वार्षिक प्रतिवेदन
Annual Report
2020-21

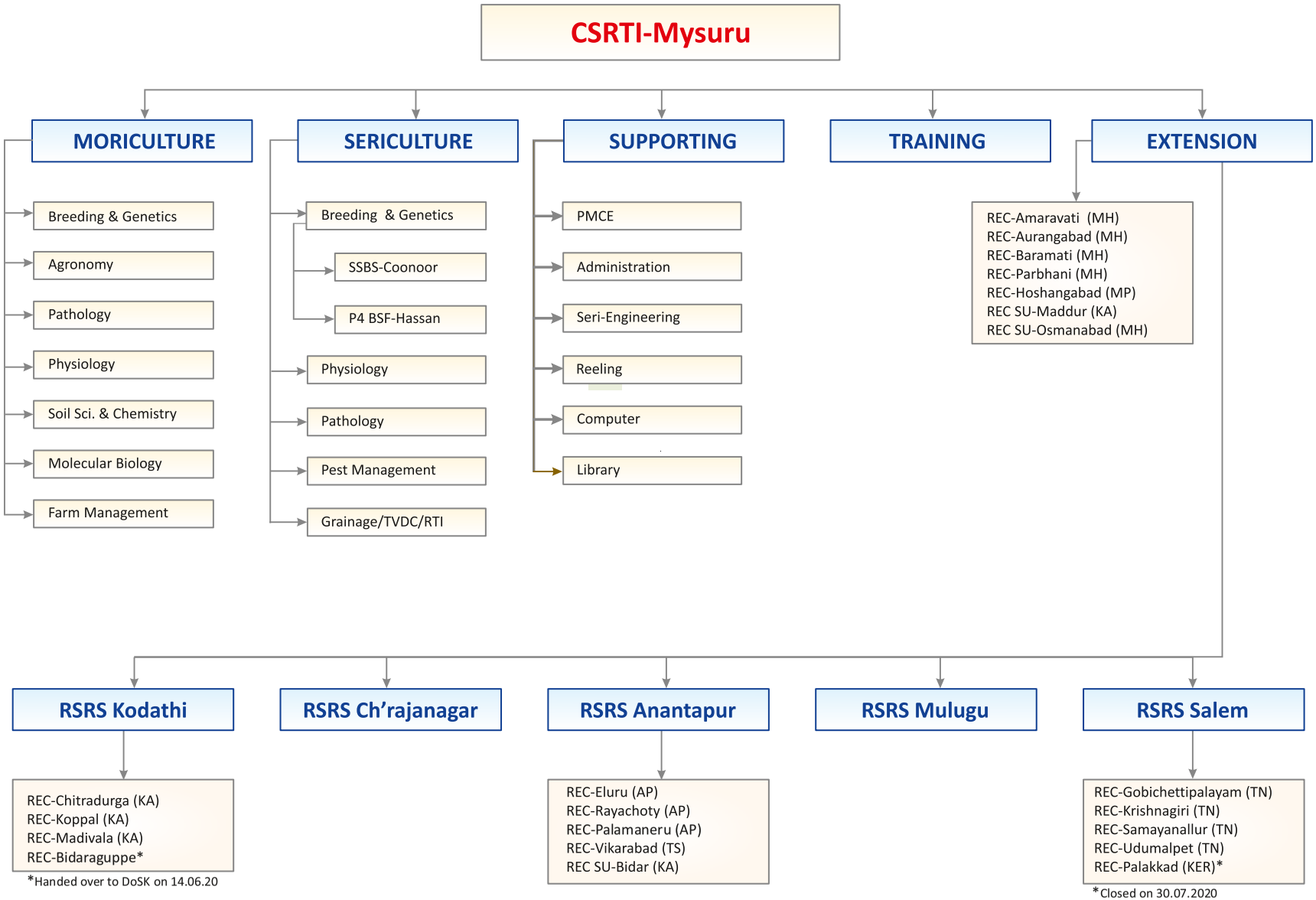
केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान

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

Central Sericultural Research & Training Institute (CSRTI)

Central Silk Board, Ministry of Textiles, Govt. of India

CSRTI-Mysuru Organizational set-up



सं./No. 57

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निदेशक
केंरेअप्रसं, मैसूरु

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हिंदी अनुवाद
श्री एस के उपाध्याय
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पृष्ठ अभिविन्यास एवं साज सज्जा
श्री जे.जस्टिन कुमार

मुद्रण
सर्वश्री गुप्ता प्रिंटर्स
विद्यारण्यपुरम
मैसूरु 570 008

प्रतियां: 100

जनवरी 2022

Published by
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Director
CSRTI, Mysuru

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Book Layout & Design
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Printed at
M/s Guptha Offset Printers
Vidyaranyapuram
Mysuru 570 008

No. of Copies: 100

December 2021

Content

प्रस्तावना

रेशम उत्पादन में राष्ट्र को आत्मनिर्भर बनाने हेतु केंद्रीय रेशम बोर्ड ने कई अनुसंधान, प्रशिक्षण एवं विस्तार कार्यक्रमों की परिकल्पना की है । भारत में रेशम उत्पादन के अग्रणी संस्थान होने के नाते केंरेअप्रसं, मैसूरु के द्वारा वर्ष 2020-21 के दौरान भी निर्धारित लक्ष्य प्राप्त करने हेतु लगातार प्रयास किया गया । कोविड़-19 महामारी के कारण मानव जीवन का दैनंदिन कार्यकलाप प्रतिकूलतः प्रभावित होने के बावजूद संस्थान प्रतिबद्ध लक्ष्य प्राप्त करने हेतु संचालित की जा रही परियोजनाओं को कार्यान्वित करते हुए अत्यंत सावधानी एवं समर्पण की भावना के साथ क्रियाशील रहा एवं अनुसंधान कार्यक्रमों का कार्यान्वयन, विभिन्न प्रशिक्षण कार्यक्रमों का संचालन तथा द्विप्रज समूह संवर्धन के माध्यम से प्रौद्योगिकी स्थानांतरण आदि कार्य अनवरत रूप से जारी रखा गया । मुख्य अनुसंधान संस्थान सहित क्षेरेअकें, अविकें, अविकें-उप एककों ने आंध्र प्रदेश, कर्नाटक, मध्य प्रदेश, महाराष्ट्र , तमिलनाडु एवं तेलंगना के प्रमुख रेशम उत्पादन क्षेत्रों में राज्य रेशम उत्पादन विभागों के साथ समन्वयन कर कार्य निष्पादित किया । रिपोर्टाधीन वर्ष के दौरान संस्थान ने पहले से चले आ रहे कार्यक्रमों को ज़ारी करने के साथ साथ कई अनुसंधान कार्यक्रम प्रारंभ किए हैं । समाप्त अनुसंधान कार्यक्रमों का विशेष परिणाम निकला जो रेशम उत्पादन उद्योग के लिए लाभप्रद सिद्ध हुआ और उसे प्रौद्योगिकी स्थानांतरण प्रशिक्षण और विस्तारण कार्यक्रमों के ज़रिए लक्ष्य समूहों तक पहुंचाया गया ।

संस्थान में दो ट्रान्स्जेनिक शहतूत पौधे विकसित किए गए । 17 शहतूत उपजातियों और दो उत्पादक द्वि संकरों यथा (बीएमवी-1×बीएमओ10)×(बीएमडी 3×बीएमएफडी), (बीएमवी-1×बीएमओ11)×(बीएमडी2× बीएमएफडी) के लिए कृषि पहचान चित्र पुस्तिका बनाई गई । तामान सहनशील द्विसंकर टीटी21 × टीटी56 के कुल 66,350 रो मु बी चक्तों का मूल्यांकन किया गया । दो नव विकसित बहु विषाणु रोग प्रतिरोधी द्विप्रज रेशमकीट द्वि संकर आरडीआईएन1 एवं आरडीआई एन2 का क्षेत्र स्तर पर परीक्षण किया गया । संस्थान ने शहतूत और वन्य क्षेत्र में एम-लैम्प प्रौद्योगिकी का मान्यकरण ज़ारी रखा । द्विप्रज समूह संवर्धन कार्यक्रम के माध्यम से 5006.60 मे.ट द्विप्रज कच्चा रेशम उत्पादित किया गया । 15,541 रेशम उत्पादकों को द्विप्रज प्रौद्योगिकियों से अवगत कराया गया और 12,184 कृषकों को उन्नत शहतूत उपजातियां उगाने हेतु प्रेरित किया गया । 66 प्रगतिशील कृषकों की कहानी का संकलन "रेशम उत्पादन जीवनगाथा, खंड-2" प्रकाशित किया गया । "दक्षिण भारत में द्विप्रज रेशम उत्पादन को बढाने हेतु प्रौद्योगिकियां" विषय पर दिनांक 24 फरवरी 2021 को वर्च्युअल (आभासी) कार्यशाला आयोजित की गई । संस्थान द्वारा दक्षिण क्षेत्र के चयनित 15 जिलों में भारत के माननीय प्रधानमंत्री के "एक जिला- एक उत्पाद" विजन कार्यक्रम का समन्वयन किया गया । क्षमता निर्माण और प्रशिक्षण कार्यक्रम के अंतर्गत कुल 2032 लोगों को प्रशिक्षित किया गया । बीज अधिनियम पर दक्षिण भारत के कुल 40 आकांक्षी उद्यमियों को प्रशिक्षण दिया गया । संस्थान ने विभिन्न विश्वविद्यालयों के छात्रों को 3-6 महीनों तक इंटर्नशिप/शोध कार्य करने हेतु मार्गनिर्देश प्रदान किया ।

सिल्कवर्म बोम्बिक्स मोरि प्यूपे से लिनोलिनिक एसिड निष्कर्षण एवं सांद्रीकरण प्रक्रिया और ऊजीमक्खी एक्सोरिस्टा बोम्बिसिस के लिए पीड़क आकर्षण संरूपण और तैयारी की प्रक्रिया के लिए पेटेंट (एनबीएआईआर एवं केंरेअप्रसं, मैसूरु द्वारा संयुक्त रूप से) आवेदन पत्र फाइल किया गया। इस अवधि के दौरान तीन पेटेन्ट प्राप्त हुए - यथा रेशम उत्पादन रद्दी को मूल्यवर्धक उत्पादों में परिवर्तित करने की प्रक्रिया (पेटेन्ट सं- 337598,दि 29/05/2020 को प्राप्त), बोम्बिक्स मोरि से फाइब्रोइन निष्कर्षण की प्रक्रिया (पेटेन्ट सं 343655, दिनांक 07/08/2020 को प्राप्त), कोर्डिसेप्स संवर्धन प्रक्रिया (पेटेन्ट सं 346580, दिनांक 11/09/2020 को प्राप्त), एनबीएआईआर, बेंगलूरु द्वारा आईसीएआर के माध्यम से ऊजी मक्खी फेरमोन ट्रैप का वाणिज्यीकरण दो फर्मों को किया गया और शहतूत में मूल विगलन रोग नियंत्रण हेतु ब्रोड स्पेक्ट्रम पारिस्थिति अनुकूल सूत्रीकरण का वाणिज्यीकरण एक और फर्म को दिया गया ।

केंरेअप्रसं, मैसूरु का वैज्ञानिक समुदाय, रेशम उत्पादन उद्योग के बेहतर भविष्य की कल्पना को साकार करने हेतु राज्य रेशम उत्पादन विभाग, कृषकों एवं उद्यमियों की साझेदारी से अनुसंधान, प्रशिक्षण एवं प्रौद्योगिकी स्थानांतरण के द्वारा उच्चतर लक्ष्य हासिल करने हेतु निरंतर प्रयासरत है ।

Foreword

Towards achieving self sufficiency in silk production in the country, the Central Silk Board has envisaged many Research, Training and Extension programmes. CSRTI-Mysuru being the pioneer in mulberry sericulture research in India is continuously toiling to achieve the goals set during 2020-21. Though the Covid-19 pandemic had a telling effect on the routine activities of human life, the Institute moved forward with utmost dedication and care in implementing the projects proposed for achieving the set goals. This was possible through the implementation of Research Programmes, conducting various training programmes and transfer of technologies through Bivoltine Cluster Promotion, etc. Along with the main research institute, the RSRSs, RECs, REC-SUs worked in tandom in coordination with State Department of Sericulture in the command area including Andhra Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Tamil Nadu and Telangana. During this period, the institute has initiated many research programmes, apart from continuing with the programmes initiated earlier. The research programmes concluded produced distinctive results, which is to the benefit of the sericulture industry and are being carried forward to the target groups through ToTs, training and extension programmes.

The institute was able to develop transgenic mulberry plants, Manual Cultivar Identification Diagram (MCID) was generated for 17 mulberry varieties and two productive double hybrids viz., (BMV1 x BMO10) x (BMD3 x BMFD), (BMV1 x BMO11) x (BMD2 x BMFD). A total of 66,350 dfls of temperature tolerant double hybrid TT21 x TT56 were evaluated. Two newly developed multi-viral diseases tolerant bivoltine silkworm double hybrids, RDIN1 and RDIN2 were subjected to evaluation under on station trials (OST). The institute continued with the validation of the M-LAMP technology in Mulberry and Vanya sector. Through Bivoltine Cluster Promotion Programme 5006.60 MT bivoltine raw silk was produced, 15,541 sericulturists were sensitized with bivoltine technologies and 12,184 farmers were motivated to plant improved mulberry varieties. A compilation depicting 66 progressive farmers narrating their saga of sericulture was published with the title, "Sericulture Success stories, Volume-2". A virtual Workshop was Organised on 24th February 2021 with the theme “Technologies to enhance Bivoltine silk production in South India”. Coordinated the “One District – One Product project”, vision of Hon’ble Prime Minister of India, in the 15 selected districts in South zone. Under Capacity Building and Training, a total of 2032 persons were trained. A total of 40 aspiring entrepreneurs from southern states were trained under Seed Act. The institute facilitated students from different Universities for internship/dissertation work for 3-6 months.

Patents applications were filed for process for extraction and concentration of α-linolenic acid from silkworm, *Bombx mori* pupae and a pest attractant composition and method of preparation thereof for uzi fly, *Exorista bombycis* (Joint patent by NBAIR and CSRTI, Mysuru). Three patents were granted during this period – *viz.,* Process for converting sericulture waste into valuable products (Patent No. 337598 granted on 29/05/2020); a process for the extraction of Fibroin from *Bombyx mori* (Patent No. 343655 granted on 07/08/2020) and a process for culturing Cordyceps (Patent No. 346580 granted on 11/09/2020). Uzi fly pheromone trap was commercialized by NBAIR, Bangalore through ICAR (Joint Product developed by NBAIR and CSRTI, Mysuru) to two firms and Rot fix - A Broad Spectrum Eco-Friendly Formulation for Control of Root Rot Disease in Mulberry was also commercialized to one more firm.

The CSRTI-Mysuru is striving hard for achieving higher goals for the benefit of the sericulture industry through Research, Training and Transfer of Technology by joining with the scientific community, the departments of sericulture and the farmers and entrepreneurs for a better tomorrow.

कें रे अ प्र सं, मैसूरु के बारे में

केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, मैसूरु केंद्रीय रेशम बोर्ड, वस्त्र मंत्रालय, भारत सरकार के तत्वावधान में संस्थापित हुआ । वर्ष 1961 में संस्थान का कार्य चन्नपट्टणा में प्रारंभ हुआ और बाद में 1963 में इसे मैसूरु स्थानांतरित किया गया । प्रशिक्षण घटक को सम्मिलित करने के बाद इस संस्थान का वर्ष 1965 में केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, मैसूरु (केंरेअप्रसं) के रूप में पुनर्नामकरण किया गया । यह संस्थान देश में रेशम उद्योग के विकास के लिए पिछले 60 सालों से समर्पित भाव से सेवाएं अर्पित 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 को 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 कृषि क्षेत्र में 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 में 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 ।
- हर पहलू से सम्बंधित मानव- संसाधन के विकास हेतु गतिविधियां संचालित करना ।
- गुणवत्तापूर्ण रेशम के उत्पादन में वृद्धि हेतु क्षेत्र में प्रभावी प्रौद्योगिकियां विकसित करके उन्हें लोकप्रिय बनाना ।

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 प्रौद्यो्गिकियों 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, बुलेटिन, पुस्तिकाएं एवं तकनीकी पैम्फलेट तथा सेरिडोक पत्रिका जिसमें अन्तर्राष्ट्रीय स्तर पर रेशम संवर्धन के बारे में लिखी जाने वाली शोध प्रबंधों का संकलन समाविष्ट रहता है, आदि का प्रकाशन किया जाता है |

विस्तार कार्य-तंत्र

प्रयोगशाला उपलब्धियों के मान्यकरण में एवं उन्हें क्षेत्र में प्रभावी ढंग से स्थानांतरित करने में 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 स्थित क्षेत्रीय रेशम उत्पादन अनुसंधान केंद्र क्षेत्र विशेष के अनुकूल और प्रायोगिक अनुसंधान संचालित करते हैं । कृषकों और विस्तारण कर्मचारियों को प्रशिक्षित करने के अतिरिक्त क्षेत्रीय आवश्यकताओं के लिए उपर्युक्त 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 तकनीकी कार्मिकों के समन्वयन से प्रौद्योगिकियों का प्रभावी स्थानांतरण किया गया है ।

प्रशिक्षण केंद्र

इस संस्थान को उष्णकटिबंधीय रेशम उत्पादन के क्षेत्र में प्रशिक्षित मानव संसाधन विकसित करने हेतु 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 हैं और योग्य संकाय सदस्यों द्वारा कार्यक्रम संचालित किए जाते हैं । करीब 125 व्यक्तियों 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 सेवाएं (11274 पुस्तकें, 8088 वैज्ञानिक पत्रिकाओं का बंध खंड, 4 अन्तर्राष्ट्रीय एवं 10 भारतीय इलेक्ट्रोनिक जर्नल तथा 35 भारतीय एवं अन्तर्राष्ट्रीय प्रिंट संस्करण जर्नल, 319 शोध पत्र, 55 पी एच डी शोध प्रबंध, तकनीकी रिपोर्ट एवं सी डी रोम डेटाबेस- 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 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 is completing 60 years of dedicated service for the development of sericulture industry in the country.

The Institute has the distinction of being premier institution for tropical sericulture research par excellence with required modern facilities and infrastructure including experienced scientific and technical personnel. CSRTI is recognized as 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 undertake Human Resource Development at all levels of operation
- To promote and popularize the cutting edge technologies in the field to increase production base of quality silk.

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 four 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 and maintenance of the breeding stocks. The institute is recognized as a nodal centre by PPV & FRA, New Delhi, for mulberry varieties. The Institute regularly publishes books, bulletins, leaflets and technical pamphlets. The institute publishes Seridoc a half yearly combilation, 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 Sub-Units (REC-SU) to facilitate validation and translation of laboratory findings effectively to the field. RSRSs are located in major sericultural zones of southern states 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 staff. 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 technical personnel of State Departments of Sericulture.

Training Centre

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

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 (11274 books; 8088 bound volumes of scientific journals; 04 Internationl Electronic journals; 10 Indian Electronic journals and 35 Indian & International print version journals; 319 dissertations; 55 Ph.D. theses; technical reports and CD-ROM database-AGRIS)

अनुसंधान, प्रशिक्षण एवं विस्तार गतिविधियों के मुख्यांश

केंरेअप्रसं, मैसूरु एवं इसके संबद्ध एककों की उपलब्धियों की मुख्य बातें निम्नवत हैं:

परपोषी पादप

- शहतूत सी.वी.जी.4 के बीजपत्र एवं बीजपत्राधर कर्त्तोतकों का उपयोग करते हुए पी.ई.पी.सी. + पी.ई.पी.सी.के. एवं सी.ए जीन युक्त ट्रान्सजेनिक शहतूत पादप विकसित किए गए ।
- सी.ए.जीन और पी.ई.पी.सी. + पी.ई.पी.सी.के. जीन युक्त 4 ट्रान्सजेनिक तंबाकू पादप विकसित किए गए । 60% क्षेत्र क्षमता के अधीन उनकी प्रकाश-संश्लेषण दर और वायु विनिमय प्राचल जीन अपरिवर्तित तंबाकू की तुलना में बेहतर रही ।
- शहतूत सी.वी.जे.4 के बीजपत्र एवं बीजपत्राधर कर्त्तोतकों का उपयोग करते हुए एस.एच.एन 1 + डी.आर.ई.बी.2 ए जीन विकसित किए गए । इन ट्रान्सजेनिक पादपों ने 60% क्षेत्र क्षमता के अंतर्गत अपरिवर्तित पौधों की तुलना में प्रकाश-संश्लेषण दर, वायु विनिमय प्राचल एवं एस.पी.ए.डी मूल्य दर्शाया ।
- ए.जी.बी-8 उपजाति ने कम निवेश सामग्री-60% उर्वरक और 60% सिंचाई की स्थितियों में अधिकतम पत्ती उपज 36.8 मे.ट/हे/वर्ष दर्ज की । इसके बाद एम.एस.जी 2 (25.0 मे.ट/हे/वर्ष) और वी-1 (24.6 मे.ट/हे/व) का निष्पादन अच्छा रहा |
- कम सिंचाई एवं उर्वरक स्थिति के अंतर्गत ए.जी.बी-8 का पत्ती से नाइट्रोजन उद्ग्रहण स्तर सबसे अधिक रहा । इसके बाद यथाक्रम जी-4 (205.4 कि.ग्रा/हे) वी-1 (195.4 कि.ग्रा/हे) और एम.एस.जी-2(188.4 कि.ग्रा/हे का निष्पादन अच्छा रहा ।
- क्षारीयता सहनशीलता हेतु दो मानचित्रण जीवसंख्या एम.आर-2×वी-1 एवं सहना×वी-1 विकसित कर क्षेत्र में लगाए/स्थापित किए गए ।
- प्रत्येक शहतूत उपजाति यथा जी-2,एआर-12,आरसी-1,सहना और एमएसजी-2 के डीयूएस परीक्षण हेतु आवेदन तैयार करके इन शहतूत उपजातियों का पीपीवी व एफआरअधिनियम 2001 के अंतर्गत पंजीकरण हेतु फाइल किया गया ।
- शहतूत की सत्रह उपजातियों के लिए कृषिजोपजाति (कल्टिवर) पहचान चित्र पुस्तिका तैयार की गई जिसका शहतूत उपजातियों की पहचान हेतु उपयोग किया जा सकता है । इसका उपयोग करते हुए सात डी.यू.एस लक्षणों के आधार पर सत्रह उपजातियों की पहचान की गई ।
- 22 सूचनाप्रद एस.एस.आर का उपयोग करते हुए 144 शहतूत जननद्रव्यों में से जीनोटाइप तैयार किया गया । एम.यू.एल.एस.एस.आर 26, एम 2 एस.एस.आर 68, एम.यू.एल.एस.एस.आर 313, एम.यू.एल.एस.एस.आर.258 और एम.ओ.एस.ओ 157-2 से 3 से 7 तक ऐलील प्राप्त किए गए जो नमूनों में विषमयुग्मजता दर्शाता है ।शुद्ध संकरों (मोरस मल्टीकॉलिस×थाइलैंड नर) को पहचानने हेतु बहुरूपी एस.एस.आर की पहचान की गई ।

रेशमकीट

- दक्षिण भारत में क्षेत्र परीक्षण के अंतर्गत दो उत्पादक द्वि संकरों यथा (बी.एम.वी.1×बी.एम.ओ10)×(बी.एम.डी 3×बी.एम.एफ.डी), (बी.एम.वी.1×बी.एम.ओ11) × (बी.एम.डी 2×बी.एम.एफ.डी) के 20,000 रो.मु.बी चकत्तों का मूल्यांकन किया गया । 62-84 कि.ग्रा/100 रो.बी.च की उपज और 22.3-22.82 कोसा कवच प्रतिशतता प्राप्त हुई जबकि साधारण एफ.सी 1× एफ.सी 2 की उपज 61-76 कि.ग्रा/100 कि.ग्रा और कोसा कवच प्रतिशतता 21.00-22.6 रही । परीक्षणाधीन संकर की रेंडिट्टा 5.00.-6.00 और रेशम कोटि 3 ए-4ए रही ।
- दक्षिण, पूर्वी,पूर्वोत्तर एवं उत्तर भारत में तापमान सहनशील द्वि संकर टी.टी.21 × टी.टी-56 के कुल 66350 रो.मु.बी चकत्तों का मूल्यांकन किया गया और यथाक्रम उपज 58-80 कि.ग्रा/100 रो.मु.बी.च, 40-88 कि.ग्रा/100 रो.मु.बी.च और 46-56 कि.ग्रा/100 रो.मु.बी.च प्राप्त हुई ।
- बहु विषाणु रोग-सहनशील दो नए विकसित द्विप्रज रेशमकीट द्विप्रज संकरों यथा आर.डी.आई.एन-1 और आर.डी.आई 2 को चार केंद्रों यथा क्षेरेअकें-कोड़ति, क्षेरेअकें, चामराजनगर, क्षेरेअकें-अनंतपुर एवं क्षेरेअकें-सेलम में क्षेत्र परीक्षण के अंतर्गत मूल्यांकन हेतु रखा गया । उत्तरजीविता प्रतिशत एवं कोसा प्राचलों के आधार पर 54% प्यूपाकरण(प्यूपेशन) आर.डी.आई एन.2 की तुलना में 74% प्यूपेशन आर.डी आई. एन 1 का चयन भविष्य के क्षेत्र परीक्षण हेतु किया गया ।
- नए विकसित रेशमकीट द्वि संकरों (डीएचपी5) का मूल्यांकन करने पर क्षे.रे.उ.अ.के. में डी.एच.पी 5 का निष्पादन बेहतर रहा ।
- शहतूत और वन्य क्षेत्र में एम-लैम्प प्रौद्योगिकी के मान्यकरण से संबंधित क्षेत्र परीक्षण के अंतर्गत केंतअप्रसं, रांची और मूलबीप्रपकें, चेन्नूरु के 500 तसर शलभों तथा पी-4 मूल बीज फार्म,हासन, पी-3 मूल बीज फार्म,मैसूरु, केंरेअप्रसं,बहरमपुर, पांपोर एवं क्षेरेअकें, देहरादून के 1565 शहतूत रेशम शलभों के परीक्षण किए गए ।

- चॉकी आहार पूरक (सीएफएसएफ) के मान्यकरण हेतु भी क्षेत्र परीक्षण किया गया । कुल 3000 रो.मु.बी.चकत्तों का मूल्यांकन करने पर पाया गया कि लार्वों की गुमशुदगी में 33% कमी हुई जबकि कम आकार की लार्वा प्रतिशत में भी अपेक्षाकृत 16% की कमी हुई । मानक की तुलना में कोसा उपज में 5% की वृद्धि हुई ।
- पी.एम.4 वंश का निष्पादन रेशम उत्पादन विभाग, कुनिगल द्वारा रेशम उत्पादन विभाग, कर्नाटक के मूल बीज फार्मों में बनाए रखे वंशों से बेहतर रहा ।
- पी.एम.4×सी.एस.आर 2 के 1500 संकर नस्लों की 150 कृषकों को आपूर्ति की गई । क्षेत्र में उपलब्ध संकर नस्ल की तुलना में बेहतर लाभप्रद विशेषक परिलक्षित हुए ।अंड़ जनन क्षमता 53.6±20, उपज 69-74/100 रो.मुबी.च, कोसा कवच आपूर्ति 1.936-2.01 ग्राम), कोसा कवच अनुपात (19.79-21.0) और प्यूपीय/प्यूपा निर्माण की दर 87-91 दर्ज की गई ।
- कावेरी गोल्ड(एम.वी1×एस8) से वर्तमान संकर-नस्ल पी.एम × सी.एस.आर 2 की अपेक्षा रु.15 से रु.35 प्रति कि.ग्रा अधिक आय प्राप्त हुई जबकि औसतन उपज 63.37 कि.ग्रा/100 रो.बी.च रही ।
- देशी और विदेशी द्विप्रज नस्लों का उपयोग करते हुए उन्नत रेशम गुणवत्तावाले बहु प्रज नस्ल विकसित करने हेतु उप रति एवं अनुपरति लक्षण से संबद्ध 3 जीन (मिथाइल ट्रांसफरेज़, एसील कोएंज़ाइम, ए.डीहाइड्रोजीनेस एवं न्यूक्लियोस एसेम्बली प्रोटीन) पैतृक वंशों में प्रकट हुए ।
- उत्पादकता बढ़ाने हेतु रेशमकीट मध्यांत्र से नए प्रोबायोटिक की छान-बीन करके उनका मूल्यांकन किया गया ।
- "दक्षिण भारतीय राज्यों में रेशमकीट रोग अनुवीक्षण" पर संचालित किए जा रहे श्रृंखला कार्यक्रम से प्राप्त सर्वेक्षण आंकड़ों का संकलन किया गया । आंध्रप्रदेश में ग्रैसरी का प्रकोप 2.57%, फ्लैचरी का प्रकोप 3.55% और मस्कार्डिन का प्रकोप 0.34% रहा जबकि महाराष्ट्र में ग्रैसरी का प्रकोप 0.44% और फ्लैचरी का प्रकोप 0.17% रहा । तमिलनाडु में 0.03% गैसरी, 0.29% फ्लैचरी और 0.66 % मस्कार्डिन का प्रकोप दर्ज किया गया ।
- सर्वेक्षण के माध्यम से विषाणु प्रगुणन प्रक्रिया में सम्मिलित सक्रिय प्रोटीन की पहचान की गई । मार्गबाधक के निरोध के लिए सजातीयता बंधन, हाइड्रोजन बोंड एवं ऊर्जा क्षमता के आधार पर दस प्रभावी ड्रग का चयन किया गया ।
- कर्नाटक और तमिलनाडु में दो मौसम में बी.एम.डी.एन.वी सर्वेक्षण किया गया । कर्नाटक में वाइरल फ्लैचरी के सामान्य लक्षणों के साथ रोग प्रकोप मई 2020 के दौरान 0.95% रहा जबकि अक्तूबर 2020 के दौरान कोई प्रकोप नहीं हुआ । तमिलनाडु में अक्तूबर के दौरान 0.1% प्रकोप पाया गया ।
- केंरेअप्रसं, मैसूरु में पेब्रिन अनुवीक्षण की 20 वीं बैठक आयोजित की गई । निदेशक, केंरेअप्रसं, मैसूरु ने बैठक की अध्यक्षता की । निदेशक, रा.रे.बी.सं एवं सभी मू.बी.फा के चयनित दल-प्रधानों ने आभासी बैठक में भाग लिया ।
- 1350 कृषकों (कर्नाटक-425, तमिलनाडु-330, आंध्र प्रदेश-415, महाराष्ट्र-180 कृषक) के साथ ऊजी मक्खी फेरमॉन ट्रैप परीक्षण का प्रदर्शन एवं प्रचार-प्रसार किया गया जबकि 1000 कृषकों के साथ परीक्षण करने का लक्ष्य निर्धारित था ।
- रेशमकीट ऊजी मक्खी का नियंत्रण करते हुए 862 रो.मु.बी.चकत्तों का पालन करने के लिए नेसोलिंक्स थाइमस की कुल 1724 थैलियों की आपूर्ति की गई। पत्ती रॉलर(डायफेनिया पलवेरुलेंटालिस) के प्रबंधन हेतु कर्नाटक, तमिलनाडु और आंध्र प्रदेश के कृषकों को 130 अंड परजीव्याभ (पारासिटाइड) (ट्राइकोग्रामा किलोनिस) और 67 लार्वीय परजीव्याभ (ब्रेकान ब्रेविकोर्निस) की आपूर्ति की गई । कर्नाटक एवं तमिलनाडु के किसानों को मलबरी थ्रिप्स (स्यूडोडेंड्रोथ्रिप्समोरी) पर जैविक नियंत्रण करने के लिए पीड़क (ब्लएोस्टेथस पैलेसिंस) के 38 एकक की आपूर्ति की गई । पीड़कों को छोड़ने से थ्रिप्स संक्रमण की दर 43% से घटकर 10% हो गई ।

विस्तारण

- कर्नाटक, आंध्रप्रदेश, तमिलनाडु, केरल, तेलंगाना और महाराष्ट्र के मेगाक्लस्टरों तथा स्वतंत्र क्षेत्र के क्लस्टरों (6 स्वतंत्र क्लस्टरों समेत 26 मेगा क्लस्टर) में कार्यान्वित द्विप्रज क्लस्टर विकास कार्यक्रम के अंतर्गत 449.75 लाख रोमुबीचकत्तों का कीटपालन कर 73.83 कि.ग्रा / 100 रोमुबीच की औसत उपज प्राप्त की गई जिससे 5006.60 मी.ट. द्विप्रज कच्चा रेशम उत्पादित किया गया ।
- 246 विस्तार संचार कार्यक्रमों के माध्यम से 15541 रेशम उत्पादकों को द्विप्रज रेशम कीटपालन, शहतूत एवं रेशमकीट रोग प्रबंधन और गुणवत्तापूर्ण कोसा उत्पादन प्रक्रिया से अवगत कराया गया ।
- एम-किसान पोर्टल के अंतर्गत कर्नाटक, आंध्रप्रदेश, तमिलनाडु, केरल, तेलंगाना और महाराष्ट्र तथा मध्य प्रदेश के 76200 पंजीकृत कृषकों

को हर पखवाड़े कन्नड, तेलुगु, तमिल और हिंदी में 96 संदेश भेजे गए ।

- कृषकों तथा छात्रों समेत कुल 180 आगंतुकों ने संस्थान का दौरा किया ।
- प्रगतिशील रेशम उत्पादकों की विवरणिका "सेरिकल्चर सक्सेस स्टोरिज़" खंड-2 का प्रकाशन किया गया एवं इसका विमोचन डॉ. महादेव बी शेट्टि, उप कुलपति, अ.स.स. के अध्यक्ष कृषि विज्ञान विश्वविद्यालय, धारवाड और डॉ. पंकज तिवारी, निदेशक, केंरेअप्रसं, मैसूरु ने किया । इस पुस्तक में रेशम उत्पादन को सुस्थिर आजीविका के रूप में अपनाए वाले 66 प्रगतिशील कृषकों की जीवन गाथा पर प्रकाश डालते हुए उनके प्रयास की सराहना की गई है । यह पुस्तक भारत भर के केंरेबो संस्थानों और रेशम उत्पादन विभाग को वितरित की गई ।
- संबंधित राज्य रेशम विभाग के समन्वय से अप्रैल से नवंबर 2020की अवधि की दक्षिण अंचल समूहों की सी.पी.पी की समीक्षा 28 एवं 29 दिसंबर 2020 को वर्चुअल (आभासी) माध्यम से के.रे.उ अ. व प्र.सं, मैसूर में आयोजित की गई |
- क्लस्टरों में रेशम उतपादन को बढावा देने हेतु 26 मेगा क्लस्टरों में 12184 कृषकों को उन्नत शहतूत उपजातियां लगाने को प्रेरित करते हुए कुल 16202.58 एकड़ क्षेत्र में अनुप्रस्थ पौधरोपण विस्तार पर ज़ोर दिया गया ।
- सीम प्रभाग, केंरेअप्रसं, मैसूरु द्वारा 'दक्षिण भारत में द्विप्रज रेशम उत्पादन को बढावा देने हेतु प्रौद्योगिकियां' विषय पर दि 24 फरवरी 2021 को वर्चुअल (आभासी) कार्यशाला आयोजित की गई । विभिन्न संस्थानों/विभागों/विश्वविद्यालयों के वैज्ञानिक कार्मिकों के साथ उपलब्धियों और भविष्य की प्रौद्योगिकियों के बारे में विचार-विनिमय करना इस कार्यशाला का उद्देश्य था । वाणिज्यिक चॉकी कीटपालन केंद्र की संस्थापना हेतु बीज अधिनियम के अंतर्गत दक्षिण राज्यों के कुल 40 उद्यमियों को प्रशिक्षण दिया गया । विभिन्न विश्वविद्यालयों के छात्रों ने 3-6 महीनों की अवधि के लिए इंटर्नशिप/प्रबंधन कार्य किया ।
- भारत के माननीय प्रधानमंत्री की भावी-दृष्टि "एक जिला –एक उत्पाद" के अंतर्गत केंरेबो द्वारा क्षेत्र की भौगोलिक स्थिति जलवायु स्थिति, उगाई जाने वाली मुख्य फसलें, लोगों की सामाजिक आर्थिक स्थिति, उपलब्ध अवसंरचनाएं, रेशम उत्पादन में विकास की संभावनाएं आदि के आधार पर चयनित दक्षिण अंचल के 15 जिलों में रेशम उत्पादन विकास परियोजना के कार्यान्वयन का समन्वयन किया गया ।

प्रशिक्षण

- क्षमता निर्माण एवं प्रशिक्षण कार्यक्रम के अंतर्गत 2032 अभ्यर्थियों को प्रशिक्षित किया गया जबकि लक्ष्य 1860 था ।
- उद्यमी विकास कार्यक्रम पर कुशलता प्रशिक्षण कार्यक्रम के अंतर्गत दक्षिण राज्य के 39 केंरेबो कर्मचारियों को प्रशिक्षण दिया गया जबकि राज्य के लिए लक्ष्य 30 निर्धारित था ।
- दावनगेरे, कर्नाटक के कृषक अन्वेषक डॉ करिबसप्पा द्वारा कृषि फसलों में कीटों और पीड़कों के प्राकृतिक नियंत्रण के लिए "सोलर ट्रैप" का प्रदर्शन किया गया जिसका उपयोग पीड़क नियंत्रण हेतु शहतूत बागानों में किया जा सकता है ।
- सही सिंचाई प्रबंधन और रेशम कीटपालन एवं सफल कोसा प्राप्ति हेतु रेशम कीटपालन गृह में अनुकूल तापमान एवं आर्द्रता बनाए रखने हेतु कृत्रिम बुद्धिमता से युक्त सलाहकारी "स्मार्ट फार्मिंग" का प्रदर्शन वोल्कस टेकनॉलॉजी सोल्यूशन्स प्राइवेट लिमिटेड, बेंगलूरु द्वारा संचालित किया गया ।
- वाणिज्यिक चॉकी कीटपालन केंद्र की संस्थापना पर बीज अधिनियम के अंतर्गत दक्षिण राज्य के कुल 40 उद्यमियों को प्रशिक्षण दिया गया ।
- विभिन्न विश्वविद्यालयों के 52 छात्रों ने 3-6 महीनों की अवधि के लिए इंटर्नशिप/प्रबंधन कार्य किया ।

एकस्व (पेटेंट) व वाणिज्यीकरण

फाइल किए गए पेटेंट

- रेशमकीट बोम्बिक्स मोरी प्यूपे से अल्फा लिनोलेनिक एसिड का निष्कर्षण एवं सांद्रीकरण(भारतीय एकस्व आवेदन सं 202041042040, दि 25 सितंबर 2020) प्रस्तुत किया गया ।
- ऊजी मक्खी पीड़क आकर्षणकारी संरचना एवं तैयारी विधि एक्सोरिस्टा बोम्बिसिस (एनबीएआईआर और सीएसआरटीआई, मैसूरु द्वारा संयुक्त रूप से एकस्व आवेदन सं 202011034663, दि 12 अगस्त 2020 प्रस्तुत किया गया) ।

प्राप्त एकस्व

- रेशम उत्पादन अवशिष्ट को मूल्यवान उत्पाद में परिवर्तन करने की प्रक्रिया (एकस्व सं-337598 की मंज़ूरी दि. 29.05.2020 को प्राप्त हुई)
- बोम्बिक्स मोरी से फाइब्रोइन निष्कर्षण की प्रक्रिया (दि. 07.08.2020 को एकस्व सं.343655 की मंज़ूरी प्राप्त हुई ।
- कोर्डिसिप्स संवर्धन प्रक्रिया (एकस्व सं.346580 दि 11.09.2020)

वाणिज्यीकृत

- एनबीएआईआर, बेंगलूरु द्वारा आई सी ए आर के माध्यम से (एनबीएआईआर और सीएसआरटीआई, मैसूरु द्वारा संयुक्त रूप से विकसित उत्पाद) ऊजी मक्खी फेरमोन ट्रैप का वाणिज्यीकरण दो फर्म-ए जी ओर्गेनिक्स, दूसरा क्रोस, सं 5/51, बिकासिपुर मेन रोड, जे,सी इंडस्ट्रियल एरिया, येलचेनहल्ली, बेंगलूरु. तथा प्योर केमिकल्स लैबोरटरीज़ प्राइवेट लिमिटेड, 82. प्रथम एवेन्यू, टीचर्स कॉलनी, कोरमंगला, बेंगलूरु के साथ किया गया ।
- रॉट फिक्स- शहतूत में मूल विगलन रोग नियंत्रण हेतु ब्रोड स्पेक्ट्रम पारि-अनुकूल सूत्र । सर्वश्री कावेरि एग्रो प्रोडक्ट्स द्वारा अनुज्ञप्ति पत्र (18.05.2020) लिया गया ।

अनुज्ञप्ति का नवीनीकरण

- विजेता-बेड़ विसंक्रामक: सर्वश्री रेइनबो एग्रो-वेट टेक्नॉलजिज़, कड़प्पा । अनुज्ञप्ति नवीकरण दि 22.09.2020 को किया गया ।
- अंकुश-नया बेड विसंक्रामक: सर्वश्री सेरि-कॉन टेक्नॉलजिज़, बेंगलूरु । अनुज्ञप्ति का नवीकरण दि 22.09.2020 को किया गया ।
- अंकुश-नया बेड़ विसंक्रामक: सर्वश्री सेरि कॉन टेक्नॉलजिज़, बेंगलूरु । अनुज्ञप्ति का नवीकरण दि 01.10.2020 को किया गया ।
- विजेता अनुपूरक चूर्ण- सर्वश्री रेइनबो एग्रो-वेट टेक्नॉलजिज़, कड़प्पा । अनुज्ञप्ति नवीकरण दि 22.09.2020 को किया गया ।

HIGHLIGHTS OF RESEARCH, TRAINING AND EXTENSION ACTIVITIES

The salient achievements of CSRTI-Mysuru and its nested units

HOST PLANT

- Developed two transgenic mulberry plants containing PEPC+ PEPCK genes and CA gene using cotyledon and hypocotyl explants of mulberry cv. G4.
- Four transgenic tobacco plants containing CA gene and PEPCK+PEPC genes were developed. They showed better photosynthetic rate and gas exchange parameters than non-transformed tobacco under 60% field capacity
- Transgenic mulberry plants containing SHN1+DREB2A genes were developed using cotyledon and hypocotyl explants of mulberry cv. G4 which showed better photosynthetic rate, gas exchange parameters and SPAD value than non-transformed plants under 60% field capacity.
- Under low input conditions i.e. 60% fertilizer and 60% irrigation levels, the variety AGB-8 recorded the highest leaf yield of 36.8 MT/ha/yr followed by MSG-2 (25.0 MT/ha/yr) and V1 (24.6 MT/ha/yr).
- Highest level of nitrogen uptake from leaf was observed in the variety AGB-8 (311.6 kg/ha) followed by G-4 (205.4 kg/ha), V-1 (195.4 kg/ha) and MSG-2 (188.4 kg/ha) respectively under low input conditions.
- Two mapping population MR-2 × V-1 and Sahana × V-1 for alkalinity tolerance has been developed and established in the field.
- The DUS test application for each mulberry variety viz. G-2, AR-12, RC-1, Sahana and MSG-2 was prepared and have been filed for registration of these mulberry varieties under PPV&FR Act 2001.
- Manual Cultivar Identification Diagram (MCID) was generated for seventeen (reference and candidate) varieties of mulberry which is used for the identification of mulberry varieties. Utilizing this, seventeen

varieties were identified based on seven DUS characters.

