericulture technologies were disseminated in 13 clusters in Andhra Pradesh. 151.845 lakh bivoltine hybrid dfls were reared with an achievement of 108.46% against the target of 140.00 lakh dfls and a cocoon yield of 78.55 kg/100 dfls. The raw silk production achievement was 1811.72 MT against the target of 1507.69 MT, with an achievement percent of 120.17%.

### Extension communication programmes (ECPs)

Workshops, Group discussions, Awareness programmes, Field Days, Farmer days and Exposure visits were conducted by RSRS-Anantapur and its nested units for the transfer of technologies developed by the main institute.

Table 19.1: Extension communication programmes conducted by RSRS Ananthapur and nested units

| Centre | Technology Demonstrtion | | Awareness Programmes | | Field Day | | Work Shop | | Reshme Krishimela | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Prog. (No) | Far. (No) | Prog. (No) | Far. (No) | Prog. (No) | Far. (No) | Prog. (No) | Far. (No) | Prog. (No) | Far. (No) |
| RSRS-Anantapur | 2 | 51 | 8 | 800 | 2 | 238 | 1 | 121 | 1 | 550 |
| REC-V.Kota | 4 | 187 | 3 | 260 | 2 | 229 | - | - | - | - |
| REC-Eluru | 4 | 117 | 2 | 171 | - | - | 1 | 125 | - | - |
| REC-Rayachoty | 5 | 162 | 2 | 141 | 2 | 182 | - | - | - | - |
| REC-SU Bidar | 4 | 123 | 2 | 127 | - | - | - | - | - | - |
| Total | 19 | 640 | 17 | 1499 | 6 | 649 | 2 | 246 | 1 | 550 |

Prog.: Programme; Far.: Farmer

### Resham Krishimela/Farmers' workshop

One *Reshme Krishimela* was organized at Hindupur on 27th March, 2023. The programme was inaugurated and initiated with the introduction speech by Smt. C. Aruna Kumari, Additional Director. During her speech she emphasized on the benefits of Bivoltine sericulture adoption and the farmers encouraging and financially supporting schemes involved to the Bivoltine rearers for their benefit and socio economic up-liftment. Dr. K. P. Kiran Kumar has given Inaugural Address regarding workshop. In the technical session, presentations were made on Disease and Pest management of Mulberry and silkworm, Soil Health Management and Packages of practices in Mulberry Cultivation, Eco-friendly management of mulberry pests through bio-control agents, Chawki and late age silkworm rearing and role of ecological factors and Overall management of sericulture.

Table 19.2: Farmers Skill Training (FST) Programme (3 days)

| Unit | No. of programmes | No. of benificiaries |
|---|---|---|
| RSRS-Anantapur | 4 | 120 |
| REC-V.Kota | 3 | 65 |
| REC-Rayachoty | 2 | 50 |
| REC SU-Bidar (KA) | 1 | 20 |
| Total | 10 | 255 |

# 20. REGIONAL SERICULTURAL RESEARCH STATION (RSRS) CHAMARAJANAGARA

| | |
|---|---|
| In-Charge officer | T. Sivasubramonian [Upto 28.02.23] |
| Scientists | 01 |
| Technical staff | 01 |

| Units | Total area (acres) | Mulberry acreage |
|---|---|---|
| RSRS- Chamarajanagara | 14.02 | 7.80 |

**Collaborative Research Projects/Programmes**

| Project/Programme | Unit |
|---|---|
| MOE 01021 SI: Evaluation and popularization of improved technologies developed in the field of mulberry sector for South India<br>Component 9: Impact of drip fertigation on mulberry productivity (Nov. 2021-Oct. 2023) | RSRS-Chamarajanagar |
| MOE 01021 SI: Popularization of improved breeds and technologies for Southern India (on farm/on station trials of CSRTI-Mysuru)<br>Component 3: Evaluation of productive double hybrid, DHP5 at farmers' level (Apr. 2021 – Mar. 2023) | RSRS-Chamarajanagar |
| AIT 08005 MI: Development and Evaluation of Bidensovirus resistant silkworm hybrids developed from marker assisted breeding lines - Phase II [in collaboration with SBRL- Bengaluru] (Mar. 2020 - Feb. 2023) | RSRS-Chamarajanagar |

**MOE 01021 SI: Impact of drip fertigation on mulberry productivity [Component 9]:** The third crop leaf harvest data revealed that the plants with drip fertigation treatment recorded a leaf yield of 2.82 kgs per plant whereas, conventional practice recorded a leaf yield of only 1.87 kgs per plant. This result indicated that the drip fertigation improved leaf yield by 54% in comparison to conventional practice.

**MOE 01021 SI: Evaluation of productive double hybrid, DHP5 at farmers' level:** 25 dfls each S8 x D2 and CSR16 x CSR51 was reared and supplied 14 kg cocoons of each FC to CSRTI, Mysuru. Eggs per kg of cocoons for DHP5 was 56.98 g and for DHP5R it was 63.5 g.

**AIT 08005 MI: Development and Evaluation of Bidensovirus resistant silkworm hybrids developed from marker assisted breeding lines:** The third OST rearing was carried out for the BmBDV resistant double hybrid FC1R x FC2R along with control FC1 x FC2. Hatching percentage of 92.9% was recorded in control and 92.4 % in test hybrid. 10 dfls of each hybrids were reared and the cocoons were supplied to CSRTI, Mysuru.

**Mulberry garden maintenance:** With 8 acres of allotted mulberry plot, 4 acres of mulberry garden is actively maintained. Totally 12 varieties of mulberry germplasm is also maintained.

**Extension activities:** Two trainings farmers training programmes were conducted for 42 farmers in two batches. One awareness program for 137 farmers in two batches, and one demonstration program for 16 farmers were also organised.

**Collaboration with KVK Chamarajanagara:** Large scale production of *Trichoderma viride* and *T. harzinium* for controlling root rot and *Psuedomonas fluorescence* for controlling root knot were discussed. Further

discussions were held with Dr. S. V. Suresha, Vice Chancellor, GKVK, UAS, Dr. Doraiswamy, Officer-in-charge and Dr. Yogesh, Head, KVK, Chamarajanagara at KVK campus on future collaboration and transfer of technologies to the sericulture farmers under the jurisdiction of RSRS Chamarajanagara.

# 21. REGIONAL SERICULTURAL RESEARCH STATION (RSRS) – KODATHI

| | |
|---|---|
| In-Charge officer | S.B. Kulkarni, Sci-D (till 12.06.22)<br>V. Lakshmanan, Sci-D (from 13.06.22) |
| Scientists | 03 |
| Technical staff | 03 |

| Units | Total area (aces) | Mulberry acreage |
|---|---|---|
| RSRS-Kodathi | 66.91 | 11.00 |
| REC-Chitradurga | 7.00 | 2.41 |
| REC-Madivala | 8.00 | 3.50 |
| REC-Koppal | 8.00 | 1.50 |

**Collaborative Research Projects/Programmes**

| Project/Programme | Unit |
|---|---|
| PIB 3632: Evaluation of superior triploid genotypes for yield and adaptability under varied agro-climatic conditions (Mar. 2018-Feb. 2024) | RSRS-Kodathi |
| PIE 13001 MI (AICEM Phase-IV): All India Coordinated Experimental Trial in Mulberry Phase-IV (Apr. 2019-Mar. 2025) | RSRS-Kodathi & REC-Madivala |
| MOE 01021 SI: Evaluation and popularization of improved technologies developed in the field of mulberry sector for South India<br>Component 9: Impact of drip fertigation on mulberry productivity (Nov. 2021-Oct. 2023) | RSRS-Kodathi |
| PPA 01016 SI: Development of an agronomical package for tree mulberry cultivation for wide acceptance among the seri-farmers of Southern India (Nov. 2020 - Feb. 2023) | REC-Madivala |

**On-Station Trials (OSTs)**

**Evaluation of new Cross-Breed Double Hybrids developed through the project AIB 01011 SI: Development of multivoltine foundation crosses for productivity and high silk percentage:**

V. Lakshmanan

Trial-I: Seven new double hybrids and one control hybrid received from MBL, CSRTI-Mysuru were evaluated during Sep.-Oct, 2022. Rearing and cocoon parameters were recorded as per standard format and submitted to the CSRTI-Mysuru. Survival in the new hybrids was higher (>5%) than in the control. Evaluation index on rearing and cocoon parameters indicates that (Table 21.1) CB-DH-04, CB-DH-02, CB-DH-07, CB-DH-05 could be considered for further studies.

Trial-II: Five short-listed double hybrids and two control hybrids received from CSRTI-Mysuru were evaluated during Dec. 2022-Jan. 2023. Survival in all the new hybrids was higher (>4 to 5%) than control-1, except CB-DH-06. Quantitative traits were also higher in the new hybrids. Compared to Control-2, only CB-DH-04 performed better in both rearing and cocoon parameters.

Table 21.1: Performance of short-listed new Cross-Breed double hybrids

| Hybrid | Fec. | ERR (No) | ERR (Wt. kg) | SCW | SSW | Shell (%) |
|---|---|---|---|---|---|---|
| CB-DH-01 | 499 | 9028 | 14.260 | 1.595 | 0.293 | 18.36 |
| CB-DH-02 | 541 | 8763 | 14.690 | 1.709 | 0.315 | 18.43 |
| CB-DH-03 | 566 | 9256 | 14.594 | 1.595 | 0.294 | 18.43 |
| CB-DH-04 | 565 | 9093 | 15.562 | 1.775 | 0.343 | 19.32 |
| CB-DH-06 | 543 | 8032 | 12.870 | 1.646 | 0.304 | 18.46 |
| Control-1 | 424 | 8612 | 13.469 | 1.601 | 0.283 | 17.67 |
| Control-2 | 436 | 8969 | 15.606 | 1.771 | 0.335 | 18.91 |
| Mean | 510 | 8847 | 14.478 | 1.670 | 0.310 | 18.56 |
| CV (%) | 11.66 | 4.61 | 6.99 | 4.85 | 7.27 | 2.75 |
| CD 5% | 54 | 376 | 0.94 | 0.07 | 0.02 | 0.47 |

**OST-II: Evaluation of Bi-densovirus resistant hybrid developed through the project AIT 08005 MI (Collaborative project of SBRL & CSRTI, Mysuru)**

V. Lakshmanan

Three trials were conducted during the autumn, winter, and summer seasons. The new hybrid FC1R x FC2R has performed marginally better in survival (3 to 8% more) during the autumn and winter seasons, while survival was on par (81%) during the summer season compared to the control hybrid FC1 x FC2. The mean data for all three seasons indicated that there is no significant difference between the hybrids (Table 21.2).

Table 21.2: Performance of new Bi-denso-virus resistant hybrids (Mean of three trials)

| Hybrid | ERR ( No) | ERR wt (kgs) | SCW (g) | SSW (g) | Shell (%) |
|---|---|---|---|---|---|
| FC1R x FC2R | 8674 | 14.525 | 1.758 | 0.338 | 19.24 |
| FC1 x FC2 | 8368 | 14.216 | 1.735 | 0.340 | 19.48 |
| Sig. | NS | NS | NS | NS | NS |

**Evaluation and Multiplication of new Breed, MV1**

V. Lakshmanan

As a supporting programme to breeding labs of CSRTI-Mysuru, new breeds *viz*., MV1 was reared in three experimental batches and S8 in one experimental rearing. A quantity of 11.100 kgs of MV1 cocoons and 15.100 kgs of S8 cocoons generated were handed over to SWBL, CSRTI-Mysuru for further utilisation.

Table 21.3: Performance of new breeds, MV1 and S8

| Breed | ERR (No) | ERR (kg) | SCW (g) | SSW (g) | Shell (%) |
|---|---|---|---|---|---|
| MV1* | 9295 | 11.842 | 1.272 | 0.204 | 16.03 |
| S8 | 8533 | 14.260 | 1.380 | 0.330 | 23.91 |

*Mean of three batches

## Other activities

**Evaluation of fruit yielding mulberry accessions and establishment of demo plot at RSRS Kodathi (Collaborative project with CSGRC-Hosur)**

S. B. Kulkarni (up to Feb. 2023), N. Balachandran (from Mar. 2023), G. Thanavendan (CSGRC-Hosur)

As a part of the proposed project on evaluation of fruit yielding mulberry accessions by CSGRC-Hosur, a demo plot was established at RSRS-Kodathi in 2.5 acres in Oct. 2022. Seven shortlisted fruit yielding mulberry accessions supplied by CSGRC-Hosur was planted. The accessions include four species *viz.*, *Morus indica* (1), *M. latifolia* (1), *M. Cathayana* (1) *and M laevigata* (4). Of these two are exotic and five are indigenous accessions. The accessions are planted at a wider spacing of 12' x 12', which are maintained as tree.

| # | Acc. No. | Name of the accession |
|---|---|---|
| 1 | MI-0380 | Saraswathi tea estate |
| 2 | ME-0018 | Indonesia-1 |
| 3 | MI-0427 | Moulvaiphei |
| 4 | ME-0253 | Paraguay-1 |
| 5 | MI-0486 | Maranahalli-1 |
| 6 | MI-0572 | Gurugoan local-1 |
| 7 | MI-0776 | Jamwadi |

**Cluster Promotion Programme**

Bivoltine sericulture technologies were disseminated in 9 mega clusters. A total of 184.24 lakh dfls were distributed and harvested cocoons at average of 72.62 kg/100 dfls.

**Extension Communication Programmes**

Against the target of thirty-six events comprising Field Day, Awareness programme, Technology Demonstration and Workshops assigned to RSRS, Kodathi and its three RECs, a total of 42 such events were conducted and sensitised the farmers on Sericulture technologies for successful harvest of cocoon crops during the year, 2022-2023.

Two workshops, one at Chitradurga and the other one at Kodathi campus was conducted during the year, which had evoked very good response, wherein the DoS field functionaries were the main beneficiary groups. Various issues pertaining to bivoltine sericulture encountered by farmers as well as field functionaries were discussed.

Table 21.4: Extension Communication Programmes under RSRS and nested units

| # | Programme | Target (No. of events) | Programmes conducted | farmers sensitised | Expenditure (Rs.) |
|---|---|---|---|---|---|
| 1 | Farmers Field Day | 6 | 6 | 592 | 82,500 |
| 2 | Awareness Prog | 14 | 14 | 1538 | 140,000 |
| 3 | Tech. Demon./Enlightenment | 14 | 16 | 342 | 14,000 |
| 5 | Workshops | 2 | 2 | 255 | 1,00,000 |
| 6 | Other programmes/ activities | - | 4 | 206 | - |
| | Total | 36 | 42 | 2933 | 3,36,500 |

**Training programmes**

Two Seri-Resource Centres functioning under RSRS, Kodathi, one at BS Doddi, Kanakapura and another at BG Kere, Chitradurga had imparted training to 150 seri-farmers each as per the target assigned and sensitised the farmers on various technical know-hows.

A total of 100 farmers were training under Farmers Skill Training programme. Training kit comprising Technology books, secatures and other seri-implements were distributed to the beneficiaries. Also, a study tour was undertaken to visit progressive sericulture farmers so as to encourage farmer to farmer exchange of knowledge and sharing their experiences.

Table 21.5: Sericulture Resource Centres (SRC)

| Unit | SRC | Annual Target | | Achievement | |
|---|---|---|---|---|---|
| | | Physical | Financial | Physical | Financial |
| RSRS-Kodathi | B. S. Doddi, Kanakapura | 150 | 63,750 | 150 | 63,750 |
| REC-Chitradurga | B. G. Kere | 150 | 63,750 | 150 | 63,750 |
| Total | | 300 | 1,27,500 | 300 | 1,13,050 |

Table 21.6: Farmers Skill Training (FST)

| Unit | Target | | Achievement | |
|---|---|---|---|---|
| | No. of farmers | Amount (Rs.) | No. of farmers | Amount (Rs.) |
| RSRS-Kodathi | 25 | 93,750 | 25 | 93,750 |
| REC-Chitradurga | 25 | 93,750 | 25 | 93,750 |
| REC-Madiwala | 25 | 93,750 | 25 | 93,750 |
| REC-Koppal | 25 | 93,750 | 25 | 93,750 |
| Total | 100 | 3,75,000 | 100 | 3,75,000 |

**Revenue Generation**

Table 21.7: Revenue generation

| Particulars | RSRS Kodathi | REC Chitradurga | REC Madivala | REC Koppal | Total |
|---|---|---|---|---|---|
| Sale of mulberry leaf | 3015 | 5000 | 6789 | - | 14804 |
| Sale of dried branches | 500 | - | - | - | 500 |
| Sale of cocoons | 16903 | - | - | 13447 | 30350 |
| Sale of saplings | - | - | 2980 | 5200 | 8180 |
| Sale of chawki worms | - | - | - | 25000 | 25000 |
| Miscellaneous | - | - | 3950 | - | 3950 |
| Total | 20418 | 5000 | 13719 | 43647 | 82784 |

# 22. REGIONAL SERICULTURAL RESEARCH STATION (RSRS), MULUGU

| | |
|---|---|
| In-Charge officer | Praveen Kumar K, Sci-D (till 30.11.2022)<br>Vinod Kumar Yadav, Sci-C (from 01.12.2022) |
| Scientists | 01 |
| Technical staff | 01 |
| Administrative/Supporting staff | 01 |

| Units | Total area (acres) | Mulberry acreage |
|---|---|---|
| RSRS-Mulugu | - | - |
| REC-Vikarabad | 5.31 | 2.50 |

## Collaborative Projects

| Project/Programme | Unit |
|---|---|
| PRP 01015 SI: Identification, evaluation and inclusion of potential antagonistic microbes in Integrated Root Rot Disease Management in Mulberry (Nov. 2020-Oct. 2023. | RSRS-Mulugu |
| AIE 01026 MI: Evaluation of new bivoltine silkworm hybrid BFC1 x BFC10 at farmers level for authorization for commercial exploitation (Feb. 2022-Jan. 2025) | RSRS-Mulugu |
| MOE 01021 SI: Popularization of improved breeds and technologies for Southern India (on farm/on station trials of CSRTI-Mysuru)<br>Component 3: Evaluation of productive double hybrid, DHP5 at farmers' level. (Apr. 2021 – Mar. 2023) | RSRS-Mulugu |
| PIE 13001 MI (AICEM Phase-IV): All India Coordinated Experimental Trial in Mulberry Phase-IV (Apr.2019-Mar. 2025) | REC-Vikarabad |

### Cluster Promotion Programme

Bivoltine sericulture technologies were implemented in two mega clusters *viz*., Karimnagar & Siddipet and one non-captive cluster in Zaheerabad, in Telangana. A total of 18.28 lakhs dfls were distributed and obtained an average cocoon yield of 82.5 kg/100 dfls.

### Extension Communication Programmes

| Programme | No of Programmes | No of farmers | No of Programmes | No of farmers |
|---|---|---|---|---|
| | RSRS-Mulugu | | REC-Vikarabad | |
| Farmers Field day | 6 | 592 | - | - |
| Awareness Programmes | 2 | 163 | 2 | 182 |
| Tech. Demo./Enlightenment | 2 | 83 | 4 | 149 |
| Resham Krishi Mela | 1 | 711 | - | - |
| Total | 11 | 1549 | 6 | 331 |

### Resham Krishi Mela

Resham Krishi mela was conducted at Jangaon on 24th March 2023. In this program, Dr.S.M.H Qadri, former Director, CSRTI, Mysuru and Shri Sudhakar, Deputy Director, Department of Sericulture, Telangana attended as Cheif guests. A total of 711 Sericulture farmers participated from the clusters in Telangana. Scientists, Officers and staff from Central Silk Board and DoS, Telangana participated in the Mela.

### Technical workshop

Two technical workshops were organized for the officials of Central Silk Board and DoS, Govt. of Telangana, reelers, CRC holders and progressive farmers on recent sericulture technologies used for the improvement of sericulture in Telanaga state.

### Capacity Building Farmers Training Programme (FST)

| Name of the event | No. of beneficiaries | Expenditure |
|---|---|---|
| CBT | 251 | 9,37,500 |

# 23. REGIONAL SERICULTURAL RESEARCH STATION (RSRS) - SALEM

| | |
|---|---|
| In-Charge officer | N. Dhahira Beevi |
| Scientists | 06 |
| Technical staff | 09 |
| Administrative & supporting staff | 03 |

| Units | Total area (aces) | Mulberry acreage |
|---|---|---|
| RSRS-Salem | 20.00 | 1.75 |
| REC-Krishnagiri | 2.77 | 2.50 |
| REC-Samayanallur | 2.62 | 0.80 |
| REC-Gobichettipalayam | - | - |
| REC-Udumalpet | - | - |

## Concluded Research Projects

### PIN 01018 SI: Effect of Potassium Mobilising Bacteria *Frateuria aurentia* on growth and development of mulberry (Nov. 2020-Oct. 2022)

N. Dhahira Beevi and S. Kamaraj

**Objective**

- To study the influence of potassium mobilizing bacteria with graded levels of potassium on growth and leaf yield of mulberry
- Reduce the cost of cultivation by curtailing the chemical fertilizer application
- Conserving the soil sustainability by applying eco-friendly biological agents

The experiment was conducted in the farmer's field of Pudupatty village having V-1 & G-4 varieties (1 acre each) in Paired row system. KMB application @ 1500 ml $ha^{-1}$ or 25 kg $ha^{-1}$ (1 x $10^8$ CFU $ml^{-1}$) with graded levels of potassium application. After each pruning, bacterial cultures were applied to plants by mixing with well decomposed FYM as per the treatment schedule with regular package of practices.