- 144 mulberry germplasm were genotyped using 22 informative SSRs. SSRs of MULSSR26, M2SSR68, MULSSR313, MULSSR258 and MoSo-157-2 produced three to seven alleles representing heterozygosity among the samples. Polymorphic SSRs were also identified for detection of true hybrids (*Morus multicaulis* x Thailand Male)

SILKWORM

- Two productive double hybrid viz., (BMV1 x BMO10) x (BMD3 x BMFD), (BMV1 x BMO11) x (BMD2 x BMFD) were evaluated with 20,000 dfls each under OFT in South India. The yield obtained was 62-84kg/100 dfls with shell% of 22.3 to 22.82 compared to 61-76kg /100kg yield with shell% of 21.0 to 22.6 in control, FC1 x FC2. The test hybrid exhibited renditta of 5.0 to 6.0 with 3A-4A grade.
- A total of 66350 dfls of temperature tolerant double hybrid TT21 x TT56 was evaluated in South India, Eastern & North Eastern India and North India. The yield obtained was 58-80kg/100 dfls, 40-88kg/100 dfls, and 46-56kg/100 dfls in South India, Eastern & North Eastern India and North India respectively
- Two newly developed multi-viral diseases tolerant bivoltine silkworm double hybrids, RDIN1 and RDIN2 were subjected to evaluation under on station trials (OST) at four RSRSs - *viz.,* RSRS-Kodathi, RSRS-Chamarajanagara, RSRS-Ananthapur and RSRS-Salem. Based on the survivability percentage and cocoon parameters, RDIN1 has been further selected for OFT with a pupation of 74% under inoculated condition compared with RDIN2 with 54 % pupation.
- Under OST Evaluation of newly developed silkworm double hybrids, DHP5 has performed better at RSRS.
- Under the OST Programme: Validation of the M-LAMP technology in Mulberry and Vanya sector, tested 500 Tasar moths at CTR&TI, Ranchi and BSMTC Chennuru and 1565 Mulberry silk moth samples from P4 BSF Hassan, P3 BSF Mysuru, CSRTI, Berhampore, CSRTI Pampore and RSRS Dehradun.
- On station trials were undertaken to validate the chawki feed supplement formulation (CFSF). These were evaluated for 3000 dfls and showed 33% reduction in missing larvae, 16% reduction in undersized larvae percentage with an average improvement of 5% cocoon yield over control.
- PM4 line performed better over the lines maintained by DOS Kunigal at BSFs of department of sericulture, Karnataka.
- 1500 cross breed dfls of PM4xCSR2 supplied to 150 farmers. The economical traits were better than the available crossbreed with a fecundity 536±20, Yield 69-74 /100dfls, cocoon wt. (1.935 – 2.01g), Shell ratio (19.79-21.0) and pupation % of 87 to 91.
- Cauvery gold (MV1X S8) got Rs. 15 to 35 /Kg more than the existing cross breed PM×CSR2 with an average yield of 63.37 Kgs/100 dfls.
- For the development of multivoltine breeds with improved silk quality utilizing indigenous and exotic bivoltine breeds three genes (*Methyl transferase, Acyl coenzyme A dehydrogenase and Nucleosome assembly protein*) associated with diapause and non-diapause characters were expressed in parental lines.
- Novel probiotic bacteria from silkworm midgut were screened and evaluated for improving productivity.
- Compiled the survey data obtained from the continuous programme “Silkworm Disease Monitoring in South Indian States”. In Andhra Pradesh grasserie incidence was 2.57%, followed by 3.55% flacherie and 0.34% muscardine. Whereas the grasserie incidence in Maharashtra was 0.44% and 0.17% flacherie. In Tamil Nadu 0.03% grasserie, 0.29% flacherie and 0.66% muscardine was reported.

- The proteins that are actively involved in viral multiplication process were identified by thorough literature survey. Based on the binding affinity, number of hydrogen bonds and energy efficiency for the inhibition of the pathway ten effective drugs has been shortlisted.
- BmDNV survey was carried out in two seasons in Karnataka and Tamil Nadu. The incidence of disease with typical symptoms of viral flacherie was 0.95% in May 2020 in and Nil in October 2020 in Karnataka. The incidence was 1.0% in Tamil Nadu during October 2020.
- Conducted the 20th meeting of pebrine monitoring committee at CSRTI, Mysuru. Director CSRTI chaired the meeting. Director NSSO and the team leaders of all BSFs selected for the monitoring attended the meeting virtually.
- Demonstration and popularization of Uzi fly pheromone trap trials have been conducted with 1350 farmers (Karnataka 425 farmers; Tamil Nadu 330 farmers; Andhra Pradesh 415 farmers and in Maharashtra 180 farmers) against the target of 1000 farmers.
- A total of 1724 pouches of *Nesolynx thymus* were supplied to cover 862 dfls rearing for the management of silkworm uzi fly. For Leaf roller (*Diaphania pulverulentalis*) management, 130 units of egg parasitoid (*Trichogramma chilonis*) and 67 units of larval parasitoid (*Bracon brevicornis*) were supplied to farmers from Karnataka, Tamil Nadu and Andhra Pradesh. For the biological control of mulberry thrips, *Pseudodendrothrips mori,* supplied 38 units of predator, *Blaptostethus pallescens* to Karnataka and Tamil Nadu farmers. Following the introduction of the predators the thrips incidence reduced from 43% to below 10 %.

EXTENSION

- A quantity of 5006.60 MT bivoltine raw silk was produced through Bivoltine Cluster Promotion Programme implemented in 26 mega clusters including 6 Non Captive clusters of Karnataka, Andhra Pradesh, Tamil Nadu, Kerala, Telangana, Maharashtra and non captive area from 449.75 lakh dfls rearing with an average cocoon yield of 73.83 kg/100 dfls.
- 15541 sericulturists were sensitized with new technologies through 246 extension communication programmes in bivoltine rearing, mulberry and silkworm disease management and quality cocoon production.
- Under M-*kisan* Portal, 96 Messages were sent to 76200 registered farmers fortnightly to Karnataka, Andhra Pradesh, Telangana, Tamil Nadu, Maharashtra and MP in Kannada, Telugu, Tamil and Hindi.
- A total of 180 visitors including farmers and students visited the Institute.
- A compilation depicting flourishing sericulturists titled “Sericulture Success stories” volume -II was published and released by Dr. Mahadev B Chetti, RAC Chairman & Vice Chancellor, University of Agricultural Sciences, Dharwad and Dr. Pankaj Tewary, Director, CSRTI, Mysuru on 23rd December, 2020 at CSRTI, Mysuru. The book is a collection of 66 progressive farmers narrating their saga of sericulture life and appreciation on taking it as their way of life for sustainable livelihood. The books were distributed to all CSB institutes and DOS offices across India.
- To monitor the performance of south zone clusters for the period from Apri to Nov. 2020, a virtual CPP review meeting in coordination with the respective state sericulture departments was held during 28th & 29th Dec. 2020 at CSRTI-Mysuru.
- In order to increase the silk production in the clusters, more emphasis was given on horizontal expansion and 12184 farmers were motivated to plant improved mulberry varieties to the extent of 16202.58 acres in the 26 mega clusters along with non-captive areas.

- Virtual Workshop was Organised by SEEM division, CSRTI-Mysuru on 24th February 2021 with the theme "*Technologies to enhance Bivoltine silk production in South India*", with a purpose to exchange ideas on the achievements and future sericulture technologies with scientific personnel of various institutions / departments/Universities/ DOS representatives, farmers, reelers and weavers.
- Coordinated in implementation of Sericulture Development Project under '*One District – One Product*' vision of Hon'ble Prime Minister of India, in the 15 districts selected in South zone based on the details pertaining to geography, climatic conditions, predominant crops grown, socio-economic status of people, sericulture infrastructures already available, scope for development of sericulture.

TRAINING

- Under Capacity Building and Training, a total of 2032 persons were trained against the target of 1860.
- Under the skill Training on Entrepreneurship Development Programme (STEP) 39 CSB staff from southern states were trained against a target of 30.
- A demonstration of "Solar Trap" for natural control of insects and pests in agriculture crops was conducted by Dr. Karibasappa, Farmer inventor from Davangere, Karnataka which can be used for control of pests in mulberry gardens.
- Demonstrated "Smart Farming", AI backed intelligence and advisory for the precise irrigation management, monitoring climate inside the rearing house for maintenance of optimum temperature and humidity required for silkworm rearing and successful harvesting of cocoons. The demonstration was conducted by WOLKUS TECHNOLOGY SOLUTIONS PVT LTD, Bangalore.
- A total of 40 aspiring entrepreneurs from southern states were trained under Seed Act for the establishment of commercial Chawki rearing Centre (CRC).
- 52 Students from different Universities attended internship/dissertation work for a period of 3-6 months.

Patents and commercialization

Patents filed

- Process for extraction and concentration of α-linolenic acid from silkworm, *Bombx mori* pupae [Indian patent Appl. no. 202041042040, dated 25th September 2020]
- A pest attractant composition and method of preparation thereof for uzi fly, *Exorista bombycis* (Joint patent by NBAIR and CSRTI, Mysuru - Filed by NBAIR, Bangalore). Indian patent Appl. no. 202011034663 dated 12th August 2020.

Patents granted

- Process for converting sericulture waste in to valuable products (Patent No. 337598 granted on 29/05/2020).
- A process for the extraction of Fibroin from *Bombyx mori* (Patent No. 343655 granted on 07/08/2020).
- A process for culturing Cordyceps (Patent No. 346580 granted on 11/09/2020)

Commercialized

- Uzi fly pheromone trap commercialization was under taken by NBAIR, Bangalore through ICAR (A Joint Product developed by NBAIR and CSRTI, Mysuru) to two firms AG ORGANICZ, 2nd Cross, No.51/5,

Bikasipura Main Road, JC Industrial Area,, Yelachenahalli, Bangalore. Pure Chemicals Laboratories Pvt. Ltd., 82, Ist Avenue, Teachers Colony, Koramangala, Bangalore.

- Rot fix - A Broad Spectrum Eco-Friendly Formulation for Control of Root Rot Disease in Mulberry. License was taken by M/s. Kaveri Agro Products Mysuru (18.05.2020)

License renewed

- *Vijetha* - Bed disinfectant: M/S. Rainbow Agro-Vet Technologies, Cuddapah License renewed on 22.09.2020.
- Ankush - Bed disinfectant: M/S. Rainbow Agro-Vet Technologies, Cuddapah License renewed on 22.09.2020.
- Ankush - Bed disinfectant: M/S. Seri-Con Technologies Bangalore License renewed on 01.10.2020.
- Vijetha Supplement Powder - Silkworm bed disinfectant: M/S. Rainbow Agro-Vet Technologies, Cuddapah License renewed on 22.09.2020.

राजभाषा कार्यान्वयन संबंधी गतिविधियाँ

केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, मैसूरु में वर्ष 2020-21 के दौरान राजभाषा नीति का सफलतापूर्वक अनुपालन किया गया। राजभाषा के महत्वपूर्ण प्रावधान यथा राजभाषा अधिनियम की धारा 3(3), राजभाषा नियम - 5 आदि का भी शत प्रतिशत अनुपालन सुनिश्चित किया गया । संस्थान में हर तिमाही में राजभाषा कार्यान्वयन समिति की बैठक का आयोजन कर राजभाषा प्रगति के बारे में समीक्षा की गई एवं हिन्दी कार्यशाला का आयोजन नियमित रूप से किया गया । निर्धारित लक्ष्य के अनुसार हिन्दी टिप्पण-आलेखन के अलावा महत्वपूर्ण वैज्ञानिक एवं तकनीकी साहित्य को भी हिन्दी में प्रकाशित करने का कार्य किया गया ।

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

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

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

3. **हिंदी पत्राचार:** वर्ष के दौरान क, ख तथा ग क्षेत्र स्थित केंद्रीय सरकारी कार्यालयों को क्रमश: 77%, 78% और 78% पत्र हिंदी में भेज कर निर्धारित लक्ष्य प्राप्त किया गया है ।

4. **राजभाषा कार्यान्वयन समिति की बैठकों का आयोजन:** संस्थान में हर तिमाही में राजभाषा कार्यान्वयन समिति की बैठक का आयोजन कर राजभाषा के प्रगामी प्रयोग के बारे में समीक्षा की गई । वर्ष 2020-21 के अंतर्गत दिनांक 05.06.2020, 26.08.2020, 03.12.2020 एवं 05.03.2021 को राजभाषा कार्यान्वयन समिति की बैठक आयोजित की गई तथा बैठकों में लिए गए निर्णय पर अनुवर्ती कार्रवाई की गई।

5. **हिंदी कार्यशालाओं का आयोजन :** संस्थान के पदधारियों को सरकारी काम-काज में हिंदी का प्रयोग करने और साथ-साथ राजभाषा नीति की जानकारी देने के लिए प्रत्येक तिमाही में हिंदी कार्यशाला का आयोजन किया गया। तकनीकी तथा प्रशासनिक पदधारियों एवं वैज्ञानिकों के लिए इस वर्ष के दौरान दिनांक 10.06.2020, 07.09.2020, 28.11.2020 और 04.03.2021 को अलग-अलग पूर्णकालिक एक दिवसीय हिंदी कार्यशाला का आयोजन कर कुल 40 अधिकारियों व 50 कर्मचारियों को प्रशिक्षित किया गया।

6. **हिंदी टिप्पण-आलेखन प्रोत्साहन योजना का कार्यान्वयन:** संस्थान एवं इसके अधीनस्थ केंद्रों में कार्यरत अधिकारियों तथा कर्मचारियों को हिंदी में मूल रूप से काम – काज निष्पादन को प्रोत्साहित करने के लिए टिप्पण-आलेखन प्रोत्साहन योजना कार्यान्वित किया गया है जिसके अंतर्गत निर्धारित शब्द लिखने पर नकद पुरस्कार दिया जाता है । वर्ष 2020-21 के दौरान इस योजना के अंतर्गत संस्थान तथा अधीनस्थ कार्यालयों के 18 पदधारियों को पुरस्कृत किया गया ।

7. **हिंदी प्रकाशन:** वर्ष के दौरान अर्धवार्षिक राजभाषा गृह पत्रिका "रेशम किरण" जून 2020 का संपादन/प्रकाशन किया गया । इसके अलावा शहतूत में मूल विगलन रोग प्रबंधन नामक तकनीकी पुस्तिका का भी हिन्दी में संपादन/प्रकाशन किया गया ।

8. **राजभाषा नियम 10(4) के अंतर्गत अधीनस्थ कार्यालयों को अधिसूचित किया जाना:** जिन कार्यालयों में हिंदी में कार्यसाधक ज्ञान रखने वाले अधिकारी / कर्मचारी का प्रतिशत 80 या अधिक हो जाता है, उन कार्यालयों को मंत्रालय द्वारा राजभाषा नियम10(4) के अधीन अधिसूचित किया जाता है । वर्ष के दौरान 3 केंद्रों को अधिसूचित करने संबंधी प्रस्ताव केंद्रीय कार्यालय को भेजा गया ।

9. **हिंदी दिवस / पखवाड़ा का आयोजन :** संस्थान में दिनांक 01.09.2020 से 14.09.2020 तक राजभाषा पखवाड़ा मनाया गया । इस दौरान 4 विभिन्न हिंदी प्रतियोगिताओं का आयोजन किया गया । प्रत्येक प्रतियोगिता के विजेताओं को प्रथम, द्वितीय, तृतीय एवं सांत्वना पुरस्कार प्रदान किए गए । दिनांक 14.09.2020 को हिन्दी दिवस पूर्ण उत्साह के साथ मनाया गया । साथ ही मूल रूप से सरकारी कामकाज हिंदी में करने हेतु पात्र कर्मचारी को पुरस्कृत किया गया ।

10. **कंप्यूटर पर हिंदी में कार्य:** महत्वपूर्ण मद जैसे धारा 3(3) का अनुपालन, फार्म/प्रपत्र,मानक मसौदे, तिमाही रिपोर्ट तथा मूल्यांकन रिपोर्ट, बैठकों की कार्रवाई संबंधी कार्य कंप्यूटर पर सुचारू रूप से किए जा रहे हैं । संस्थान में सभी कंप्यूटरों में यूनिकोड की संस्थापना की गई है जिससे हिंदी,अंग्रेजी तथा अन्य भारतीय भाषाओं में काम करने में सुविधा प्राप्त हो गई है ।

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

12. **हिन्दी पुस्तक :** बृहत प्रशासनिक शब्दावली की 50 प्रतियां खरीदकर अधीनस्थ केन्द्रों एवं संस्थान के अनुभागों में वितरित की गई ।

13. **प्रशिक्षण** : दो राज्यों (महाराष्ट्र व उत्तर प्रदेश) से आए कुल 317 प्रशिक्षणार्थियों को रेशम संवर्धन के विविध विषयों पर कुल 17 विभिन्न पाँच - दिवसीय कार्यक्रम में हिन्दी माध्यम से प्रशिक्षण प्रदान किया गया ।

14. हिंदी पत्राचार में वृद्धि करने हेतु 6 अधीनस्थ कार्यालयों को कुल 50 द्विभाषी मानक पत्र तैयार कर उपयोगार्थ भेजे गए ।

15. ई मेल: द्विभाषी/हिंदी में अधिकाधिक ई-मेल भेजे जाने की शुरुआत करते हुए संस्थान द्वारा विभिन्न तकनीकी एवं सामान्य विषयों पर वर्ष के दौरान कुल 2021 ई मेल द्विभाषी/हिंदी में भेजे गए ।

16. वेबसाइट का द्विभाषीकरण: संस्थान के वेबसाइट को पूर्णत: द्विभाषी बनाने की प्रक्रिया पूरी की गई । साथ ही राजभाषा गतिविधियों की विशेष जानकारी हेतु एक आइकॉन राजभाषा जोडा गया ।

ACTIVITIES REGARDING OFFICIAL LANGUAGE IMPLEMENTATION

During 2020-21 Official Language policy was implemented succesfully at Central Sericultural Research and Training Institute, Mysuru. Cent-percent compliance of important Official Language Provisions *i.e*., Section 3(3) of Official Language Act, Official Language Rule-5 were ensured. The progress in implementation of Hindi was reviewed regularly by conducting quarterly meeting of the Official Language Implementation Committee and the progress regarding the Official Language was reviewed in each quarter. Apart from doing Hindi Noting and Drafting in Hindi as per prescribed target, important Scientific and Technical literature were also published in Hindi.

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

1. **Compliance of Section 3(3)**: All documents specified under section 3(3) of the Official Language Act 1963 were issued in bilingual.

2. **Compliance of Rule 11**: All types of Forms, Letter Heads, Rubber Stamps, Signboards, Name plates, Identity Cards etc are made bilingual. Check points (Stores Section, Despatch Section and at the level of concerned officer) have been devised to ensure the same in bilingual.

3. **Hindi Correspondence**: During the year, more than the prescribed targets for correspondence of Hindi were achieved by sending 77%, 78% and 78% letters in Hindi to Central Govt. Offices located in A, B and C regions respectively.

4. **Organisation of Meetings of the Official Language Implementation Committee**: The progress of implementation of the Official Language was reviewed from time to time by conducting OLIC meeting

in every quarter. During the year 2020-21 Official Language Implementation Committee meetings were organised on 05.06.2020, 26.08.2020, 03.12.2020 and 05.03.2021 and follow up action was taken on the decisions of the meeting.

5. **Organisation of Hindi Workshops**: Hindi workshop was organised in every quarter for the employees of the Institute to provide information related to use of Hindi in the Official work and to extend other relevant information about Official Language Policy. During the year, 40 Scientists / 50 Officers and Staff were trained in one day full time Hindi workshop organised in the institute on 10.06.2020, 07.09.2020, 28.11.2020 and 04.03.2021

6. **Implementation of Noting-Drafting Incentive Scheme**: To encourage the officers and staff of this Institute and its subordinate offices to do their work originally in Hindi, Noting-Drafting Incentive Scheme was implemented in which cash awards are given for writing prescribed words in Hindi. During the year under report 18 officials of the Institute and subordinate offices were awarded.

7. **Publications in Hindi**: Half yearly house magazine – Resham Kiran June 2020 was Edited/published. Besides, technical booklets 1) Automation in disinfection of rearing house 2)Management of root rot disease in mulberry were edited/published in Hindi.

8. **Notification of the subordinate offices under 10(4) of the Official Languages Rules**: The Offices in which 80% or more of the staff have attained working knowledge in Hindi are notified under 10(4) of the official languages Rules. It is proposed to Central office to notify 3 more offices during the year.

9. **Organisation of Hindi Day/Fortnight:** Official Language Fortnight was organised from 01.09.2020 to 14.09.2020 during which Hindi competitions were organised. The winners of the competitions were awarded with First, Second, Third and Consolation prizes. Hindi Day was celebrated on 14.09.2020 with full enthusiasm. Besides incentives were given to eligible officials for transacting original official work in Hindi.

10. **Work on Computers in Hindi**: Compliance of Section 3(3), Forms, Standard drafts, quarterly progress report, evaluation report of works related to meetings are carried out smoothly on computers. Unicode system has already been installed in all computers which facilitates employees to do work in Hindi, English and other Indian languages.

11. **Official Language Inspection**: 5 Sub-ordinate offices viz. RSRS, Anantapur, Shadnagar, REC Vikarabad, Hassan and Amaravathi were inspected for reviewing the progress made regarding implementation of Official Language Policy and necessary suggestions & guidance were extended accordingly. Besides, on Official Language Implementation Committee comprising of 4 members has been constituted for inspecting the Official Language works going on in different sections of the Institute.

12. Apart from this 50 copies of comprehensive administrative glossary were purchased and distributed to all sections and subordinate offices of the institute.

13. **Training:** 317 trainees from 2 states (Maharastra and Uttar Pradesh) were trained on various topics of sericulture through Hindi medium in 17 different Five Day Training Programmes.

14. 50 Bilingual standard formats were prepared and sent to 6 sub-ordinate offices.

15. **E.mail:** Emphasising on sending emails in Hindi, more than 2021 emails of the Institute have been sent in bilingual.

16. **Bilingualisation of Website:** Website of the institute has been done in bilingual Cent percent. Official Language icon has been added newly to the website to highlight the official language activities.

1. MULBERRY BREEDING AND GENETICS

On-going Research projects

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

Tanmoy Sarkar, Raghavendra AS, (Univ. of Hyderebad), Gandhi Doss S (up to Mar. 2021), Gayathri T, Arunakumar GS, Ravindra KN (JRF), Pankaj Tewary (up to Dec. 2020) and Babulal

Major objective: To develop transgenic mulberry with C*4* traits through *Agrobacterium* mediated genetic transformation for climate resilience.

Specific objectives:

- Construction of gene constructs using C_4 genes (*viz*., *PEPC*, *CA*) and selectable marker gene in binary vector and mobilization of recombinant binary vector in *Agrobacterium tumefaciens*.
- Genetic transformation and molecular characterization of transgenic tobacco co-expressing C_4 genes and selectable marker gene.
- Genetic transformation and molecular characterization of transgenic diploid mulberry co-expressing C_4 genes and selectable marker gene.

In the study, protocol for *in vitro* regeneration for obtaining complete plantlets from cotyledon and hypocotyl explants of G-4 mulberry has been optimized. Genetic transformation was carried out by using 680 cotyledons and hypocotyls of G-4 mulberry with PEPC, CA, PEPCK+PEPC constructs. Eight putative transgenic mulberry plants containing CA or PEPCK+PEPC genes have been transferred to earthen pots for hardening. Shootlets of nineteen putative transformed mulberry plants containing PEPC gene were tested for root induction. Genetic transformation was carried out by using 254 leaf disc explants of tobacco with above-said three gene constructs. Twenty hardened putative transgenic tobacco plants containing CA or PEPCK+PEPC genes were hardened. Gene specific primers were designed and synthesized. Genomic DNA of putative transgenic tobacco and mulberry have been extracted and quantified. Two transgenic tobacco plants containing CA gene and four transgenic tobacco (Fig. 1.1) containing PEPCK+PEPC genes were confirmed by gene specific PCR assay. Four transgenic tobacco plants containing PEPCK+PEPC genes showed better gas exchange parameters than non-transformed plant under 60% pot capacity (Table 1.1).

Fig 1.1: Confirmation of transgenic tobacco plants containing *PEPC+PEPCK* genes using PEPCK gene specific primers. L: 100 bp ladder, Lane 1: Positive control, Lane 2: Negative control, Lane 3, 6, 8 and 13 showed four transgenic tobacco plants.

Table 1.1: Physiological characterization of transgenic tobacco lines (PEPC+PEPCK) under 60% pot capacity

Genotype	SPAD Value	Photo. rate (µmol CO_2 $^{m-2\ s-1}$)	Stomatal Conductance (mol $^{m-2\ s-1}$)	Internal CO_2 (Ci) (mmol $^{m-2\cdot s-1}$)	Transpiration rate (mmol H_2O $^{m-2\ s-1}$)	Leaf Temp. (°C)
TO_C6_5	32.16	5.41	0.13	432.52	2.13	25.86
TO_C6_6	32.96	5.98	0.06	277.20	1.72	29.46
TO_C6_8	32.60	7.16	0.07	301.49	2.27	28.27
TO_C6_21	40.76	2.41	0.06	378.09	1.02	26.85
TO_CON_1	29.06	3.80	0.06	375.78	1.61	26.25
CD at 5%	3.06	1.11	0.02	41.55	0.64	0.53
CV %	5.02	12.38	17.36	6.47	20.23	1.08

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

Tanmoy Sarkar, Gandhi Doss S (up to Mar. 2021), Arunakumar GS, Bharath Gowda RN (JRF), Pankaj Tewary (up to Dec. 2020) and Babulal

Objectives:

- To identify superior genotypes with drought adaptive traits under sub-optimal irrigated condition
- Evaluation of introgression lines/mapping populations developed for drought adaptation using molecular markers/carbon isotope discrimination-Δ13C

Experimental plot with 21 mulberry genotypes along with respective check varieties was maintained with 3 replications under optimal and suboptimal irrigated conditions. Based on three crop data of the first year, it was recorded that out of 21 test genotypes, four genotypes *viz.,* D21, D22, D23, D57 showed leaf yield, above ground biomass, total shoot length were on par with that of check varieties (Vishala, RC-1, AGB-8) under sub-optimal irrigated conditions (Table 1.2). Under optimal irrigated conditions, genotypes viz., D23, D48, D67 were showed leaf yield, above ground biomass, total shoot length on par with that of check varieties (Vishala, G-4, V-1) (Table 1.3).

Table 1.2: Growth and yield parameters of selected mulberry genotypes and three check varieties under Sub-optimal irrigated conditions

Genotype No.	No. of Shoots	Longest Shoot Length (cm)	Total Shoot Length (cm)	Above Ground Biomass (g/plant)	Leaf Yield (g/ plant)	Moisture Content (%)
D21	8.38	125.11	851.22	840.81	470.96	81.43
D22	7.94	128.55	876.94	876.87	497.90	76.13
D23	9.11	126.27	905.88	962.28	590.56	76.05
D57	8.05	105.22	931.5	977.83	540.00	80.70
Vishala	8.38	107.77	703.44	970.16	539.42	81.72
AGB-8	8.22	98.38	653.44	783.75	405.77	80.89
RC-1	6.66	102.66	511.00	587.45	379.60	78.20
CD at 5%	3.19	23.65	395.16	374.13	200.27	4.95
CV %	21.97	23.78	27.48	20.78	29.05	3.84

Table 1.3: Growth and yield parameters of selected mulberry test genotypes and three check varieties under Optimal irrigated conditions

Genotype No.	No. of Shoots	Longest Shoot Length (cm)	Total Shoot Length (cm)	Above Ground Biomass (g/plant)	Leaf Yield (g/ plant)	Moisture Content (%)
D23	9.16	124.94	951.33	1034.16	671.94	79.76
D48	13.16	120.38	1135.33	1004.57	642.59	81.92
D67	8.77	132.11	1001.11	1007.47	659.09	81.10
Vishala	8.11	124.44	813.05	1023.71	615.52	83.17
V-1	7.22	129.27	871.44	989.14	530.04	79.77
G-4	7.44	110.33	802.94	888.09	549.74	79.76
CD at 5%	3.18	21.30	287.00	146.84	77.54	ns
CV %	21.87	19.92	23.80	22.51	19.46	3.16

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

Gandhi Doss S, Aruna Kumar GS, Jalaja S Kumar (up to Feb. 2020), Hanumantharayappa SK (from Mar. 2020), Vijaya Naidu B, Kamaraj S, and Babulal (Coordinator)

Objectives:

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

After establishment of experimental mulberry garden under optimal input conditions at CSRTI, Mysuru test location, 2 crops were harvested for the first year and the data were recorded along with major foliar and root diseases. Similarly, the experimental garden under sub-optimal treatment was pruned after establishment and first year first crop data was recorded (Table 1.4 & 1.5).

Table 1.4: Growth and yield parameters of triploid genotypes under optimal conditions for first year 2 crops

#	Gen	DSP	NS	LLS (cm)	TSL (cm)	AGB (g/ pl)	LY (g/ pl)	L/S ratio	MC (%)	MRC (%)
1	Tri-1	13.8	9.8	101.2	829.5	889.58	518.58	0.57	69.69	92.18
2	Tri-5	14.1	10.6	92.8	824.8	855.17	427.00	0.50	65.96	87.29
3	Tri-6	5.6	14.0	103.0	1206.4	994.58	467.25	0.47	66.73	84.64
4	Tri-8	13.7	10.4	87.0	818.0	991.67	564.67	0.60	68.01	89.31
5	Tri-9	14.2	10.6	102.7	887.0	995.75	550.08	0.55	68.04	90.63
6	Tri-10	10.8	15.1	98.8	1217.2	1075.67	617.17	0.58	67.85	89.54
7	G-4	12.7	9.6	86.9	699.9	872.67	543.67	0.62	69.04	89.41
8	Vishala	13.2	8.4	105.5	769.8	1026.08	490.58	0.48	70.38	92.00
CD at 5%		1.4	1.9	7.34	174.2	NS	NS	0.03	NS	NS
CV %		6.51	13.67	5.83	14.83	16.33	16.76	4.70	2.73	3.03
Significance		**	**	**	**	-	-	**	-	-

Table 1.5: Growth and yield parameters triploid genotypes under Sub-Optimal conditions (I crop data)

#	Gen	DSP	NS	LLS (cm)	TSL (cm)	AGB (g/ pl)	LY (g/ pl)	L/S ratio	MC (%)	MRC (%)
1	Tri-1	14.0	7.0	67.1	389.1	633.33	393.33	0.61	74.98	91.52
2	Tri-5	6.3	14.6	73.4	867.3	933.33	553.33	0.59	75.97	89.51
3	Tri-6	5.6	23.2	93.3	1863.8	1843.33	897.50	0.48	77.94	91.74
4	Tri-8	15.6	12.6	74.3	759.8	1140.00	691.67	0.60	76.72	98.43
5	Tri-9	6.3	11.5	73.7	664.3	853.33	476.67	0.56	76.01	90.91
6	Tri-10	7.3	22.5	95.4	1732.1	1780.00	947.50	0.53	77.26	92.61
7	G-4	13.0	11.1	55.6	489.5	956.67	649.17	0.68	75.19	90.74
8	Vishala	10.3	5.3	55.8	257.4	305.00	188.33	0.62	74.63	89.74
CD at 5%		2.16	2.60	11.57	167.23	221.42	124.06	0.03	NS	NS
CV %		12.59	11.01	8.97	10.87	17.96	17.72	3.31	3.37	5.45
Significance		**	**	**	**	**	**	**	-	-

Data reveals that genotype Tri-10 showed better performance over the check varieties in both optimal and suboptimal irrigated conditions.

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

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

Tanmoy Sarkar, Nataraja Karaba N (UAS-Bengaluru), Gandhi Doss S (upto March 2021), Lalitha Kumari (PA), Pankaj Tewary (up to Dec. 2020) and Babulal

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

Specific objectives:

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

Received three multi-gene constructs containing two or more genes coding for transcription factors such as (a) nptII+SHN1+DREB2A, (b) igRA + EcZF+ AhBTF3 + AhNFYA7, (c) AKR1 + EcNAC1 + EcMYC57 + EcBzip60 from UAS, GKVK, Bengaluru. These gene constructs have been approved by IBSC, Mysuru and RCGM, DBT, India for using in genetic transformation experiments. 855 cotyledons and hypocotyls of G-4 genotype were used for genetic transformation using three multi-gene constructs such as (a) nptII+SHN1+DREB2A, (b) igRA + EcZF+ AhBTF3 + AhNFYA7, (c) AKR1 + EcNAC1 + EcMYC57 + EcBzip60. Five putative transgenic mulberry plants containing SHN1+DREB2A genes were hardened. Thirty six putative transformed mulberry shootlets containing

igRA + EcZF+ AhBTF3 + AhNFYA7 or AKR1 + EcNAC1 + EcMYC57 + EcBzip60 genes were incubated in medium for root induction. Genomic DNA of five putative mulberry plants (SHN1+DREB2A) have been extracted and quantified. Two transgenic mulberry plants (SHN1+DREB2A) were confirmed by PCR using DREB2A gene specific primers (Fig.1.2). These two transgenic mulberry plants (SHN1+DREB2A) showed better photosynthetic rate and gas exchange parameters and SPAD chlorophyll meter value than non-transformed plants under 60% pot capacity (Table 1.6).

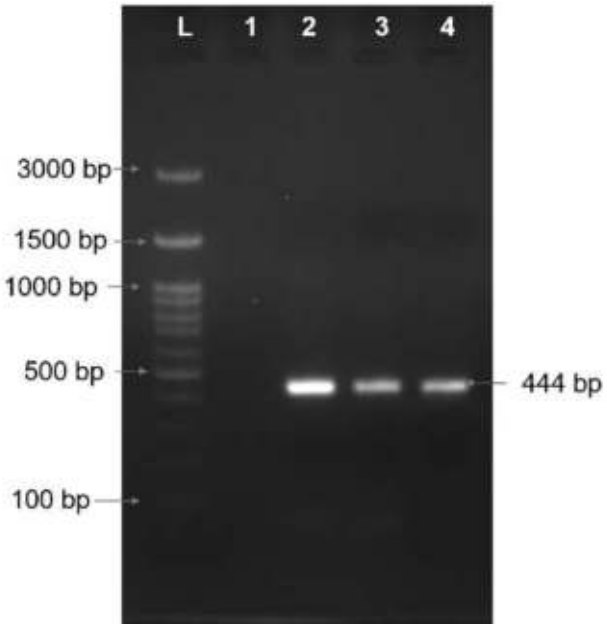


Fig. 1.2: Confirmation of transgenic mulberry plants containing *DREB2A+SHN1* genes using gene specific primers. L: 100 bp ladder, Lane 1: Negative control, Lane 2: Positive control, Lane 3, and 4 showed transgenic mulberry plants.