**Treatments:** T1-Absolute control; T2-Recommended dose of NPK; T3-Recommended dose of 100% NPK & KMB; T4-100% N&P + 75% K + KMB; T5-100% N&P + 50% K + KMB; T6-100% N&P + 25% K+ KMB; T7-100% N&P + 0% K + KMB.

A total of nine crops were harvested during the project period at an interval of about 70 days. Six randomly selected plants per replication per treatment were tagged and different parameters such as plant height, longest shoot length, leaf area, leaf area index, leaf moisture, leaf moisture retention, leaf yield per hectare and qualitative parameters like chlorophyll and carbohydrate content, chemical analysis like potassium in soil and plant parts, potassium uptake, fractions of potassium and CFUs in rhizosphere were recorded following the standard methods. The rhizosphere soil samples were collected from each treatment and replication in both varieties during first and second year and enumerated for studying bacterial and fungal population as CFUs/g of soil. The data recorded were subjected to statistical analysis.

Table 23.1: Status of experimental garden

| # | pH | EC (m.mhos/ cm) | Organic carbon (%) | Available P (kg/ha) | Available K (kg/ha) | Sulphur (ppm) |
|---|---|---|---|---|---|---|
| Before inoculation | 8.62-8.92 | 0.118-1.025 | 0.49- 0.65 | 31-47 | 120-314 | 7.24-14.9 |
| After inoculation | 8.01-8.55 | 0.142-0.987 | 0.56-0.69 | 15-33 | 134-672 | 8.92-14.99 |

**Variety V-1:** Quantitative parameters like plant height, longest shoot length were higher in the treatment T3 and this was found to be on par with T4 followed by T2. However qualitative parameters like leaf yield and potassium content in leaf were found to be higher in the treatment T4 followed by T3. The highest leaf area and leaf area index, leaf moisture content, total chlorophyll content and total carbohydrate content was recorded in T3 whereas treatment T4 exhibited the highest leaf moisture retention content.

**Variety G-4:** Quantitative parameters like plant height, longest shoot length were higher in the treatment T4 and T3 followed by T2. Qualitative parameters like leaf yield and potassium content in leaf were also found to be higher in the treatment T4 followed by T3 Highest total chlorophyll content was also recorded in the treatment T4. Treatment T3 exhibited the highest leaf area and leaf area index, leaf moisture content, leaf moisture retention content and total carbohydrate content followed by T4 and T2 respectively.

Table 23.2: Effect of Potassium Mobilising Bacteria *Frateuria aurentia* on plant growth parameters

| Treat-ment | Variety- V1 | | | | Variety- G4 | | | |
|---|---|---|---|---|---|---|---|---|
| | Plant height (cm) | Longest shoot length (cm) | Leaf yield (kg $ha^{-1}$ $yr^{-1}$) | Tot. chlorophyll (mg $g^{-1}$) | Plant height (cm) | Longest shoot length (cm) | Leaf yield (kg $ha^{-1}yr^{-1}$) | Tot. chlorophyll (mg $g^{-1}$) |
| T1 | 148.67 | 121.67 | 34770 | 2.16 | 126.69 | 79.33 | 37130 | 1.48 |
| T2 | 165.99 | 133.33 | 54892 | 3.52 | 142.27 | 92.33 | 50315 | 2.75 |
| T3 | 171.65 | 149.67 | 56708 | 3.93 | 144.27 | 94.00 | 51195 | 3.23 |
| T4 | 170.08 | 148.33 | 57864 | 3.74 | 145.25 | 93.67 | 51490 | 3.28 |
| T5 | 158.44 | 144.67 | 54395 | 3.24 | 135.23 | 86.67 | 49445 | 2.49 |
| T6 | 163.56 | 135.67 | 50180 | 3.28 | 136.45 | 87.33 | 48185 | 2.52 |
| T7 | 162.41 | 126.67 | 44647 | 3.06 | 129.85 | 81.33 | 42148 | 2.27 |
| CD @ 5% | 7.25 | 6.45 | 496.94 | 0.113 | 6.45 | 4.08 | 1910.9 | 0.109 |
| SED± | 3.29 | 2.96 | 225.58 | 0.051 | 2.93 | 1.85 | 867.5 | 0.050 |
| CV | 2.48 | 2.70 | 2.80 | 1.921 | 0.015 | 2.177 | 1.837 | 2.38 |

Table 23.3: Effect of Potassium Mobilising Bacteria *F. aurentia* on mulberry leaf parameters

| Treatment | V-1 | | | | G-4 | | | |
|---|---|---|---|---|---|---|---|---|
| | Leaf area ($cm^2$) | LAI | Leaf moisture (%) | Leaf moisture retention (%) | Leaf area ($cm^2$) | LAI | Leaf moisture (%) | Leaf moisture retention (%) |
| T1 | 34717 | 4.82 | 71.74 | 78.91 | 34847 | 4.84 | 71.50 | 79.87 |
| T2 | 47269 | 6.56 | 73.49 | 89.81 | 47446 | 6.59 | 73.24 | 89.15 |
| T3 | 101146 | 14.05 | 75.43 | 93.21 | 101526 | 14.10 | 75.18 | 93.94 |
| T4 | 84312 | 11.70 | 75.35 | 93.98 | 84629 | 11.74 | 75.11 | 93.17 |
| T5 | 38487 | 5.35 | 72.35 | 92.53 | 38632 | 5.37 | 72.10 | 92.49 |
| T6 | 75939 | 10.55 | 74.33 | 91.12 | 76224 | 10.59 | 74.08 | 92.78 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| T7 | 74381 | 10.34 | 75.02 | 90.82 | 74660 | 10.38 | 74.75 | 90.02 |
| CD @ 5% | 4139.99 | 0.575 | 2.969 | 2.576 | 2765.17 | 0.384 | 2.580 | 2.378 |
| SED± | 2034.85 | 0.283 | 1.459 | 1.266 | 1359.11 | 0.189 | 1.268 | 1.168 |
| CV | 3.12 | 3.12 | 1.973 | 1.405 | 2.077 | 2.07 | 1.720 | 1.29 |

Table 23.4: Effect of Potassium Mobilising Bacteria *F. aurentia* on quality attributes of K in leaf and soil

| Treatment | V-1 | | | G-4 | | |
|---|---|---|---|---|---|---|
| | K content in leaf (%) | K uptake (kg ha$^{-1}$) | Avail. K in soil (kg ha$^{-1}$) | K content in leaf (%) | K uptake (kg ha$^{-1}$) | Avail. K in soil (kg ha$^{-1}$) |
| T1 | 1.68 | 14.35 | 134 | 1.42 | 15.27 | 134 |
| T2 | 2.19 | 42.31 | 269 | 1.92 | 46.15 | 269 |
| T3 | 2.50 | 59.35 | 672 | 2.13 | 54.37 | 672 |
| T4 | 2.52 | 61.34 | 582 | 2.14 | 57.34 | 672 |
| T5 | 2.48 | 57.66 | 404 | 1.85 | 53.19 | 582 |
| T6 | 2.01 | 40.15 | 314 | 1.78 | 50.24 | 404 |
| T7 | 1.74 | 35.36 | 314 | 1.79 | 40.29 | 314 |
| CD @ 5% | 0.132 | 2.19 | 13.49 | 0.10 | 1.946 | 12.36 |
| SED± | 0.06 | 0.996 | 4.25 | 0.05 | 0.883 | 3.26 |
| CV | 3.4 | 2.25 | 1.106 | 2.686 | 1.95 | 0.749 |

Table 23.5: Effect of KMB treatments on total carbohydrate content (%)

| Treatment | V-1 | G-4 |
|---|---|---|
| T1 | 13.59 | 13.57 |
| T2 | 15.01 | 15.58 |
| T3 | 17.22 | 16.14 |
| T4 | 15.28 | 15.63 |
| T5 | 14.02 | 13.55 |
| T6 | 14.07 | 13.46 |
| T7 | 14.04 | 13.06 |
| CD @ 5% | 0.61 | 0.64 |
| SED± | 0.29 | 0.31 |
| CV | 2.52 | 2.70 |

Table 23.6: Effect of KMB treatments on fraction of potassium at different depths of soil

| Treat-ment | V-1 | | | | | | G-4 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Water soluble K (mg kg$^{-1}$) | | Exchangeable K (mg kg$^{-1}$) | | Non exchangeable K (mg kg$^{-1}$) | | Water soluble K (mg kg$^{-1}$) | | Exchangeable K (mg kg$^{-1}$) | | Non exchangeable K (mg kg$^{-1}$) | |
| | 0-15 cm | 15-30 cm | 0-15 cm | 15-30 cm | 0-15 cm | 15-30 cm | 0-15 cm | 15-30 cm | 0-15 cm | 15-30 cm | 0-15 cm | 15-30 cm |
| T1 | 5.90 | 4.80 | 241.4 | 301.7 | 376.6 | 376.2 | 7.10 | 4.70 | 307.5 | 319.15 | 388 | 395.3 |
| T2 | 14.50 | 17.90 | 322.7 | 320.6 | 321.8 | 324.8 | 20.7 | 36.2 | 251.7 | 269.7 | 270.4 | 224.4 |
| T3 | 24.30 | 13.85 | 294.7 | 307.7 | 321.0 | 325.6 | 20.9 | 11.9 | 314.5 | 280.7 | 383 | 355.2 |
| T4 | 27.40 | 12.70 | 204.3 | 215.9 | 252.1 | 373.4 | 22.9 | 11.4 | 245.5 | 260.2 | 179.15 | 255.4 |
| T5 | 22.40 | 15.10 | 243.50 | 210.8 | 305.9 | 267.0 | 21.1 | 16.7 | 199.8 | 243.7 | 278.2 | 272.4 |
| T6 | 26.40 | 19.10 | 212.23 | 212.7 | 353.4 | 296.2 | 23.9 | 16.9 | 291.3 | 336.9 | 321.2 | 260.9 |
| T7 | 17.70 | 24.50 | 222.4 | 224.8 | 186.6 | 288.6 | 18.4 | 15.7 | 232.4 | 232.7 | 292.4 | 306.3 |
| CD @ 5% | 1.06 | 0.49 | 8.42 | 10.317 | 16.916 | 12.17 | 1.23 | 0.60 | 13.47 | 12.14 | 12.36 | 14.03 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SED± | 0.48 | 0.22 | 3.82 | 4.68 | 7.68 | 5.52 | 0.56 | 0.27 | 6.11 | 5.51 | 5.61 | 6.37 |
| CV | 2.97 | 1.77 | 1.88 | 2.24 | 3.11 | 2.10 | 3.55 | 2.06 | 2.84 | 2.43 | 2.28 | 2.64 |

Table 23.7: Effect of KMB treatments on yield and economics of mulberry

| Treatment | Variety- V1 | | | Variety- G4 | | |
|---|---|---|---|---|---|---|
| | Leaf yield (kg ha$^{-1}$ yr$^{-1}$ ) | Net return (Lakh ha$^{-1}$) | B:C | Leaf yield (kg ha$^{-1}$ yr$^{-1}$ ) | Net return (Lakh ha$^{-1}$) | B:C |
| T1 | 34770 | 5.14 | 1.50 | 37130 | 4.51 | 1.33 |
| T2 | 54892 | 11.39 | 2.44 | 50315 | 9.85 | 2.12 |
| T3 | 56708 | 11.83 | 2.53 | 51195 | 9.90 | 2.25 |
| T4 | 57864 | 12.29 | 2.70 | 51490 | 11.98 | 2.50 |
| T5 | 54395 | 11.46 | 2.61 | 49445 | 9.72 | 2.20 |
| T6 | 50180 | 10.56 | 2.50 | 48185 | 9.46 | 2.18 |
| T7 | 44647 | 9.39 | 2.32 | 42148 | 8.27 | 2.06 |
| CD @ 5% | 10.053 | - | - | 1910.9 | - | - |
| SED± | 4.564 | - | - | 867.5 | - | - |
| CV | 2.80 | - | - | 1.837 | - | - |

The response of PMB may be attributed to the mobilization of K from soil because of secretion of organic acids by the bacterial strains there by enhanced plant growth and development and finally greater acquisition of nutrients. The overall development of mulberry plants in terms of higher chlorophyll content, total leaf yield may be due to the enhanced photosynthesis and production of assimilates, absorption of more nutrient due to mobilization of nutrients which in turn increase the yield.