Table 1.6: Physiological characterization of transgenic mulberry lines (*DREB2A+SHN1*) under 60% pot capacity

Genotype	SPAD Value	Photo. rate (µmol CO_2 $^{m-2\ s-1}$)	Stomatal Conductance (mol $^{m-2\ s-1}$)	Internal CO_2 (Ci) (mmol $^{m-2\ s-1}$)	Transpiration rate (mmol H_2O $^{m-2\ s-1}$)	Leaf Temperature (°C)
M_C1_5	28.36	4.61	0.17	418.86	3.76	26.42
M_C1_2	27.83	4.46	0.10	373.94	2.07	26.86
Mul_Con1	24.03	3.41	0.05	336.00	1.33	27.42
CD at 5%	1.76	0.61	0.003	33.36	0.23	0.12
CV %	4.03	7.4	1.24	4.4	4.83	0.22

AICEM Phase IV: All India Coordinated Experimental Trial in Mulberry (South Zone) Apr. 2019 - Mar. 2025)

Zonal Coordinator (south zone): Pankaj Tewary (upto Dec. 2020) and Babulal (from Jan. 2021)

Gandhi Doss S, Pratheesh Kumar PM (up to Jul 2020), Arunakumar GS, Jalaja S Kumar (up to Feb. 2020), Hanumantharayappa SK (from Mar. 2020), Noble Morrison M (up to Jul. 2020), Narendra Kumar JB (from Aug. 2020), Sudhakar P, Venugopal A, Srinath B and Jhansilakshmi K

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

The mulberry experimental gardens with three test genotypes along with two check varieties of all test centres as indicated in Table 1.7 were maintained with recommended cultural practices. Gap-filling and

replacement of weak saplings with sturdy ones carried out in the experimental plot. The details of mulberry varieties to be tested under the programme are given in Table 1.8.

Table 1.7: Test Centres of AICEM Phase-IV programme (south zone)

Sl. No.	Test Centre	State
1	CSRTI-Mysuru	Karnataka
2	RSRS-Kodathi	Karnataka
3	REC-Madivala	Karnataka
4	RSRS-Anantapur	Andhra Pradesh
5	REC-Rayachoty	Andhra Pradesh
6	REC-Vikarabad	Telangana
7	REC-Krishnagiri	Tamil Nadu

Table 1.8: Mulberry varieties under AICEM Phase-IV programme (south zone)

Name of the variety	Designated Code	Progenitor Institute	Experiment Code
AGB-8	CMY-01	CSRTI, Mysuru	MV 1
C-1360	CBP-01	CSRTI, Berhampore	MV 2
PPR-1	CPP-01	CSRTI, Pampore	MV 3
G-4	Check-1	CSRTI, Mysuru	MV 4
V-1	Check-2	CSRTI, Mysuru	MV5

Continuous/Other activities

Maintenance of mulberry germplasm, mother culture and demonstration plot

Gandhi Doss S, Tanmoy Sarkar, Pankaj Tewary (up to Dec. 2020) and Babulal (from Jan. 2021)

A working germplasm with 28 accessions was maintained for carrying out hybridization programmes. Nineteen elite mulberry varieties were also maintained in the demonstration plot for the benefit of sericulturists, students and other stakeholders. Breeders seed cutting stock plots of six mulberry varieties *viz.,* G-4 (late age silkworm rearing), G-2 (young age silkworm rearing), MSG-2 (soil moisture stress environments) AGB-8 (sub-optimal irrigated conditions) and AR-12 (alkaline resistant) and Sahana (Shade tolerant) were maintained for seed multiplication.

Meteorological observatory

Honorary Superintendent: Dr. S. Gandhi Doss, Sci-D

Observers: Sri Muthappa, STA (from Jan. 2020)

Sri Ramesh, AT (from Jan. 2020)

The Part-time observatory of India Meteorological Department [IMD] has been functioning at the Institute and keeping records and communication to IMD, Bengaluru. The data on various meteorological informations *viz.,* temperature, humidity, pressure, dew point, vapour pressure, cloud types and quantum, wind direction and speed and rainfall were recorded every day at 08:30 h and 17:30 h and communicated to IMD. The meteorological data is regularly utilized by the scientists of the Institute as well as other national Institutes *viz.,* CFTRI, University of Mysore, Mysuru etc.

Meteorological data for the year 2020

Month	Temperature [°C]			Humidity [%]			Rainfall [mm]
	Max.	Min.	Avg.	Max.	Min.	Avg.	
January	30.36	18.17	24.40	72.61	44.23	58.42	0
February	31.67	19.23	25.45	67.17	45.31	56.24	0
March	33.68	22.12	27.90.	78.67	44.46	61.56	24.60
April	34.48	22.99	28.74	80.26	52.74	60.50	77.80
May	34.21	23.14	28.68	83.87	63.52	72.69	170.70
June	30.20	21.73	25.99	84.57	76.43	80.50	85.90
July	29.03	21.10	25.06	83.58	76.52	80.05	93.90
August	28.55	20.93	24.74	83.90	75.58	79.74	93.00
September	28.91	21.06	24.99	83.93	76.07	80.00	94.00
October	29.61	20.72	25.16	85.26	70.58	77.92	146.50
November	29.30	20.30	24.80	85.67	68.10	76.88	41.00
December	29.34	19.11	24.22	89.48	72.33	80.85	2.00
Mean	30.78	20.88	28.66	81.58	68.82	72.11	69.12
Extm. High	33.33	23.95					
Extm. Low	26.45	18.20			93.25	79.83	
					Total Rainfall (mm)		829.40
					No. of rainy days (d)		60

2. MULBERRY MOLECULAR BIOLOGY

On-going Research projects

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

Arunakumar GS and Bhavya MR

Objectives:

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

Six different crosses and one OPH F1 hybrids were established in the experimental field (Table 2.1). Four crops were harvested and data recorded on growth and yield parameters. Shortlisted the best performing hybrids among four different crosses based on different growth and yield parameters (Table 2.2). The OPH seeds of G-4 and English Black were sown in the seed beds under glasshouse condition. Totally, 504 G-4 seedlings of OPH F1 hybrids developed under glasshouse condition and established in the experimental field. However, there was no germination of OPH seeds collected from English Black accession. Seedlings of Hosur C3 × V-1 cross F1 hybrid population was transplanted to experimental field after four months of development under seed beds and maintained regularly for proper establishment.

Four crosses (G-2 × Thailand male, Hosur C3 × V-1, Zimbabwe 4 × Gajapathipur 2, *Morus multicaulis* × V-1) seeds and OPH seeds of two popular varieties (G-4 and English Black) were sown under nursery beds (Cement blocks) in the glasshouse condition for raising seedlings. There was poor seed germination among the crosses G-2 × Thailand male (7 seedlings), Zimbabwe 4 × Gajapathipur 2 (15 seedlings) and *Morus multicaulis* × V-1 (13 seedlings); whereas good germination was observed in the cross Hosur C3 × V-1 (93 seedlings) and OPH seeds of G-4 (910 seedlings). Very poor germination of seeds was observed in the OPH seeds of English black accession. During second season, seeds were extracted from the crossed fruits pertaining to two crosses (*Morus multicaulis* × V-1 and Hosur C3 × V-1) and two OPH (G-4 & English black). Crossed seeds of Hosur C3 × V-1 (410), *Morus multicaulis* × V-1 (552) and OPH seeds of two popular varieties, G-4 (1120) and English Black (1211) were sown in the seed beds to raise seedlings under glasshouse condition.

Table 2.1: Details of crosses attempted, seedlings raised under glasshouse condition and established in the experimental field

Cross	No. of seeds recovered	No. of seedlings raised in glasshouse condition	No. of seedlings established in field condition
M. multicaulis × Thailand male	2544	1100	221
G-2 × Thailand male	1694	646	174
Punjab local × Cathayana hybrid	500	200	70
BR-8 × ERRC-103	1142	227	111
Hosur-C3 × V-1	201	108	80
G-4 OPH	2071	910	502
Total	8152	3191	1158

Table 2.2: Top ten shortlisted F1 hybrids among four different crosses

Growth and yield parameters	*M. multicaulis* × Thailand male	G-2 × Thailand male	Punjab local × Cathayana hybrid	BR-8 × ERRC-103
Length of longest shoot (cm)	106, 54, 153, 71, 124, 77, 27, 165, 74, 102	113, 114, 122, 153, 76, 100, 63, 53, 112, 119	9, 10, 13, 51, 4, 12, 53, 52, 48, 49	6, 80, 4, 77, 28, 11, 88, 60, 79, 43
No. of leaves in longest shoot	8, 77, 22, 106, 102, 100, 146, 103, 170, 173	54, 106, 86, 143, 113, 145, 146, 71, 40, 152	12, , 9, 52, 10, 7, 13, 2, 31, 42, 45	28, 56, 55, 48, 47, 77, 40, 30, 80, 76
Shoot weight (g)	72, 106, 153, 143, 177, 175, 68, 102, 104, 45	5, 41, 14, 106, 153, 137, , 76, 53, 113, 152	10, 13, 1, 4, 12, 45, 9, 50, 53, 11	28, 10, 16, 64, 2, 89, 33, 70, 17, 34
Stem weight (g)	72, 106, 153, 143, 175, 102, 68, 177, 45, 103,	53, 55, 137, 54, 114, 153, 113, 152, 144, 76	10, 13, 1, 12, 4, 9, 53, 45, 50, 11	28, 34, 10, 46, 44, 9, 60, 47, 2, 73
No. of branches	18, 175, 143, 115, 7, 164, 10, 155, 153, 107	126, 4, 9, 154, 125, 106, 76, 5, 1, 148	27, 19, 50, 52, 49, 53, 28, 25, 9, 5	25, 64, 83, 16, 70, 69, 61, 9, 76, 42
Highest survival (%)	124, 123, 102, 87, 85, 78, 76, 74, 64, 49, 47	154, 152, 139, 117, 85, 28, 149, 129, 128, 149	9, 10, 13, 51, 4, 12, 53, 52, 48, 49	6, 80, 4, 77, 28, 11, 88, 60, 79, 43
Highest rooting (%)	39, 43, 90, 8, 33, 54, 87, 6, 10, 62	48, 124, 14, 34, 138, 73, 69, 55, 22, 119	12, , 9, 52, 10, 7, 13, 2, 31, 42, 45	28, 56, 55, 48, 47, 77, 40, 30, 80, 76

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

Bhavya MR, Gayathri T, Sanath Kumar YN and Bharatesh S

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

Mapping population was developed using identified alkaline resistant (MR-2 and Sahana) and susceptible (V-1) genotypes. Crossing was attempted between MR-2 **×** V-1 (cross 1) and Sahana **×** V-1 (cross 2) during June, 2020 and the crossed seeds were sown in nursery bed in glasshouse condition and survived seedlings were transplanted to field after six months. From the two sets, 19 plants in cross 1 and 144 plants in cross 2 were survived in the field (Table 2.3). These survived plants in the field will be used for multiplication of mapping population for further phenotyping to alkaline stress. For genotyping of mapping population, 1800 SSRs and flanking sequences of *Morus alba* genome has been mined.

Table 2.3: Status of number of seeds obtained, germinated and survived in Sahana × V-1 and MR-2 × V-1 crosses.

#	Hybridization period	Crosses attempted	No. of seeds sown	No. of seeds germinated	No. of seedlings survived & transplanted to field	No. of plants survived in field
Set-1	Nov. 2019	Sahana × V-1	580	200	100	44
		MR-2 × V-1	158	70	30	19
Set-2	Jun. 2020	Sahana × V-1	1500	615	175	100
		MR-2 × V-1	30	0	0	0

PIE 3511: Development of Distinctiveness, Uniformity and Stability guidelines for Mulberry (*Morus* spp.) and their validation (Phase III). (Apr. 2020-Mar. 2023)

Pankaj Tewary (up to Dec. 2020), Babulal (from Jan. 2021), Bhavya MR and Sowbhagya P

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, 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.
- Establishment of Co-nodal DUS test centre at CSR&TI, Berhampore.

Progress achieved

- DUS test plot with 46 accessions in three replications was maintained with standard cultural practices like pruning, weeding, irrigation, FYM application and other farm operations.
- Twelve germplasm varieties were procured from CSGRC, Hosur and grafted on V-1 root stock as they are poor rooters.
- Fifty one germplasm accessions were sent to CSR&TI, Berhampore for establishment of co-nodal DUS test center.

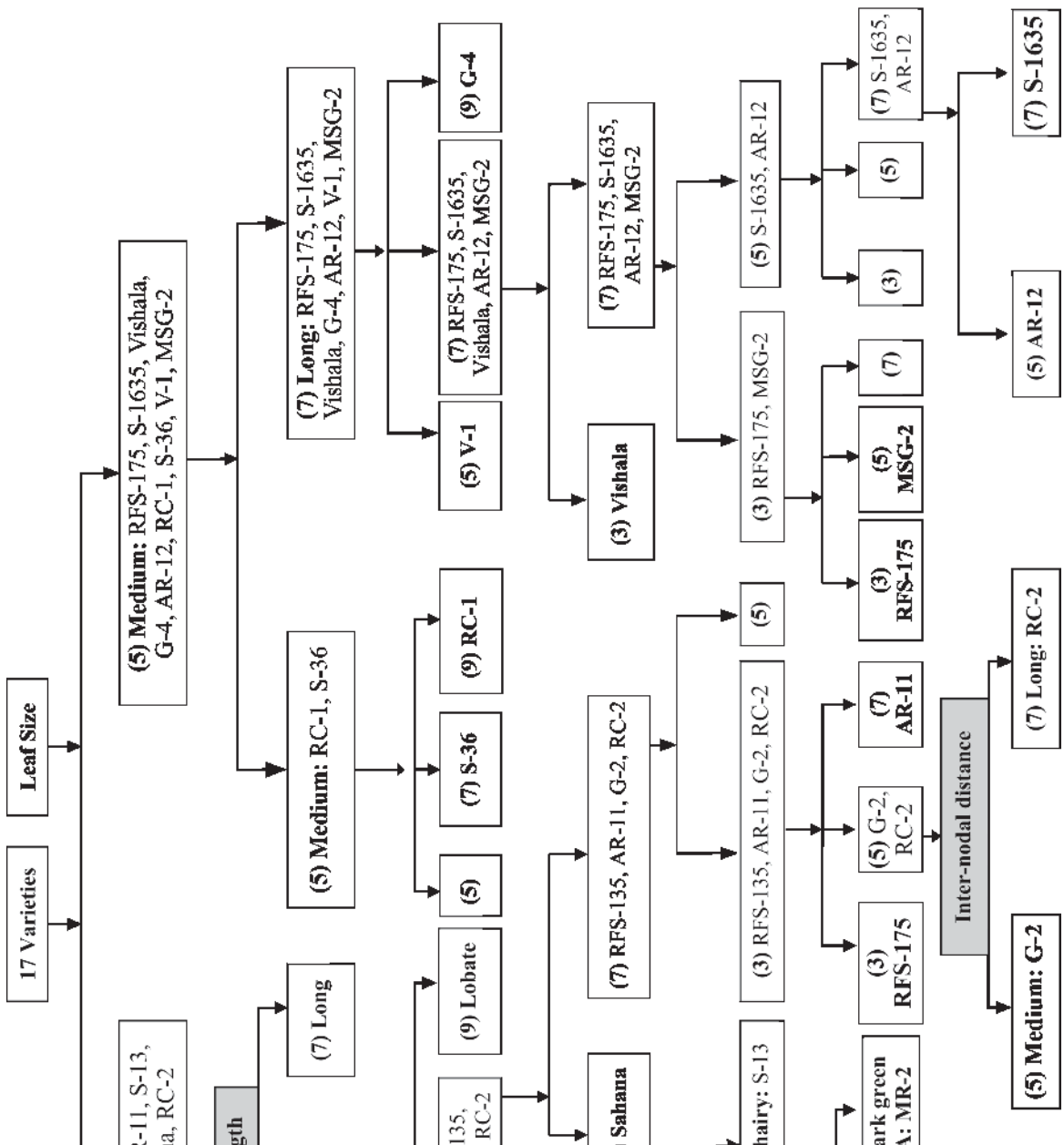


Fig. 2.1: Manual Cultivar Identification Diagram

- Example genotypes (34), reference varieties (12) and candidate varieties (6) were DUS characterized for 35 characters.
- Reference varieties (12) were planted in three replications with 8 plants in each and 10 example genotypes with three replications of 6 plants in the main field.
- Nursery was raised for candidate varieties for further transplantation to DUS test field.
- Nursery was also raised for another 32 genotypes through cuttings and bud grafting for gap filling of example and reference varieties in DUS test plot.
- The DUS test application for each mulberry variety *viz*. G-2, AR12, RC1, Sahana and MSG-2 was prepared and filed for registration of these mulberry varieties under PPV&FR Act 2001.
- Colored photographs showing distinct characters of each candidate variety with reference varieties (Fig. 2.2 to 2.6) along with "Deed of assignment" with some additional information was submitted to PPV&FRA.
- Manual Cultivar Identification Diagram (MCID) was generated for eleven reference and six candidate varieties of mulberry (Fig. 2.1). This is usable for the identification of mulberry varieties. This was clearly separated and individually identified seventeen varieties based on seven DUS characters of mulberry.

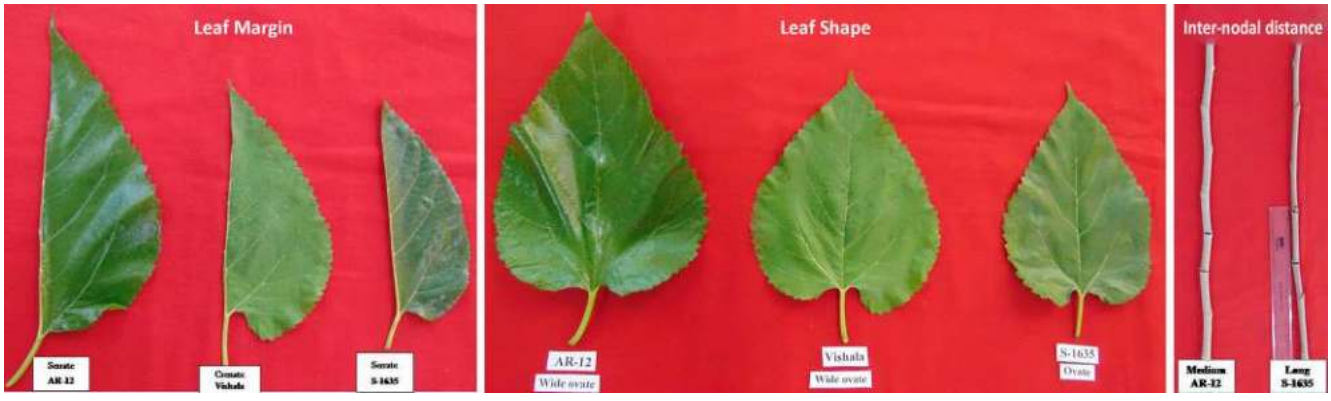


Fig. 2.2: Distinct characters of candidate variety AR-12 with reference varieties Vishala and S-1635

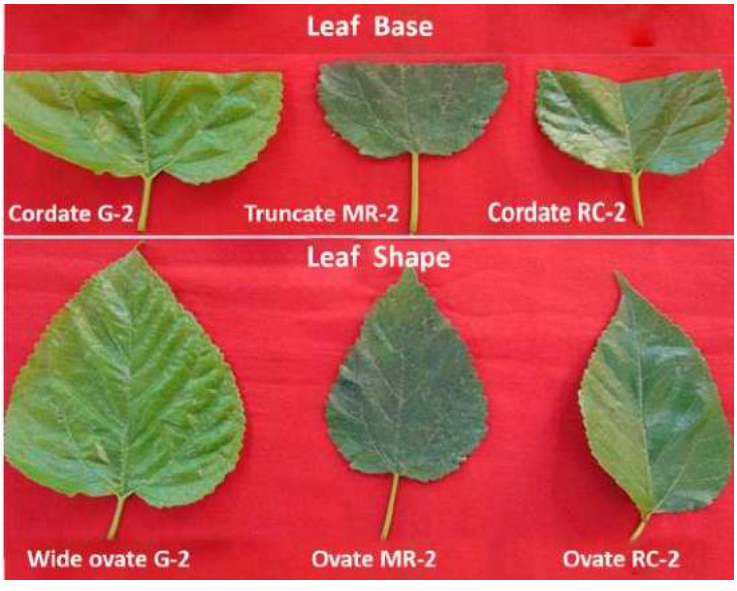


Fig. 2.3a: Distinct characters (Leaf Base & Leaf Lamina width) of candidate variety G-2 with reference varieties MR-2 and RC-2

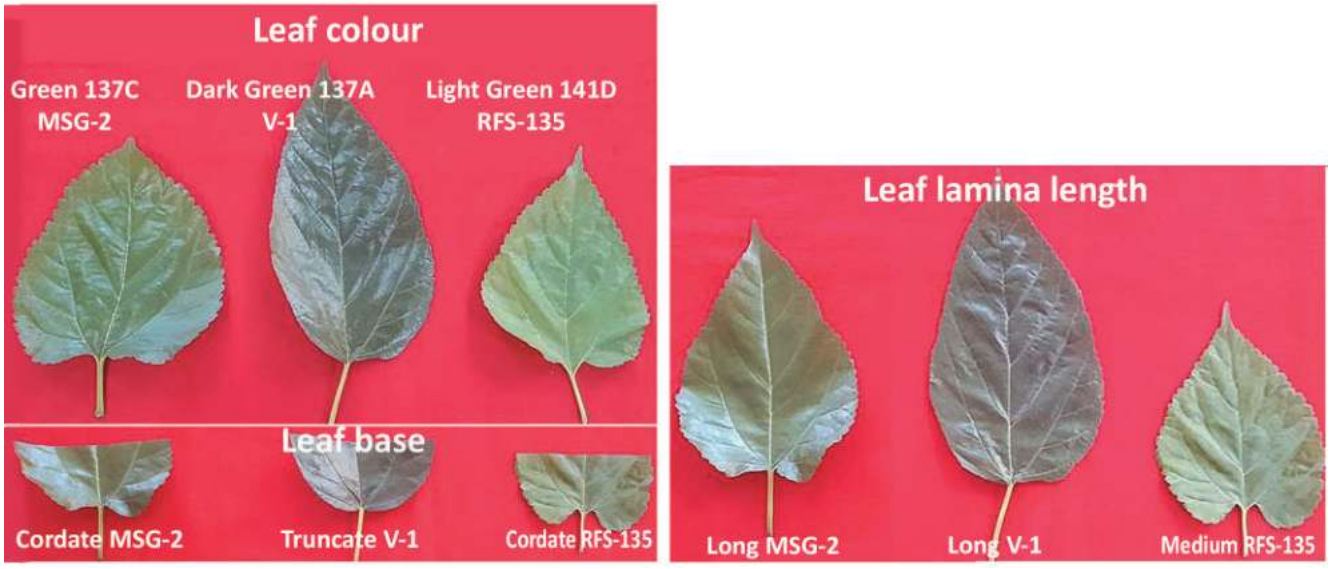


Fig. 2.4a: Distinct characters of candidate variety MSG-2 with reference varieties V-1 and RFS-135

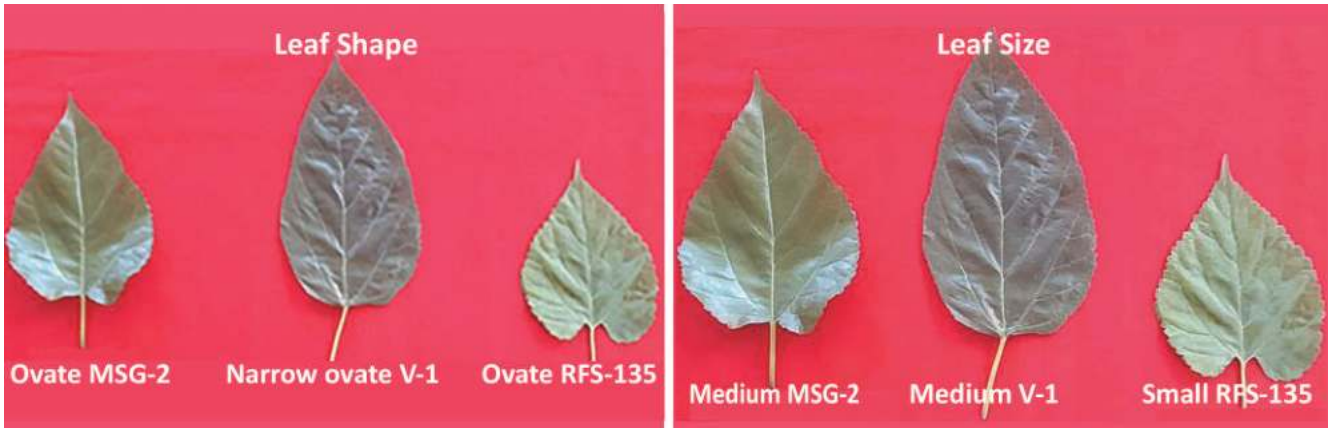


Fig. 2.4b: Distinct characters of candidate variety MSG-2 with reference varieties V-1 and RFS-135

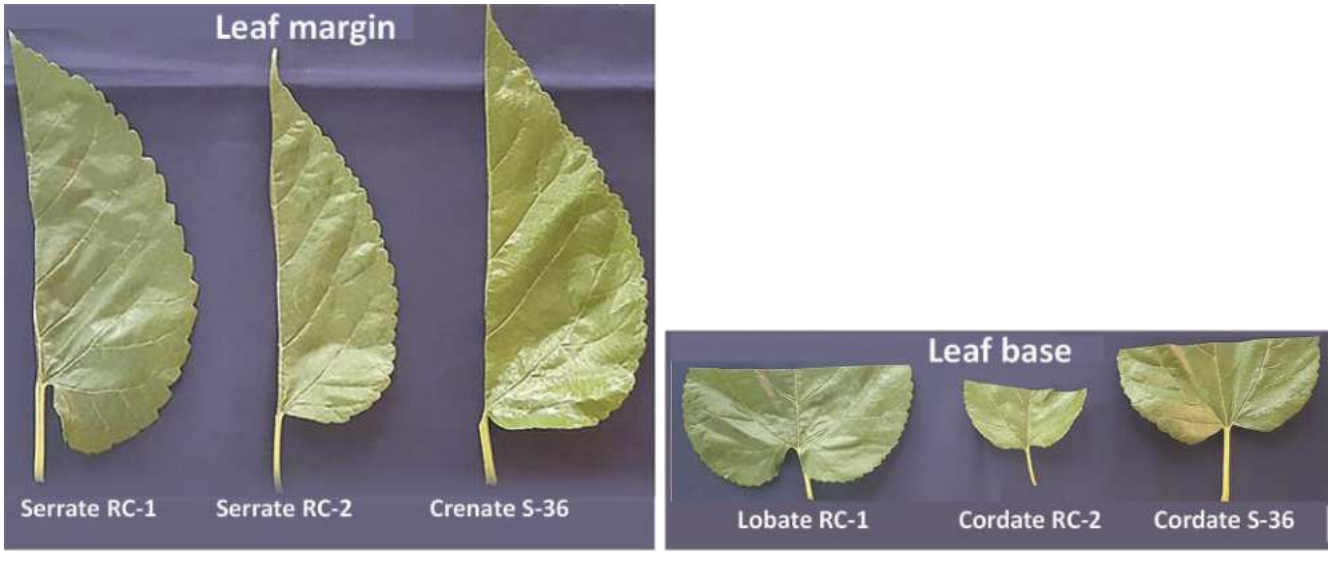


Fig. 2.5a: Distinct characters of candidate variety RC-1 with reference varieties RC-2 and S-36

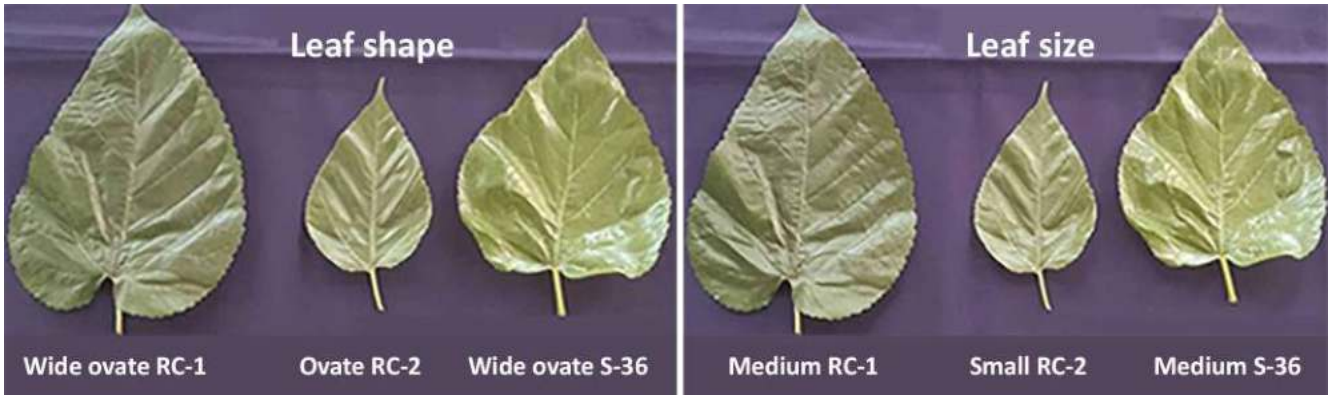


Fig. 2.5b: Distinct characters of candidate variety RC-1 with reference varieties RC-2 and S-36

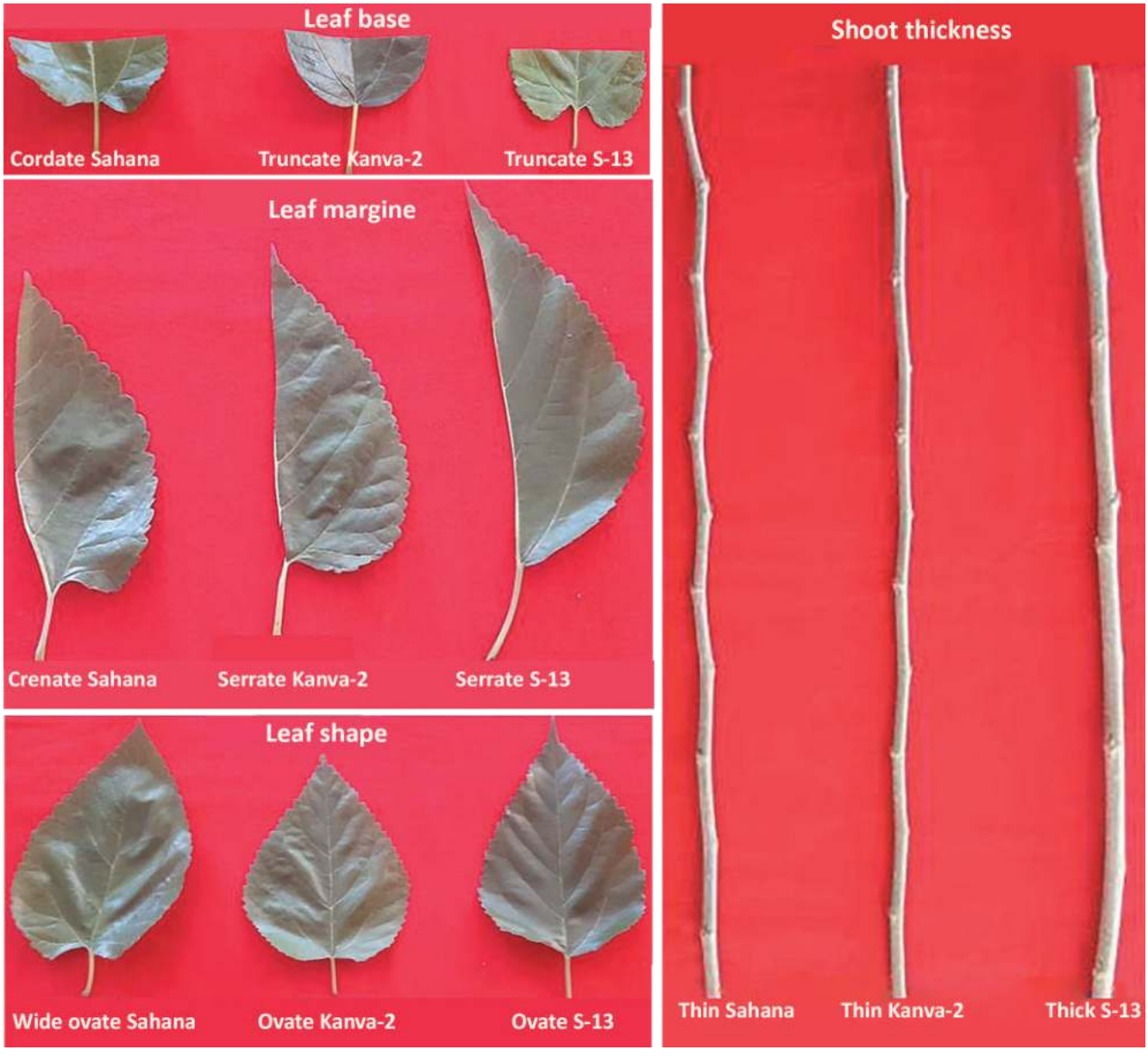


Fig. 2.6: Distinct characters of candidate variety Sahana with reference varieties Kanva-2 and S-13

PIC 01003 CN (NW2a): Validation of a high-density SNP genotyping array for QTL discovery by association mapping and bi-parental analysis in Mulberry (Sep. 18 - Dec. 21)

Gnanesh BN, Arunakumar GS, Tanmoy Sarkar and Manoj Kumar HB (RA)

Objectives:

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

Genotyping the germplasm and bi-parental mapping population using SSR and SNP markers

Isolation of genomic DNA

DNA was isolated from the mapping population consists of 200 F1 progenies developed from root rot resistant and susceptible parents. Isolation of DNA of 450 mulberry germplasm accessions was also completed using the slightly modified method of Doyle and Doyle method, (1990). All these DNA samples are stored at -20°C till further use.

SSR genotyping

In total, 144 mulberry germplasm accessions were selected for SSR genotyping. A total of 192 SSRs were used for the study, 82 markers were successfully amplified and 20 (24.39%) markers revealed polymorphism with the allelic variation of 2 to 8 across mulberry germplasm. Microsatellite fingerprint database was generated for 144 mulberry germplasm (Table 2.4) using 20 polymorphic SSRs. High level of polymorphism were detected among the different germplasm. The number of alleles per locus ranged from 2 (M2SSR112A) to 7 in M2SSR20 with an average of 4.7. The effective number of alleles (Ne) varied from 1.16 (M2SSR112) to 3.41 (M2SSR20) with an average of 2.40. The observed heterozygosity (Ho) differed among the SSR and it ranged from 0.13 (MULSSR313) to 0.53 (M2SSR1) with an average of 0.36. The marker with high PIC value was selected for identifying parental polymorphism (Table 2.5 & Fig. 2.7).

Table 2.4: List of 144 mulberry accessions used for SSR genotyping

#	Germplasm	#	Germplasm	#	Germplasm	#	Germplasm
1	Dharatwala	17	English Black	33	Jalalgarah-3	49	Haridwar-4
2	Madhopur-1	18	Seekupari	34	Bagaban Masijd	50	Keeraithodu
3	Hairythick	19	KNG	35	Naudan-1	51	Pouri-2
4	Hosur-C3	20	V-1	36	Vadapuram	52	Goshoerami
5	*M. lhouseringe*	21	S-1	37	Churai Mohal	53	Roso
6	Kokuso	22	Pouri-1	38	School, Salem	54	Kosen
7	Belona	23	Jabalpur	39	Sujanpur-5	55	*M. multicaulis*
8	Ujjain-2	24	Saranath-1	40	RC-1	56	*M. rotundiloba*
9	Nalhdwara-1	25	*M. macroura*	41	Bonniampadi	57	*M. Serrata*
10	Ranchi-5	26	*M. cathayana* *	42	S-13	58	MR-2
11	Birds Foot	27	S-642	43	S-36	59	AR-12
12	Nao Khurkul	28	Chandrapuri	44	Thattahalli Villa-1	60	Kanva-2
13	Nagpur-3	29	Palampur Local	45	S-34	61	G-2
14	Lava Forest-1	30	Assama Bola	46	Thandikudi	62	G-4
15	New Delhi	31	Nowshera-1	47	S-30	63	*M. cathayana*
16	UP-22	32	Sabbawala-2	48	Palsana-3	64	*M. multicaulis*

65	Punjab local	85	ERRC-215	105	BR-2	125	Vietnam-1
66	C-776	86	Monla-I	106	BR-8	126	Mandalaya
67	Sahana	87	R-1	107	Semmedu	127	S-1635
68	RC-2	88	Cuckpilla	108	BU-33	128	Hosur-C3
69	Vishala	89	Mysore local	109	Kollegal	129	Birds Foot
70	Kokuso-20	90	S-1708	110	Australia	130	Nao Khurkul
71	Valparai-05	91	C-15	111	MS-1	131	KNG
72	Thai pecah	92	C-18	112	SRDC-3	132	V-1
73	Furcata	93	ERRC-73	113	ERRC-103	133	C-776
74	Moretti	94	Acc. 8	114	Karanjtoli-1	134	RC-2
75	Lun 40-2	95	Chekmajra	115	S-763	135	UP-5
76	S-41	96	UP-5	116	Baragarh-3	136	S-741
77	Vishwa	97	ERRC-106	117	Acc. 115	137	S-523
78	US-51 (OPH)	98	S-741	118	Calabresa	138	BR-2
79	S-242	99	S-523	119	China-27	139	BR-8
80	Suvarna 1	100	KPG-11	120	Papua New Guinea	140	S-763
81	Suvarna 2	101	Bilidevalaya	121	Thailand male	141	Acc. 118
82	Suvarna 3	102	SRDC-2	122	Himachal local	142	Acc. 115
83	Acc. 118	103	Acc. 165	123	Gamettee	143	S-1635
84	C-6	104	Reblaira	124	Thailand lobed	144	Hosur-C3

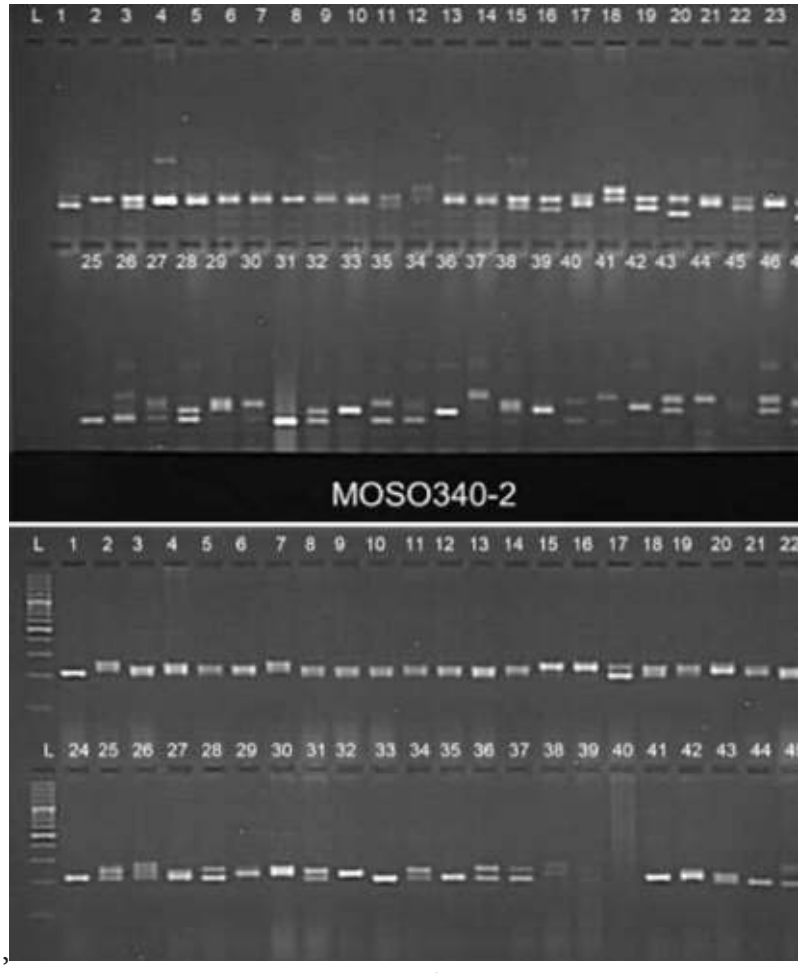


Fig. 2.7: Gel pictures showing the polymorphism of SSR markers Moso340-2 and MulSSR253

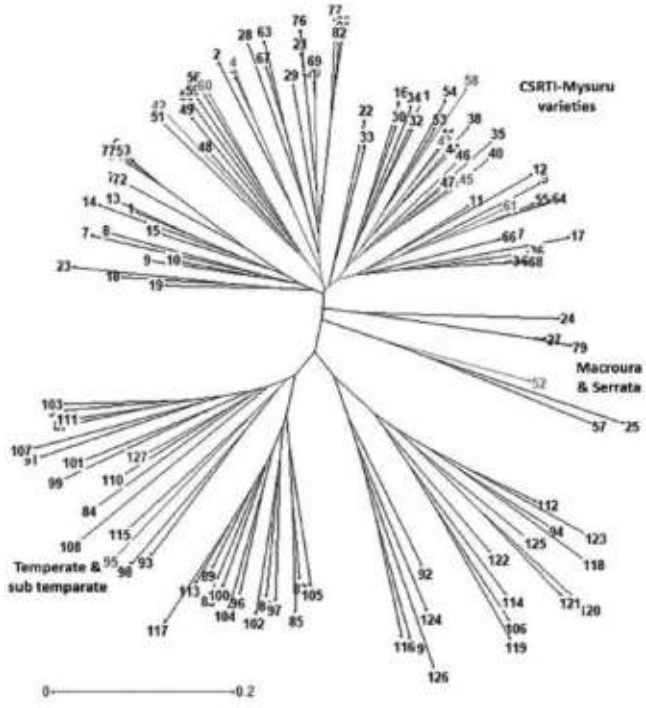


Fig. 2.8: Radial dendrogram showing the genetic relationships among 144 mulberry accessions based on the alleles detected by polymorphic SSRs

Genetic relationship among 144 diverse germplasm were analyzed and shown in the radial dendrogram and UPGMA cluster dendrogram (Fig. 2.8 & 2.9). The germplasm accessions were distributed according to geographic location as CSR&TI-Mysore accessions in 1st group and temperate and sub temperate in 2nd group. Similarly, wild accessions belonged to Macroura and Serrata formed another group separately in both the dendrograms.

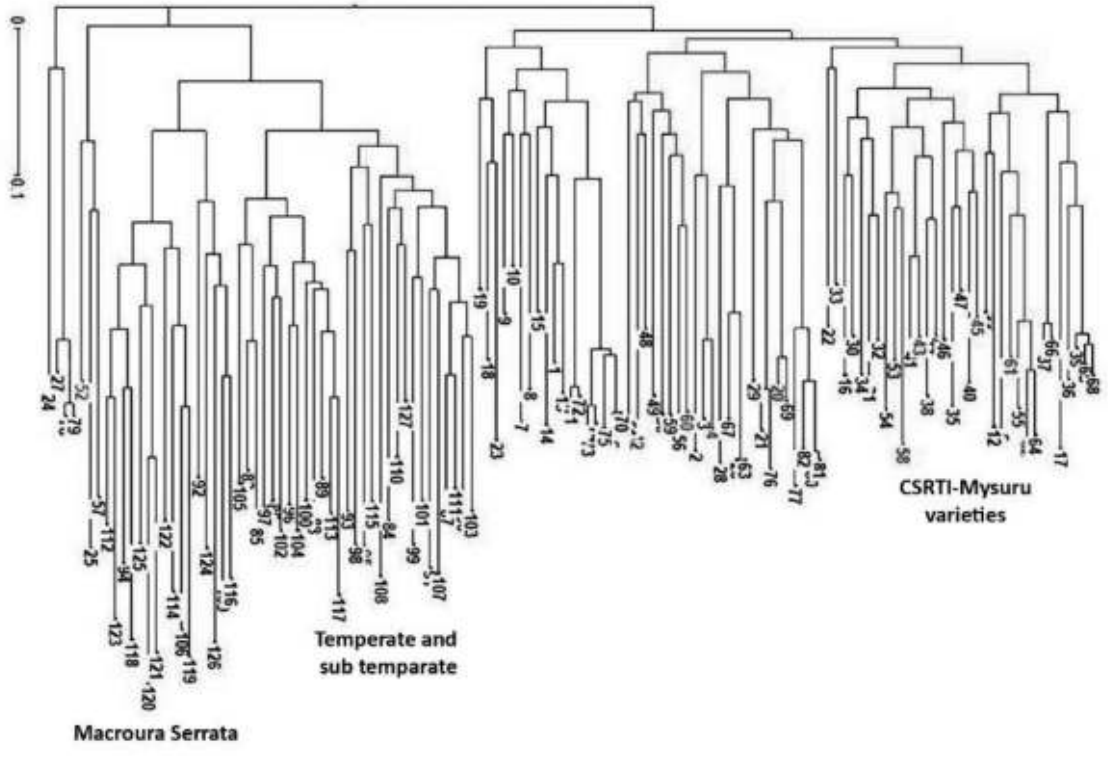


Fig. 2.9: A UPGMA cluster dendrogram showing the genetic relationships among 144 mulberry germplasm based on the alleles detected by polymorphic SSR markers

Molecular analysis of diverse germplasm belongs to different *Morus* species has studied for detecting genetic variation. The study revealed that SSR genotyping is informative for determining the genetic diversity and relationship between the different species of *Morus*. Some specific banding pattern may be used for genotype characterization and grouping mulberry germplasm and also additional SSRs will facilitate for practical use for mapping the mulberry genome as well as for classical breeding.

Table 2.5: Allelic diversity as revealed by polymorphic SSR markers

#	Marker list	No. of alleles	Expected hetero-zygosity	PIC	Effective no. of alleles	Observed hetero-zygosity	Shannon's index
1	M2SSR81	3	0.52	0.58	2.87	0.24	0.89
2	Moso340-2	6	0.36	0.54	2.46	0.38	1.18
3	M2SSR87	3	0.54	0.41	1.86	0.33	0.61
4	Moso288	4	0.24	0.75	2.21	0.35	0.68
5	MULSSR 253	4	0.19	0.44	2.29	0.18	0.64
6	M2SSR112A	2	0.28	0.62	1.16	0.34	0.51
7	MULSSR26	4	0.67	0.44	2.36	0.39	1.96
8	M2SSR68	3	0.75	0.41	1.86	0.19	0.62
9	MULSSR313	5	0.85	0.48	2.24	0.13	1.61
10	MULSSR258	7	0.70	0.41	3.06	0.22	1.32
11	MoSo-157-2	6	0.67	0.68	2.98	0.38	0.87
12	M2SSR36	5	0.52	0.44	2.87	0.39	1.92
13	M2SSR1	5	0.41	0.47	2.36	0.53	0.76
14	MulSSR85	7	0.62	0.62	3.24	0.42	1.71
15	MULSSR96B	5	0.81	0.61	2.51	0.41	0.68
16	M2SSR10	4	0.54	0.56	2.04	0.52	0.73
17	M2SSR89A	5	0.41	0.48	2.36	0.37	0.52
18	M2SSR107	3	0.32	0.41	1.71	0.46	0.76
19	M2SSR82	6	0.41	0.46	2.25	0.48	0.64
20	M2SSR20	7	0.36	0.49	3.41	0.51	1.78
	Average	4.7	0.50	0.51	2.40	0.36	1.01

SNP genotyping

SNP selection criteria were finalized for 90K chip array design. The main considerations for choosing SNPs to maximize conversion rate and space on the array are as followed;

- SNPs observed on multiple strains (genotypes) or breeds, more than one NGS platform and at greater depth were prioritized.
- If quality scores are available from NGS platform, SNPs observed at higher quality were prioritized. Where information on minor allele frequency (MAF) is available, MAF ≥0.05 is preferred for most applications. Low MAF SNPs are difficult to test and validate on reasonable sample sizes.
- SNP sites without other polymorphisms within 30 bp were prioritized.
- SNP sites within repetitive element regions were deprioritized.
- SNP sites with the lowest number of 16-mer matches to the reference genome (ideally <50) were prioritized.

- A/T and C/G SNPs were deprioritized, as they take twice as much room on the array.

A total of 650 genotypes finalized for SNP genotyping, which includes 450 diverse accessions selected under different traits (drought, yield and nutrient use efficiency) for association studies and 200 F1 progenies for linkage mapping for root rot disease trait. Among 450 accessions for different traits, 63 are common across the three different traits and 85 accessions are common between drought and yield traits. Whereas, 21 accessions are common between yield and nutrient use efficiency. Similarly, 13 accessions are common between drought and nutrient use efficiency (Table 2.6). Finally, 208 accessions for drought, 233 accessions under yield and 258 accessions under Nutrient use efficiency are finalized for SNP genotyping.

Table 2.6: List of accessions finalized for GWAS and Linkage mapping

NW2b (Drought)	NW2c (Yield)	NW2d (NUE)	NW2e (Biotic)	Total	Remarks
63	63	65	Root rot mapping Population	63	Common
46	64	158		268	Unique
86	85	0		85	Common between Nw2b & 2c
0	21	22		21	Common between Nw2c & 2d
13	0	13		13	Common between Nw2b & 2d
208	233	258		450	-
-	-	-	200	200	-
-	-	-	Total	650	-

PIC 01 003CN (NW 2C): Identification of QTLs for yield associated traits in mulberry (Sep. 2018 – Dec. 2021)
Bhavya MR, Tanmoy Sarkar and Jagadambha MY

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

An experimental plot with 233 mulberry genotypes under ARBD [experimental plot contains 13 blocks with V-1 border and each block has 18 test samples and 2 check genotypes (V-1 and Kosen)] was maintained as per the standard package of practice. Harvested four crops for the first year and recorded data from 233 mulberry genotypes on growth and yield associated traits.

The descriptive statistics of first year fourth crop was given in Table 2.7. In the study the number of shoots/plant ranges from 2 to 23.35 and mean is 10.97; highest number of shoots is observed in the genotype MI-0029. Length of longest shoot ranges from 71.53 cm to 245.03 cm and mean is 170.49 cm, average shoot length (cm) ranges from 60.93 cm to 230.6 cm and mean is 157.41 cm. Length of longest shoot and average shoot length is highest in MI-0672 accession and lowest in ME-0108. Number of leaves in longest shoot ranges from 12.45 to 61.03 and mean is 33.11, internodal length ranges from 3.5 to 8.65 cm and mean is 6.1. Shoot yield/plant ranges from 200 g to 3797.5 g and mean is 1394.2, leaf yield/plant ranges from 50 g to 1783.4 g and mean 666.74, highest leaf yield recorded in MI-0699 while highest shoot yield in MI-0523. Hundred leaf weight ranges from 29 to 620.5 g and mean is 232.69 g, leaf area ranges from 7.08 to 323.58 cm^2 and mean is 133.08 cm^2; leaf area and hundred leaf weight is highest in the genotype ME-0140. Moisture content of genotypes ranges from 53.38 % to 89.62 % and mean is 68.89 %. Correlation plot showed positive relation of leaf yield with number of shoots per plant, length of longest shoot, average shoot length and hundred leaf weight. These traits can be used for indirect selection for high yielding genotypes. Leaf area have positive correlation with hundred leaf weight in turn have negative correlation with number of leaves in the longest shoot (Fig. 2.10).

Based on four crops data sixteen contrasting genotypes were identified for the leaf yield. Genotypes for high yield are MI-0066, MI-0523, MI-0024, MI-0699, ME-0246, ME-0169, MI-0777 and low yielding genotypes are MI-0075, MI-0128, MI-0446, ME-0020, MI-140, MI-0246, MI-0293, MI-0440 and MI-0481.

Table 2.7: Descriptive statistics for yield and growth parameters

Trait	Mean	Std. Error	Std. Deviation	Minimum	Maximum
No. of shoots/plant	10.97	0.28	4.15	2.00	23.35
Length of longest shoot (cm)	170.49	2.12	31.14	71.53	245.03
Average shoot length (cm)	157.41	2.06	30.15	60.93	230.60
No. of leaves in longest shoot	33.11	0.53	7.73	12.45	61.03
Internodal length (cm)	6.10	0.07	0.98	3.50	8.65
Shoot yield/plant (g)	1394.20	53.36	782.46	200.00	3797.50
Leaf yield/plant (g)	666.74	26.40	387.06	50.00	1783.40
Hundred leaf weight(g)	232.69	7.72	113.27	29.00	620.50
Leaf area (cm^2)	133.08	3.91	57.32	7.08	323.58
Moisture content (%)	68.89	0.27	4.01	53.38	89.62

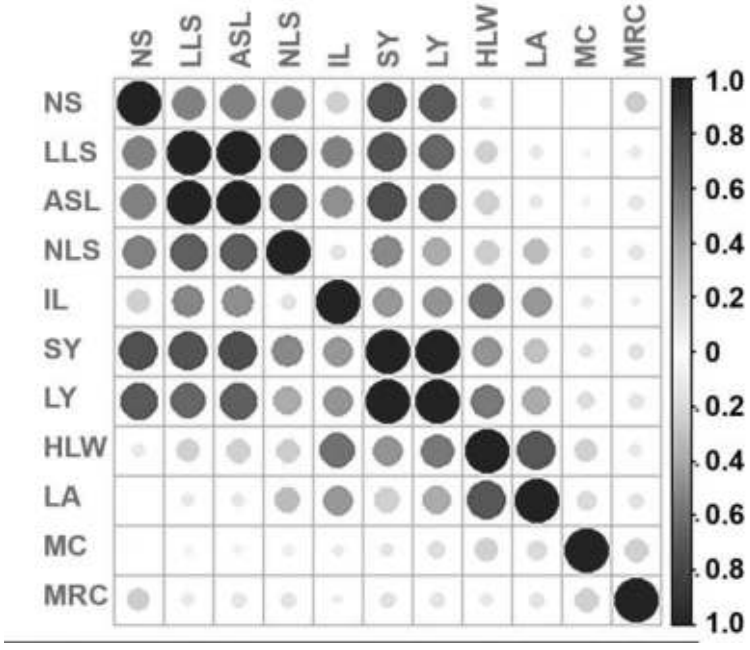


Fig. 2.10: Correlation plot

NS: Number of shoots/plant, LLS: Length of longest shoot (cm), ASL: Average shoot length (cm), NLS: Number of leaves in the longest shoot, IL: Internodal length (cm), SY: Shoot yield/plant (g), LY: Leaf yield/plant (g), HLW: Hundred leaf weight, LA: Leaf area (cm^2), MC: Moisture content (%), MRC: Moisture retention capacity (%)

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

Arunakumar GS, Gnanesh BN, Supriya M and Harshitha MM

Objectives:

- To develop mapping populations (by crossing of contrasts) for root rot resistance by pseudo-test cross strategy.

- Evaluation of segregating F1 progeny for disease resistance phenotype.
- QTL analysis for disease resistance by linkage mapping (genotypic data input from the subprogram NW2a).

Development of mapping populations for root rot resistance by pseudo-test cross strategy:

Three mapping population namely, *M. multicaulis* (ME-0006) (R) x Thailand Male (S) with 300 F1 progenies, *M. multicaulis* (ME-0168) (R) x Thailand Male (S) with 200 F1 progenies and Punjab Local (S) x *M. cathayana* (Hybrid) (R) with 45 F1 progenies were developed and established in the field. Among the three different population, selected *M. multicaulis* (ME-0168) (R) x Thailand Male (S) with 200 F1 progenies for root rot phenotyping and SNP/SSR genotyping. Additionally, all the three population is being evaluated for yield and growth characteristics under progeny row trial. The selected 200 F1 progenies were also evaluated for the survivability and rooting ability. Selection of progenies in mapping population based on the morphological observation was carried out (Fig. 2.11).

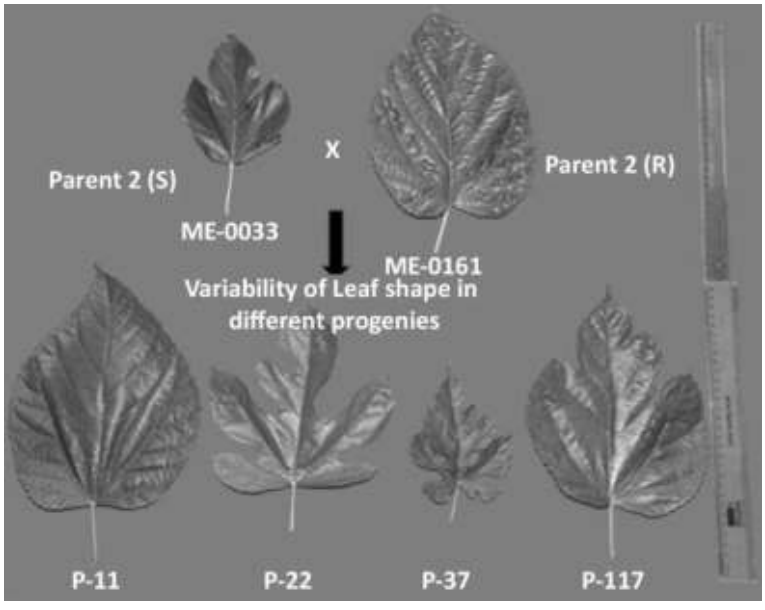


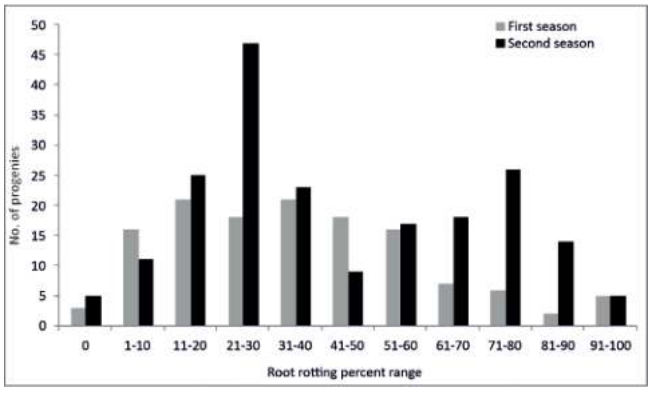
Fig. 2.11: Variability of leaf shape among F1 progenies under field conditions

Evaluation of segregating F1 progeny for disease resistance phenotype

- Raised required number of F1 progenies in the nursery beds.
- Isolated, identified and characterized root rot causing fungal pathogens.
- Mass multiplied and maintained the inoculums of *Fusarium solani* and *Lasiodiplodia theobromae*.
- Transplanted F1 progenies from nursery beds to earthen pots after four months of growth.
- Inoculated five replications of F1 progenies with root rot pathogens and experiment was conducted under glasshouse condition.
- Regularly maintained the inoculated and un-inoculated F1 progenies for root rot phenotyping.
- Recorded the data on development of root rot symptoms like number of healthy and wilted leaves and no. of healthy and wilted shoots. F1 progenies were examined every fortnight and observation was continued up to 180 days after inoculation.
- After six months plants were uprooted and recorded the data on total biomass, healthy and rotted root weight. Later, the wilting % and rotting % were calculated for each F1 progenies.

Results

The evaluation of 200 F1 progenies against root rot pathogens in two seasons showed more or less similar disease reaction as shown in Fig. 2.12a & 2.12b. Similarly it was observed that polynomial distribution of progenies in each reaction grades (Fig. 2.13).



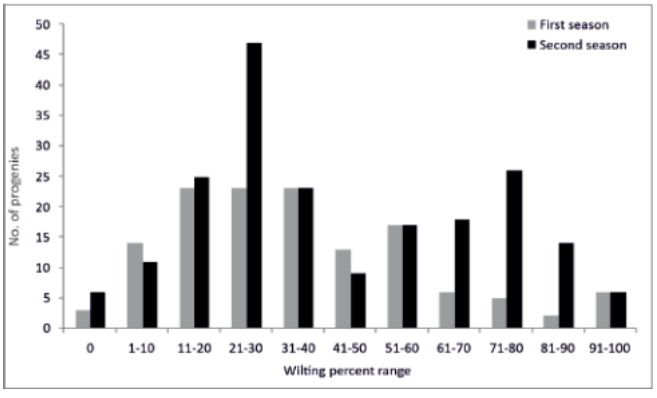


Fig. 2.12a & 2.12b: Comparison of first and second season data on rotting and wilting percent

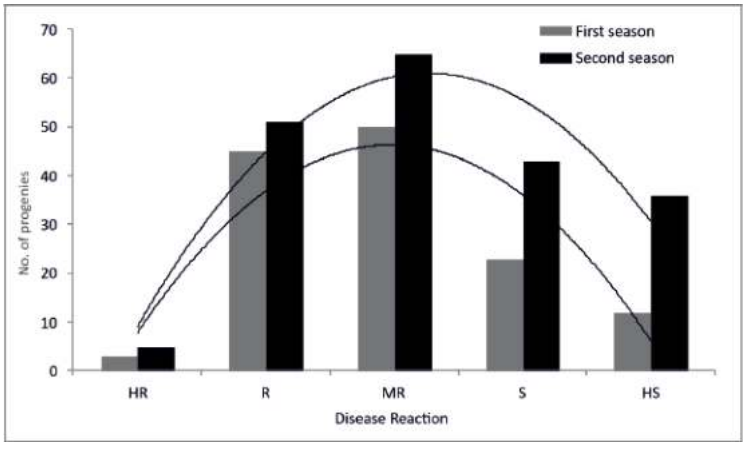


Fig. 2.13: Polynomial distribution of F1 progenies against *Fusarium solani* in five disease reaction grades. HR: Highly resistant, R: Resistant, MR: Moderately resistant, S: Susceptible, HS: Highly susceptible

The progenies have showed high rate of segregation and resulted in good number of highly resistant and highly susceptible progenies along with intermediate disease reaction grades. It is also observed the highly significant (*P>0.0001*) positive correlation between wilting and rotting percent (Fig. 2.14). When it was considered only two disease reaction grades as resistant and susceptible, it was noticed that the segregation ratio is more or less 1:1 (Fig. 2.15).

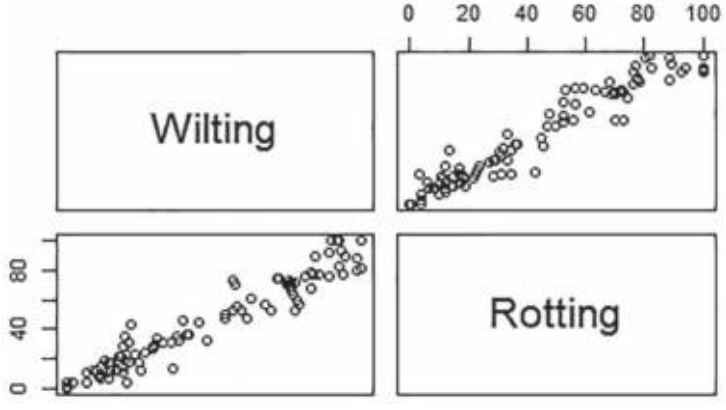


Fig. 2.14: Correlation coefficient between data on wilting and rotting

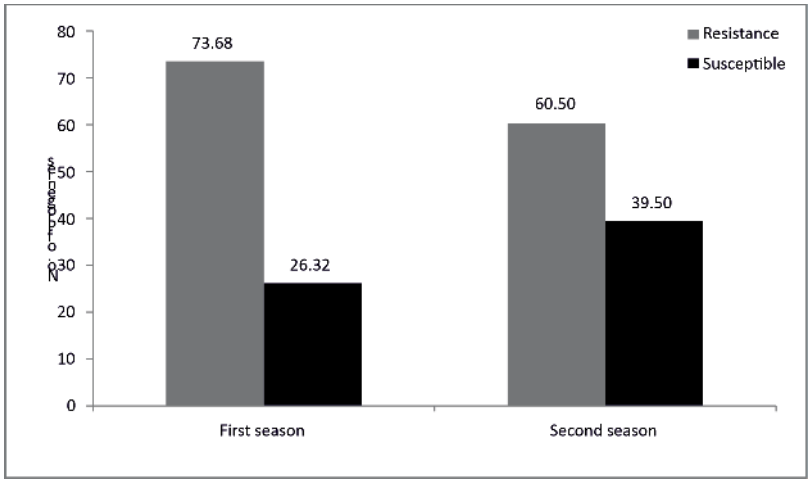


Fig. 2.15: Comparison of percent distribution of F_1 Progenies among resistance and susceptible disease reactions in both the season.

The CTAB method is adopted for isolation of DNA from 200 F1 progenies. The high quality DNA samples were stored at -20°C for further use. Agarose gel electrophoresis was performed to run the amplified PCR product and DNA bands were visualized under Gene Genius Gel doc. A total of 20 SSR markers were used to screen the parents root rot resistant (*Morus multicaulis)* and susceptible (Thailand male). Out of twenty SSRs, six were produced the polymorphic bands between the parents. They are MULSSR96A, M2SSR68, MESTSSR31, MULSSR96B, M2SSR23 and M2SSR89A (Fig. 2.16). Remaining fourteen markers resulted in monomorphic bands. Similarly studies have been undertaken in other crops by Sharma, *et al*., (2011) in Indian mustard out of twenty SSRs screened the parental genotype, five were polymorphic which were used to confirm the hybridity of F_1 hybrids. Total six markers were used for the confirmation of hybridity among F1 mapping population.

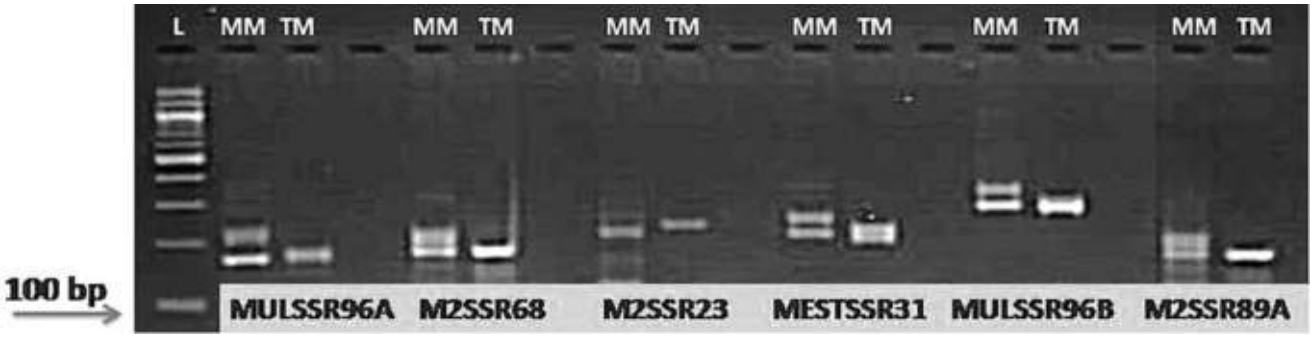


Fig. 2.16: SSR markers showing the parental polymorphism

Amplification of DNA using SSR Primers

The SSR markers which were polymorphic based on the amplification pattern to the parents were taken and used for forty-five DNA sample of F1 progenies and the same PCR samples amplified using thermal cycler were run on agarose gel to confirm the hybridity of the F1's. These SSRs were suitable for confirmation of true hybrids as per the gel profile of the six selected SSR markers in F1 progenies.

The number of alleles varied in the range of 1-4. Marker MESTSSR31 revealed the maximum number (four) of alleles while the marker M2SSR89A (one) showed the least number of allele per locus (Fig. 2.17). While MULSSR96B resulted in three alleles per locus and MULSSR96A, M2SSR68 and M2SSR23 revealed two alleles per locus (Fig. 2.18).

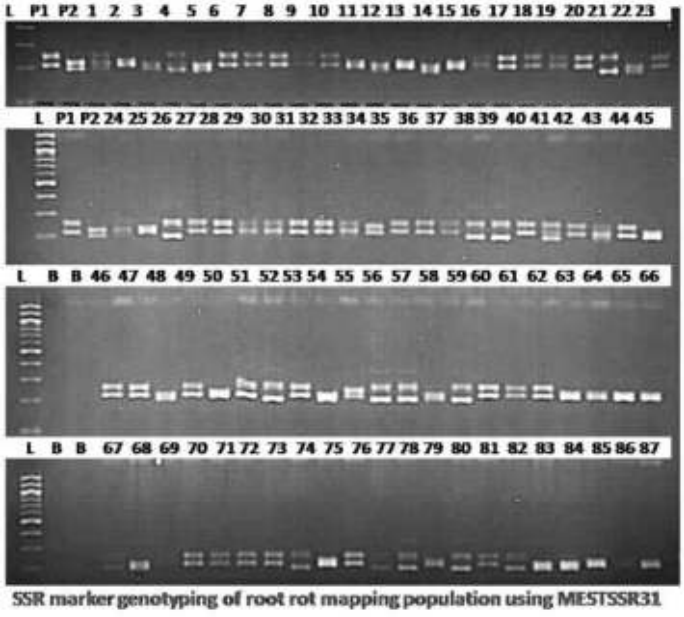


Fig. 2.17: SSR marker genotyping of root rot mapping population using MESTSSR31

The complementary banding pattern of both parents made a way to identify the hybrids. The marker MULSSR96A produced the allele size at 180 bp for female parent (*Morus multicaulis)* and allele 210 to 180 bp for male parent (Thailand male). M2SSR68 produced the allele size at 210bp to 190 bp for female parent and 190bp for male parent. M2SSR23 produced the allele size at 240 to 230 bp for female parent and 240bp for male parent. MESTSSR31 produced the allele size at 240 to 210 bp for female parent also 220 and 200 bp for male parent. MULSSR96B produced the allele size for female parent at 320 and 290 bp similarly for male parent two alleles produced with 300 and 290 bp.

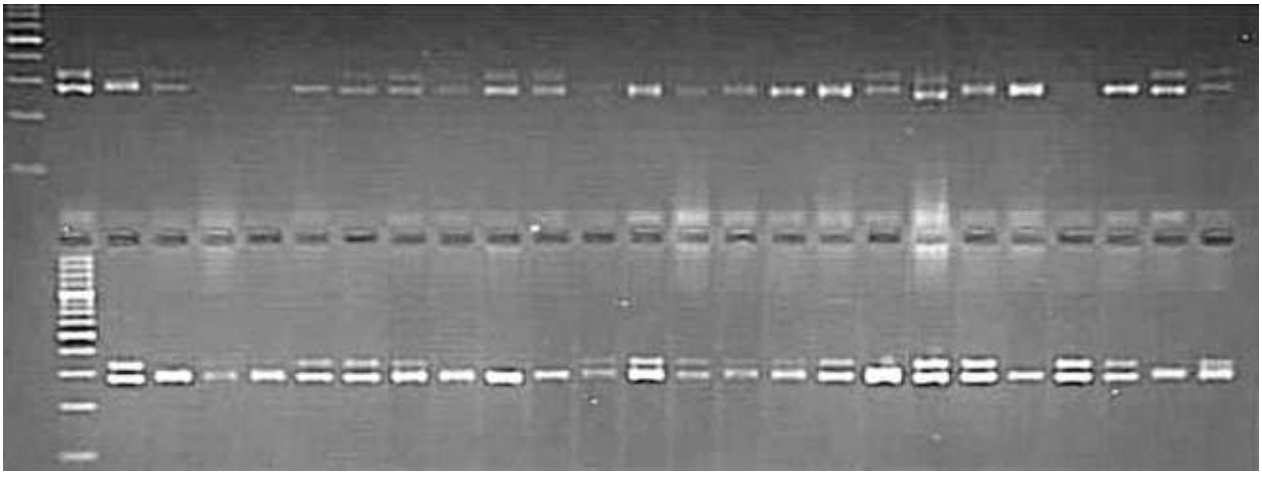


Fig. 2.18: SSR marker genotyping of root rot mapping population using MulSSR96B

Table 2.8: Allele size of female (*Morus multicaulis*) and male parent (Thailand Male) with respect to polymorphic SSR markers

Markers	Allele Size	
	Morus Multicaulis	Thailand Male
MULSSR96A	210bp 180bp	- 180bp
M2SSR68	210bp 190bp	- 190bp
M2SSR23	240bp 230bp	240bp -
MESTSSR31	240bp 210bp	220bp 200bp
MULSSR96B	320bp 290bp	300bp 290bp
M2SSR89A	160bp	180bp

The male and female allele's combination of different markers have been produced in different progenies. The list has been mentioned in Table 1 which was obtained by these specific polymorphic markers. The SSR markers clearly separated the progenies as female parent type, male parent type and hybrid type (Table 2.9).

Table 2.9: Percentage of male, female and hybrid plant type with respect to specific marker

Markers used in this study	Percentage of female parent type (%)	Percentage of male parent type (%)	Percentage of hybrid parent type (%)
MULSSR96A	0.00	57.70	42.30
M2SSR68	0.00	37.70	62.30
MESTSSR31	2.22	2.22	95.50
MULSSR96B	2.22	31.10	46.60
M2SSR23	8.88	28.80	62.20
M2SSR89A	28.80	13.30	57.70

Continuous/Other Activities

- Maintenance of 400 Panel of diverse Germplasm
- Development and maintenance of mapping resources

Concluded Research Project

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

Gnanesh BN

Objectives

- Genome size of mulberry
- Transcriptome profiling of mulberry root tissues of both *Morus indica* and *M. alba* and identification of SNP for QTL analysis

- Molecular phylogeny, identification and pathogenicity of foliar and root rot associated fungal pathogens
- Identification of novel sources of resistance to biotic stresses in mulberry collections for biparental and association mapping

Genome size is a key trait related to morphology, taxonomy and genetic variation of complex traits. Nuclear DNA content of 157 accessions of mulberry was estimated by flow cytometry using propidium iodide (PI) stained nuclei. These accessions comprised of 15 diverse species and different hybrid combinations, including diploid, triploids, tetraploid and hexaploids (Table 2.10). Remarkable genome size variation between individuals of the same species was found, representing a wide range of intraspecific genome size variation. There is a variation in genome size within ploidy levels. The pollen grain size and inflorescence length had a strong correlation with triploid mulberry (Fig. 2.19). Wide genetic diversity between *M. alba* and *M. indica* species were estimated using SSR markers (Fig. 2.20). DNA content measurement shows relationship between genome size and ploidy level in the selected diverse mulberry germplasm. This is the first report of correlating genome size and ploidy level.

Availability of relatively well-annotated genome reference sequences of *Morus alba* and Root-Knot Nematode (RKN), the mulberry–RKN system is an excellent crop model for the study of host–pathogen interactions in perennial species. In this study expression profiles of both mulberry and RKN genes from *in vivo* infected mulberry roots under soil-grown conditions at two infection time intervals (3 DAI and 21 DAI) in both susceptible and resistant genotypes was studied.. Genes involved in cell wall architecture, development, and defense responses elicited by RKN in susceptible and resistant mulberry roots were identified (Fig. 2.21). In addition, SNP were mined from transcriptome data for extensive marker development. This is the first comprehensive study to simultaneously highlight the expression profiles of mulberry and RKN during susceptible and resistant responses under glasshouse conditions.

Table 2.10: Genome content and predicted ploidy level of *Morus* species estimated by flow cytometry

#	Species	No. of germplasm	Diploid	Triploid	Tetraploid	Hexaploid
1	*M. alba*	33	0.73 - 1.00			
2	*M. australis*	01	0.98			
3	*M. bombycis*	01	0.98			
4	*M. cathayana*	02	0.80 - 0.93			
5	*M. indica*	60	0.72-1.02	1.35 - 1.39	1.69 - 1.99	
6	*M. laevigata*	16	0.87 - 0.98	1.32 - 1.40	1.57 - 1.97	
7	*M. latifolia*	20	0.75 - 0.99			
8	*M. macroura*	01	0.83			
9	*M. rotundiloba*	01	0.93			
10	*M. serrata*	01				3.21
11	*M. sinensis*	01	0.94			
12	*M. species*	17	0.81 - 0.98	1.34 - 1.35		
13	*M. tiliaefolia*	01		1.35		
14	*M. atropurpurea*	01	0.88			
15	*M. nigra*	01	1.07			
	Total	157				

A comprehensive survey was performed to assess fungal pathogens associated with root rot of mulberry throughout the main mulberry growing areas of South India. More than 250 fungal strains were isolated,

identified and evaluated for pathogenicity. The identification was conducted with morphological and molecular tools such as species-specific PCR and DNA sequencing of the internal transcribed spacer (ITS), Beta-tubulin and translation elongation factor 1-α (EF1-α) loci. The common fungus found in the field samples was *Fusarium* species complex, followed by *Lasiodiplodia theobromae* and *R. oryzae*. Phylogenetic analyses based on ITS and EF1-α sequences of the isolates showed that those belonging to the same species were clearly separated in the dendrogram. The result of this study exhibited the existence of 17 species of fungi including *F*usarium species complex (*F.facliforme*, *F.equiseti*, *F. incartum*), *R. oryzae*, and the occurrence of weak pathogens or saprophytes that are associated with the root rot of mulberry in India (Fig. 2.22). This is the first extensive study on molecular phylogeny, identification and pathogenicity of root rot associated fungal pathogens in mulberry and the first report of the *Fusarium* species complex.