## Collaborative Research Projects/Programmes

| Project/Programme | | Unit |
|---|---|---|
| PIB 3632: | Evaluation of superior triploid for yield and adaptability under varied agro climatic Condition (Mar. 2018 – Feb. 2024) | RSRS-Salem |
| PIE 13001 MI: | All India Coordinated Experimental Trial in Mulberry Phase-IV (Apr. 2019-Mar. 2025) | REC-Krishnagiri |
| MOE 01021 SI:<br>Component 1: | Evaluation and popularization of improved technologies developed in the field of mulberry sector for South India<br>Evaluation of chawki feed supplement formulation in commercial chawki rearing centers (Apr. 2021-Mar. 2023) | RSRS-Salem |
| MOE 01021 SI:<br>Component 3: | Popularization of improved breeds and technologies for Southern India (on farm/on station trials of CSRTI-Mysuru)<br>Evaluation of productive double hybrid, DHP5 at farmers' level. (Apr. 2021 – Mar. 2023) | RSRS-Salem |
| MOE 01021 SI:<br>Component 7: | Evaluation of improved technologies of mulberry sericulture in South India<br>Evaluation of robust bivoltine silkworm hybrids suitable for different regions of high temperature and high humidity conditions (Apr. 2021-Mar. 2023) | RSRS-Salem |
| MOE 01021 SI:<br>Component 9: | Evaluation and popularization of improved technologies developed in the field of mulberry sector for South India<br>Impact of drip fertigation on mulberry productivity (Nov. 2021-Oct. 2023) | REC-Krishnagiri |

| | | |
|---|---|---|
| AIE 01026 MI: | Evaluation of new bivoltine double hybrid, BFC1 x BFC10 at farmers' level for authorization for commercial exploitation (Feb. 2022-Jan. 2025) | RSRS-Salem |
| PRP 01015 SI: | Identification, evaluation and inclusion of potential antagonistic microbes in Integrated Root Rot Disease Management in Mulberry (Nov. 2020 - Oct. 2023) | RSRS-Salem |

## Continuous/Other activities

### Cluster Promotion Programme

Bivoltine sericulture technologies were disseminated in 6 mega clusters across Tamil Nadu. A total of 134.52 lakh dfls were distributed and an average cocoon yield of 81.85 was harvested per 100 dfls.

### Extension Communication Programme (ECPs)

Table 23.8: Extension Communication Programmes

| Centre | Awareness programme | Exhibition | Farmers day | Resham krishimela | Tech. demon. | Tech. Workshop | ATMA |
|---|---|---|---|---|---|---|---|
| RSRS-Salem | 110 (1) | 2897 (1) | 796 (8) | 310 (1) | 71 (2) | 330 (2) | 6 (1) |
| REC-Gobi | 363 (3) | - | - | - | 103 (4) | - | - |
| REC-K.giri | 489 (4) | - | - | - | 130 (4) | - | - |
| REC-S.nallur | 716 (8) | 1447 (1) | - | - | 425 (15) | - | - |
| REC-Ud'pet | 399 (4) | - | - | - | 112 (4) | - | - |
| Total | 2077 (20) | 4344 (2) | 796 (8) | - | 841 (29) | 330 (2) | 6 (1) |

Note: Figures in parenthesis denotes number of programmes

Apart from this, the RSRS Salam and nested units have participated in 33 ATMA programmes and sensitised 1351 farmers.

### 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 (kg) | G4 (kg) | V1 (kg) | Serifit (packets) |
|---|---|---|---|---|---|
| RSRS-Salem | 22 (11) | 550 (1) | 1100 (1) | 1400 (1) | - |
| REC-Gobi | - | - | - | - | 2400 (480) |
| REC-Krishnagiri | - | - | 15204 (3) | - | - |

*Values in parentheses denote number of farmers covered*

### Training programmes

Table 23.9: Farmers Skill Training (FST)

| Unit | Events | Farmers | Male | Female | SC | ST | OBC | Gen. |
|---|---|---|---|---|---|---|---|---|
| RSRS-Salem | 4 | 70 | 55 | 15 | 2 | 0 | 68 | 0 |
| REC-Gobich'palayam | 2 | 30 | 29 | 1 | 0 | 0 | 18 | 12 |
| REC-Krishnagiri | 4 | 51 | 37 | 14 | 0 | 0 | 21 | 30 |
| REC-Samayanallur | 2 | 50 | 41 | 9 | 2 | 2 | 0 | 46 |
| REC-Udumalpet | 4 | 50 | 34 | 16 | 4 | 4 | 23 | 19 |
| Total | 16 | 251 | 196 | 55 | 8 | 6 | 130 | 107 |

Table 23.10: Sericulture Resource Centres (SRC)

| Unit/SRC | Events | Farmers | Male | Female |
|---|---|---|---|---|
| REC-S.nallur/Maangadu, Alangudi | 5 | 150 | 138 (Gen-130, SC-8) | 12 (Gen-9, SC-3) |
| REC-Udumalpet/Manupatty | 5 | 164 | 148 (Gen-131, SC/ST-17) | 16 (Gen-7, SC/ST-9) |
| Total | 10 | 314 | 286 | 28 |

**Mass multiplication and distribution of Bio-control Agents**

| Biocontrol agent | Target host | Units supplied | UOM | No. supplied (Nos.) | Farmers covered |
|---|---|---|---|---|---|
| *Acerophagus papayae* (1 unit=250 nos.) | Papaya mealybug | 25 | units | 1250 | 20 |
| *Nesolynx thymus* | Uzifly | 174 | pouches | 174 | 45 |
| *Bracon brevicornis* | Leaf roller | 30 | units | 30 | 21 |

**Centre for Higher Studies in Botany and Sericulture, RSRS, Salem**

Periyar University, Salem has recognized RSRS, Salem as a Centre for Higher Studies in Botany and Sericulture for pursuing M.Phil. & Ph.D., and the following students are pursuing Ph.D. programme.

| Name of the candidate | Guide | Year of Joining | Topic of Research |
|---|---|---|---|
| T. S. Manoj | Dr. N. Dhahira Beevi Scientist-D | 2019 | Studies on supplementation of organic inputs vis-a vis reduction of chemical fertilizers in G-4 mulberry variety (*Morus* spp.). |
| M. Devamani | Dr. N. Dhahira Beevi Scientist-D | 2019 | Effect of micronutrient application on growth and yield of mulberry. |
| A. Abdul Faruk | Dr. S. Balasaraswathi Scientist-D | 2018 | Studies on economic impact of cocoon production by sericulturists through training. |

**Revenue Generation**

| Particulars | Amount (Rs) |
|---|---|
| Sale of cocoons | 1,04,601.00 |
| Sale of mulberry cuttings & saplings | 19,502.00 |
| Chawki rearing charges | 1,35,000.00 |
| Sale of publication | 1,01,050.00 |
| uctioning of weeds, coconut etc., | 13,390.00 |
| Sale of bio control agents | 1,250.00 |
| Soil analysis charges | 31,865.00 |
| Student visit | 2,000.00 |
| Serifit handling charges | 5,250.00 |

# 24. LECTURES, WEBINARS, VIDEO OR RADIO-TALKS DELIVERED

## Lecture

| Topic | Organized by | Date | Name |
|---|---|---|---|
| Opportunities in the sericulture sector for By-product utilization | Office of the Joint Director of Agriculture, Public offices Building, Mysore District | 29.03.2023 | Y. Thirupathaiah |
| Quality leaf production technologies in mulberry | ADS, Villuppuram | 20.05.2022 | N. Dhahira Beevi |
| Economics of Sericulture | Periyar University, Salem | 19.10.2022 | N. Dhahira Beevi |
| Entrepreneurship opportunities in Sericulture | Vivekanandha College of Arts and Sciences for Women (Autonomous), Elayampalayam, Tiruchengode, Namakkal | 13.12.2022 | N. Dhahira Beevi |
| Profitability in Sericulture | KVK, Theni | 25.08.2022 | A. Mahima Santhi |
| Entrepreneurship in Sericulture | MVM college, Dindigul & CO, CSB, Bengaluru | 30.10.2022 | A. Mahima Santhi |
| Entrepreneurship in Sericulture | Prosper India & American college, Madurai, | 16.02.2023 | A. Mahima Santhi |
| Women in Sericulture | Kalasilingam university, Krishnankoil | 03.02.2023 | A. Mahima Santhi |
| Scope of sericulture | ATMA, Tenkasi | 23.03.2023 | A. Mahima Santhi |
| Journey of technology in shaping civilization | MMK & SDM Mahila Mahavidyalaya, Krishnamurthypuram, Mysuru | 31.05.2022 | G. S. Arunakumar |

## Webinar

| Topic | Organized by | Date | Name |
|---|---|---|---|
| Sericulture for sustainable lively hood Mulberry cultivation technologies | KVK, Namakkal | 17.06.2022 | N. Dhahira Beevi |

## Radio Talk

| Topic | Organized by | Date | Name |
|---|---|---|---|
| Sericulture | AIR-Tamil Nadu | 12.09.2022 | V. Vijay |
| IDM of root rot disease of mulberry | AIR-Mysuru | 16.01.2022 | G.S. Arunakumar |