An efficient and reliable screening method was developed to evaluate the disease resistant germplasm accessions for the development of cultivars resistance to root rot. Colonized sorghum grains (CSG) and root dip (RD) method of inoculation was found to be effective for large scale screening of mulberry resources and bi-parental mapping populations for identification of resistant QTLs. The mulberry accession *M. latifolia*(ME-0168) which is an Indonesian origin was found to be highly resistant consistently against root rot. Furcata and Moretti accessions were found to be highly resistant to mealy bug infestation and biochemical basis of resistance shown that they possess high amount of phenols (Caffeic acid - Toxic activity against insects, p & 0 -Coumaric acid - Antibiosis effect and Feeding deterrent, Salicylic acid - System Acquired Resistance) and flavonoids (Quercetin-Repellent and antifeedant, Luteolin- Antifeedant, Hesperetin-Defence, Rutin- Protect plants against ultraviolet radiation or pathogens) (Fig. 2.23). These promising resistant sources may be exploited in mulberry breeding for developing resistant varieties and to develop mapping populations which successively helps in identification of molecular markers associated to biotic stress in mulberry.

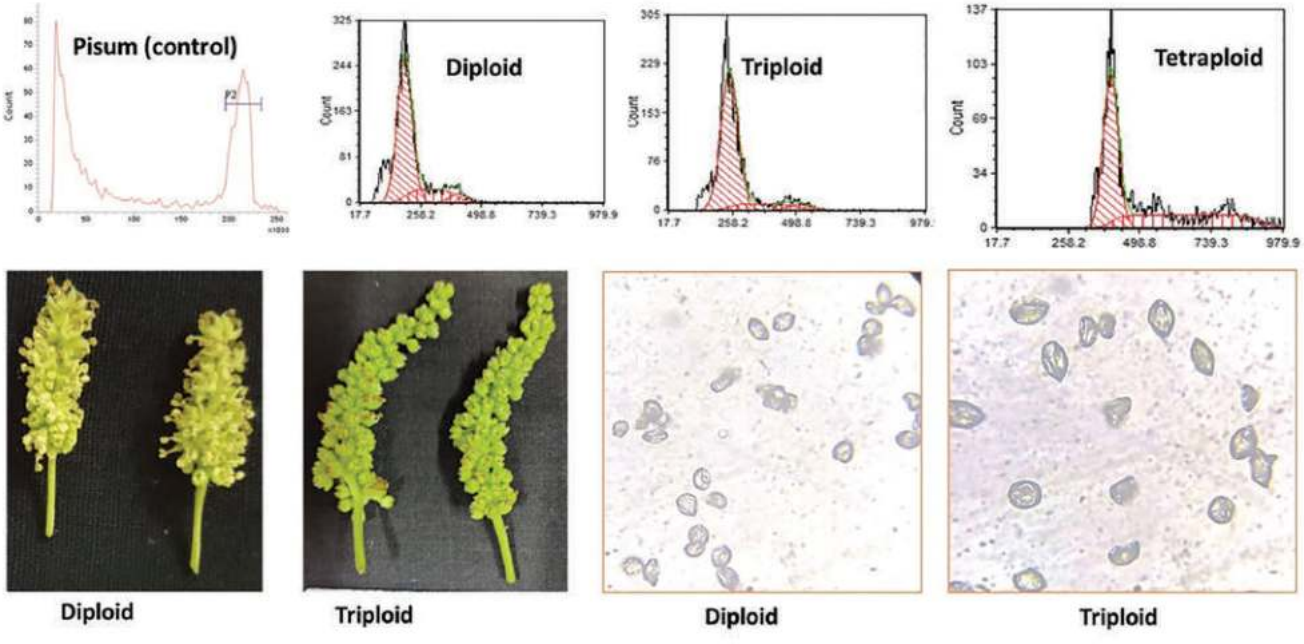


Fig. 2.14: Genome size and ploidy variation in mulberry

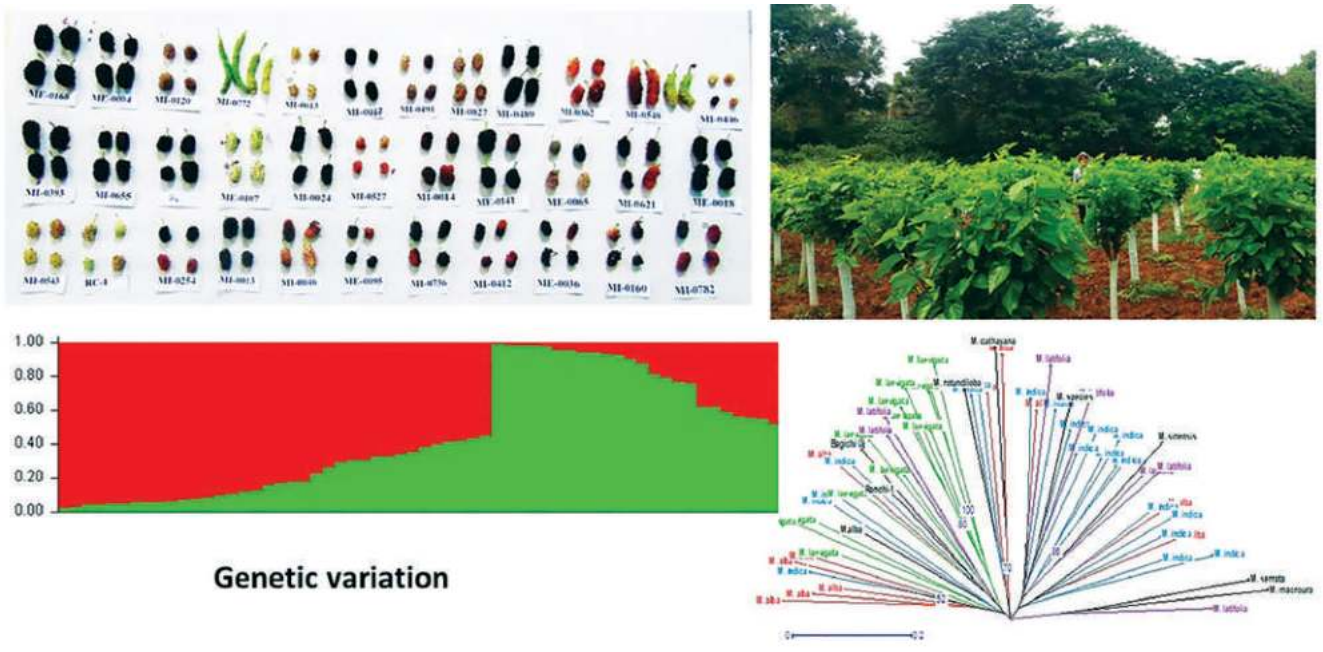


Fig. 2.20: Genetic variation reveal intraspecific diversity in mulberry

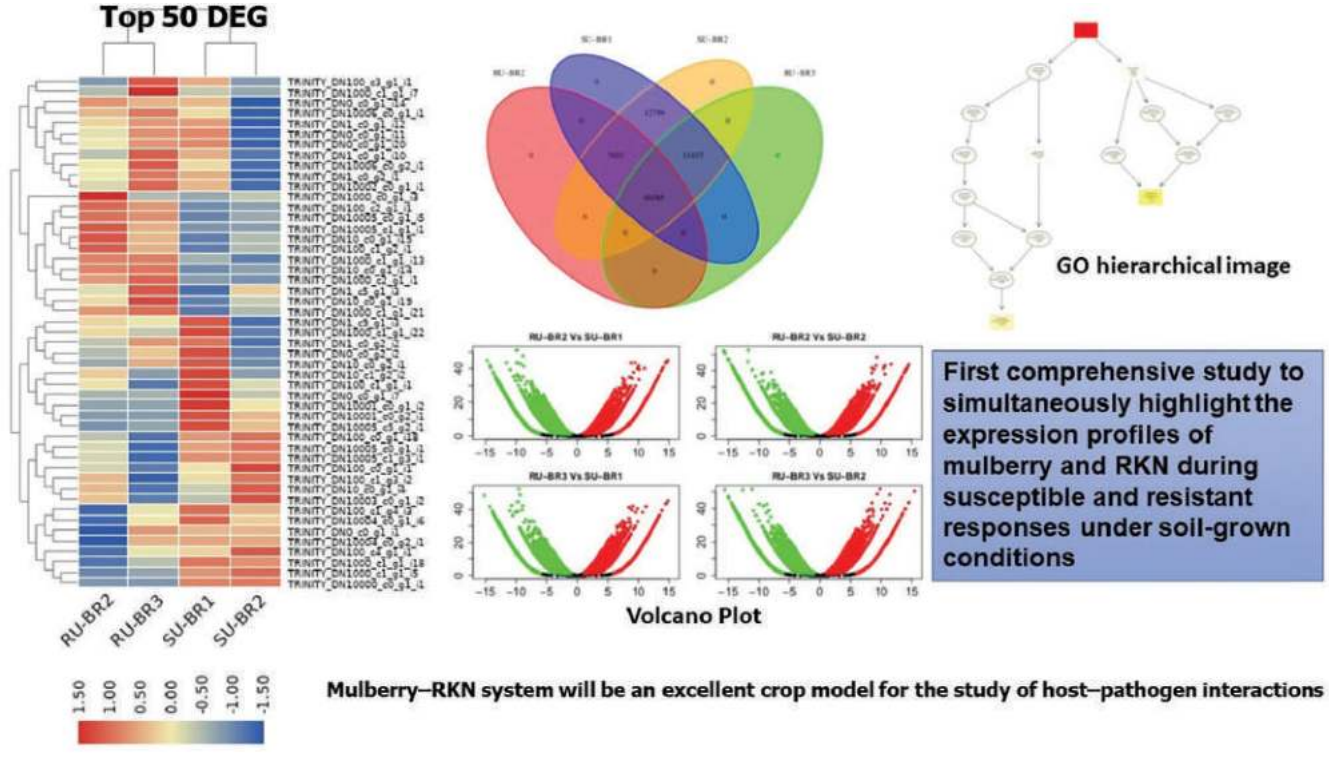


Fig. 2.21: Transcriptome of mullberry in Response to Root-Knot Nematode

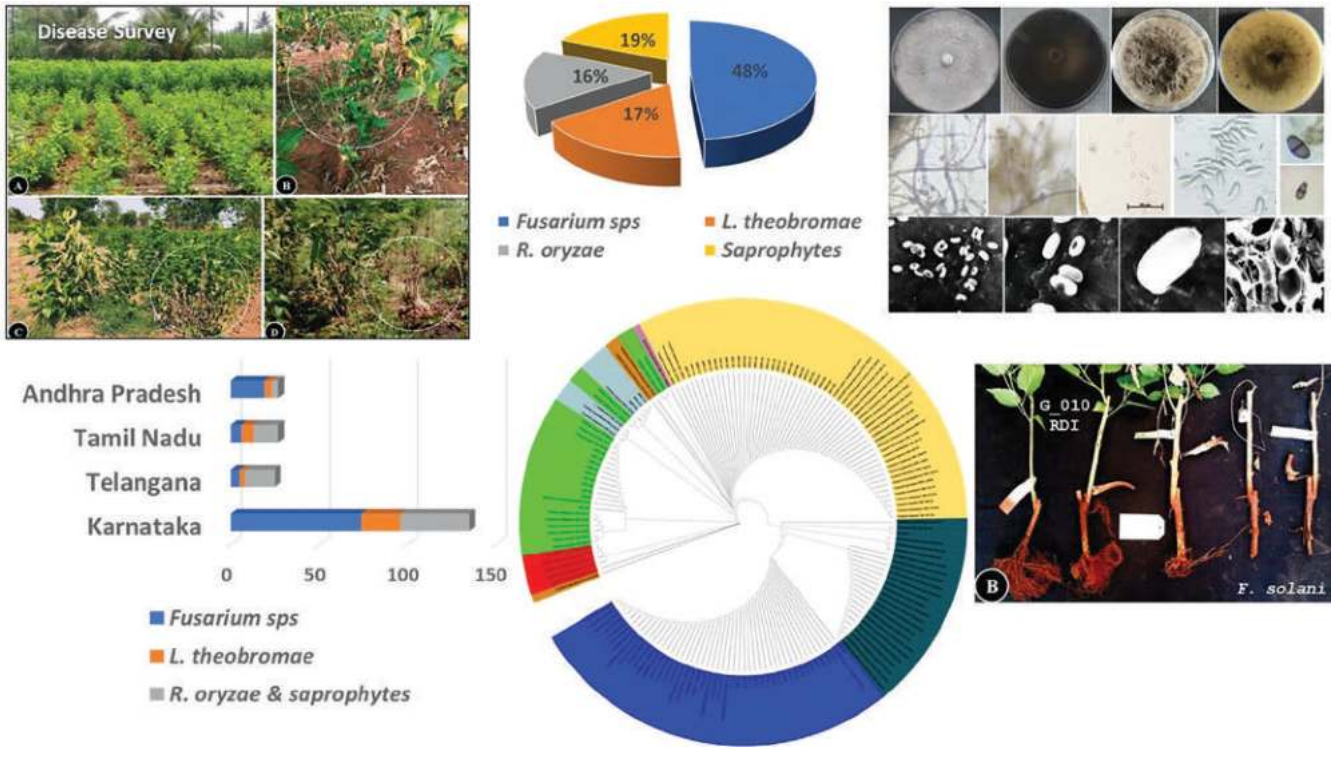
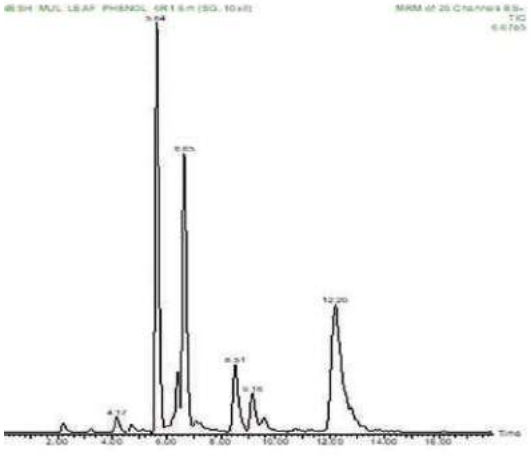


Fig. 2.22: Molecular phylogeny, identification and pathogenicity of fungal pathogens associated with root rot mulberry in India

Grading	Category	Exotic	Ind	Total
0.1-10%	Resistant	2	-	2
11-25%	Moderately resistant	-	-	-
26-50%	Moderately susceptible	2	3	5
56-75%	Susceptible	-	1	1
76-100%	Highly susceptible	59	231	291
Total		63	235	298



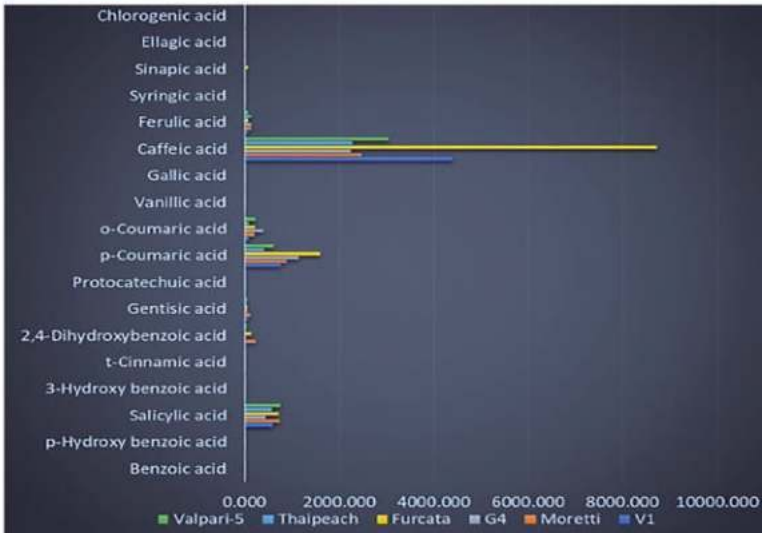


Fig. 2.23: Biochemical basis of resistance to mulberry accessions against mealy bug

3. SOIL SCIENCE & CHEMISTRY

On-going Research Projects

PIC 01003 CN: Genetic enhancement of Mulberry through Genomic approaches Sub Component: Identification of QTLs for Nutrient Use Efficiency (NW2d) (Sep. 2018 - Dec. 2021)

Sobhana V, Ravindra and Dhaneshwar Padhan

Objectives:

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

Diverse mulberry germplasm accessions shortlisted (250) were collected from CSGRC, Hosur and the nursery was raised at CSRTI, Mysuru for phenotypic evaluation of nutrient uptake and utilization efficiency with respect to nitrogen, phosphorus, sulphur and zinc for two trials. Four month old saplings were transplanted to the pots for phenotypic evaluation of nutrient use efficiency with respect to nitrogen, phosphorus, sulphur and zinc for first trial. Fertilizer treatments were imposed with 2 levels i.e., recommended dose of fertilizer (RDN) and low dose of fertilizer (LDN) i.e., 30 % recommended dose of fertilizer. Growth and yield parameters were recorded for phenotypic evaluation of diverse germplasm accessions for nitrogen use efficiency. A good variation in growth parameters was observed in diverse mulberry accessions both under RDN and LDN. Under low dose of nitrogen high variability was observed among the mulberry accessions studied for leaf yield (27%), nitrogen uptake efficiency (35%), nitrogen utilization efficiency (45%) and nitrogen use efficiency (27%). The SPAD value ranged from 20.4-49.5 with RDN and 19.95-44.0 with LDN. Leaf yield ranged from 30.5-127.1 g/plant with RDN and 21.5-112.2 g/plant with LDN. The mean values of uptake efficiency and nitrogen utilization efficiency recorded was 0.65 and 57 respectively with RDN and LDN. The nitrogen use efficiency ranged from 12.2-52.9 with RDN and 11.1-62.3 with LDN. The high performing accessions (> mean + SD) for nitrogen use efficiency under low dose of nitrogen were MI-0530, MI-029, MI-0637, ME-0154, MI-0054, MI-0082, MI-0683, MI-0090 MI-0550, MI-0052, MI-0685, G4, MI-0810, MI-0573, MI-0240, MI-0461, ME-0143, MI-0291, ME-0162, ME-0223, MI-0160, MI-0249, MI-0122, V1, MI-0130.

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

Ravindra, Dhaneshwar Padhan, Divya Singh, Thirupathaiah Y, Sobhana V, Gayathri T and Hukkeri SM

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 objectives: Purification and characterization of sericin and fibroin from organic cocoon

Half acre mulberry garden has been established by following the recommended organic cultivation practices with V1 variety in (5 x 3) x 2 ft spacing. Phytoremidiation of soil was completed three times by growing mustard plants before plantation. The soil samples were tested for heavy metals after phytoremediation and the results revealed that there is a remarkable reduction in the heavy metals. (Fig. 3.1)

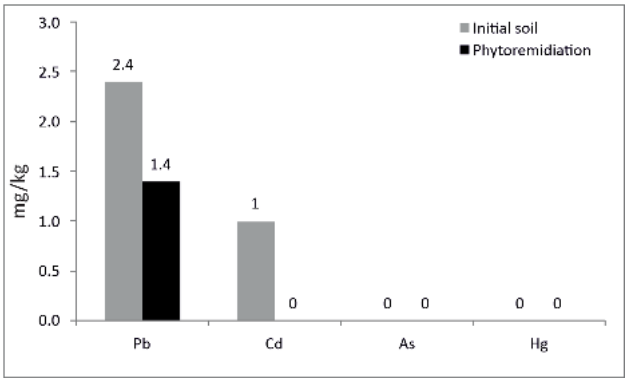


Fig. 3.1: Analysis of heavy metals before and after phytoremediation of soil

Bio-assay

Bioassay was conducted using mulberry leaf produced from organic garden as well as from conventional farming. In the silkworm rearing lime and bed disinfectant were used in control batches whereas no chemicals/ bed disinfectants were used in the treatment (organic leaf rearing). The soil, leaf, midgut, silk gland and cocoon samples were analysed for the presence of heavy metals. Even though the presence of heavy metals was detected in the organic garden soil, in the leaf, it was below the detection limit except for lead. In the case of organic cocoon it was within the permissible limit. It was observed that the heavy metals may be coming from soil through leaf to silk gland and finally reaches to cocoon (Table 3. 1). Inputs such as farm yard manure (FYM), neem cake and Vijetha (bed disinfectant) were analysed for heavy metals and Pb and As were above permissible limit (Table 3.2).

Table 3.1: Occurrence of heavy metals in soil, leaf, cocoon, gut and silkgland samples

Heavy metals	Soil (organic garden)	Leaf (Organic)	Cocoon (Organic)	Cocoon (Control)	Gut	Silk gland
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Pb	11.00	3.60	0.06	0.13	0.23	BDL
Cd	5.00	BDL	BDL	BDL	BDL	BDL
As	0.56	BDL	BDL	BDL	BDL	BDL
Hg	0.04	BDL	BDL	BDL	BDL	BDL

BDL: Below Detection Limit

Table 3.2: Heavy metals in biofertilizers and bed-disinfectant

Heavy metals	FYM (mg/kg)	Neem cake (mg/kg)	*Vijetha* (mg/kg)
Pb	1.6	1.2	4.5
Cd	0.2	0.2	0.22
As	BDL	BDL	2.59
Hg	BDL	BDL	BDL

Hydroponic-Nutrient Film Technique (NFT)

Mulberry plants were grown through hydroponic method in the laboratory on trial basis. A hydroponic prototype set up Nutrient Film Technique (NFT) was erected in soil science & chemistry at CSR&TI, Mysuru. The nutrient solution was standardized for growing mulberry plants in hydroponic culture and this solution was filled in tank and supplied through PVC pipe. Nutrient solution was pumped with motor and circulated in the system as shown in Fig. 3.2. The mulberry cuttings and saplings were used for the experiment but only saplings have survived in this system. The growth of roots and shoots are shown in Fig. 3.3.

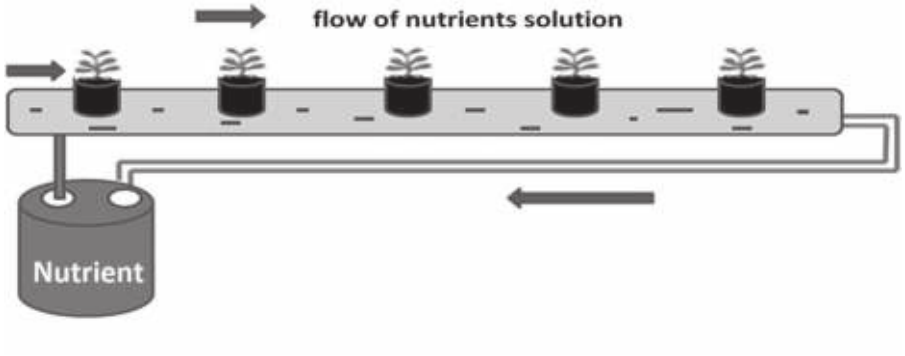


Fig. 3.2: Schematic representation of NFT system

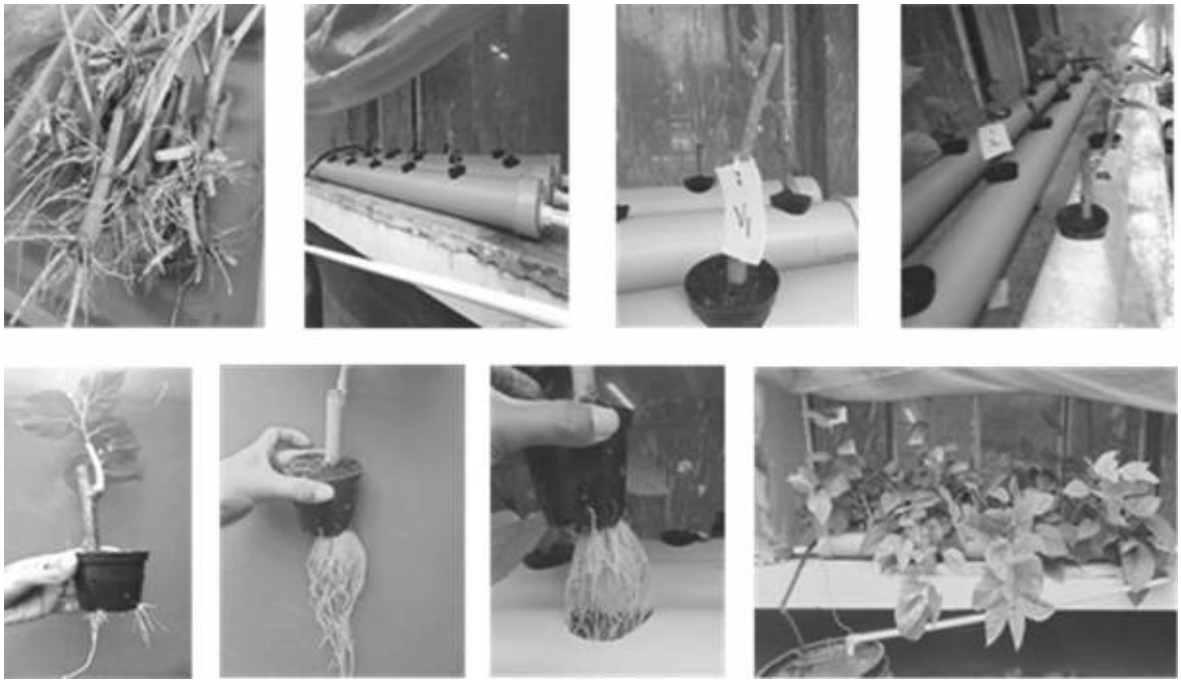


Fig. 3.3: Hydroponic prototype set up - growth of mulberry saplings in NFT system

Sand bed culture

Standardised the nutrient solution for cultivating the mulberry in sand bed culture and mixture of coco peat and sand (Table 3.3). The mulberry saplings (V1) were used for the experiment and recorded the growth of roots and shoots.

Table 3.3: Composition of nutrient solution for hydroponic and sand culture experiment

pH	5.8-6.15		
TDS	500-1000		
Nutrient	ppm	Nutrient	ppm
N	220	Fe	1.00
K	220	Mn	0.55
P	196.91	Zn	0.55
Ca	69.17	Cu	0.30
Mg	48.61	MO	0.15
B	0.25		

Continuous/Other Activities

Quality Testing of disinfectants and inputs used in sericulture

Commercialized products developed by CSR&TI, Mysore were analysed in the laboratory to check the quality parameters. Samples of soil and water also tested (Table 3.4). Based on the test results, technical guidance was provided to the stake holders.

Table 3.4: Products/Samples analyzed and revenue generated

Products	No of samples	Revenue Generated (Rs.)
Soil	127*	10699.00
Irrigation Water	14	994.00
Asthra	08	7552.00
Vijetha	04	14160.00
Vijetha Supplement	02	2360.00
Sanitech	01	944.00
Amruth	01	1180.00
Ankush	03	12390.00
Poshan	04	14160.00
Vermi-compost/FYM	07	2891.00
Dr.Soil	04	14160.00
Ankur	02	7080.00
Serichlor-20	01	944.00
Total	116	89514.00

* 65 soil samples were tested against payment

4. AGRONOMY

On-going Research Projects

PIN 3563: Evaluation of improved mulberry genotypes for yield potential, nutrient uptake and nitrogen use efficiency under varied cultivation practices (Feb. 2016 – Mar. 2022)

Dhaneshwar Padhan, Sibayan Sen (up to Jun. 2020), Sobhana V, Bhuvaneshwari E & Thirupathaiah Y

Objectives:

- To evaluate yield potential, nutrient uptake efficiency of new mulberry genotypes under varied levels of irrigation and fertilizer inputs.

- To evaluate new mulberry genotypes cultivated under varied conditions for their efficacy in silkworm rearing.
- To determine nitrogen use efficiency from soil to cocoon production.

To evaluate the improved mulberry genotypes (AGB8, MSG2, G4 and V1) for its yield potential, nutrient uptake and nitrogen use efficiency under varied cultivation practices, an experiment was conducted at CSRTI, Mysuru. The experiment was laid down in split-split plot design with three replications comprising two levels of irrigations (I_0: 100% and I_1: 60%) and three levels of fertilizer dosages (F_0:350: 140: 140 kg/ha/yr; F_1: 280: 112: 112 kg/ha/yr and F_2: 210: 84: 84 kg/ha/yr). Same quantity of FYM @ 25 MT/ha/yr was applied to all the treatments.

Harvested five crops for the second year and recorded the data on growth and yield parameters. Analyzed the soil samples for its physical and chemical properties during different seasons. Bioassay and feed conversion efficiency studies were carried out with bivoltine silkworm hybrid (FC1 x FC2) during different seasons. Nitrogen content in mulberry leaf and its uptake potential was calculated for five crops of second year. Pooled data of 5 crops for the second year revealed that under low input conditions (treatment I_1F_2) the AGB8 variety recorded the highest leaf yield of 36.8 MT/ha/yr followed by MSG2 (25.0 MT/ha/yr) and V1 (24.6 MT/ha/yr). However, there was no significant varietal difference between V1 and G4 in leaf yield (Fig. 4.1). Percentage of nitrogen estimated from the leaf varied among the varieties and also under different treatments (Fig. 4.2). The highest level of nitrogen uptake in leaf was found in AGB8 (311.6 kg/ha) followed by G4 (205.4 kg/ha), V1 (195.4 kg/ha) and MSG2 (188.4 kg/ha) respectively under low input conditions (treatment I_1F_2) (Fig. 4.3)

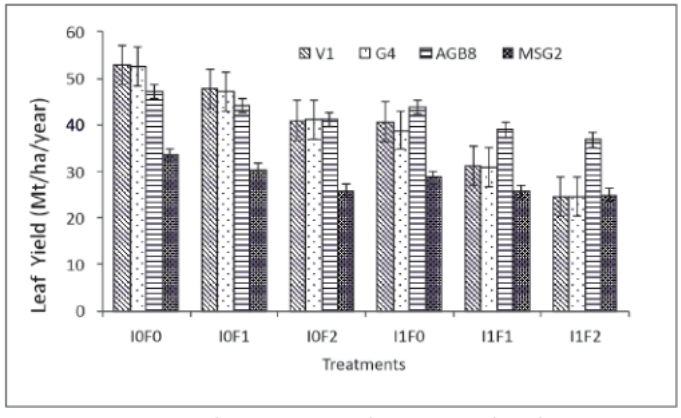


Fig. 4.1: Leaf yield data of 5 crops of different mulberry varieties under various treatments

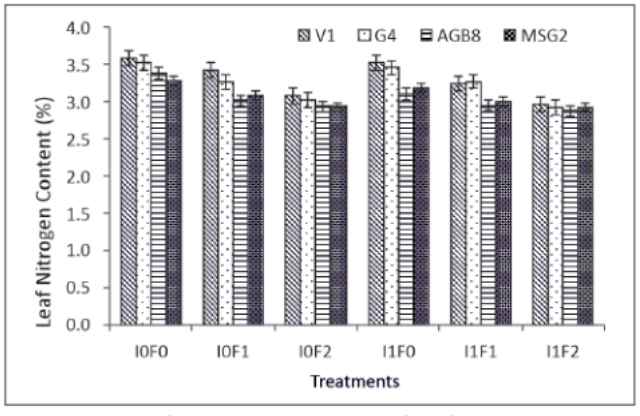


Fig. 4.2: Leaf nitrogen content of different mulberry varieties of 5 crops under various treatments

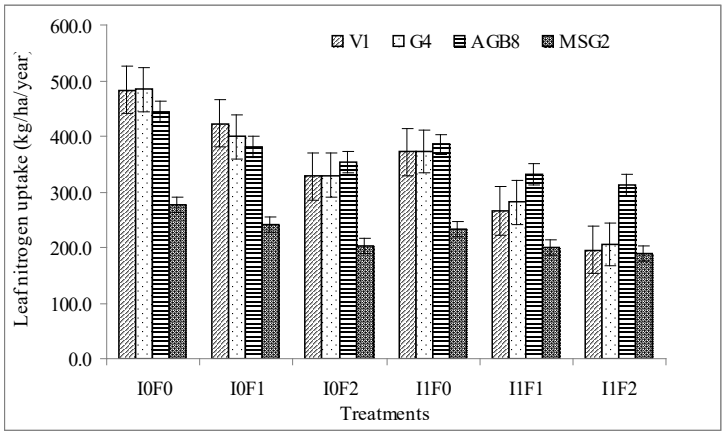


Fig. 4.3: Leaf nitrogen uptake of different mulberry varieties of 5 crops under various treatments

PPA 01016SI: Development of an agronomical package for tree mulberry cultivation for wide acceptance among the seri-farmers of Southern India (Nov. 2020 - Oct. 2022)

Dhaneshwar Padhan, Babu CM, Sobhana V, Narendra Kumar JB, Sivasubramonian T and Guruswamy D

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.

To evaluate the optimum requirement of nutrients for sustainable growth and leaf production under tree mulberry cultivation, the experiment was initiated with farmers' participatory mode in three locations *viz*., Maddur, Chamarajanagara and Kolar areas where farmers are widely adopting tree mulberry cultivation. Farmers survey was conducted in all the test locations and selected farmers for the study.

CYF 07011SI: New methods of recycling of discarded silk materials/waste for sustainability (Oct. 2019 - Nov. 2021) [Collaborative Project with CSTRI, Bengaluru]

Nivedita S, Radhalakshmi YC, Kiran B Malali, Hippargi SA, Moon MA and Babu CM

Objectives:

- To develop mill spun yarns from pre and post consumer silk waste and characterize them
- To prepare other new products like silk waddings and silk powder from left over fibres and explore their application
- To study the compostability of unusable silk waste and to estimate its nutritional value

The silk waste samples supplied by the CSTRI, Bengaluru were subjected for composting under 5 different treatment combinations in the compost pots to study the composting feasibility of silk waste for a period of 8 months. It was observed that the silk waste was not fully decomposed in any of the treatments. However, in treatment T2 (Mixture of Soil + partially decomposed compost + cow dung slurry) it was estimated that 79.6 % of silk waste was decomposed followed by 77.2 % in T3 (Mixture of soil + rearing waste+ cow dung slurry).

Continuous/Other Activities

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

5. MULBERRY PHYSIOLOGY

On-going Research Projects

PIC 01003CN: Genetic enhancement of mulberry by genomics approaches: Multi-Component Network Project

Subproject: ***NW2b*****: Discovery of QTL to drought adaptive traits by association mapping in Mulberry: in collaboration with GKVK, UAS, Bangalore. (Sep. 2018 to Dec. 2021)**

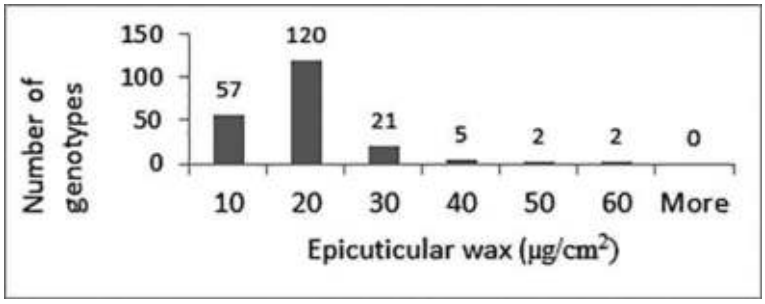
Sheshshayee MS (UAS, Bangalore) and Gayathri T

Objectives:

- Extensive phenotypic characterization of the panel of diverse germplasm for drought adaptive traits.
- To identify QTLs for drought adaptive traits by association mapping.

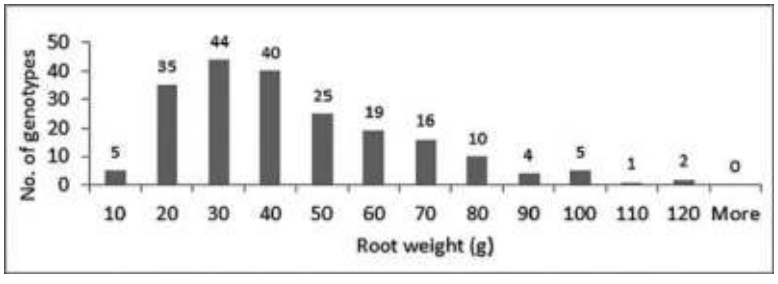
CSRTI, Mysuru

Saplings of diverse germplasm accessions (206) were transplanted in root structures (cement structures) in augmented design and maintained for phenotyping study for 1st season. Phenotypic data were recorded in all these diverse germplasm accessions *viz*., chlorophyll, epicuticular wax, specific leaf weight, leaf area and number of stomata. Growth parameters (shoot length, shoot weight, leaf weight, *etc*.) and root traits (number of roots, root weight, length and weight of longest root, *etc*.) were recorded in these genotypes. Chlorophylls and epicuticular wax content showed variation among the mulberry germplasm accessions and chlorophyll SPAD readings ranged from 21-44 and epicuticular wax content ranged from 0.50-57 µg/cm^2 (Fig. 5.1). Stomatal frequency also showed variation among the diverse genotypes (36628-323256 stomata/cm^2). Growth parameters and root traits (root weight on dry weight basis: 7-119 g, longest root length: 11-92 cm) (Fig.5.2) also showed variation among the genotypes. Saplings of diverse germplasm accessions were raised in nursery (2nd set) for undertaking phenotyping study for 2nd season.



Trait	Mean	SD	SE	CV (%)	Min.	Max.	Sample variance
Epicuticular wax (µg/cm2)	14.36	8.32	0.57	57.93	0.47	57.32	69.38

Fig.5.1: Variation of epicuticular wax content in diverse germplasm accessions (1st season)



Trait	Mean	SD	SE	CV (%)	Min.	Max.	Sample variance
Root wt. (g)	39.68	22.58	1.573	56.9	6.7	118.63	510.06

Fig. 5.2: Variation in root weight of diverse germplasm accessions (1st season)

UAS, Bengaluru

The major emphasis of the project is to enhance the potential productivity of mulberry leaves by improving drought adaption to cope up with looming water crisis. To achieve this, diverse set of 209 mulberry germplasm lines are being screened for drought adaptive traits. The germplasm lines are planted in specially designed root structures at two locations (CSRTI, Mysore and UAS, Bangalore) for extensive phenotyping of drought adaptive traits like, WUE, stomatal frequency and chlorophyll content. The morpho-physiological parameters such as root

length, root weight, deep root weight, leaf area and total dry matter etc., were been measured. The physiological and morpho-physiological parameters recorded at two locations are analysed to short list the prominent accessions to take up field experiments. The 192 germplasm lines have been screened with 29 genomic SSR markers to identify the allelic differences and polymorphism. Currently, 154 mulberry accessions are planted in managed drought environment (MDE) to assess the bud burst, drought susceptibility index for leaf area, total biomass and leaf expansion rate.PIC 01003CN: Genetic enhancement of mulberry by genomics approaches: Multi-Component Network Project

PIC 01003CN: Genetic enhancement of mulberry by genomics approaches: Multi-Component Network Project

Sub-project: NW4a: **Comparative quantitative and qualitative analysis of secondary metabolites for identification of biomarkers responsible for feed quality in mulberry [in collaboration with CSIR-National Chemical Laboratory (NCL), Pune. (Sep. 2018 - Dec. 2021).**

Thulasiram HV (CSIR-NCL, Pune), Gayathri T and Bhuvaneswari E

Objective:

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

CSRTI, Mysuru

Primary metabolites (protein, carbohydrates, amino acids, ascorbic acids and tocopherols) were estimated in ten genotypes (V-1, G-2, G-4, S-13, K-2, Mysore Local, S-36, MR-2, MS-2, Morus multicaulis) for 3 crops. Data on primary metabolites analysis showed variation among ten genotypes. Total protein ranged from 17 mg/g fw to 34 mg/g fw, carbohydrates varied from 18 mg/g fw to 36.5 mg/g fw, tocopherol ranged from 73 µg/g fw to 191 µg/g fw and ascorbic acid ranged from 11 mg/g fw to 17.5 mg/gfw (average of three crops). Quantity of total free amino acids ranged from 1.6 mg/g fw to 4.8 mg/g fw. Among the ten genotypes; higher primary metabolites were recorded in V1, G4 and Morus multicaulis; whereas least metabolites were observed in Mysore Local.

The feed conversion efficiency study was undertaken during winter season (November-December 2020). The results showed that nutritional indices traits were better in G-4 followed by V-1, G-2, S-36, K-2 and Morus multicaulis. The consumption traits have been compared with the conversion trait, i.e., efficiency conversion of ingesta to shell (ECI shell) was highest in G4 (12.32%), V-1 (12.174%), G-2 (11.106%) and S-36 (10.07%). Similarly, the PECS (Production efficiency of cocoon shell) was highest in G-4 (11.061%), V-1 (10.331%), G-2 (7.702%), S-36 (7.690%), K-2 (7.518%) and Morus multicaulis (7.725%).

CSIR-NCL, Pune

- Secondary metabolites extraction methods were standardized with three mulberry varieties (V-1, G-4 and G-2). Secondary metabolites were extracted from these 3 varieties under different conditions and subjected to GC-MS analysis.
- TBME extracts under sonication showed better metabolite levels.
- TBME extract of methanol sonicated crude showed better levels of fatty acids derivatives.
- Fresh leaf samples of ten mulberry varieties (V-1, G-2, G-4, S-13, K-2, Mysore Local, S-36, MR-2, MS-2 and Morus multicaulis) were collected from CSRTI, Mysore for the extraction of secondary metabolites from the leaf samples.

6. MULBERRY PATHOLOGY

On-going Research Projects

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

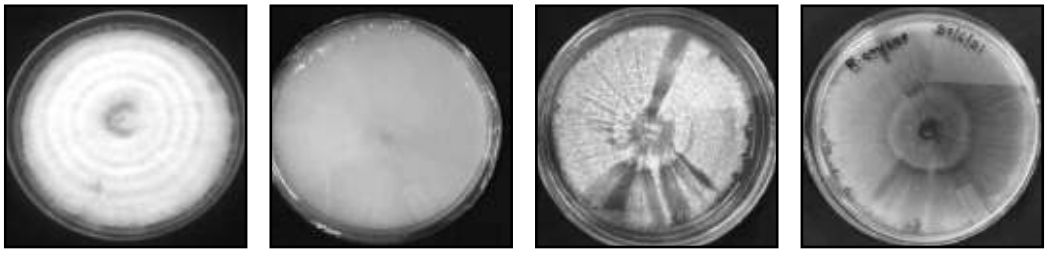
Arunakumar GS, Satish L, Dhahira Beevi N, Sudhakar P, Vinod Kumar Yadav and Nisarga Pushpa

Objectives

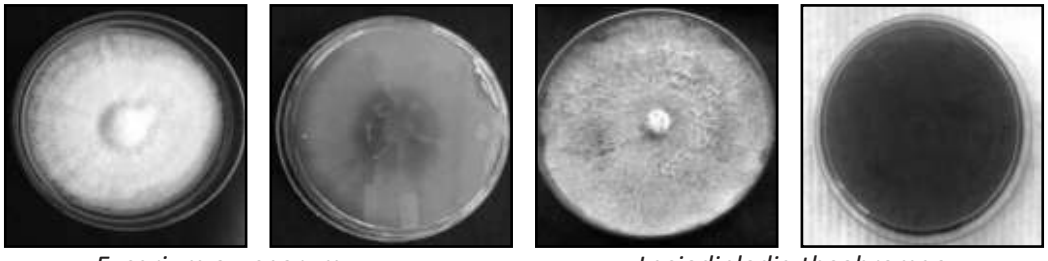
- Collection, isolation, identification and characterization of potential biocontrol agents available at rhizosphere of mulberry
- *In-vitro* evaluation of potential bio-control agents available at rhizosphere of mulberry against root rot causing pathogens
- To study compatibility of potential bio-control agents 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

Progress of the project

- Collected ten soil/root samples from mulberry gardens of farmers' field from Dharwad, Haveri, Mysuru, Hassan and Kolar (Karnataka).
- Pure cultures of *Fusarium solani*, *Fusarium oxysporum, Rhizopus oryzae* and *Lasiodiplodia theobromae* were freshly isolated from root rot infected mulberry roots (Fig. 6.1).
- Isolated beneficial organism, which is being identified as *Trichoderma harzianum.*
- Required number of susceptible plants in pots are being maintained for *in vivo* evaluation.



Fusarium solani *Rhizopus oryzae*



Fusarium oxysporum *Lasiodiplodia theobromae*

Fig. 6.1: Mulberry root rot fungal pathogens

Continuous/Other Activities

- Maintenance of different bacterial and fungal cultures.
- Quality evaluation of *Navinya* and *Rot fix* samples by *in vitro* evaluation against root rot causing fungal pathogens were conducted
- Resolved arround 40 field problems related to mulberry diseases

7. FARM MANAGEMENT

Y. N. Sanath Kumar

Continuous/Routine Activities

- Maintained 19 acres of mulberry garden including 2 acres chawki garden and 3 acres tree plantation for the production of quality mulberry leaf with recommended package of practices.
- Maintained the farm machineries such as two tractors, two power tillers, nine irrigation pump sets, pruning machines and other equipments for effective management of mulberry gardens of the institute.
- Maintained 2 acres of *chawki* plot with V1 and G2 varieties following the recommended agronomical practices to supply the quality leaf for *chawki* rearing.
- Supplied 15,405 kg *chawki* leaf from the chawki garden to model Commercial Chawki Rearing Centre of the Institute to undertake the chawki rearing of 56,450 dfls.
- Supplied 60,010 kg mulberry leaf and 38,770 kg mulberry shoot from to different rearing sections for the experimental rearings of 4,980 dfls. Pls check the figurs
- Maintained 5 acres of mulberry garden with V1, G2 & G4 varieties for the seed multiplication programme.
- Supplied 24.486 MT of V1 mulberry seed cuttings to 52 farmers for expanding an area of 97.94 acres and generated an income of Rs. 1,10,202/-. Similarly, 0.725 MT of G4 cuttings were supplied to 2 farmers for expanding 2.9 acres and generated an income of Rs. 3,263/-.
- A total of Rs.1,13,465/- was generated through sale of mulberry seed cuttings and auction of green grass.

8. BIVOLTINE BREEDING

Concluded Research Projects

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

Meenal R, Hukkeri SM, Sashindran Nair K, Shankara and Pankaj Tewary

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

Large scale evaluation of the promising bivoltine single hybrid, S8 x CSR16 was undertaken with the farmers of South India. A quantity of 3740 P1 dfls (S8 and CSR16) was reared by selected adopted seed Rearers and the seed cocoons generated were processed at SSPCs Ramanagara, Chintamani, Hindupur and Bangalore. 3,00,050 dfls of S8 x CSR16 hybrid were prepared and the average egg recovery/kg of cocoons recorded was 59.88 g (Table 8.1).

Table 8.1: Grainage performance of S8 x CSR16

Centre	No. of Crops/ Lots	No. of P1 dfls brushed	No. of hybrid dfls produced	Egg recovery/ kg of cocoon (g)
SSPC, Ramanagar	12	2685	201750	62.20
SSPC, Chintamani	2	475	52000	65.92
SSPC, Hindupur	1	300	21250	56.49
SSPC, Bangalore	1	270	24150	54.77
CSRTI, Mysore	1	10	900	60.00
Total/Average	17	3740	300050	59.88

Performance of S8 x CSR16 at farmers' field: A total of 3,00,050 dfls were distributed to 1243 farmers, covering Karnataka, Andhra Pradesh, Tamil Nadu and Maharashtra (Table 8.2). Simultaneously, the rearing performance of 1,44,975 dfls of FC1 x FC2 reared by 894 farmers was also evaluated as control. The overall data for the new hybrid S8 x CSR16 revealed an average cocoon yield of 67.9 Kg/100 dfls as against 68.31 kg/100 dfls in FC1 x FC2 (Table 8.3). The cocoon parameters recorded for S8 x CSR16 hybrid are single cocoon wt. 1.792 g, single shell wt. 0.377 g and cocoon shell % 21.06. Similarly, the cocoon parameters recorded for FC1 x FC2 are single cocoon wt. 1.768 g, single shell wt. 0.366 g and cocoon shell % 21.25. The average rate fetched per kg of cocoons was Rs.310/- for S8 x CSR16 as against Rs.319/- for FC1 x FC2.

Region wise performance: The rearing performance data was analyzed statistically to find out the influence of regions on the performance of the hybrid. Highly significant difference with respect to cocoon yield and cocoon shell % was noticed among the regions (Table 8.3 & 8.5). Yield/100 dfls was 67.33 kg in Andhra Pradesh as against 73.16 and 70.01 kg in Karnataka and Tamil Nadu respectively. Similarly the cocoon shell % was 20.74% in Andhra Pradesh, as against 22.02% and 21.54% in Karnataka and Tamil Nadu respectively.

Season wise performance: The rearing performance data of each state was classified into three seasons *viz.,* summer, rainy and winter and analyzed statistically (Table 8.4 & 8.5). There was no seasonal influence on the performance of the hybrid. This indicates that the hybrid S8 x CSR16 can be reared throughout the year where as the ruling single hybrid CSR2 x CSR4 is recommended only for favorable seasons.

Table 8.2: Performance of S8 x CSR16 at farmers' field

State	No.of dfls reared	No.of farmers covered	Cocoon yield/100 dfls (Kg)	SCW (g)	SSW (g)	Cocoon shell (%)	Rate/Kg of cocoons (Rs)
Karnataka	152250	642	73.16	1.820	0.403	22.02	316
		SD	10.43	0.11	0.04	0.77	63.24
		CV%	14.3	6.0	9.3	3.5	20.0
Andhra Pradesh	43200	218	67.33	1.722	0.357	20.74	290
		SD	2.77	0.11	0.03	0.8	41.17
		CV%	4.1	6.1	7.9	3.7	14.2
Tamil Nadu	102600	377	70.01	1.746	0.375	21.54	359
		SD	3.68	0.10	0.02	0.73	43.96
		CV%	5.26	5.46	6.19	3.39	12.26
Maharashtra	2000	6	61.10	1.874	0.362	19.30	273
		SD	3.68	0.07	0.002	0.79	3.54
		CV%	6.0	3.5	0.58	4.09	1.3
Total/ Average	300050	1243	67.88	1.792	0.377	21.06	310

Table 8.3: Performance of FC1 x FC2 (Control) at farmers' field

State	No. of dfls reared	No. of farmers	Yield/100 dfls (kg)	SC Wt (g)	SS Wt (g)	Cocoon shell (%)	Rate/Kg of cocoons (Rs)
Karnataka	68750	471	69.84	1.778	0.392	22.05	346
Andhra Pradesh	27835	174	70.31	1.748	0.352	20.86	291
Tamil Nadu	48140	248	71.48	1.725	0.371	21.85	365
Maharashtra	250	1	61.60	1.820	0.350	20.23	275
Total/ Average	144975	894	68.31	1.768	0.366	21.25	319

Table 8.4: Performance of S8 x CSR16 during different seasons

State	Season	No. of dfls	No. of farmers	Yield/100 dfls (Kg)
Karnataka	Summer	27800	116	74.13
	Rainy	77000	310	71.65
	Winter	47450	216	73.75
Total/ Average		152250	642	73.16
Andhra Pradesh	Summer	4000	8	66.94
	Rainy	16500	84	68.16
	Winter	22700	126	66.89
Total/ Average		43200	218	67.33
Tamil Nadu	Summer	27300	85	69.53
	Rainy	34500	122	69.88
	Winter	40800	170	70.62
Total/ Average		102600	377	70.01
Maharashtra	Winter	2000	6	61.10

Table 8.5: Two way Anova on influence of region & season on performance of S8 x CSR16

A: Region wise	Yield/100 dfls (kg)	Shell Ratio (%)
Karnataka	73.18	22.02
Andhra Pradesh	67.33	20.74
Tamilnadu	70.01	21.54
F-Value	**	**
CD	2.13	1.03
B: Season wise		
Summer	70.17	20.73
Rainy	69.83	21.93
Winter	70.42	20.86
F-Value	NS	**
CD	--	0.96
A x B Interaction	NS	NS

Comparative analysis between S8 x CSR16 and FC1 x FC2: "t" test was done to compare the performance of S8 x CSR16 with the ruling double hybrid FC1 x FC2. Non-significant difference with respect to cocoon yield and cocoon shell % was observed between the test and control hybrid indicating that the new single hybrid is at par with the double hybrid (Table 8.6).

Table 8.6: Comparative analysis between S8 x CSR16 and FC1 x FC2 (Control)

Hybrid	Yield/100 dfls (kg)	Cocoon shell %
S8 X CSR16 [test hybrid]	70.14	21.18
FC1 X FC2 [control]	70.54	21.47
t-Test	NS	NS

Reeling performance: The cocoon lots of S8 x CSR16 were tested for cocoon and silk quality at CSTRI, Bangalore. Twenty two cocoon samples (3 kg each) from Southern states were evaluated for post cocoon parameters and raw silk quality parameters (Table 8.7 & 8.8). The samples from Karnataka exhibited higher values with respect to post cocoon parameters, followed by that of Tamil Nadu. The average filament length recorded was 948 m with 85.47% reelability and 15.62% of raw silk with 75.65% of recovery in Karnataka samples. Similarly, all the raw silk quality parameters are high in samples received from Karnataka followed by that of Tamil Nadu. Overall, the raw silk obtained from S8 x CSR16 cocoons were graded as 2A to 3A.

Table 8.7: Post cocoon parameters of S8 x CSR16

#	Cocoon Parameters	KA 12 samples	AP 2 samples	TN 8 samples
1	SCW (g)	1.380-2.000	1.460-1.650	1.360-1.750
2	SSW (g)	0.300-0.480	0.310-0.330	0.261-0.380
3	Cocoon shell % (%)	20.83-23.90	20.18-21.10	20.20-22.74
4	AFL (m)	824-1062	758-807	766-1080
5	NBFL (m)	524-974	551-608	684-931
6	Denier	2.40-3.21	2.60-2.70	2.10-2.90
7	Reelability (%)	78-93	72-73	86.20-92.60
8	Renditta	5.8-7.7	7.10	5.40-7.20
9	Raw silk %	12.9-16.8	14.3	13.90-18.70
10	Raw silk recovery %	58.00-85.90	66.90-70.00	64.30-83.40

Table 8.8: Raw silk quality parameters of S8 x CSR16

#	Cocoon Parameters	Karnataka (12 samples)	Andhra Pradesh (2 samples)	Tamil Nadu (8 samples)
1	Winding breaks/10 skeins	2-4	2-5	2-4
2	Average size (d)	20.08-22.43	21.09-21.13	19.04-22.56
3	Standard size deviation	1.28-1.58	1.48-1.60	1.27-1.60
4	Maximum deviation (d)	1.80-3.20	3.2-3.4	1.90-3.10
5	Evenness variation -I (stripes)	60-130	130-140	70-130
6	Cleanness (%)	96-99	93-94	93-98
7	Neatness (%)	92-98	90-92	93-97
8	Tenacity (gpd)	3.7-3.9	3.8-3.9	3.7-4.0
9	Elongation (%)	18-23	18-18.5	19-23
10	Cohesion (Strokes)	61-86	61-68	60-75
11	Grade	2A-3A	2A	2A-3A

Cocoon yield frequency: Based on the average cocoon yield/100 dfls, the farmers were grouped in to different yield frequencies. The yield range between 41-50 kg/100 dfls was recorded by 3.06% of farmers. Maximum farmers (36.2%) recorded an average yield between 61-70 Kg followed by 71-80 Kg by 32.66% of farmers. Maximum cocoon yield i.e., above 90 Kg was recorded by 0.64% (Table 8.9).

Table 8.9: Cocoon yield frequency distribution in Farmers' field

State	No. of farmers	41-50 kg	51-60 kg	61-70 kg	71-80 kg	81-90 kg	≥ 90 kg
Karnataka	642	14	75	190	190	164	7
Andhra Pradesh	218	24	55	80	53	2	1
Tamil Nadu	377	0	28	177	163	9	0
Maharashtra	6	0	3	3	0	0	0
Total	1243	38	161	450	406	175	8
Percentage		3.06	12.95	36.20	32.66	14.08	0.64

Conclusion: From the above results, it is clear that the performance of S8 x CSR16 is at par with that of ruling bivoltine hybrids. It is confirmed to be a productive single hybrid, easy to rear throughout the year with 2A - 3A grade silk. It provides better returns for cocoon producers and reelers. It can be used as an alternative to the bivoltine single hybrids, wherever preferred.

AIT 3628: Assessment of SNP Variation in Silkworm (*Bombyx mori* L.) by Genotyping by Sequencing and genome-wide association mapping of important commercial traits. [DBT funded, in Collaboration with RVCE, Bangalore] (Dec. '17 to Nov. '20, extended upto Mar. 2021)

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

Objectives

- Identification of SNP variation in silkworm genotypes through genotyping by sequencing of diverse silkworm genotypes
- Analysis of SNP data for use in different aspects of molecular breeding of silkworm
- Development of web accessible database hosting the developed genomics resources for use by different silkworm researchers in India.

India has rich and diverse collection of silkworm genotypes with some are unique in nature i.e., thermo and disease tolerance, high productivity, bimodal moth emergence pattern *etc*. Understanding the molecular mechanism underlying uniqueness/genetic variation of these strains/ breeds is very much essential, by which adaptive capacity of these under different climatic condition can be understood and thereby use them in further silkworm improvement programme. In this project, an analysis SNP variation in silkworm was carried out Genotyping by sequencing (GBS). The SNP information also enables for association or linkage analysis of traits of commercial interest in silkworm. This project has two major components *viz.,* phenotyping and genotyping of selected silkworm breeds.

Selection of genotypes and phenotyping: In India different sericulture research institutes maintain >500 silkworm genotypes comprising of multivoltine and bivoltine. Among them, 100 genotypes (60 bivoltine and 40 multivoltine) were shortlisted based on geographical origin and hierarchal clustering, which contains maximum allelic diversity in a minimum set of germplasm. These genotypes were collected from different sericulture R&D institutes across India (Table 8.14) and reared following the standard rearing procedure for conforming to their original characters. Twelve quantitative (Pupation (%), cocoon weight (g), shell weight (g), shell %, thermo-tolerance (%), NPV tolerance (%), filament length (m), reelability (%), raw silk (%), neatness (p) and evenness (p) and along with five qualitative traits (egg colour, larval marking, larval colour, cocoon shape and colour) were considered for phenotyping and was carried out as per standard procedure. A total of nine cycle of phenotyping was carried out and data was subjected to ANOVA and clustering.

Table 8.14: List of silkworm genotypes selected from different sericulture R&D institutes

Institutes	No. of Silkworm Genotypes	
	Bivoltine	Multivoltine
CSRTI, Mysuru	12	20
CSRTI, Berhampore	14	6
CSRTI, Pampore	14	-
CSGRC, Hosur	15	9
KSSRDI, Bengaluru	2	1
APSSRDI, Hindupur	3	4
Total	60	40

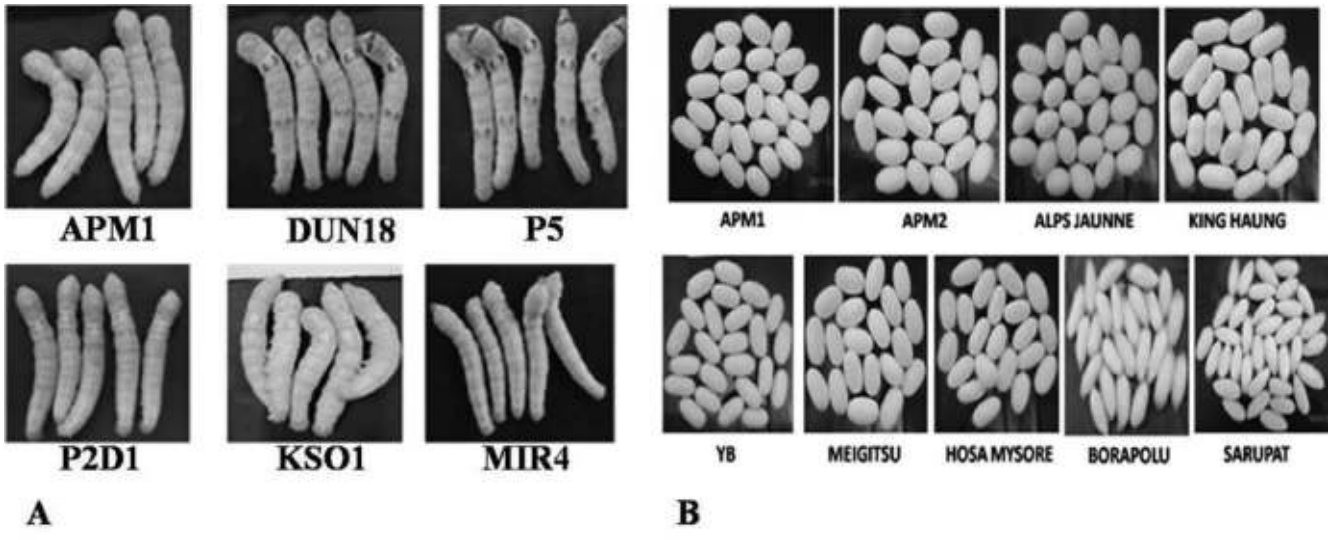


Fig. 8.1: Phenotyping of silkworm genotypes. A: Larval colour, larval markings B: Cocoon colour and cocoon shape

Table 8.15: Genetic variations in 100 silkworm genotypes

	Survival (%)	Yield/ 10000 Lar. (wt.kg)	SCW (g)	SSW (g)	Shell (%)	NPV tolerance	Thermo tolerance	FL (m)	Reel-ability	Raw silk (%)	Neat-ness (p)	Even-ness
Mean	8610	11.07	1.301	0.239	17.92	49.56	52.12	552	79.20	10.254	80.15	77.62
Min	5400	6.92	0.716	0.089	11.16	15	20	261	69	6.75	75	74
Max	9700	15.56	1.771	0.412	23.14	83	84	879	91	14.5	92	88
SD	779.3	1.89	0.29	0.06	3.58	17.98	18	187.63	5.32	2.62	5.56	4.62
CV%	9.25	17.52	19.12	32.59	19.38	36.64	33.05	34.69	6.95	23.92	6.79	6.13
P value	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	<0.001	< 0.001	< 0.001	< 0.001

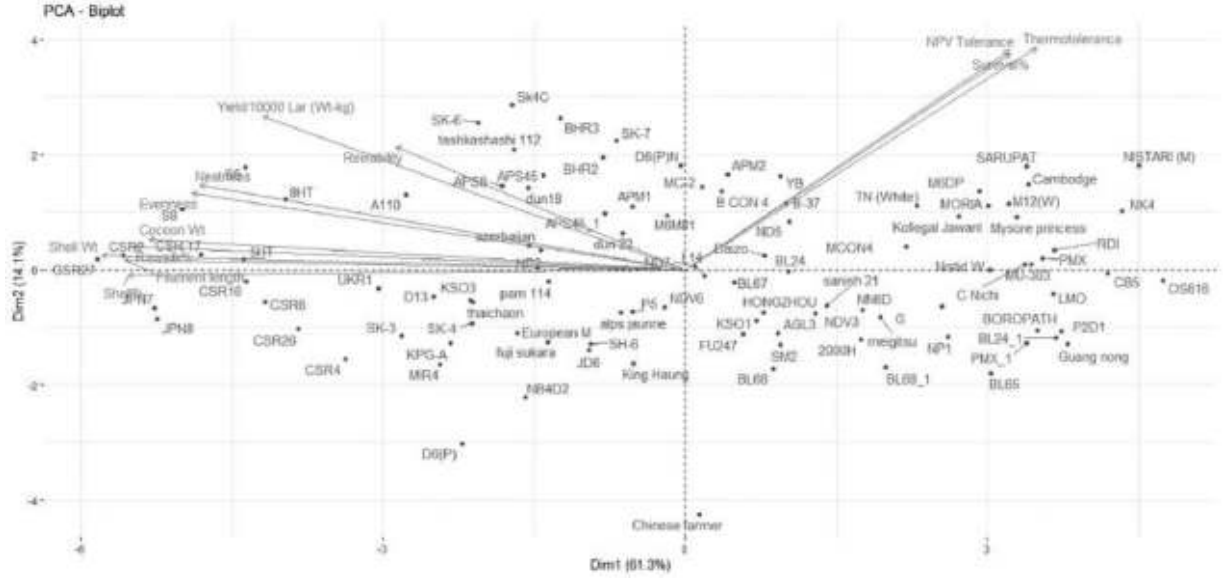


Fig. 8.2: Principal component analysis of the silkworm genotypes

Analysis of variance revealed (Table 8.15) significant differences among the genotypes for all the parameters studied. Pupation (survival) ranged from 54-97%, cocoon weight (0.72-1.77 g), shell weight (0.09-0.41 g), thermo-tolerance (20-84%), NPV tolerance (15-83%), filament length (261-879 m), reelability (69-91%), raw silk (6.75-14.5%), neatness (75-92) and evenness (74-88) (Table 8.14).

Principle component analysis (PCA) was performed to find out the linear combination with a maximal variance of quantitative traits after log transformation (Figure 2). All the statistical analysis was performed using R 3.5.2 version (R Core Team 2018). PCA revealed that the first two components (PC1 and PC2) accounted for the variation of 74.2% of which PC1 alone explains 62.5% of the total variation. The component - PC1 was associated with traits such as Yield/10000 Larvae (Wt-kg), Cocoon weight, Shell weight, Shell%, Filament length, Reelability, Raw silk %, Neatness and Evenness whereas PC2 (14.8 %) was associat ed with Survival (%), NPV tolerance and thermo-tolerance.

The hierarchical cluster analysis was performed to identify the diversity of the 100 silkworm genotypes based on the quantitative traits such as Survival (%), Yield/10000 Larvae (Wt-kg), Cocoon weight, Shell weight, Shell% , NPV Tolerance, Thermo-tolerance, Filament length, Reelability, Raw silk %, Neatness and Evenness. The Euclidean distance by Ward's method was calculated and the relationship between the genotypes was examined by constructing the dendrogram (Fig. 8.3).

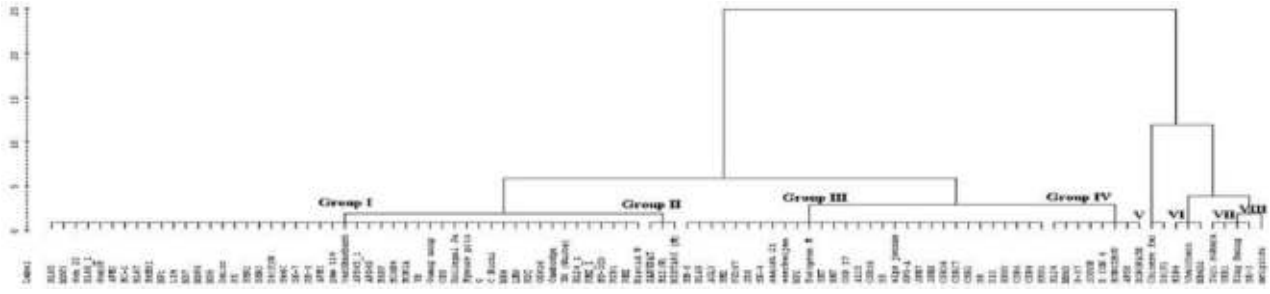


Fig. 8.3: Dendrogram constructed by ward's method using Euclidean distance by hierarchical clustering of silkworm genotypes

Genotyping of silkworm Breeds

a) SSR marker based genotyping: To understand diversity and population structure, 20 SSR markers (Table 8.16) was analyzed and genotyped 100 silkworm genotypes. Based on the scoring data, simple matching dissimilarity co-efficient was calculated using the Dice's dissimilarity co-efficient with the help of the software, DARwin V5.0.158. Genetic differentiation parameters such as number of alleles (na), observed heterozygosity (H_O), expected heterozygosity (H_E) and polymorphic information content (PIC) were calculated for SSR markers. In the second scoring pattern, the bands were scored based on their size. The clearest bands were scored from each marker and these data were subjected to structural analysis using STRUCTURE programme (Pritchard, Stephens, & Donnelly, 2000) to evaluate the population structure. The fixation index (Fst) for each sub-population by the best 'K' was estimated by the STRUCTURE software. Twenty SSR markers were polymorphic with mean allele number of 4.3, polymorphic information content (PIC) of 0.47 and gene diversity of 0.51.

Table 8.16: Genetic differentiation parameters *viz*., number of alleles (na), observed heterozygosity (H_O), expected heterozygosity (H_E) and polymorphic information content (PIC).

Marker	Number of Silkworm (N)	Number of alleles observed (Na)	Observed heterozygosity (Ho)	Allelic Diversity (H_E)	Polymorphic information content (PIC)
Marker1	100	4	0.97	0.79	0.55
Marker2	100	6	0.71	0.68	0.61
Marker3	100	4	0.86	0.60	0.58
Marker4	100	4	0.64	0.51	0.67
Marker5	100	7	0.43	0.31	0.69
Marker6	100	8	0.48	0.40	0.77
Marker7	100	4	0.67	0.59	0.79
Marker8	100	6	0.96	0.28	0.81
Marker9	100	4	1.00	0.51	0.50
Marker10	100	5	0.77	0.78	0.71
Marker11	100	4	0.73	0.68	0.79
Marker12	100	4	0.66	0.59	0.69
Marker13	100	6	0.75	0.74	0.58
Marker14	100	8	0.91	0.90	0.53
Marker15	100	4	0.94	0.90	0.50
Marker16	100	5	0.89	0.88	0.54
Marker17	100	4	0.88	0.21	0.62
Marker18	100	7	0.40	0.74	0.61
Marker19	100	4	0.39	0.75	0.50
Marker20	100	9	0.71	0.68	0.58

Structure analysis placed most of the genotypes into two sub-populations with highest diversity among the silkworms. The allele frequency divergence of 0.076 was estimated between the two subpopulations. The expected heterozygosity in subpopulation 1 was 0.71, while subpopulation 2 recorded expected heterozygosity of 0.69. The higher disease (NPV), thermo-tolerance, higher survival rate showing silkworm genotypes (Sarupat, M12 (W), Nistari) and lower quantitative traits showing silkworms (Chinese farmer, D6(P)) are represented in cluster 1 with observable diversity. Fixation index (FST) in subpopulation 1 is 0.07 and in subpopulation 2 is 0.14 which shows the distribution of silkworm genotypes in two clusters with mixed capability in their traits.

b) SNP based genotyping (GBS) method: Genomic DNA Isolation from the silk moths collected for 100 genotypes was carried out using CTAB method. After Isolation the DNA samples are subjected to Quality Check. Total DNA of each sample was quantified by using Agarose Gel Electrophoresis (1% agarose gel) (Fig. 8.4) and Nanodrop.

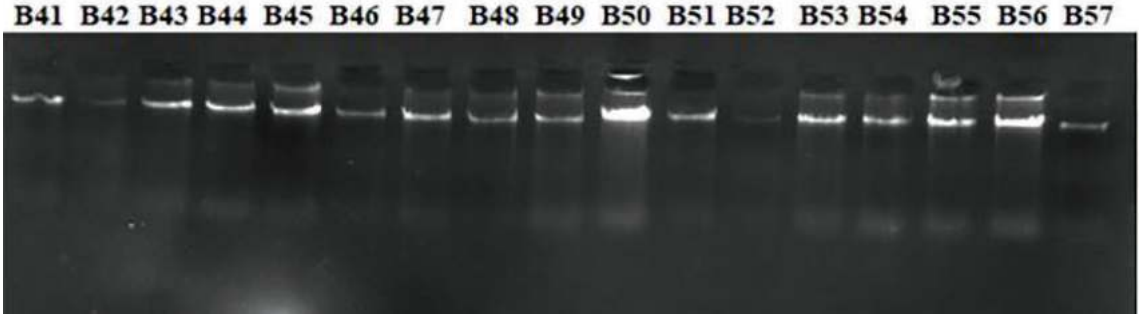


Fig. 8.4: Agarose gel quantification of the genomic DNA isolated from silkmoths (B41-B57 indicate the sample codes)

100 silkworm genotypes were sequenced (GBS) using Illumina NovaSeq 6000 at ~1 million of reads each (144 bp paired end reads) and Sequencing results revealed a total of 266915 SNPs with 865 indels, 2826 alleles with multiallelic sites whereas 1964 were with multiallelic SNP sites.

Genome wide association mapping

The mapping panel comprising 100 silkworm breeds with 12 traits and 266915 site. Q-Q plots reveal that most of the traits follow the normal distribution bar (Fig. 8.5).

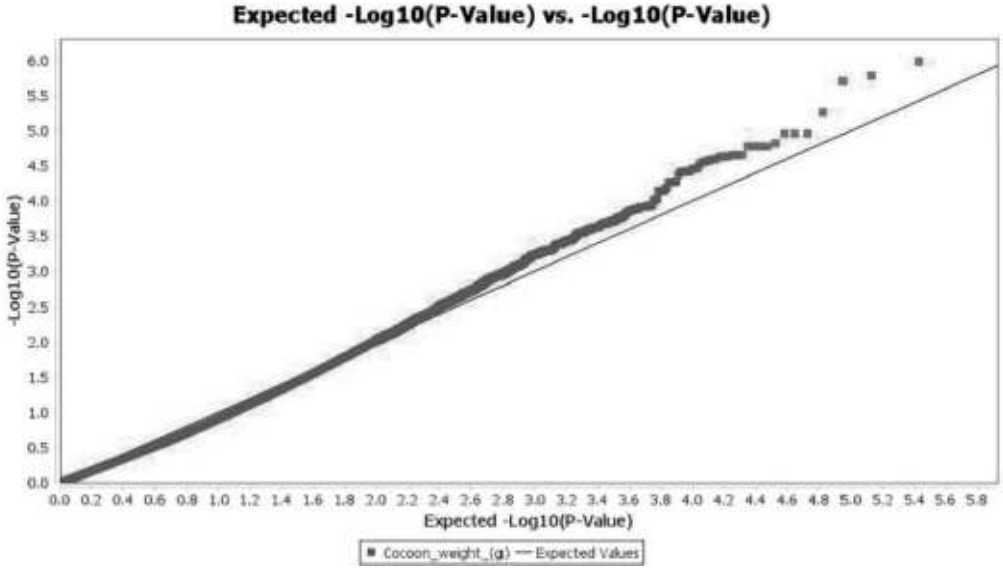


Fig. 8.5: Q-Q plot for the trait; Cocoon weight

Manhattan plots reveal the presence of a few marker sites that were significantly associated with the phenotypic traits (Fig. 8.6). Based on the -$\log_{10}$ P value cut off, the silkworm yield trait in 44 breeds are significantly associated with the SNPs which is present in chromosome 3. Similarly, 21 breeds for cocoon weight were significantly associated with the SNPs present in chromosome 10. Further, 21 breeds for reelability, 21 breeds for evenness and 21 breeds for survival rate are significantly associated with the SNPs on chromosome 17. 20 breeds for shell weight and 14 breeds for shell % are significantly associated with the SNPs present in chromosome 23 and 2 respectively. For the traits, filament length and thermo-tolerance, 18 breeds and 16 breeds were significantly associated with the SNPs present in chromosome 7 and 8 respectively.

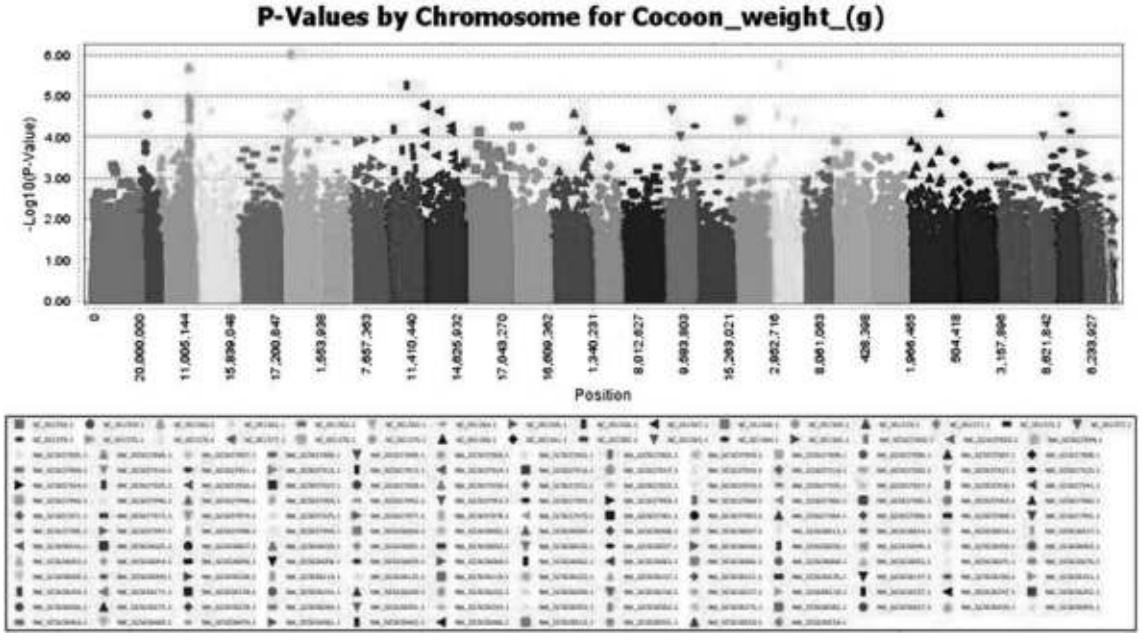


Fig 8.6: Manhattan plots for the trait-Cocoon weight

Linkage Disequilibrium (LD) analysis: LD analysis revealed LD decay to be seen at around 0.45 Mb genetic distance for the dataset.