# 25. CONFERENCES, WEBINARS, WORKSHOPS ATTENDED

| Programme | Organized by | Date | Name |
|---|---|---|---|
| The 26th International Sericultural Commission Congress, Seritech 2022 - The new concepts in sericulture | International Sericultural Commission & | 07.09.2022 to 11.07.2022 | G. S. Arunakumar<br>M. K. Raghunath<br>M. Muthulakshmi |

| | | | |
|---|---|---|---|
| | University of Agricultural Science and Veterinary Medicine of Cluj-Napoca, Romania | | M. R. Bhavya (online)<br>Ravindra (online)<br>Tanmoy Sarkar<br>Manjappa<br>Y. Thirupathaiah (online) |
| Climate Smart Sericulture-2022 | Central Office, Central Silk Board, Bangalore | 06.10.2022 to 07.10.2022 | Amit Kumar<br>C. M. Babu<br>Divya Singh<br>E. Bhuvaneswari<br>G. S. Arunakumar<br>J. Justin Kumar<br>K. N. Madhusudhan<br>L. Kusuma<br>L. Satish<br>M. K. Raghunath<br>M. R. Bhavya<br>M. S. Ranjini<br>R. Mahesh<br>Ravindra<br>Tanmoy Sarkar<br>Manjappa<br>V. Sobhana<br>Y. Thirupathaiah |
| National symposium on Vanya Sericulture: Opportunities Galore, | CTRTI, Ranchi | 28.10.2022 to 29.10.2022 | Amit Kumar<br>M. K. Raghunath<br>Manjappa |
| समग्र रेशम उत्पादन-चुनौतियाँ एवं भावी रणनीति | CTRTI, Ranchi | 28.01.2023 | Divya Singh<br>L. Kusuma |
| Platinum Jubilee conference, Plant and soil health management: Issues and innovations | University of Mysore, Mysuru | 02.02.2023 to 04.02.2023 | G. S. Arunakumar |
| शहतूत रेशम उत्पादन में आधुनिक तकनीकें राजभाषा तकनीकी सेमिनार | CSRTI, Mysore | 23.02.2023 | Amit Kumar<br>Dhaneshwar Padhan<br>Divya Singh<br>G. S. Arun kumar<br>L. Kusuma<br>L. Satish<br>M. K. Raghunath<br>Tanmoy Sarkar<br>Manjappa<br>M. S. Ranjini<br>R. Mahesh<br>Ravindra<br>S. Mahiba Helen<br>T. Gayathri |
| National Seminar on Entrepreneurship in Sericulture | Sri Krishnadevaraya University S.V.Puram, Anantapuramu, Andhra Pradesh | 28.04.2022 to 29.04.2022 | M. Muthulakshmi<br>N. G. Selvaraju<br>Raveendra Mattigatti |

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|---|---|---|---|
| Workshop on Intellectual Property Rights | Seri Biotechnology Research Laboratory, Central Silk Board and Karnataka State Council for Science and Technology | 25.05.2022 at Central Silk Board, Bangalore | Y. Thirupathaiah |
| Role of microbes in sericulture | International Conference on Novel Paradigms in Microbiology for Sustainable Future Organized by The American College, Madurai, TN | 10.11.22 to 11.11.22 | V. Vijay |
| International conference on Agriculture sciences, technologies, innovation and entrepreneurship | Prosper India foundation and Agri Amicos, Theni | 17.02.23 to 18.02.23 | A. Mahima Santhi |

## 26. HUMAN RESOURCE DEVELOPMENT

| Training Programme | Organized by | Date | Name |
|---|---|---|---|
| Natural farming-principles and practice (Online) | MANAGE, Hyderabad | 17.05.2022 to 20.05.2022 | R. Mahesh |
| Hands on training on eSubMIS | CO Bengaluru | 06.03.2023 | Anand Kumar<br>C. M. Babu<br>G. S. Arunakumar<br>K. B. Chandra Shekar<br>K. N. Madhusudhan<br>L. Satish<br>M. K. Raghunath<br>M. Muthulakshmi<br>M. N. Chandrashekar<br>R. Bhagya<br>R. Meenal<br>Raveendra M. Mattigatti<br>S. Balasarasvathi<br>S. Mahiba Helen<br>Shivakumar M Hukkeri<br>Y. N. Sanath kumar |
| Hands on training on eSubMIS | CO Bengaluru | 07.03.2023 | A. V. Mary Josepha (Shery)<br>Amit Kumar<br>Dhaneshwar Padhan<br>Divya Singh<br>E. Bhuvaneswari<br>G. Mallikarjuna<br>L. Kusuma<br>M. R. Bhavya<br>M. S. Ranjini<br>Manjappa<br>R. Mahesh |

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|---|---|---|---|
| | | | Ravindra<br>Shivkumar<br>T. Gayathri<br>Tanmoy Sarkar<br>Y. Thirupathaiah |
| Mulberry and silkworm germplasm Conservation and Management | CSGRC, Hosur | 09.01.2023 to 10.01.2023 | Divya Singh<br>E. Bhuvaneswari<br>G. S. Arunakumar<br>M. R. Bhavya<br>R. Mahesh<br>Ravindra<br>T. Gayathri<br>Tanmoy Sarkar<br>Manjappa<br>Y. Srinivasulu |
| Mulberry and silkworm pest and disease management with changing climatic conditions | CSRTI, Mysuru | 15.12.2022 | C. M. Babu<br>Dhaneshwar Padhan<br>Divya Singh<br>M. K. Raghunath<br>M. Muthulakshmi<br>M. R. Bhavya<br>N. Dhahira Beevi<br>R. Bhagya<br>R. Mahesh<br>Raveendra Mattigatti<br>T. Gayathri<br>Tanmoy Sarkar<br>Manjappa<br>Y. Thirupathaiah |
| Basic molecular techniques applied in the field of Sericulture | Seri-Biotech Research Laboratory (SBRL), Kodathi | 14.11.2022 to 23.11.2022 | Dhaneshwar Padhan<br>G. Mallikarjuna<br>M. R. Bhavya<br>Shivkumar |

# 27. PATENTS & COMMERCIALIZATION

**Patents filed**

1. Process for extraction of chitin from moth scales by submerging fragmentation technology. Patent application No. 202241059744 filed on 19.10.2022.
2. An optical tool embedded silkworm pupal gender classification and sorting machine. Patent application No. 202241060352 filed on 21.10. 2022.

**Patents granted**

1. Dusting Machine for silkworms. Patent No. 394974 granted on 19/04/2022.
2. A Machine for cleaning and disinfection of trays for rearing silkworms. Patent No. 402483 granted on 28.07.2022.

**Commercialization**

| Product | Name of the firm | Date |
|---|---|---|
| Poshan: a multi-nutrient formulation for correcting nutrient deficiency in mulberry | M/s. R. V. SERI AGRO VET<br>Plot No. 27c, 1st Main Road<br>KIADB Industrial Area<br>Malur Taluk, Kolar - 563130 | 13.06.2022 |
| | M/s. SERIO CARE<br>Sy No.118, Kamadenahalli Village<br>Kasaba Hobali, Kolar Taluk<br>Kolar 563101 | 14.07.2022 |
| | M/S. Seri-Con Technologies<br>20th K.M. Mysore Road<br>Kumbalgod Post, Bengaluru - 560 074 | 20.09.2022<br>(Renewal) |

# 28. RESEARCH ADVISORY COMMITTEE & MEETINGS

**Chairman**

Dr. Mahadev B. Chetti
Vice-Chancellor
University of Agricultural Sciences (UASD)
Yettinagudda Campus
Krishinagar, Dharwad - 580 005

**Members**

Dr. E. Sreenivasa Rao
Principal Scientist, Division of Vegetable crops
ICAR-Indian Institute of Horticultural Research
Hesaraghatta Lake post
Bengaluru - 560 089

Prof. Janarthanan
Professor and Head
Department of Zoology
University of Madras
Chennai - 600 025

Dr. K. Narayanagowda
Associate Director of Extension
Agricultural Science Museum
University of Agricultural Sciences
GKVK Bengaluru - 560 065

Dr.H.K.Basavaraja
Retd. Director (I/c)
National Silkworm Seed Organization (NSSO)
No.263, 9th Cross, Srirampuara 2nd stage
Mysore -570 023

The Commissioner of Sericulture
Sericulture Development & Director of Sericulture
Govt. of Karnataka, 5th Floor
M. S. Building, Dr. B. R. Ambedkar Veedhi
Bengaluru - 560 001

The Director of Sericulture
Govt. of Tamil Nadu
Nethaji Nagar, Hasthampatti,
Tamil Nadu, Salem - 636 007

The Commissioner of Sericulture
Dept. of Sericulture, Govt. of Andhra Pradesh TTDC building, First floor, Old market yard, Chuttugunta (besides Mini Rythyu Bazaar), Guntur - 522 007, Andhra Pradesh

The Commissioner of Sericulture
Govt. of Telengana
Road no-72, Prashashan Nagar
Adjacent to Water tank, Jubilee hills
Telengana, Hyderabad - 560 033

The Director of Sericulture
Dept. of Sericulture
Govt. of Maharashtra, New Administrative building, No-2, B-wing, Civil lane, lV floor
Maharashtra, Nagpur - 440 010

The Commissioner of Sericulture
Govt. of Madhya Pradesh,
Lower Basement, Satpuda Bhavan,
Bhopal - 462 004, Madhya Pradesh

Sri Y. Shankar Reddy
S/o Narasimha Reddy
Nadimi Kallada Village,
Kolamasinapalli Post, Palamaner Mandal,
Chittoor - 517 432, Andhra Pradesh

Sri Shaik lsmail
Chinnasandra Village and post,
Chintamani Taluk
Chikkaballapura - 503 125

The Director
National Silkworm Seed organization(NSSO)
Central Silk Board, CSB Complex
BTM Layout, Madiwala
Bengaluru - 560 068

The Director (Tech)
Central Silk Board, CSB Complex
BTM Layout, Madiwala
Bengaluru - 560 068

Scientist-D & Head
Research Co-ordination Section
Central Silk Board, CSB Complex
BTM Layout, Madiwala
Bengaluru - 560 068

The Director (Member Convener)
Central Sericulturual Research and Training
Institute, Central Silk Board, Manandavadi Road,
Srirampura,Mysuru - 570 008

**Details of Review Meetings at CSRTI-Mysuru**

| | |
|---|---|
| 68th Research Council | : 20th & 21st April 2022 |
| 69th Research Council | : 16th December 2022 |
| 70th Research Council | : 10th March 2023 |
| 48th Research Advisory Committee | : 28th & 29th September 2022 |
| 49th Research Advisory Committee | : 17th & 18th March 2023 |

# 29. PUBLICATIONS

**Book/Book Chapter**

Anuj Kumar Chandel, Jesús Ascencio, Akhilesh Kumar Singh, Ruly Teran Hilares, Lucas Ramos Rishi Gupta, Yeruva Thirupathaiah and Sridevi Jagavati (2022) White Biotechnology: Impeccable Role in Sustainable Bio-Economy (Book chapter 1). Book: Lignocellulose Bioconversion through White Biotechnolog (Wiley), 1-17. ISBN-13: 9781119735953.

Arti Bhatia, Avijit Ghosh, Amit Kumar and Ranjan Bhattacharyya (2022) Greenhouse Gas Emission and Carbon Sequestration in Conservation Agriculture. Conservation Agriculture in India, 1: 281-302.

Arunakumar GS, Akhil Suresh, Nisarga PMNR, Bhavya MR, Sowbhagya P and Belaghihalli N. Gnanesh (2022) Application of green synthesized nanoparticles in sustainable mulberry production: current trends and opportunities. In: Kole C. (ed.) The Mulberry Genome, Springer Nature, Switzerland, pp. 273-292.

Belaghihalli N. Gnanesh, Arunakumar GS, Tejaswi A, Supriya M, Anil Pappachan and Harshitha MM (2022) Molecular diagnositics of soil-borne and foliar diseases of mulberry: Present trends and future perspective [Chap. 9]. In: Kole C. (ed.) The Mulberry Genome, Springer Nature, Switzerland, pp. 215-241.

Belaghihalli N. Gnanesh, Raju Mondal, Manojkumar HM, Bhavya MR, Pradeep Sing, Arunakumar GS and Thalapally Mogili (2022) Relaltionship between genome size and ploidy level in mulberry [Chap. 5]. In In: Kole C. (ed.) The Mulberry Genome, Springer Nature, Switzerland, pp. 131-147.

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Gulshan Kumar Sharma, Shakeel Ahmad Khan, Amit Kumar, Ittyamkandath Rashmi, Fayaz Ahmad Malla and Gopal Lal Meena (2022) Algal Biorefinery: A Synergetic Sustainable Solution to Wastewater Treatment and Biofuel Production. Microalgae, 1-20.

Manoj Kumar Chitara, Sachin Sharma, Manoj Parihar, Jeevan B, Prashanth A Sangannavar, Amit Kumar, Kutala Sathyanarayana, Jalaja S Kumar, Reeta Luikham and Gangavarapu Subrahmanyam (2022) The structure, function, and utility of the rhizosphere microbiome of cereal crops. Microbial Resource Technologies for Sustainable Development, 77-111.

Pavan Saini, Gulab Khan Rohela, Jalaja S. Kumar, Aftab A. Shabnam and Amit Kumar (2022) Cultivation, utilisation and economic benefits of mulberry [Chap. 2]. In: Kole C. (ed.) The Mulberry Genome, Springer Nature, Switzerland, pp. 13-56.

Prashanth Sangannavar A, Mainu Kalita, Gangavarapu Subrahmanyam, Amit Kumar, Kutala Sathyanarayana and Rajal Debnath (2022) Biomethane: a sustainable bioenergy source from potential waste effluents. Microbial Resource Technologies for Sustainable Development, Elsevier, 195-212.

Ravindra M. Aurade, Thirupathaiah Y, Sobhana V, Dhaneshwar Padhan, Kishore Kumar B and Babulal (2022) Application of mulberry and mulberry silkworm by-products for medical uses [Chap. 11]. In: Kole C. (ed.) The Mulberry Genome, Springer Nature, Switzerland, pp. 261-272.

Tanmoy Sarkar, Raghunath MK, Vankadara Sivaprasad and Babulal (2022) Transgenic mulberry (*Morus* spp.) for stress tolerance: Current status and challenges [Chap. 10]. In: Kole C. (ed.) The Mulberry Genome, Springer Nature, Switzerland, pp. 243-259.

Thalappally Mogili, Tanmoy Sarkar and Belaghihalli N. Gnanesh (2022) Mulberry breeding for higher leaf productivity [Chap. 3] In: Kole C. (ed.) The Mulberry Genome, Springer Nature, Switzerland, pp. 57-114.

Vijayan K, Arunakumar GS, Gnanesh BN, Sangannavar PA, Ramesha A and Zhao W (2022) Genomic designing for biotic stress resistance in mulberry. In: Kole, C. (eds) Genomic designing for biotic stress resistant technical crops. Springer Nature, Switzerland, pp. 285-336. https://doi.org/10.1007/978-3-031-09293-0_8

Vijayan K, Gnanesh BN, Shabnam AA, Sangannavar PA, Sarkar T and Zhao W (2022) Genomic designing for abiotic stress resistance in mulberry (*Morus* spp.). In: Kole C (eds). Genomic designing for abiotic stress resistant technical crops. Springer Nature, Switzerland, pp.157-244. doi.org/10.1007/978-3-031-05706-9_7

**Booklets**

Mahiba Helen S, Narendra Kumar JB, Justin Kumar J and Mary Josepha (Shery) AV (2023) Mass production of bio-control agents for the management of major pests in sericulture. Central Sericultural Research & Training Institue, Mysuru, pp. 1-34.

Sobhana V, Khare TR, Ravindra A, Amit Kumar, Dhaneshwar Padhan, Raghunath MK and Mary Josepha (Shery) AV (2023) A practical manual for soil and plant analysis in mulberry. Central Sericultural Research & Training Institue, Mysuru, pp. 1-64.

**Research Papers**

Amit Kumar, Aftab A Shabnam and Babulal (2022) Sericulture: Prospect to address the global challenges of climate change and microplastic in textile sector. *Plant Archives*, 22: 100-102.

Arunakumar GS and Gnanesh BN (2023) Evaluation of artificial inoculation methods for inducing dry and black root rot disease in mulberry (*Morus* spp.). *Archives of Phytopathology and Plant Protection* (GAPP) GAPP 2170692. https://doi.org/10.1080/03235408.2023.2170692.

Babulal (2022) Mulberry sericulture sector for south India. In: Souvenir, National Seminar on Climate Smart Sericulture-2022 Approaches for Sustainable Sericulture, 6th – 7th October 2022, Central Silk Board, Bengaluru, pp.8-15.

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Bharath Kumar N, Shivkumar, Kiran R, Kumaresan P and Sardar Singh (2023) Identification of superior autumn specific silkworm (*Bombyx mori* L.) hybrids suitable for temperate region of Jammu and Kashmir. *Int. J. Agric. Sci.,* 19: 1-7. DOI:10.15740/HAS/IJAS/19,RAAAHSTSE-2023/1-7.

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Bhuvaneswari E, Shaeeza Anjum, Thirupathaiah Y, Mallikarjuna G and Babulal (2022) Biochemical alterations in the energy metabolism of spinning and unspun larvae of silkworm, *Bombyx mori*. *Sericologia,* 62(1): 18-27.

Fagodiya RK, Malyan SK, Singh D, Kumar A, Yadav RK, Sharma PC and Pathak H (2022) Greenhouse gases emission from global salt-affected soils: Mechanistic understanding of interplay factors and reclamation approaches. *Sustainability*, 14(19): 11876.

Gayathri T, Mogili T, Rajashekar K, Gandhi Doss S, Tanmoy Sarkar, Teotia RS and Pankaj Tewary (2022). Physio-biochemical evaluation and in situ localization of reactive oxygen species (ROS) in mulberry genotypes under optimal growth conditions. *Acta Physiologiae Plantarum*. 44:141 https://doi.org/10.1007/s11738-022-03475-7

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Khare TR, Sobhana V and Kalpana GV (2023) Weed management in mulberry (*Morus alba*): A review. *Agricultural Reviews*, 44(1): 60-65.

Mahimasanthi A and Rajaram S (2021) Farmers' perceptions on drought, technological preferences in drought mitigation and their implications in mulberry sericulture in South India. *Journal of Extension Education,* 32(4): 6604-6612.

Manojkumar HB, Arunakumar GS, Gnanesh BN (2022) Molecular characterization of mulberry root-knot nematode, caused by Meloidogyne incognita using modified DNA isolation protocol. *Int. J. Curr. Microbiol. App. Sci*., 11(07): 85-98.

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Padhan D, Shivaswamy MB, Sobhana V, Ravindra, Babu CM and Babulal (2022) Selection of suitable extractants for the determination of available copper in soils of mulberry garden. *Chemical Science Review and Letters*, 11(42): 276-283.

Raju Mondal, Amit Kumar, Aftab Ahmad Shabnam and Ashish K Chaturvedi (2022) Elucidation of molecular and physiological mechanisms addressing integrated omic approaches for heavy metal stress tolerance in crops. *Crop & Pasture Science*, 73(7-8): 927-942.

Ranjini MS, Kusuma L, Moorthy SM, Chandrashekar KB, Gandhi Doss S (2023) Differential adult lifespan and starvation stress responses in laboratory evolved bivoltine silkworm breeds of *Bombyx mori* L. *Int. J. Zool. and Appl. Biosci.*, 8(5): 9-15.

Rasmi KM, Chandrasekharaiah M, Soren NM, Prasad KS, David CG, Thirupathaiah Y, Sivaprasad V (2022) Defated silkworm pupae meal as an alternative protein source for cattle. *Tropical Animal Health and Production* 29, 54(5): 327. I.F:2.0.

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Ravikumar J, Samuthiravelu P, Tilak M, Hemant Kumar L and Bhuvaneshwari T (2022) Bio-composting of Seri-farm Residues by *Trichoderma viride*. *Asian J. Microbiol. Biotech. Env. Sci.*, 24(2): 384-387.

Satish L, Kusuma L, Shery AVMJ, *et al*. (2023) Development of productive multi-viral disease-tolerant bivoltine silkworm breeds of *Bombyx mori* (Lepidoptera: Bombycidae). *Appl. Entomol. Zool*., 58: 61-71 https://doi.org/10.1007/s13355-022-00803-8

Shivkumar, Bharath Kumar N, Kiran R and Sardar Singh (2022) Development of autumn specific silkworm stable breeds and hybrids for temperate climatic condition of Jammu and Kashmir. *J. Crop and Weed*, 18(2): 162-170. DOI: https://doi.org/10.22271/09746315.2022.v18.i2.1586.

Smita S Kumar, Amit Kumar, Sandeep K Malyan, Pooja Ghosh, Madan Kumar, Rimika Kapoor, Ajay Kumar Agrawal, Sumit Kumar, Vivek Kumar and Lakhveer Singh (2022) Landfill leachate valorization: A potential alternative to burden off resources and support energy systems. *Fuel*, 331: 125911.

**International Conferences/Seminars**

Arunakumar GS, Harshitha MM, Supriya M, Manojkumar HB, Bhavya MR, Gnanesh BN, Raghunath MK, Babulal and Shivaprasad V (2022) Selection of superior mulberry hybrid based on gnenetic diverisity root rot disease resistance and higher yield. In: The 26th International Sericulture Commission Congress, 7th - 11th September 2022, University of Agricultural Science and Veterinary Medicine, Cluj-Napoca, Romania, p. 59.

Arunakumar GS, Harshitha MM, Supriya M, Manojkumar HB, Bhavya MR, Gnanesh BN, Raghunarh MK, Babulal and Sivaprasad V (2022) Selection of superior mulberry hybrids based on genetic diversity, root rot disease resistance and higher yield. In: The 26th International Sericulture Commission Congress, 7th - 11th September 2022, University of Agricultural Science and Veterinary Medicine, Cluj-Napoca, Romania, p. 89.

Balasarawathi S, Ravikumar J, Babulal and Sivaprasad V (2022) Impact of insecticides, fungicides, herbicides and bio-pesticides used for pest, weed and disease management in mulberry on soil biota in Tamil Nadu (2022). In: The 26th International Sericulture Commission Congress, 7th - 11th September 2022, University of Agricultural Science and Veterinary Medicine, Cluj-Napoca, Romania, p.85-86.