QTL identification and position at Chromosome: QTLs associated with different characters were identified and are as follows (Table 8.17) (Fig. 8.7).

Table 8.17: QTL identified for some of the important traits

Trait	Chromosome	Number of silkworm Breeds
Survival	**17**, 16, 10, 24	21
Yield	**3**, 1, 4, 10, 7, 18	44
Cocoon weight	3, **10**, 4, 1, 9, 17, 22	21
Shell weight	10, 17, 19, **23**	20
Thermo-tolerance	7, **8**, 2, 22, 27	16
Filament length	**7**, 13, 16, 17, 19	18
Reelability	2, 7, 11, **17**, 19	21
Evenness	9, 10, 1, 12, **17**	21
Bold number in the table indicates the most associated/ linked chromosome among the silkworm breeds screened for genome wide marker trait association through GBS		

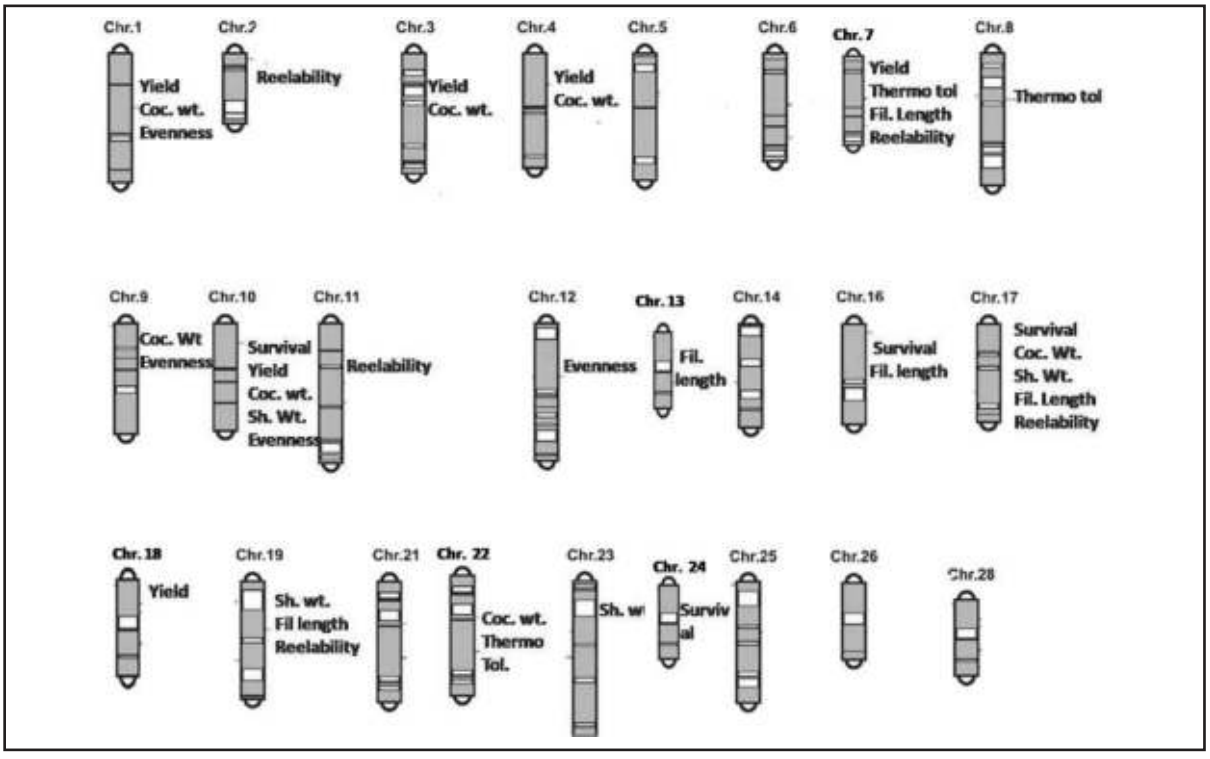


Fig. 8.7: Linkage map of the silkworm B. mori for commercially important traits based on genome wide association mapping

Based on the genome wide marker trait associations through GBS, five SNPs were significantly associated with economic trait-yield-weight: WC-051360.1, Thermo-tolerance: WC-051365.1, cocoon weight:NW-021618427.1, shell weight: WC-051360.1, filament length:NW-023678039.1. The QTLs were identified for important economic traits and were also found associated with more than one trait.

Conclusion: This is a first study which has represented information on genetic variability /similarity among wide range of Indian silkworm breeds both phenotypically and genotypically. The identified QTLs are required to be validated and five major QTLs identified through GBS are useful for selection of suitable parents in different targeted breeding programmes for silkworm improvement employing marker assisted selection.

On-going Research Projects

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

Satish L, Kusuma L, Mary Josepha Shery AV and Manthira Moorthy S

Objective:

- To evaluate the newly identified multi viral disease tolerant (DNV1, IFV & NPV) hybrids at RSRSs

Based on survivability percentage and SSR based marker-assisted selection, two promising hybrids were developed and evaluated at lab for multi viral diseases tolerance. Upon satisfactory performance, two hybrids were selected for further trial at RSRS Kodathi, Chamarajanagara, Salem and Ananthapur. 10 dfls of each test hybrids and 10 dfls of control were brushed with two trials in each RSRS. RDIN1 performed better than RDIN2 in terms of survivability and post cocoon parameters. The rearing performance of OST trials are given in Table 8.18 and the post cocoon performance are given in Table 8.19.

Table 8.18: Rearing performance of multiviral tolerant hybrids (RDIN1 and RDIN2) at RSRSs

Hybrid	Fec.	Hatch %	LD (days)	10 Lar. wt (g)	Actual yield		Yield/ 100 dfl	ERR		SCW (g)	SSW (g)	SR%
					By No.	By wt		By No.	By wt. (kg)			
RSRS Kodathi												
RDIN1	458± 2.47	85.5± 0.30	25	40.25 ±0.10	5281± 21.9	8.25 ±0.0	42± 0.7	6837± 34.2	11.7± 0.2	1.69± 0.0	0.36± 0.0	21.5± 0.09
RDIN2	456± 0.35	85± 0.84	25	39.00 ±0.33	4700± 35.0	7.40 ±0.0	38± 0.62	7889± 11.3	13.0 ±0.02	1.7± 0.0	0.35± 0.0	21± 0.37
Control	450	85.0	25	43.3	2986	5.245	52.45	7816	14.77	1.89	0.441	23.36
RSRS Chamarajanagara												
RDIN1	456± 4.24	86.85± 0.10	25	40.15 ±0.03	3741 ±1053	6.1± 1.48	45.45± 3.2	7603± 440	13.3 ±0.84	1.69± 0.0	0.35± 0.0	20.7± 0.8
RDIN2	460± 0.35	85.7± 0.84	25	40.8 ±0.21	3482± 731	5.7 ±1.23	44± 3.9	8299± 278	13.8 ±0.26	1.6± 0.0	0.34± 0.0	20.9± 0.5
Control	478	85	25	40.5	1629	3.0	60.0	6947	12.79	1.822	0.378	20.75
RSRS Anantapur												
RDIN1	482± 7.00	97.75± 0.035	23	36.65 ±0.38	3313± 112	3.86 ±0.11	39± 0.91	7122± 131	8.4 ±0.0	1.21± 0.0	0.22± 0.0	18.4± 0.1
RDIN2	488± 5.65	98.5± 0.28	23	36.60 ±1.06	3659± 225	5.2 ±0.28	50.8± 3.7	7756± 363	10.7 ±0.6	1.49± 0.0	0.28± 0.01	19.1± 0.1
Control	489	97.7	23	39.8	3068	4.98	49.8	6494	10.54	1.622	0.353	21.76
RSRS Salem												
RDIN1	469± 2.12	96.8± 0.63	24	36.00 ±0.21	3083± 50	3.50 ±0.19	36.6± 0.8	6779± 110	8.1 ±0.14	1.2± 0.0	0.23± 0.01	19.8± 0.8
RDIN2	482± 0.35	97± 0.42	25	36.00 ±0.70	3609± 189	4.97 ±0.32	48.7± 2.5	7569± 230	10.0 0.15	1.3± 0.0	0.28± 0.01	20.7± 1.0
Control	489	97.7	23	39.8	3068	4.98	49.8	6494	10.54	1.622	0.353	21.76

Table 8.19: Post cocoon parameters of multiviral tolerant hybrids reared at RSRSs

Hybrid	Reelability %	AFL (m)	NBFL (m)	Denier	Raw silk %	RS recovery %	Neatness %
RSRS Kodathi							
RDIN1	80.71	871.7	748.7	2.81	10.91	49.3	94
RDIN2	84.34	799.11	631.55	2.98	16.53	74.61	94
RSRS Chamarajanagara							
RDIN1	80.79	792.72	623.32	3.05	14.32	63.17	94
RDIN2	80.18	763.21	615.55	3.07	15.37	65.75	94
RSRS Anantapur							
RDIN1	86.16	804.28	773.90	2.62	7.69	16.24	58.74
RDIN2	84.09	794.05	688.64	2.54	8.18	12.68	56.62
RSRS Salem							
RDIN1	85.67	797.03	674.28	2.95	15.63	67.12	94
RDIN2	80.28	832.99	759.56	2.91	16.90	74.53	94

mRNA Transcriptome analysis of midgut samples of 5th age 3rd day of PAM117 silkworms inoculated with BmDNV1, BmNPV and BmIFV was carried out. Uninoculated PAM117 silkworms were considered as control. Total RNA of each sample was extracted using C-TAB method. After isolation, the RNA samples were subjected to Quality Check. Total RNA of each sample was quantified and qualified by using Agilent 2100 bioanalyzer and Qubit® 3.0 Fluorometer. Library preparation and sequencing were performed on illumina sequencers. Sequencing data were compared between Control vs BmDNV1 vs BmIFV vs BmNPV. Based on the results obtained, Toll and Imd pathway was shown to be significantly upregulated (Table 8.20, Fig. 8.8) which are involved in production of anti-viral peptide production in silkworm.

Table 8.20: Pathways involved in BmDNV1, BmIFV inoculated silkworms

Treatment	Control	Upregulated	Downregulated
BmDNV1	Control	Toll and Imd	Endocytosis, Hippo pathway
BmIFV	Control	DNA replication	Toll and Imd
BmDNV1	BmIFV	Toll and Imd	Endocytosis, Ubiquitin pathway

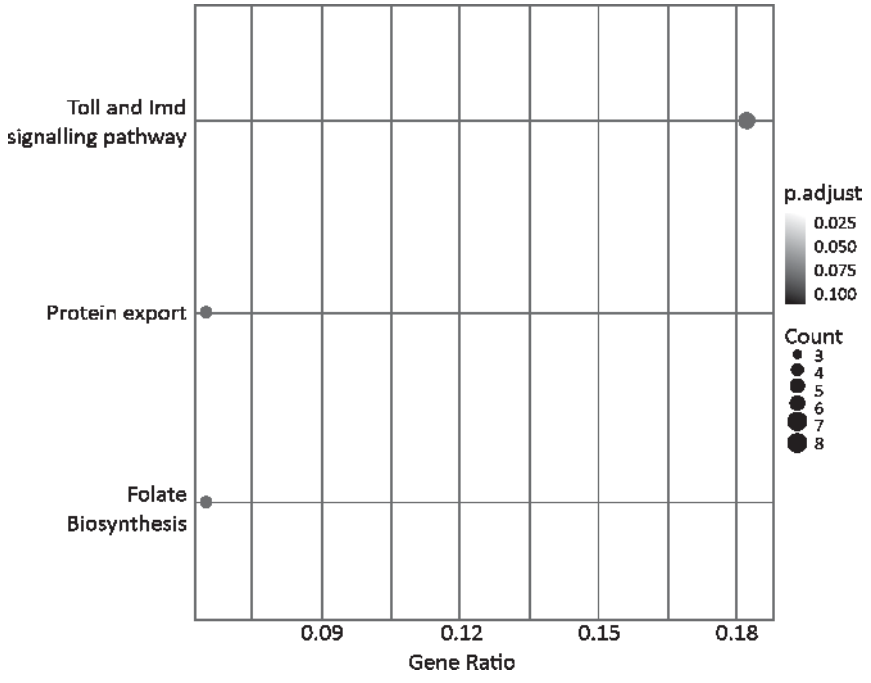


Fig. 8.8: Pathways upregulated significantly during DNV1 infected silkworm

AIB 01009 MI: Evaluation of new bivoltine silkworm double hybrid TT21 x TT56 at farmers' level for authorization and commercial exploitation (Mar. 2020 - Feb. 2023)

Manthira Moorthy S, Kusuma L, Ranjini MS, Madhusudhan KN, Chandrasekar MN, Dhahira Beevi N, Kiran Kumar KP, Kulkarni SB, Sreenivasa Rao TVS, Praveen Kumar K, Shashindran Nair K and Shankar (NSSO,) Sivakumar KP (CSTRI, Bengaluru), Chandrakanth N (CSRTI, Berhampore), Singh RP, (RSRS Sahaspur) & Rita Singh (CSRTI, Pampore)

Objective:

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

Continuous maintenance of parents (N1, N2, N5 and N6) is being carried out in Bivoltine Breeding Laboratory.

P2 rearing of 100 dfls was conducted and 1800 P1 layings were prepared and utilized as well as kept in different preservation schedules. 1400 dfls of P1 rearing (NSSO) is completed. Out of 82,850 hybrid dfls prepared by NSSO, 66,350 dfls were supplied to various centers and 16,500 are kept in 3 months hibernation schedule.

PIC 01008 SI: Isolation, characterization of chitin/chitosan from silkworm pupal exuviae/spent pupae and its commercial exploitation (Feb. 2020 - Jan. 2022) [Collaborative Project with CSR Agroproducts]

Madhusudhan KN and CSR Agroproducts, Bhimavaram, AP

Objectives:

- Extraction and purification of chitosan from pupal exuviae /spent pupae
- Characterization of Chitosan
- Standardization of protocols for commercial production/exploitation

The Standardization of Chitin extraction from pupal exuviae was carried out using different concentrations of deproteinizing chemicals and the percentage recovery of chitin obtained was found to be the highest with sodium sulphide, sodium hydroxide and calcium hydroxide. Different chemicals were screened also for demineralizing potential. Among them, HCl showed promising results. The chitin recovery was 70-75%. Conversion of chitin to chitosan was carried out using different deacetylating chemicals. NaOH and CaOH showed better results. The chitosan recovery was 65% of chitin.

Similarly, the standardization of chitin extraction from spent pupae was carried out by using different deproteinizing and demineralizing chemicals. Best among the deproteining and demineralizing chemicals were Sodium Sulphite and HCl with recovery of 30-35%. Conversion of chitin to chitosan was carried out using different deacetylating chemicals, among them CaOH showed better results with conversion of chitin to chitosan upto 55%.

Deproteinizing (8 isolates), demineralizing (2 isolates) and deacetylating (1 isolate) bacteria were isolated from different sources. The properties of the bacteria were confirmed by specific tests.

AIT 08005 MI: Development and Evaluation of Bi-densovirus resistant silkworm hybrids developed from marker assisted breeding lines Phase II [in Collaboration with SBRL, Bengaluru & CSRTI, Berhampore]

Tulsi Naik KS, Ramesha A (SBRL), Ranjini MS, Chandrashekar MN (CSRTI, Mysuru), Rahul K, Mihir Rabha (CSRTI, Berhampore)

Objectives:

- Identification of productive multivoltine/bivoltine parents carrying BmBDV resistance
- Development of cross breeds and bivoltine hybrids resistant to BmBDV with productive traits

Analysis of multivoltine breeds *viz*., PM, ICB-29, ICB-30, HB4 and MV1 for the BmBDV resistant gene was completed at SBRL and all of them showed susceptibility. Bivoltine breeds *viz*., CSR16, 5HT, 8HT, Dun17, Dun18, Gen1, 2C, 4S, 4D, CSR16N, CSR26N and D2 was supplied to SBRL, Bengaluru, for screening of BmBDV resistant gene and the shortlisted positive breeds' dfls or eggs were selected for further analysis.

Pilot Study

Identification of candidate gene markers for the development of silkworm hybrid with longevity associated with stress tolerance and productive traits [No.CSB/CSRTI/PMCE/Pilot Studies/2020-21/217/31.12.2020]

Ranjini MS, Manthira Moorthy S and Kusuma L

Objectives:

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

Under the first objective, the pupal duration, lifespan assay and the starvation stress analysis in the breeds *viz*., CSR2, CSR4, CSR6, CSR16, CSR17, CSR26, CSR27, CSR50, CSR51, CSR53 and S8 was initiated. SDS-PAGE electrophoresis was carried out in the control and starved samples and the analysis is under progress. Under the second objective, primers have been received and the standardization of PCR is under progress.

OST/OFT Programmes

Evaluation of newly developed silkworm double hybrids at RSRSs

Meenal R, Purushotham S and Madhusudan KN

Objective:

- To evaluate the performance of newly developed bivoltine silkworm double hybrids through On Station Trials.

Two double hybrids *viz*., DHR4 and DHP5 developed as an outcome of the project AIB 3536 were evaluated through OST along with G11 x G19 as control. Three trials were conducted at four RSRSs of CSRTI and the rearing performance data revealed that DHP5 performed better with respect to larval wt, cocoon yield and cocoon quality parameters when compared to DHR4 and control (Table 8.21 & 8.22). Yield/10000 larvae was 16.034, 17.205 & 14.638 respectively in DHR4, DHP5 & G11 x G19. Sample cocoons were collected and reeling analysis was conducted at CSRTI, Mysore.

Table 8.21: Rearing performance of new bivoltine double hybrids (mean of 3 trials)

Hybrid	Wt. of 10 matured Larvae (g)	Yield/10000 Larvae		SCW (g)	SSW (g)	Shell Ratio %
		By No.	By Wt.			
DHR4	43.72	8912	16.034	1.781	0.374	21.03
DHP5	45.34	9122	17.205	1.875	0.413	22.07
G11 x G19 (c)	41.86	8634	14.638	1.728	0.364	21.05

Table 8.22: Reeling performance of new bivoltine double hybrids (mean of 3 trials)

Hybrid	AFL (m)	NBFL (m)	Reelability (%)	Denier	Renditta	Raw Silk (%)	Raw Silk Rec. %
DHR4	846.450	743.820	83.70	2.96	7.30	14.99	69.12
DHP5	853.800	758.450	83.77	2.94	7.27	15.12	69.97
G11 x G19 (C)	856.630	756.490	83.54	2.99	7.25	15.48	70.34

Evaluation of newly developed silkworm double hybrids at Hotspots

Meenal R, Purushotham S and Madhusudhan KN

As an outcome of the project AIB 3561, "Identification of robust bivoltine silkworm hybrids suitable for different regions of high temperature and high humidity conditions", four double hybrids mentioned below were identified:

- (S8 x D2) x (CSR4xSK6): HSDH1
- (CSR2 x CSR27) x (CSR6 x SK6): HSDH2
- (CSR52 x Gen1) x (CSR6 x SK6): HSDH3
- (S8 x D2) x (CSR6 x SK6): HSDH4

One trial with 100 dfls each of the hybrid along with FC1 x FC2 as Control was conducted with selected farmers in hotspot areas of Tamil Nadu. Out of the 4 double hybrids, uniformity in larval size and larval marking was noticed only in HSDH1.

Table 8.15: Rearing performance of bivoltine double hybrids in hot spot areas of Tamil Nadu

Hybrid	Wt. of 10 Matured Larvae	Yield/10000 Larvae		SCW (g)	SSW (g)	Shell Ratio %	Larval marking
		By No.	By Wt.				
HSDH1	45.23	8482	13.546	1.843	0.384	20.84	Plain
HSDH2	44.81	6427	9.632	1.786	0.345	19.32	Mixed
HSDH3	42.81	7404	10.547	1.528	0.305	19.96	Mixed
HSDH4	40.21	6490	8.962	1.403	0.247	17.61	Mixed
FC1 x FC2	44.78	6869	12.501	1.821	0.387	21.25	Marked

Table 8.16: Reeling performance of bivoltine double hybrids in hot spot areas of Tamil Nadu

Hybrid	AFL (m)	NBFL (m)	Reela-bility (%)	Denier	Renditta	Raw Silk (%)	Raw Silk Rec. %
HSDH1	879.57	798.33	84.71	2.84	7.13	16.92	70.00
HSDH2	817.19	738.63	79.71	2.91	7.40	14.88	62.86
HSDH3	839.22	779.94	81.71	2.88	7.21	15.93	67.83
HSDH4	824.04	747.14	80.28	2.99	7.31	15.06	63.31
FC1xFC2	903.09	848.01	86.28	2.83	6.88	17.70	75.90

Popularization of G11xG19 double hybrid in Kolar region

Madhusudan KN, Manthira Moorthy S, Narendra Kumar JB, Pramod Sasivahalli (SSPC, Malavalli) and Kariyappa (CSTRI, Bengaluru)

The foundation crosses were reared under the supervision of SSPC, Malavalli. 83,000 dfls of G11 x G19 and reciprocal crosses were prepared from the cocoons. The dfls were kept under 3 and 4 month hibernation schedule.

Continuous/Other activities

Maintenance of bivoltine Genetic Resources

Manthira Moorthy S, Meenal R, Madhusudan KN, Ranjini MS, Kusuma L and Satish L

Productive bivoltine breeds (8), robust bivoltine breeds (11), thin denier bivoltine breeds (2) and sex limited breeds (6), amylase marker assisted selection breeds (12), NPV tolerant breeds (12) and morphological mutants (7) were maintained for conservation and evaluation. The values obtained for the traits are in conformity with the original breed characters (Tabel 8.23)

Table 8.23: Characteristics of Bivoltine Genetic Resources

Breed Category	Breeds		Fec. (No.)	Pupation (%)	Coc. Wt. (g)	Shell ratio (%)	FL (m)	Raw Silk (%)	Denier
Productive	CSR2 CSR4 CSR5 CSR6	CSR16 CSR17 CSR26 CSR27	>500	>85	>1.70-1.80	>22-24	>900	>17.0	2.7-3.0
Robust	CSR18 CSR19 CSR46 CSR47 CSR50 CSR51	CSR52 CSR53 S8 D2 RD1	>500	>90	>1.60-1.80	>22-23	>900	>15.0	2.7-3.0
Thin denier	CSR48 JPN7		>500	>85	>1.60-1.80	>22-23	>1200	>15.0	2.2-2.4
Sex-limited	CSR2 (SL) CSR4 (SL) CSR8 (SL)	CSR12 (SL) CSR27 (SL) CSR202 (SL)	>400	>85	>1.50-1.70	>20-21	>700	>13.0	2.6-2.9
Amylase marker assisted selection	GEN1 GEN2 GEN3 2C 2S 3C 3D	4D 4S 4C 6P 6C	>450	>85	>1.50-1.70	>20-21	>800	>14.0	2.7-3.0
NPV tolerant	2N 5N 61N 63N 21 62	S8N 52N 16N 26N 101 Rudra	>500	>85	>1.40-1.60	>20-21	>700	>13.0	2.6-2.9
Morphological mutant	TMS 04 TMS 13 TMS 18	TMS 34 TMS 40 TMS 52 TMS 59	>300	>80	>0.90-1.30	>13-16	>350	>10.0	2.1-2.5

SATELLITE SILKWORM BREEDING STATION-COONOOR

Vijay V

Maintenance of Bivoltine Silkworm Germplasm Stocks

During the reporting year one conservation rearing/grainage for 26 breeders' stock viz., SLD1, SLD8, SLD9, D1, D11, D13, D15, D17, SSBS2, SSB3, SSBS4, SSBS5, SSBS6, SSBS7, SSBS9, SSBS10, SSBS11, SSBS12, SSBS16, SSBS17, CNR3, CNR4, CNR5, MASN4, MASN6, MASN7 were takenup during September, October at CSRTI, Mysuru on behalf of SSBS, Coonoor.

Production and supply of dfls to Bivoltine Breeding Laboratory, CSRTI-Mysuru

- One hybrid (431 x 256) of BBL, CSRTI-Mysore was reared (20 dfls) during May – June crop and a total of 2311 dfls supplied to CSRTI, Mysuru.
- Reared FC10 & FC11 races of BBL, CSRTI-Mysuru. 580 dfls of FC10xFC11 supplied to CSRTI-Mysuru.

Production of FCs of SSBS double hybrid

During the period rearing of foundation crosses of SSBS double hybrid viz., (SSBS3 x SSBS5) and (SSBS6xCSR51) were undertaken. After cocoon selection, a total of 1358 dfls (688 and 670 dfls, respectively) of SSBS FCs were prepared and consigned in cold storage at CSGRC, Hosur.

Revenue Generation

During the reporting period Rs.2,59,784 revenue was generated.

P4 BSF HASSAN

SIM 0015: Bivoltine silkworm breeds maintenance and multiplication

Dayananda and Nishita Naik V

Objectives:

- Maintenance of eight authorised/popular bivoltine breeds as per the breed maintenance procedure set for P4 level
- Production, preservation and supply of quality P3 stock for downstream multiplication centres of south India

Eight authorized/popular bivoltine breeds includes four oval types (CSR2, CSR17, CSR27 and S8) and four dumbbell types (CSR4, CSR6, CSR16 and CSR26) were maintained true to the original breed characters for four rearing cycles in a year (May-June 2020, Aug-Sep 2020, Nov-Dec 2020 and Feb-Mar 2021). Meticulous testing at every stage is carried out to keep the crop free from diseases in general and Pebrine in particular.

Table 8.18: Mean values of performance of bivoltine breeds

Breed	ERRN (no.)	ERR Wt. (kg)	SC Wt. (g)	SS Wt. (g)	CS (%)
CSR2	9426±333	16.675±1.630	1.805±0.140	0.410±0.033	22.72±0.80
CSR17	9481±735	16.838±2.091	1.803±0.143	0.378±0.030	20.95±0.72
CSR27	9515±300	17.052±1.656	1.827±0.160	0.427±0.037	23.35±0.86
S8	9521±236	17.547±1.561	1.874±0.155	0.412±0.033	22.00±0.98
CSR4	9558±286	15.956±1.147	1.706±0.102	0.373±0.023	21.89±0.87
CSR6	9524±309	16.329±1.549	1.730±0.113	0.368±0.026	21.27±0.94
CSR16	9503±347	16.455±1.340	1.787±0.111	0.385±0.029	21.56±0.98
CSR26	9390±346	16.243±1.753	1.762±1.172	0.377±0.038	21.41±0.75

A total of 26.971 kg of seed cocoons (15,050 by number) were processed as per the set procedure and produced 6,040 P4/P3 Dfls with an egg recovery of 40.13%. The dfls produced were preserved under 4 and 6 months hibernation schedule and utilized as per the programme.

Table 8.19: Dfls production at P4 Hassan

Month	Qty. of Seed Cocoon utilized (kg/nos.)	Qty. of Seed produced (nos.)	Egg recovery (%)	Pebrine Incidence (%)
June 2020	7.900/4550	1957	43.01	0.00
September 2020	8.100/4200	1571	37.40	0.31
December 2020	6.300/3400	1417	41.68	0.28
March 2021	4.671/2900	1095	37.76	0.09
Total	26.971/15050	6040	40.13	0.17

During the period under report, 815 CSR2 P3 stock were supplied in 22 splits at black box stage to four P3 Govt. Silk Farms of Department of Sericulture, Govt. of Karnataka (Kumbarahalli, Chikkonahalli, Kudige and Kaggundi) for further multiplication.

Other activities: Dr. Dayananda, Scientist-D has presented a talk on "Breeding strategies for the development of silkworm breeds tolerant to high temperature and BmNPV" in the webinar organized by the Department of studies in Sericulture, University of Mysore, Mysuru on 18.12.2020.

- As resource persons the Scientists were associated with Sericulture Training School, DoS, GoK, Hassan for organizing different training programmes.

Revenue generated:

Through sale of excess cocoons : Rs. 63,730.00

Through sale of P3 dfls : Rs. 8,965.00

Total : Rs. 72,695.00

9. MULTIVOLTINE BREEDING

Concluded Research Projects

AIB 01001 M1: Evaluation of Cauvery Gold (MV1 × S8) - An improved cross breed for cocoon productivity and silk quality (Jun. 2018 - May 2020)

Kulkarni SB, Chandrashekha KB, Soudaminy PV, Balachandran N, Hukkeri SM, Noble Morrison M, Dayananda, Santha PC, Bhagya R, Sashindran Nair K and Shankara

Objectives:

- To evaluate the field performance of newly developed cross breed Cauvery Gold (MV1 × S8) for productivity and silk quality.

P1 seed cocoons of MV1 and S8 were generated for the production of new improved cross breed (MV1 × S8) at Institute and farmer's level. The cocoons were processed at SSPCs of NSSO units at Ramanagaram and Chintamani. A total 3,12,685 dfls of MV1 × S8 were distributed to 1,397 farmers. The yield/100 dfls ranged from 62-74 kg/100 dfls with an average of 65.46 kg, the average yield of PM × CSR2 in the field was 66.5 kg/100 dfls. The new cross breed, Cauvery Gold (MV1 × S8) has gained popularity as the cocoon fetched higher price by Rs. 15 to 30 per kg in comparison to Kolar Gold (PM × CSR2) with A to 2A grade silk.

Table 9.1: Performance of MV1 seed crop

Particulars	Average	Min	Max	SD
Fecundity (No.)	453	400	530	45.08
Hatching %	92.18	90.00	96.30	1.71
Total Larval Duration (D:H)	23.84	23.00	26.00	1.26
5th age larval duration (D:H)	5.04	4.50	6.00	0.57
ERR/10000 (Nos)	8628	7791	9824	553.28
ERR/10000 by weight (kg)	12.51	9.70	17.50	1.61
Single cocoon weight (g)	1.627	1.190	2.059	0.189
Single shell weight (g)	0.297	0.200	0.363	0.035
Shell percent	18.37	14.50	19.10	0.92
Cocoons/kg	700	563	850	75.24
Yield /100 dfls	49.20	37.00	56.70	11.61

Table 9.2: State wise performance of MV1 x S8 (Cauvery Gold)

Parameters	KA	AP	TN	Overall	F-Value	P-Value	Sig.
Dfls (No.)	284655	22000	6030	312685			
Farmers (No.)	1280	85	32	1397			
Yield statistics per 100 dfls							
Average	64.66	64.69	55.7	63.68	3.141	0.080	NS
SD	4.91	2.91	3.77	3.86			
SCW (g)	1.711±0.21	1.785±0.14	1.358±0.16	1.626±0.13			
SSW (g)	0.357±0.04	0.371±0.04	0.266±0.03	0.334±0.04			
Shell %	20.84±0.73	20.57±0.82	19.59±0.87	20.35±0.89	2.09	0.17	NS

Table 9.3: Season wise performance of MV1 × S8

Season	Rainy	Summer	Winter	Total/Avg.	F-Value	P-Value	Sig.
Total no. of dfls	54997	210902	46786	312685			
Hibernation %	3.76	0.36	4.79	8.91			
No. of farmers	199	407	191	797			
Avg yield	64.8	62.7	67.5	63.6	2.25	0.147	NS
SD	4.66	4.95	3.82	4.48			
SEM	1.25	0.95	0.99	1.06			
Shell %	21.78	20.74	21.18	21.23	1.36	0.29	NS
PM × CSR2 Avg yield	61.1	63.2	65.5	63.3			

Table 9.4: Comparison of yarn characteristics

#	Parameters	MV1 × S8		PM × CSR2	
		Value	Grade	Value	Grade
1	Average denier	21.8		22.1	
2	Size deviation	1.48	2A	2.15	A
3	Max. size deviation	1.9	2A	4.7	A

4	Tenacity (g/d)	3.8	4A	3.4	2A
5	Cohesion (Strokes)	61	2A	65	2A
6	Cleanness (%)	99	4A	86	B
7	Avg. Neatness (%)	94	2A	87	A
8	Low neatness	88	2A	78	A
9	Elongation (%)	22	4A	23	4A
10	Winding breaks	0	4A	6	A
	Overall Grade		2A		B

Table 9.5: Statistical analysis of cocoon and silk characteristics

Season	SCW	SSW	SR	Def. cocoon %	FL	NBFL	Reel	RSR
Summer	1.615	0.339	20.92	11.94	805	706.64	89.02	49.84
Winter	1.870*	0.400	21.18	9.00	876	743.50	85.50	61.05
Rainy	2.028*	0.433*	21.28	10.80	943*	762.50	81.20	71.30
Average	1.838	0.390	21.13	10.58	875	737.55	85.24	60.73
F-value	11.587	13.509	0.20	1.62	5.63	0.21	0.79	3.89
p-value	0.009	0.006	0.83	0.27	0.04	0.81	0.50	0.08
CD 5%	0.211	0.045	NS	NS	100	NS	NS	NS

On-going Research Projects

AIB 01004 M1: Development of multivoltine breeds with improved silk quality utilizing indigenous and exotic bivoltine breeds (Sep. 2018 - Aug. 2022)

Chandrashekar KB, Ponnuvel KM (SBRL-Bengaluru), Manthira Moorthy S, Kulkarni SB (upto Jun. 2020), Hukkeri SM, Soudaminy PV and Kusuma L

Objective:

- 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.

During the reporting period 5 generations were completed (F8 - F12). Seven lines (Table 9.6) were shortlisted based on the non-hibernation character in the eggs. These 7 lines were analyzed for their expression pattern for diapause and non-diapause character through RT-PCR with 7 diapause and 3 non-diapause genes (Table 9.7) along with β-actine genes as a house keeping gene (Fig. 9.1). The results are documented based on their expression (Fig. 9.2). Based on the gene profile as well as phenotypic character of the cocoons, one line was rejected as it does not fit into the selection criteria. The remaining 6 lines are being maintained for further analysis (Table 9.8).

Table 9.6: Shortlisted lines based on the phenotypic character of the dfls

#	Stabilizing lines
1	MV1S6AB × BM2
2	MV1B × BMV1 (Yellow)
3	MV1B × BMV1 (Pale Yellow)
4	MV1 × S8
5	HB4 × S8
6	HB4 × BM2
7	HB4 × BMV1

Table 9.7: Diapause and non-diapause genes screened among the lines selected

#	Diapause gene	#	Non-diapause gene
1	Trehalose transporter	1	Kruppel
2	Sorbitol dehydrogenase	2	Bm period
3	Cytochrome b5	3	Bm relish
4	Methyl transferase		
5	DnaJ (Hsp40) homolog 5		
6	Paralytic peptide binding protein		
7	Hsp70		

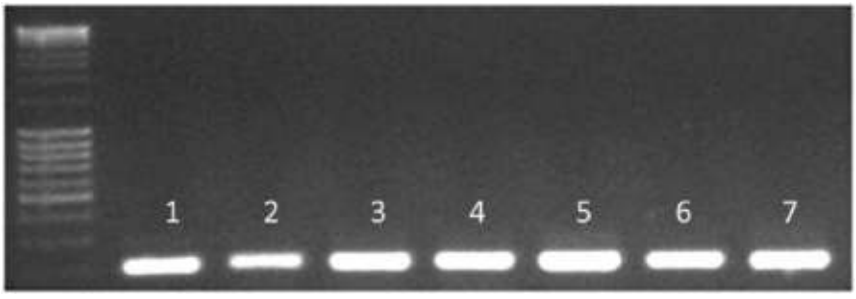


Fig. 9.1: Expression profiling of the stabilized lines with β-actin gene

Six stabilizing lines (Including multivoltine parents MV1 & HB4, bivoltine parents S8 & BM2) along with PM and Nistari as a standard control were used in the present study (Table 9.8). Stabilizing lines with less hibernation character were screened through RT-PCR analysis for 10 diapause and non-diapause genes (Table 9.9). Calculated the RT-PCR results and are given in Tables 9.10 to 9.13. The cocoons from the same stabilizing lines were studied for their reeling parameters and the results are shown (Table 9.14). Based on the RT-PCR results as well as the post cocoon silk parameter, lines with less non-hibernation character and better silk quality are taken forward for subsequent generation.

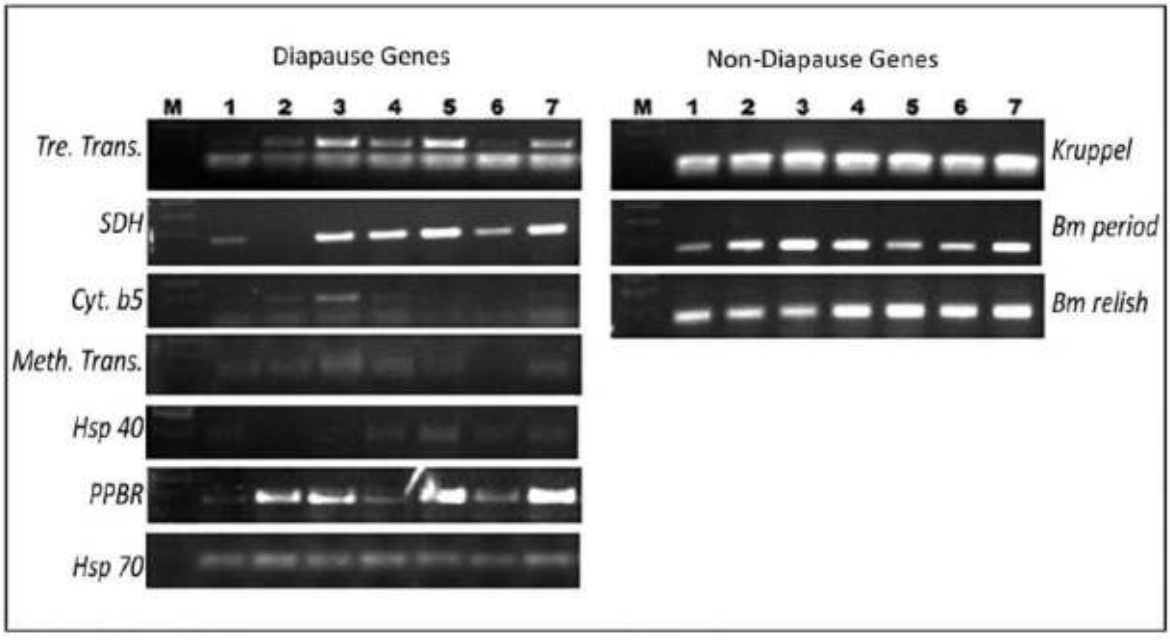


Fig. 9.2: Expression profile of the stabilized lines with diapause and non-diapause

Table 9.8: Stabilizing lines and parental breeds used of the RT-PCR analysis

#	Stabilizing lines	Parental breeds	
1	MV1S6AB × BM2	Multivoltine	Bivoltine
2	MV1B × BMV1	MV1	S8
3	MV1 × S8	HB4	BM2
4	HB4 × S8	PM (SD)	
5	HB4 × BM2	Nistari (SD)	
6	HB4 × BMV1		

Table 9.9: Diapause and non-diapause genes used for RT-PCR screening

#	Diapause gene	#	Non-diapause gene
1	Trehalose transporter	1	Pseudouridine synthase
2	Sorbitol dehydrogenase	2	Chitinase A precursor
3	Cytochrome b5	3	Kruppel
4	Methyl transferase	4	Polyubiquitin 4 UBQ4
5	DnaJ (Hsp40) homolog 5	5	Acyl-coenzyme A dehydrogenase
6	Paralytic peptide binding protein	6	Profilin protein
7	Hsp70	7	40S ribosomal protein S5
8	Spatzle	8	Bm period
9	Serotonin receptor	9	Nuclosome assembly protein
10	Dopamine receptor	10	Bm relish

Utilizing the comparative results of expression of diapause and non-diapause genes and the phenotypic character (cocoons), the dfls were selected and maintained for further study. Based on the genotypic and phenotypic characters, 6 lines were short listed and are being maintained for further evaluation study. The stabilized lines were then used for hybrid evaluation study with S8 (Indigenous), BM2 (Exotic) & CSR2 (Standard control). The results of rearing performance and cocoon characters are tabulated (Table 9.15).