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Chandrashekar KB, Abhilash HK, Ponnuvel KM, Kusuma L, Moorthy SM, Sivaprasad V and Babulal (2022) Development of multivoltine breeds through marker assisted selection (MAS) with specific reference to diapause and non-diapause character in silkworm silkworm *Bombyx mori* L. In: The 26th International Sericulture Commission Congress, 7th - 11th September 2022, University of Agricultural Science and Veterinary Medicine, Cluj-Napoca, Romania, pp. 134-135.

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Hemaraj TM, Sindhu Noronha, Shinde Vijay Sukhdeo, Prabhasankar P, Sachindra NM, Thirupathaiah Y and Sridevi Annapurna Singh (2022). Development and characterization of protein enriched pasta using mulberry silkworm pupae (*Bombyx mori*). In: International Conference on Clinical Nutrition & Dietary Lifestyle, 20th - 21st May 2022, Bangalore, India, ISBN: 978-93-92106-12-5, pp: 35.

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Kishorekumar B, Harishkumar J and Ravindra (2022) Effect of foliar application of botanical extract on Bio-chemical constituents of Mulberry Leaf and silkworm *Bombyx mori* L. cocoon quality. In: National webinar on managing agro-chemicals for crop and environmental health, 25th - 26th February 2022, Society for fertilizers and environment, Kolkata, pp-120.

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Mallikarjuna G, Madhusudhan KN, Rajesh S, Mary Josepha AV, Moorthy SM and Babulal (2022) *In Silico* approach for identification of drugs/inhibitors to inhibit the PI3K-AKT pathway in *Bombyx mori* for controlling grasserie infection. In: The 26th International Sericulture Commission Congress, 7th - 11th September 2022, University of Agricultural Science and Veterinary Medicine, Cluj-Napoca, Romania, pp. 132-133.

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Anonymous (2023) Sampoorna – a phytoecdysterioid hormone for uniform maturity in silkworm, *Bombyx mori* L. [English] Released during Krishimela at Mandya on 3rd March 2023.

Anonymous (2023) Sampoorna – a phytoecdysterioid hormone for uniform maturity in silkworm, *Bombyx mori* L. [Kannada] Released during Krishimela at Mandya on 3rd March 2023.

Anonymous (2023) Tree mulberry cultivation [English] Released during Krishimela at Mandya on 3rd March 2023.

Anonymous (2023) Tree mulberry cultivation [Kannada] Released during Krishimela at Mandya on 3rd March 2023.

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**Microbial Sequences submitted to National Centre for Biotechnology Information (NCBI)**

| # | Lab | Microbes | Accession Number |
|---|---|---|---|
| 1 | SW PATH | *Nosema bombycis* strain Kunigal | OP090641 |
| 2 | SW PATH | *Vairimorpha* sp. strain SP2 | OP093371 |
| 3 | SW PATH | *Vairimorpha* sp. strain SP2 | OP093372 |
| 4 | SW PATH | *Aurantiochytrium acetophilum* isolate SW1 | OP891035 |
| 5 | MUL PATH | *Pediococcus pentosaceus* | OP268333 |

# 30. ADMINISTRATIVE REPORT

**CSRTI-Mysuru & Nested Units**

| State | RSRS | REC | REC-SU | P4 BSF | SSBS |
|---|---|---|---|---|---|
| Andhra Pradesh | Anantapur | Eluru<br>Palamaneru<br>Rayachoti | Bidar | | |
| Karnataka | Kodathi<br>Ch'rajanagar | Chitradurga<br>Koppal<br>Madivala | Maddur | Hassan | |
| Madhya Pradesh | | Hoshangabad | | | |
| Maharashtra | | Amaravati<br>Aurangabad<br>Baramati<br>Parbhani | | | |
| Tamil Nadu | Salem | Gobi'palayam<br>Krishnagiri<br>Samayanallur<br>Udumalpet | | | Coonooor |
| Telangana | Mulugu | Vikarabad | | | |

**Staff list of CSRTI-Mysuru & Nested Units**

**CSRTI-Mysuru**

Babulal, Director [Rtd. 31.10.2022]
Gandhi Doss S, Director [fm 20.03.2023]
Mary Shery (Joseph) AV, Sci-D
Chandra Shekar KB (Dr), Sci-D
Bala Saraswathi S (Dr), Sci-D
Bhagya R (Dr), Sci-D
Raghunath MK (Dr), Sci-D
Muthulakshmi M (Dr), Sci-D
Babu CM (Dr), Sci-D
Purushotham S (Dr), Sci-D [Rtd. 31.05.2022]
Selvarajun NG (Dr), Sci-D [Rtd. 30.06.2022]
Anuradha H Jingade, Sci-D [Rtd. 31.01.2023]
Meenal R (Dr), Sci-D
Raveendra M Mattigatti (Dr), Sci-D
Mahiba Helen S (Dr), Sci-D
Madhusudhan KN (Dr), Sci-D
Sanath Kumar YN, Sci-D
Shivakumar Hukkeri M, Sci-D (R&S) [Trn.10.03.2023]
Chandra Shekar MN, Sci-D (R&S)
Anand Kumar S, Sci-D (R&S)
Surendra Kr Upadhyay, DD (OL) [Rtd. 31.01.2023]
Ganesan V, DD (Comp.)
Om Prakash Narayan Singh, Lib. & IO
Rekha M, Dy. Director (Stat)
Amit Kumar (Dr), Sci-D
Arunakumar GS (Dr), Sci-C
Satish L (Dr), Sci-C

Thirupathaiah Y (Dr), Sci-C
Joycy Rani Dasari, Sci-C
Tanmoy Sarkar (Dr), Sci-C
Bhuvaneswari E (Dr), Sci-C
Ravindra (Dr), Sci-C
Ranjini MS (Dr), Sci-C
Shobhana V (Dr), Sci-C
Kusuma L (Dr), Sci-C
Mahesh R (Dr), Sci-C
Shivkumar (Dr), Sci-C
Gayathri T (Dr), Sci-C
Mallikarjuna G (Dr), Sci-C
Chandrakanth N (Dr), Sci-C [fm 21.04.2023]
Manjappa (Dr), Sci-C
Dhaneshwar Padhan (Dr), Sci-C
Bhavya MR, Sci-C
Divya Singh (Dr), Sci-C
Munikrishnappa HM, AD, (SM)
Thandapani M, AD (Comp.)
Gayathri K, AD (A&A)
Patnaik KL, AD (A&A)
Chandrika P, AD (A&A)
Sudha U, AD (A&A)
Suresh AN, AD (A&A) [Rtd. 31.01.2023]
Sachi K, Sr. Transl. (Hindi)
Nagarathna RJ, Supdt. (Admn.)
Geetha GS (Dr), SRA (SS)
Preethi B, Asst. Supdt. (Admn.) [Trn. 10.03.2023]
Raghu YR, Asst. Supdt. (Admn.)
Venkatesh A, Asst. Supdt. (Admn.)
Unnikrishnan N, Asst. Supdt. (Admn.)
Raja Shekar NR, Asst. Supdt. (Admn.)
Govindaraj K, Asst. Supdt. (Admn.)
S. Vijayalakshmi, Asst. Supdt. (Admn.)
Shivanna C, Asst. Supdt. (Admn.)
Shobha Rani S, Asst. Supdt. (Admn.)
Ramakrishna V, Lib. & IA
Manjula S, Steno Gr-I
Sampath Kumari KS, Steno Gr-I
Umapathy, STA
Nagaraju, STA [Rtd. 30.06.2022]
Vaikuntavasa, STA [Rtd. 31.07.2022]
Chickkamahadeva Naik, STA [Rtd. 31.08.2022]
Mahesha J (Dr), STA [Rtd. 31.10.2022]
Mruthunjaya Rao K, STA [Rtd. 31.07.2022]
Satish Chandra Babu M, STA [Rtd. 28.02.2023]
Gopal CN, STA
Muthappa STA
Chandrappa S, STA
Gausia Kauser, STA
Nagashree MN, STA
Kalaiah B, STA [Trn. 25.08.2022]
Mahadevamma MN, STA [Rtd. 30.06.2022]
Shivappa, STA
Mruthyunjaya M, STA.
Mahendra Prasad KS, STA
Pushpavathy N, STA
Suresha MS, Jr Engineer
Md. Zafar Iqbal, Jr Engineer
Suresh MS, Jr Engineer
Chandrakanth HT, SCD Gr-I [Rtd. 31.05.2022]
Sadashivaiah B, SCD Gr-I
Nataraju L, SDC Gr-I
Venkatesh Murthy N, SCD Gr-I [Rtd. 30.04.2022]
Mahesha J, SCD Gr-I
Venkatesha T, SCD Gr-I
Azad Gull, Sr.Field Asst
Vasantha Kumari VC, UDC
Chandramma K, UDC
Shubha BS, UDC
Sunanda M, UDC
Shobha Rani U, UDC
Ashwini KJ, Field Asst.
Harish BM, Field Asst.
Mahadevaswamy S, Cook
Ramesha, Technician
Sundara Murthy Y, Technician
Arumugam S, Technician
Surendra MG, Technician
Imtiaz Pasha, Assist. Technician
Rajashekara, MTS [Rtd. 31.08.2022]
Basavaraju, MTS [Rtd. 31.07.2022]
Kempamma, MTS
Mahadeva, MTS
Lokesh BM, MTS
Premamma KG, MTS
Gayathri D, MTS
Leelavathi, MTS
Nalini S, MTS
Hemavathi N, MTS
Manohara, MTS
Mohan D, MTS

**REC Sub-Unit-Maddur**

Guruswamy D (Dr), Sci-D [Rtd. 31.05.2022]
Shivakumara HB, STA [Rtd. 31.05.2022]
Kalaiah B, STA [fm 01.09.2022]

**P4 Farm-Hassan**

Dayananda (Dr), Sci-D
Onkara Murthy HN, STA [Rtd. 28.02.2023]
Rangaswamy BC, STA
Nagaraju KS, STA
Nagaraja, Asst. Tech.

**RSRS-Kodathi**

Lakshmanan V (Dr), Sci-D
Balachandran N (Dr), Sci-D [fm 20.03.2023]
Satish B Kulkarni, Sci-D
Saraswathi P, Sci-D [Rtd. 31.05.2022]
Hanumantharayappa SK, Sci-D [Rtd. 31.05.2022]
Suryanarayana Rao R, STA [Rtd. 31.01.2023]
Chandrasekharagowda, STA [fm 14.07.2022]
Padmamma K, STA
Devagam Aparna, Field Asst. [fm 10.01.2023]
Vimala C, UDC [fm. 10.03.2023]
Rajakumar G, MTS [Rtd. 30.06.2022]
Gangadharan D, MTS

**REC-Madivala (Kolar)**

Narendra Kumar JB, (Dr), Sci-D
Narayanaswamy BK, STA
Venkatarevanappa K, STA
Murthy NK, STA

**REC-Chitradurga**

Srinivasulu Y (Dr), Sci-D
Papaiah G, STA
Niranjanamurthy GN, STA
Shivanna KB, STA
Vasanthi J, STA [Trn. 16.08.2022]

**REC-Koppal**

Umesha A (Dr), Sci-C
Justin Kumar J, STA
Vasanthi J, STA [fm 26.08.2022]
Raghavendra AP, FA [Trans. 31.05.2022]
Nazeera Begum, MTS

**RSRS-Chamarajanagar**

Sivasubramonian T, Sci-D [Trans. 28.02.2023]
Sudha U, Supdt. (Admn) [Trans. 31.12.2022]
Chinnaswamy C, STA [Rtd. 30.06.2022]
Shayana R, STA
Shivamma L, STA [Rtd. 31.10.2022]
Nagesh S, SCD Gr-I
Srinivasa C, MTS [Rtd. 30.06.2022]

**REC Sub-Unit, Bidar**

Nishitha Naik V (Dr), Sci-D
Sambha, STA [Rtd. 31.07.2022]

**Andhra Pradesh**

**RSRS-Ananthapur**

Sudhakar P (Dr), Sci-D [Rtd. 31.07.2022]
Srinath B (Dr), Sc-D [fm 13.03.2023]
Kiran Kumar KP (Dr), Sci-D
Matra Manohara, Asst. Supdt. (Admn.)
Shivaiah A, STA [Rtd. 31.05.2022]
Shaik Mohamad Arif, STA
Sathyavathi Byram, STA [fm. 14.06.2022]
Lakshmidevamma Sugali, STA [Exp. 07.06.2022]
Alivelu Mangamma Mannala, STA
Krishna Veni N, STA
Ramappa C, SCD Gr-I
Sreenivasulu J, SCD Gr-I
Ravindra Naik V, Field Asst. [fm 14.06.2022]
Pedda Narashimhudu T, MTS [Rtd. 31.01.2023]

**REC-Palmaner**

Venkatachalapathy M (Dr), Sci-D
Anuradha P, STA
Suresh Babu Gona Sujin, STA
Lomada Haribabu, SCD Gr-I

**REC-Rayachoty**

Venugopal A (Dr), Sci-D [Trans. 31.10.2022]
Harry Andrus A, STA
Suneetha S, STA
Rownak S, MTS

**REC-Eluru**

Kota Nirmala Kumari, STA

**SSBS-Coonoor**

Vijay V (Dr), Sci-C
Gunavathy R, STA
Sarada TT, STA
Rubasundari A, STA

Marudhammal B, MTS

**RSRS-Salem**

Dhahira Beevi N (Dr), Sci-D
Jessy Daniel, Sci-D [Trans. 31.05.2022]
Kamaraj S, Sci-C
Vijayakumari S, STA
Sheik Sadhik Ali R, SCD Gr-I
Narayanan A, SCD Gr-I
Paramashivam A, FA
Shivalingam V, MTS [Rtd. 30.09.2022]

**REC-Krishnagiri**

Kolli Jhansi Lakshmi (Dr), Sci-D
Ranganayaki R, STA
Syama Sundara Murali, STA [Trans.22.08.2022]

**REC-Samayanallur**

Mahima Santhi A (Dr), Sci-D
Bhaskaran KVT, STA
Krishna Moorthy R, STA
Vijayalakshmi G, STA
Chellaiah M, STA [Trans. 04.02.2023]
Alagarsamy P, MTS

**REC-Gobichettipalayam**

Rajalakshmi E, Sci-D [Rtd. 28.02.2023]
Sivasubramonian T, Sci-D
Himanshu Barman (Dr), Sci-C
Gnanaprakash B, Field Asst. [fm 06.02.2023]

**REC-Udumalpet**

Samuthiravelu P (Dr), Sci-D [Rtd. 28.02.2023]

**REC-Baramati**

Humayun Sharief Y, Sci-D
Neethaben Meghdut Dang, STA
Vilas Bhujangrao Nagre, MTS
Patel Aratsinh Bhalabhai, MTS

**REC-Aurangabad**

Ram Prakash (Dr.), Sci-D
Anjali Prakash Nage, STA
Pushpa Bhaulal Ganbas (Hire), STA
Ramesha S, STA [Rtd. 31.05.2022]
Chellaiah M, STA [fm 15.02.2023]
Gnanaprakash B, Field Assist. [Trans.03.02.2023]
Palaniswamy S, Assist. Technician

**RSRS-Mulugu**

Praveen Kumar Kalla (Dr), Sci-D [Rtd. 30.11.2022]
Vinod Kumar Yadav (Dr), Sci-C
Gnaneswar R, Asst. Supdt. (Admn.) [Trans. 31.10.2022]
Tuyamani NK, STA
Rauf MA, Assist. Technician

**REC-Vikarabad**

Rajadurai S (Dr.), Sci-D
Bhagya Lakshmi Gudise, STA
Munirathnam Reddy C, Field Assist.
Buchaiah Papagari, Assist. Technician

**REC-Amravati**

Ram Vilas Kushwaha, Sci-D
Sunanda G Kasampure, STA
Dinesh Chandra, STA
Bheru Lal Kumawat, STA
Ratnadeep Arjun Zine, MTS

**REC-Parbhani**

Jadhav Ashok Limbaji, Sci-C
Sidhartha Pandurang Ingle, STA
Rakeshkumar Nilkanthrai Vyas, STA
Sabale Shubhangi Vitthalrao, Field Assist.
Dineshkumar Babubhai Patel, MTS

Nirmala Suresh Popalghat, STA
Anwarkhan Mustafakhan Pathan, SCD Gr-II
Kantilal Chunilal Surti, MTS [Rtd. 31.01.2023]

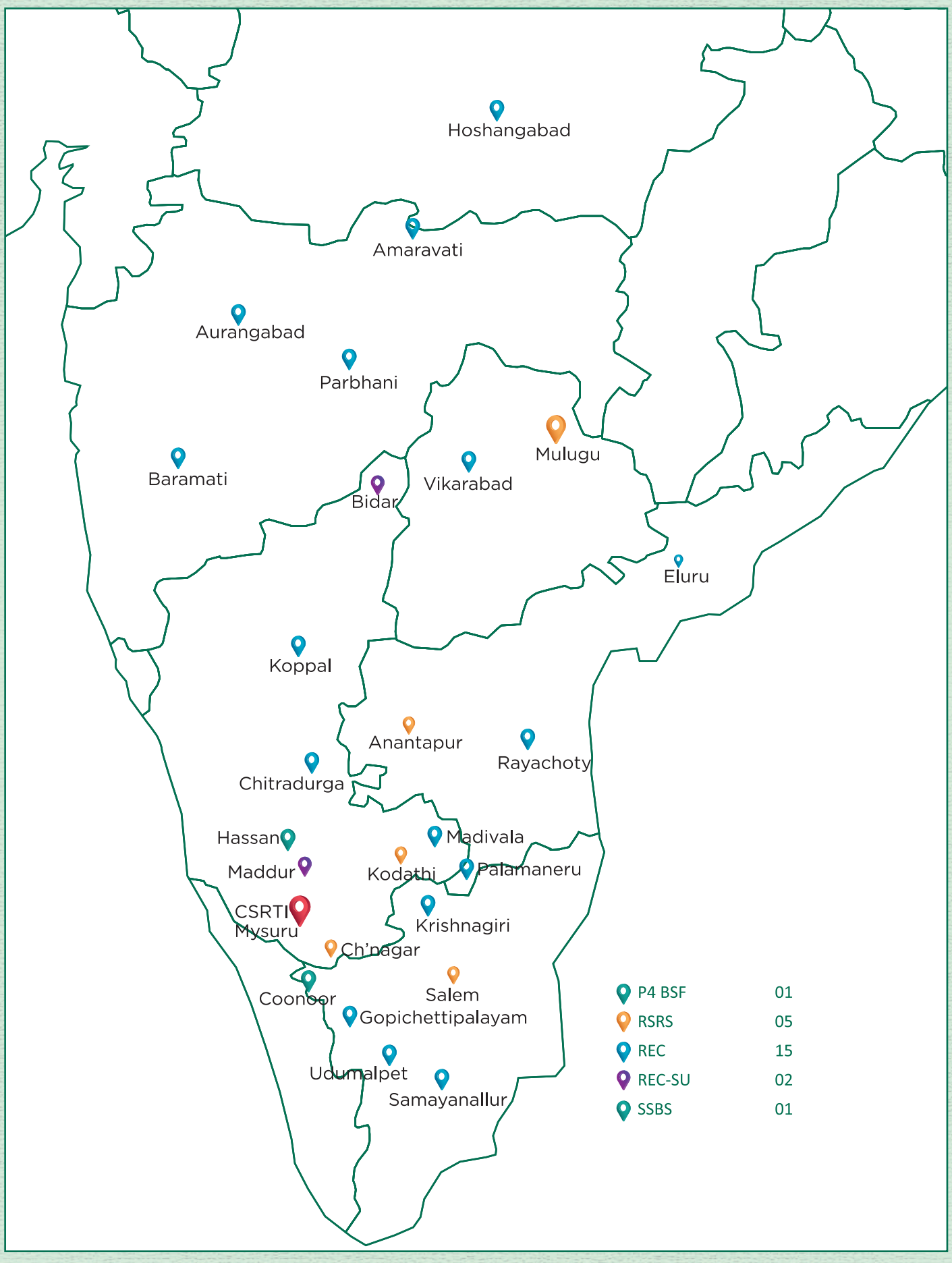
**REC-Hoshangabad**

Gnana Kumar Daniel A, Sci-D [Trans.31.03.2023]
Gamer Singh Kitawat, STA
Arjun Singh Kitawat, STA
Kanhaiya Lal Jeengar, STA

**BUDGET (Rs. in lakhs)**

| Budget Head | Grants Received | Grants Surrendered | Expenditure Incurred |
|---|---|---|---|
| 1. GIA: Salaries-36 | 3742.25 | - | 3742.25 |
| 2. GIA: SC Salaries-36 | 1052.52 | - | 1052.52 |
| 3. GIA: ST Salaries-36 | 354.55 | - | 354.55 |
| 4. GIA: Gen-31 | 789.38 | - | 789.38 |
| 5. GIA: Cap-35 | 601.07 | - | 601.07 |
| Total | 6539.77 | - | 6539.77 |

# CSRTI-Mysuru Extension/Field Units



Resham Krishimela
Organized by CSRTI-Mysuru
at Mandya on 03.03.2023

Resham Krishimela
Organized by RSRS-Ananthapur
at Hindupur
on 17.02.2023


Resham Krishimela
Organized by RSRS-Salem
at Shoolagiri, Hosur
on 21.03.2023

Resham Krishimela
Organized by RSRS-Mulugu
at Jangaondistrict, Telangana,
on 24.03.2023