Table 9.10: RT-PCR analysis results of Diapause genes expression of the parental breeds and standard control (SC)

Voltinism	Parental breeds	Trehalose Transporter		SDH		Cytochrome b5		Methyl transferase		Hsp 40	
		Ct.No	Copy Number	Ct.No	Copy Number	Ct. No	Copy Number	Ct. No	Copy Number	Ct. No	Copy Number
Multivoltine	MV1	25.21	6.98E+04	27.4	1.42E+03	27.64	1.19E+05	37.66	8.04E+03	21.93	3.61E+04
	HB4	25.46	5.82E+03	27.58	1.24E+03	26.19	3.42E+02	35.94	2.81E+02	21.49	1.05E+08
	PM4	25.49	5.69E+04	23.11	3.22E+01	25.09	7.62E+03	36.94	1.36E+02	24.62	1.07E+08
	Nistari	31.46	1.40E+03	31.23	1.65E+02	23.85	9.49E+01	34.92	1.28E+02	28.7	2.38E+01
Bivoltine	S8	25.84	4.41E+07	30.91	1.10E+06	30.9	1.11E+06	33.93	1.22E+05	23.69	2.11E+08
	BM2	26.65	2.45E+07	31.16	9.15E+05	26.87	2.08E+07	35.72	3.30E+04	22.89	3.78E+08
Voltinism	Parental breeds	Paralytic peptide binding protein		Hsp 70		Spatzle		Seritonin receptor		Dopamine receptor	
		Ct. No	Copy Number	Ct. No	Copy Number	Ct. No	Copy Number	Ct. No	Copy Number	Ct. No	Copy Number
Multivoltine	MV1	22.84	5.92E+03	39.82	6.92E+02	26.24	3.30E+02	29.27	6.34E+03	30.16	3.44E+03
	HB4	22.90	5.76E+04	37.59	5.46E+03	24.90	2.75E+04	28.54	1.05E+02	31.50	1.37E+05
	PM4	24.91	4.68E+05	39.47	2.15E+03	27.78	1.07E+05	27.76	1.79E+01	33.00	4.87E+02
	Nistari	24.54	3.34E+04	38.34	2.42E+01	21.82	1.07E+03	24.6	1.58E+01	32.1	2.04E+02
Bivoltine	S8	24.00	8.69E+08	37.89	6.80E+03	29.79	3.48E+06	25.76	7.10E+04	28.37	1.18E+04
	BM2	24.32	7.34E+08	34.62	7.82E+05	27.46	4.36E+07	29.28	6.29E+03	31.77	1.14E+03

Table 9.11: RT-PCR analysis results of Non – Diapause genes expression of the parental breeds and standard control (SC).

Voltinism	Parental breeds	Pseudouridine synthase		Chitinase A precursor		Poly. UBQ4		Acyl coenzyme A Dehydro.		Profilin protein	
		Ct.No	Copy Number	Ct.No	Copy Number	Ct. No	Copy Number	Ct. No	Copy Number	Ct. No	Copy Number
Multivoltine	MV1	22.47	5.14E+05	31.28	4.39E+09	27.09	5.77E+06	22.6	3.67E+08	21.60	4.68E+05
	HB4	23.13	4.18E+06	29.2	5.82E+08	25.64	4.10E+06	21.63	3.47E+08	20.70	3.87E+07
	PM4	25.61	8.22E+04	33.03	4.34E+05	25.49	5.69E+05	23.86	4.87E+08	22.84	3.92E+08
	Nistari	31.49	7.38E+05	36.15	6.57E+06	26.35	8.18E+04	25.13	6.09E+05	21.22	8.49E+05
Bivoltine	S8	23.30	2.81E+02	31.62	3.55E+04	26.78	2.22E+02	27.51	1.31E+03	24.12	1.54E+03
	BM2	24.32	1.34E+02	33.89	1.25E+04	26.46	2.81E+03	25.56	3.41E+02	23.41	2.59E+03
Voltinism	Parental breeds	40S ribosomal protein		Nucleosome assem. Pro.		Kruppel		Bm period		Bm relish	
		Ct. No	Copy Number	Ct. No	Copy Number	Ct. No	Copy Number	Ct. No	Copy Number	Ct. No	Copy Number
Multivoltine	MV1	21.60	4.68E+06	24.21	7.45E+06	27.40	7.42E+05	21.51	7.32E+06	15.50	4.26E+07
	HB4	20.63	3.96E+09	24.61	7.08E+06	27.19	7.65E+03	21.86	6.04E+06	15.92	3.19E+07
	PM4	22.67	4.44E+08	26.78	8.22E+07	27.90	9.84E+04	22.91	7.04E+05	17.21	5.55E+07
	Nistari	26.25	5.06E+07	32.42	9.25E+04	29.19	9.11E+03	25.08	8.13E+05	16.86	6.24E+07
Bivoltine	S8	22.02	2.13E+03	25.19	5.08E+02	27.64	2.19E+03	19.38	5.72E+02	13.73	1.79E+06
	BM2	23.14	3.15E+04	24.99	6.19E+01	27.05	5.83E+02	22.79	5.48E+03	17.21	2.55E+05

Table 9.12: RT-PCR analysis results of the stabilized lines for Diapause genes

Lines	Trehalose Transporter		SDH		Cytochrome b5		Methyl transferase		Hsp 40	
	Ct.No	Copy Number	Ct.No	Copy Number	Ct. No	Copy Number	Ct. No	Copy Number	Ct. No	Copy Number
MV1S6AB x BM2	24.28	1.96E+05	25.85	1.67E+04	30.03	1.16E+03	34.89	4.92E+02	20.45	2.74E+03
MV1B x BMV1	30.92	3.04E+06	31.37	4.49E+05	29.82	5.56E+04	36.46	6.50E+08	28.71	6.32E+04
MV1 x S8	29.71	2.68E+04	32.96	2.00E+04	36.50	2.51E+03	34.50	4.21E+04	25.17	3.07E+02
HB4 x S8	32.66	3.15E+02	36.1	3.77E+03	31.74	3.33E+03	37.89	5.68E+08	29.20	4.85E+04
HB4 x BM2	31.27	2.60E+06	30.78	2.24E+04	27.66	3.97E+03	33.44	5.90E+06	29.32	3.92E+03
HB4 x BMV1	26.74	2.61E+03	31.17	2.71E+03	27.88	2.30E+03	35.50	4.71E+02	21.25	1.58E+04
Lines	Paralytic peptide binding protein		Hsp 70		Spatzle		Seritonin receptor		Dopamine receptor	
	Ct.No	Copy Number	Ct.No	Copy Number	Ct. No	Copy Number	Ct. No	Copy Number	Ct. No	Copy Number
MV1S6AB x BM2	35.24	7.18E+02	38.88	2.46E-01	34.42	1.83E+06	34.7	1.51E+02	32.78	5.66E+02
MV1B x BMV1	25.98	8.61E+07	38.53	2.63E-01	22.93	4.97E+05	25.7	5.39E+04	32.25	8.15E+02
MV1 x S8	33.18	8.99E+01	37.97	3.38E-01	30.17	2.41E+05	33.3	3.96E+04	33.12	6.48E+02
HB4 x S8	27.95	8.12E+03	38.23	2.94E-01	24.32	3.91E+06	30.14	4.48E+03	32.81	6.55E+03
HB4 x BM2	22.79	7.30E+09	36.39	3.12E-01	22.31	3.62E+05	22.44	3.97E+05	30.58	6.57E+02
HB4 x BMV1	24.45	7.76E+03	37.37	4.22E-01	24.71	1.46E+08	26.67	3.79E+04	31.16	5.73E+03

Table 9.13: RT-PCR analysis results of the stabilized lines for Non-diapause genes

Lines	Pseudouridine synthase		Chitinase A precursor		Poly. UBQ4		Acyl coenzyme A Dehydro.		Profilin protein	
	Ct.No	Copy Number	Ct.No	Copy Number	Ct. No	Copy Number	Ct. No	Copy Number	Ct. No	Copy Number
MV1S6AB x BM2	23.57	6.20E+06	36.54	5.82E+03	34.26	7.52E+04	24.83	2.87E+07	33.16	4.06E+06
MV1B x BMV1	30.42	2.87E+03	39.81	1.29E+02	27.71	3.87E+01	25.20	4.09E+01	21.60	1.19E+02
MV1 x S8	28.35	6.19E+04	39.43	5.83E+01	37.95	6.50E+01	25.60	3.48E+05	29.02	3.28E+04
HB4 x S8	30.79	5.23E+03	Nil	4.01E+01	31.86	4.19E+02	23.90	4.39E+07	22.48	2.97E+05
HB4 x BM2	31.41	5.45E+06	36.39	4.72E+01	24.73	5.59E+01	23.46	3.33E+07	19.26	3.35E+02
HB4 x BMV1	23.75	6.83E+05	34.08	5.32E+02	27.94	6.73E+03	26.58	2.39E+06	22.26	3.57E+05
Lines	40S ribosomal protein		Nucleosome assem. Pro.		Kruppel		Bm period		Bm relish	
	Ct.No	Copy Number	Ct.No	Copy Number	Ct. No	Copy Number	Ct. No	Copy Number	Ct. No	Copy Number
MV1S6AB x BM2	18.61	9.72E+06	27.61	3.64E+06	29.76	6.90E+02	30.52	7.92E+03	15.77	6.86E+07
MV1B x BMV1	25.40	8.09E+03	27.86	2.13E+04	29.23	3.07E+01	22.82	5.37E+01	16.48	3.21E+04
MV1 x S8	24.84	8.34E+06	27.32	3.38E+04	29.15	5.15E+03	32.62	6.32E+04	26.78	5.52E+06
HB4 x S8	29.39	7.84E+05	28.65	2.08E+06	29.47	4.79E+02	26.22	5.17E+04	20.57	4.52E+05
HB4 x BM2	25.80	6.90E+03	25.68	2.38E+07	29.51	5.50E+01	17.54	6.03E+03	12.89	4.98E+07
HB4 x BMV1	21.76	9.11E+05	28.84	4.16E+05	28.7	6.67E+01	22.99	7.77E+02	13.26	5.86E+07

Table 9.14: Reeling parameters of the stabilized lines

Race	SCW (g)	SSW (g)	SR%	Reelability %	FL (m)	NBFL (m)	Denier	Rendita	Raw silk %	RS Rec. %	Neatness %
MV1S6AB × BM2	1.090	0.190	17.43	79.90	418.30	375.71	2.59	9.73	10.27	53.94	82
MV1B × BMV1	1.060	0.200	18.41	77.78	552.38	429.63	2.79	7.76	14.78	60.26	84
MV × S8	0.990	0.190	18.83	78.07	610.42	442.67	2.97	7.62	17.76	64.38	83
HB4 × S8	1.320	0.270	20.68	84.79	578.26	501.89	2.77	7.73	12.94	64.57	82
HB4 × BM2	1.140	0.230	20.35	81.61	590.36	499.54	2.88	7.84	15.49	66.11	86
HB4 × BMV1	1.030	0.190	18.70	77.59	500.69	453.78	2.82	7.92	15.57	62.33	86

Table 9.15: Hybrid evaluation study with the bivoltine parents as well as ruling bivoltine breed

Sl No.	Combination	Basic Nos.	ERR		SCW (g)	SSW (g)	SR %
			Nos.	Wt.			
1	(MV1S6AB × BM2E) × S8	250	8400	18.520	1.831	0.385	21.02
2	(MV1S6AB × BM2E) × CSR2	250	8080	15.840	1.714	0.349	20.37
3	(MV1S6AB × BM2E) × BM2E	250	8600	15.200	1.784	0.326	18.27
4	(MV1B × BMV1) × S8	250	7920	15.240	1.854	0.377	20.31
5	(MV1B × BMV1) × CSR2	250	7900	15.320	1.923	0.381	19.81
6	(MV1B × BMV1) × BM2E	250	8160	15.240	1.932	0.371	19.22
7	(MV1 × S8) × S8	250	7220	12.560	1.668	0.356	21.35
8	(MV1 × S8) × CSR2	250	7040	12.480	1.741	0.375	21.56
9	(MV1 × S8) × BM2E	250	7640	12.880	1.597	0.338	21.18
10	(HB4 × BM2E) × S8	250	8120	15.240	1.768	0.377	21.33
11	(HB4 × BM2E) × CSR2	250	8180	14.560	1.752	0.373	21.29
12	(HB4 × BM2E) × BM2E	250	7080	12.560	1.672	0.347	20.75
13	(HB4 × BMV1) × S8	250	8360	15.200	1.715	0.357	20.84
14	(HB4 × BMV1) × CSR2	250	8560	17.520	1.855	0.385	20.76
15	(HB4 × BMV1) × BM2E	250	7800	10.240	1.795	0.348	19.39
16	(HB4 × S8) × S8	250	8320	14.160	1.733	0.369	21.28
17	(HB4 × S8) × CSR2	250	7840	15.560	1.711	0.374	21.83
18	(HB4 × S8) × BM2E	250	8600	15.160	1.722	0.354	20.57

AIB 01011 S1: Development of Multivoltine foundation crosses for productivity and high silk percentage March 2020 to February 2023)

Soudaminy PV, Chandrashekar KB and Chandrashekar MN

Objective:

- To develop multivoltine foundation crosses for the production of Multi × Bivoltine double hybrids with high shell percentage

Twelve parental breeds were selected for the preparation of Multivoltine Foundation Crosses (MFC) *viz.,* PM, HB4, MO6, ND2, ND5, ND7, ND10, NDV6, NP1, NP4, PV1 and MCon1 (Table 9.16). A total of 104 multivoltine foundation crosses were prepared using these parents (Table 9.16A). The rearing will be conducted, further evaluation and shortlisting will be undertaken.

Table 9.16: Rearing performance of the parental breeds.

Sl.No	Breeds	Fec.	ERR		SCW (g)	SSW (g)	SR %
			Nos	Wt(gm)			
1	PM	460	9600	11.600	1.198	0.173	14.44
2	HB4	527	9200	14.040	1.518	0.278	18.31
3	MO6	518	9000	13.200	1.447	0.279	19.28
4	ND2	501	9080	13.120	1.431	0.244	17.05
6	ND7	528	9280	12.000	1.272	0.204	16.04

Sl.No	Breeds	Fec.	ERR		SCW (g)	SSW (g)	SR %
			Nos	Wt(gm)			
7	ND10	547	9240	13.400	1.439	0.316	21.96
8	NDV6	520	8960	13.400	1.487	0.273	18.36
9	NP1	515	9480	13.200	1.391	0.251	18.04
10	NP4	530	9360	11.800	1.241	0.232	18.69
11	PV1	519	9840	12.800	1.287	0.238	18.49
12	Mcon1	490	9040	9.400	1.019	0.148	14.52

Table 9.16A: Rearing performance of the Multivoltine foundation crosses

Sl.No	MFCs	Fec.	ERR		SCW (g)	SSW (g)	SR %
			Nos	Wt(gm)			
1	PM X ND2	565	8840	11.600	1.306	0.245	18.76
2	PM X ND5	515	9360	12.400	1.318	0.241	18.29
3	PM X ND7	524	9040	12.600	1.329	0.235	17.68
4	PM X ND10	550	9240	12.000	1.272	0.234	18.40
5	PM X NDV6	568	9000	11.600	1.262	0.218	17.27
6	PM X MO6	540	9160	11.600	1.250	0.216	17.28
7	PM X NP1	531	9560	13.400	1.400	0.238	17.00
8	PM X NP4	524	9120	9.000	1.421	0.242	17.03
9	PM X HB4	534	9480	9.400	1.305	0.223	17.09
10	PM X PV1	520	8880	12.400	1.370	0.248	18.10
11	ND2 X PM	501	8960	11.600	1.284	0.225	17.52
12	ND2 X ND5	498	9560	11.200	1.171	0.237	20.24
13	ND2 X ND7	534	9160	11.400	1.241	0.225	18.13
14	ND2 X ND10	564	8640	11.000	1.271	0.264	20.77
15	ND2 X NDV6	574	9520	13.200	1.381	0.257	18.61
16	ND2 X MO6	568	9040	12.000	1.312	0.239	18.22
17	ND2 X NP1	554	9120	13.600	1.491	0.263	17.64
18	ND2 X NP4	535	9200	13.600	1.461	0.244	16.70
19	ND2 X HB4	540	9000	12.000	1.316	0.236	17.93
20	ND2 X PV1	547	8960	11.200	1.250	0.213	17.04
21	ND5 X PM	518	8960	11.400	1.275	0.215	16.86
22	ND5 X ND5	524	9120	12.000	1.320	0.251	19.02
23	ND5 X ND7	512	8600	11.800	1.351	0.218	16.14
24	ND5 X ND10	518	9000	12.600	1.393	0.258	18.52
25	ND5 X NDV6	524	9200	12.000	1.299	0.208	16.01
26	ND5 X MO6	538	8960	12.800	1.427	0.265	18.57
27	ND5 X NP1	545	9200	11.200	1.198	0.198	16.53
28	ND5 X NP4	547	9480	11.600	1.217	0.206	16.93
29	ND5 X HB4	560	9080	13.400	1.474	0.261	17.71

Sl.No	MFCs	Fec.	ERR		SCW (g)	SSW (g)	SR %
			Nos	Wt(gm)			
31	ND7 X PM	537	9240	14.400	1.556	0.266	17.10
32	ND7 X ND2	512	9720	13.200	1.341	0.224	16.70
33	ND7 X ND5	527	8800	11.600	1.292	0.221	17.11
34	ND7 X ND10	530	9120	11.920	1.302	0.236	18.13
35	ND7 X NDV6	548	9000	11.600	1.267	0.228	18.00
36	ND7 X MO6	547	9160	13.600	1.469	0.275	18.72
37	ND7 X NP4	560	9040	13.200	1.429	0.254	17.77
38	ND7 X HB4	574	9360	15.200	1.597	0.307	19.22
39	ND10 X PM	541	9120	13.400	1.455	0.252	17.32
40	ND10 X ND2	532	9280	13.200	1.410	0.264	18.72
41	ND10 X ND5	517	8840	12.400	1.385	0.252	18.19
42	ND10 X ND7	547	9320	12.400	1.314	0.238	18.11
43	ND10 X NDV6	563	9040	10.800	1.160	0.226	19.48
44	ND10 X MO6	548	9120	13.600	1.471	0.233	15.84
45	ND10 X NP1	570	8920	13.400	1.488	0.247	16.60
46	ND10 X NP4	564	9280	14.800	1.577	0.273	17.31
47	ND10 X HB4	537	9080	15.200	1.667	0.292	17.52
48	ND10 X PV1	521	9160	15.000	1.641	0.261	15.90
49	NDV6 X PM	489	9080	15.200	1.681	0.312	18.56
50	NDV6 X ND2	534	9520	13.600	1.426	0.272	19.07
51	NDV6 X ND10	547	9440	12.400	1.304	0.222	17.02
52	NDV6 X MO6	528	9120	13.000	1.425	0.272	19.09
53	NDV6 X NP1	554	9080	12.000	1.456	0.275	18.89
54	NDV6 X HB4	523	8960	12.000	1.323	0.264	19.95
55	NP1 X PM	546	9800	13.000	1.310	0.225	17.18
56	NP1 X ND2	515	9080	12.800	1.398	0.246	17.60
57	NP1 X ND5	534	9600	12.400	1.250	0.205	16.40
58	NP1 X ND7	532	9520	14.400	1.511	0.261	17.27
59	NP1 X ND10	547	9560	14.400	1.514	0.260	17.17
60	NP1 X NDV6	541	9560	12.400	1.291	0.215	16.65
61	NP1 X MO6	564	9160	12.000	1.294	0.252	19.47
62	NP1 X NP4	547	9320	11.200	1.191	0.229	19.23
63	NP X HB4	535	9120	13.800	1.506	0.266	17.66
64	NP1 X PV1	542	9280	12.000	1.279	0.214	16.73
65	NP4 X PM	520	8920	12.800	1.405	0.278	19.79
66	NP4 X ND2	518	9520	12.600	1.314	0.239	18.19
67	NP4 X ND5	531	8920	12.800	1.420	0.267	18.80
68	NP4 X ND7	541	8800	12.840	1.446	0.280	19.36
69	NP4 X ND10	561	9480	13.400	1.407	0.270	19.19
70	NP4 X NDV6	574	8960	14.000	1.381	0.265	19.19

Sl.No	MFCs	Fec.	ERR		SCW (g)	SSW (g)	SR %
			Nos	Wt(gm)			
72	NP4 X NP1	546	9160	13.800	1.504	0.283	18.82
73	NP4 X HB4	560	9280	13.800	1.471	0.283	19.24
74	NP4 X PV1	524	9080	12.800	1.387	0.259	18.67
75	HB4 X PM	535	9240	13.600	1.472	0.249	16.92
76	HB4 X ND2	542	8880	12.800	1.423	0.253	17.78
77	HB4 X ND5	530	9720	13.000	1.336	0.260	19.46
78	HB4 X ND7	547	9040	14.400	1.572	0.283	18.00
79	HB4 X ND10	562	9640	13.920	1.448	0.271	18.72
80	HB4 X NDV6	549	9600	13.600	1.416	0.271	19.14
81	HB4 X MO6	554	9120	13.800	1.496	0.276	18.45
82	HB4 X NP1	560	9160	12.800	1.389	0.257	18.50
83	HB4 X NP4	549	9120	12.600	1.379	0.256	18.56
84	HB4 X PV1	558	9440	15.400	1.620	0.308	19.01
85	PV1 X PM	504	9200	13.400	1.443	0.250	17.33
86	PV1 X ND2	519	9200	15.200	1.643	0.289	17.59
87	PV1 X ND5	524	9160	14.000	1.523	0.259	17.01
88	PV1 X ND7	531	9120	14.800	1.623	0.288	17.74
89	PV1 X ND10	558	9480	15.280	1.611	0.288	17.88
90	PV1 X NDV6	561	9080	14.600	1.613	0.298	18.47
91	PV1 X MO6	574	9000	13.200	1.468	0.258	17.57
92	PV1X HB4	549	9080	14.400	1.579	0.292	18.49
93	PV1 X NP1	538	9000	13.200	1.466	0.263	17.94
94	PV1 X NP4	549	9200	13.200	1.433	0.267	18.63
95	MO6 X PM	501	9000	13.400	1.488	0.260	17.47
96	MO6 X ND2	521	9360	13.080	1.398	0.246	17.60
97	MO6 X ND5	567	9160	13.000	1.407	0.216	15.35
98	MO6 X ND7	564	9640	13.800	1.426	0.243	17.04
99	MO6 X ND10	549	9360	12.800	1.352	0.213	15.75
100	MO6 X NDV6	558	9040	11.440	1.269	0.222	17.49
101	MO6X PV1	564	9600	13.600	1.416	0.262	18.50
102	MO6 X NP1	571	8720	12.000	1.361	0.271	19.91
103	PV1 X NP4	573	9080	9.400	1.462	0.251	17.17
104	M06 X HB4	564	9440	12.000	1.248	0.223	17.87

OFT programme: Evaluation of Improved Pure Mysore PM4 (Apr. 2020 - Mar. 2022)

Chandrashekar KB, Soudaminy PV and Chandrashekar MN

Objective:

- To Evaluate the improved Pure Mysore lines PM4 at P3 farm, DoS Bilidevalaya, Kunigal and its crossbreed at farmers level

In co-ordination with DoS Karnataka, three rearings of 10 dfls each was undertaken at P3 GSF Bilidevalaya Kunigal during the reporting period (Table 9.17). Two batches were processed 1000 PM4×CSR2 crossbreed dfls prepared and distributed to the farmers in the Maddur area for evaluation (Table 9.18). Due to COVID-19 all the trials could not be completed hence, the programme extended upto March-2022.

Table 9.17: PM4 Performance at P3 farm DOS Bilidevalaya (Mean of 3 crops)

Lines	Fec.	Yield/10000 Larvae		SCW (g)	SSW (g)	Shell %
		Nos.	Wt. (g)			
PM-4	517	9279	12.94	1.382	0.209	15.11
PM (Dos)	499	9180	12.12	1.230	0.182	14.62
% of Improvement	3.54	1.08	6.76	12.37	14.52	3.33

Table 9.18: Field performance of PM4 x CSR2 in Maddur area

Particulars	Fec	Yield/10000 Larvae		SCW (g)	SSW (g)	Shell %	Yield / 100dfls
		Nos	Wt. (g)				
PM4 × CSR2	506	9010	15.45	1.814	0.36	19.61	71.43
PM × CSR2 (DoS)	493	8901	14.64	1.724	0.33	19.08	67.13
% of imrove	2.58	1.23	5.49	5.23	8.14	2.77	6.40

Continuous/Other activities

Maintenance of Polyvoltine Silkworm Breeds

Chandrashekar KB, Soudaminy PV and Chandrashekar MN

Objectives:

- To maintain the polyvoltine breeds conforming to their original characters.

Thirty three polyvoltine breeds were maintained conforming to their original breed character for 6 generations.

AIB 02006-MI: Improvement of Nistari lines for survival and silk productivity (In collaboration with CSRTI-Berhampore)

Dr. Thangjam Ranjitha Devi (PI), Co.PI Dr. Anil Kumar Verma, Gautam Mitra, K. Rahul, Dr. Pooja Makwana, Dr. Mihir Rhaba, Dr. K.B. Chandrashekar.

Objectives:

- To develop Nistari lines for improved survival and silk productivity.
- To evaluate improved Nistari crossbreeds for productivity traits.

The dfls was received from CSR&TI, Berhampore, reared and provided back along with necessery data for further study and evaluation. The source is also maintained at CSR&TI, Mysuru.

10. SILKWORM PHYSIOLOGY

On-going Research Projects

BPS 01013-CN: Utilization and diversification of silkworm pupae products for human and animal consumption and composting [Collaboration with other research institutes] (Oct. 2020 - Sep. 2022)

CSRTI-Mysuru: Thirupathaiah Y, Harishkumar J, Ravindra, Sanath KumarYN, Hukkeri SM, Manthira Moorthy S, Mary Josepha AV, Pankaj Tewary (upto 31.12.2020) and Babulal (from 15-01-2021)

CFTRI-Mysuru: Sachindra NM, Sathyndra Rao B, Shinde Vijay S, Sridevi A Singh, Rathinaraj K

CIFRI-Barrakpore: Das BK, Meena DK and Hassan MA

CSTRI-Bengaluru: Kiran B Malali, Itigi MR, and Radhalakshmi Y

CTRTI-Ranchi: Jena K, Susmita Das and Jitendra Singh

CMERTI-Lohdaigarh: Mahesh DS and James Keisa T

CSRTI, Mysuru

Proximate composition *viz*., Ash, fiber, moisture, protein and fat content was analyzed in spent and fresh mulberry silkworm pupae (*Bombyx mori*). Moisture content was 67% in spent pupae and 76% in fresh pupae and dry matter content was 33% in spent pupae and 24% in fresh pupae. Further, the dry matter was analyzed for fat, protein, ash and fiber content and proteins and fats were major proportions in dry matter of silkworm pupae (Table 10.1). The protein content was 51% in spent pupae and 55% in fresh pupae, whereas, fat content was 27% in spent pupae and 28% in fresh pupae. The ash content was 5% in spent pupae ad 4% in fresh pupae, whereas, fiber content was 0.2% & 0.3 % in spent and fresh pupae respectively. Heavy metals found to be below permissible levels in fresh and spent pupae. Inorganic element analysis in silkworm pupae reveled that, all key inorganic elements (N, P, K, Ca, Mg, Cu, Zn, Fe, and Mn) were present in silkworm pupae. Amino acids, sugars, fatty acid, vitamins, phenolics and flavonoids profile have been carried out in both fresh and spent pupae. The essential amino acids (Valine, Leucine, Methionine, Histidine, Phenylalanine, Tyrosine and Tryptophan) and essential fatty acids (particularly alpha linolenic acid) were in remarkable levels. Fat soluble and water soluble vitamins are also present in silkworm pupae.

CFTRI, Mysuru

For the preparation of poultry feed, analyzed whole silkworm pupae (WSWP), defatted WSWP, cuticle-free SWP (CSWP) and defatted CSWP. The studies were carried out to prepare cuticle free SWP and analyzed the samples. The formulation for layer feed and broiler feed has been finalized for the feeding experiment. Silkworm pupae are being utilized for preparation of human food products, pasta and cookies.

Table 10.1: Proximate, nutritional and bio-active compound in silkworm (*B. mori*) pupae

Parameter	Fresh pupae (%)	Spent pupae (%)
Moisture	76.78	67.235
Dry matter	23.22	32.765
Dry matter analysis		
Compounds	Fresh pupae (%)	Spent pupae (%)
Fat	28.03	27.5
Crude protein	54.5	51.66
Ash/minerals	3.95	5.6
Fiber	0.37	0.28
Carbohydrates	4.79	2.37
Free amino acids	5.468	1.705
Vitamins	0.036	0.006
Phenolic compounds	0.0835	0.1245
Flavonoids	0.01387	0.0029
Tannins	0.0029	0.0033

CIFRI, Barrakpore

Proximate analysis and anti-nutrient analysis in Mulberry and Tasar pupae were carried out. The crude protein level was about 65% and anti- nutrients present in silkworm pupae were tannins, phytate, flavonoids, Saponins and oxalates. The silkworm pupae are being utilized for formulation of fish feeds and feeding trials.

CSTRI, Bangalore

Identified reelers among traditional cluster were sensitized for adoption of a system to for collection of discarded Tasar pupae. Reelers have agreed to collect, dry and store the spent tasar pupae in a common place. During the period under report, initiated action for synthesis and sourcing of Tasar Black Gold by inviting limited tenders from commercial producers.

CTRTI, Ranchi

Analyzed the Tasar pupae, the Protein content was 60.73% and 59%, ash content was 5.05% and 4.1% and fat content was 23.5% and 21% in fresh and spent tasar pupae respectively. Similarly, in defatted samples protein content was 82.31% and 80.79%, fat content was observed 2.1% and 2% and moisture level was 2.3% and 2.0% in fresh and spent pupae respectively. Whereas, Chitin content was 3.87% and 3.83% in fresh and spent silkworm pupae respectively. Similarly, in defatted sample Chitin content was 4.83% and 4.63% in fresh and spent pupae respectively. In detanned pupae powder, protein content was 64.05% in fresh and 61.43% in spent samples. Similarly, fat content was also observed 9.39 % in fresh and 5.69% in spent detanned pupae powder.

CMERTI, Lahdoigarh

Analyzed the protein, lipid, carbohydrate, ash, free amino acids, phenols, reducing sugars, and other nutrients in both Eri and Muga pupae. The micro elements viz., iron, zinc and copper content of both eri and muga pupae were detected in trace amount. The heavy metal cadmium is also estimated in both eri and muga pupae. Amino acid , phenolic acids , flavonoids profiling were carried out in both muga and eri pupae.

AIP 01006SI: Identification of probiotic consortium to improve the productivity in mulberry silkworm, *Bombyx mori* (Nov. 2019 - Oct. 2021)

Thirupathaiah Y, Harishkumar J, Bhuvaneswari E and Mary Josepha AV and Babulal

Silkworm midgut bacterial isolates were screened for the production of enzymes, cobalamine, folate, metabolites, antimicrobial substances as well as their tolerance for wider range of pH, temperatures and anaerobic conditions. Based on the *in vitro* characteristics eight bacterial isolates were shortlisted. The cultures were maintained in the laboratory. The isolates were fed to silkworm individually and in combinations and checked the larval and cocoon parameters. Marginal improvement in silkworm growth and cocoon parameters were observed in probiotic treated batches over the control. Ten larval weight (5th day, fifth instar) of treatment batch was 44.98±1.874g and in control it was 42.19±1.599 g (double hybrid FC1 x FC2). Whereas shell ratio in treatment batch was 22.79±0.331% compared to control 21.91±0.382%.

OST Programme: Validation of Chawki feed supplement formulation in RSRS/REC of Andhra Pradesh, Karnataka and Tamil Nadu (Apr. 2020 to Mar. 2021)

Bhuvaneswari E, Thirupathaiah Y, Dhahira Beevi N, Kulkarni SB, Kiran Kumar KP, Jhansilakshmi M, and Narendrakumar JB

Objective: To validate chawki feed supplement formulation at Regional Sericulture Research Stations and Research Extension Centers of Andhra Pradesh, Karnataka and Tamil Nadu

On station trials were conducted for the chawki feed supplement formulation validation in three RSRSs (Ananthapur, Kodathi and Salem), RECs (Madiwala and Krishnagiri) units of Andhrapradesh, Karnataka and Tamil Nadu in three seasons with 500 dfls each. Additionally the validation was conducted in a private CRC in T. Narsipura by offering technical support. The validation was carried out during rainy, winter and summer seasons with FC1 x FC2 silkworm hybrids. At each trial location, the supplementation was given to first instar chawki worms for first three days @ 10 ml for 100 dfls one feed per day. The CFSF was sprinkled on mulberry leaves and left for 15 min. for absorption before feeding. For the control batch (100 dfls) normal leaves were fed and chawki certification was carried out during second moult, later the rearing and cocoon parameters were noticed in CFSF treated as well as in control batch. The results given in the tables are the average of five trial location in respective seasons.

During the rainy season (July to September, 2020), the average performance of chawki larval growth was 3.69 g in control and 3.82 g in treated batch, similarly missing larval percentage (MLP) in control was 3.67% and 2.29 % in CFSF treated batch and found 37.43% reduction in MLP. Similarly, the average undersized larval percentage (ULP) in control was 2.25% and 1.33% in CFSF treated batch and found 40.913% reduction in ULP. The batches were continued up to spinning .The pupation rate and cocoon yield was improved in the CFSF treated batch. The late age 5th instar growth and cocoon parameters were assessed (Table 10.2), The parameters tested were on par in the control and treated batch in the weight of the larvae, single cocoon weight, shell weight, pupation rate. The average cocoon yield was 75.892 kg in control and 79.79 Kg in CFSF treated batch.

During winter season (October to December 2020), the trial results show that, there was an improvement in chawki performance and in cocoon yield. The average growth was 3.701 g in control and 3.801 g in CFSF treated batch, similarly MLP in control was 3.339% and 1.855 % in CFSF treated batch and found 44.44% reduction in MLP. The average ULP in control was 2.43% and 1.446% in CFSF treated batch and found 41.142% reduction in ULP. The evaluation on the cocoon parameter noticed there is no much significance difference between the control and treatment in the weight of the larvae, single cocoon weight, shell weight but the pupation rate and cocoon yield was improved in the CFSF treated batch (Table 10.2), and The average cocoon yield was 77.506 Kg in control and 81.874 Kg in CFSF treated batch.

During January to March 2021, there was an improvement in chawki performance and in cocoon yield. The average growth was 3.704 g in control and 3.805 g in CFSF treated batch, similarly MLP in control was 3.51% and 2.22 % in CFSF treated batch and found 36.75% reduction in MLP. The average ULP in control was 2.65% and 1.90% in CFSF treated batch and found 28.37% reduction in ULP. The economic parameters were assessed (Table 10.3) and found that there is significant difference between the control and treatment in the average cocoon yield i.e., 77.8 kg in control and 81.868 kg in CFSF treated batch and found 5.209% improvement over the control. The validation of CFSF reveled that, the supplementation of CFSF through mulberry leaves for the chawki worms, reduces the missing larval percentage (MLP) minimum by 33% and reduction in undersized larval percentage (ULP) by 27% and improved cocoon yield by 5%.

Table 10.2: Validation of CFSF in RSRS and RECS of AP, KA and TN results

C/T	Chawki performance			Late age and cocoon parameters						
	Growth (g) (wt.g/ 100 L)	Missing Larvae (%)	Under sized larvae (%)	Weight of 10 larvae (g)	Single cocoon weight (g)	Single shell weight (g)	Shell ratio (%)	Pupation rate (%)	Yield (kg) / 100 dfls	Cocoon rate [Rs. /kg]
Rainy season										
Control	3.69 (±0.18)	3.67 (±1.45)	2.256 (±1.20)	44.302 (±3.883)	1.8518 (±0.086)	0.413 (±0.033)	22.55 (±1.38)	93.52 (±2.83)	75.892 (±5.940)	315.6 (±23.98)
CFSF treated	3.818 (±0.21)	2.296 (±0.73)	1.333 (±0.67)	46.094 (±3.464)	1.8958 (±0.05)	0.425 (±0.02)	22.464 (±1.18)	94.644 (±2.18)	79.794 (±5.14)	317.14 (±21.74)
PC	3.468 NS	37.438 **	40.44 NS	2.377 NS	2.905 NS	0.381 NS	1.197 NS	1.197 NS	5.141 NS	0.487 NS
Winter season										
Control	3.701 (±0.11)	3.339 (±1.23)	2.433 (±1.24)	46.984 (±1.86)	1.900 (±0.16)	0.413 (±0.04)	21.636 (±0.66)	91.320 (±6.47)	77.506 (±5.14)	381 (±71.34)
CFSF treated	3.801 (±0.20)	1.855 (±0.77)	1.446 (±0.67)	48.109 (±1.76)	1.946 (±0.13)	0.425 (±0.04)	21.711 (±0.54)	93.686 (±4.49)	81.874 (±2.49)	385 (±79.19)
PC	2.701 NS	44.44 ***	41.142 **	2.394 NS	2.421 NS	2.905 NS	0.346 NS	2.590 NS	5.635 NS	1.049 NS
Summer season										
Control	3.704 (±0.24)	3.510 (±0.90)	2.654 (±0.87)	41.728 (±3.07)	1.840 (±0.13)	0.398 (±0.03)	21.774 (±0.50)	93.184 (±3.12)	77.814 (±3.94)	393.60 (±24.61)
CFSF treated	3.805 (±0.32)	2.220 (±0.56)	1.901 (±0.72)	43.172 (±2.44)	1.915 (±0.07)	0.422 (±0.01)	22.250 (±0.88)	94.832 (±2.34)	81.468 (±3.40)	406.00 (±43.87)
PC	2.726 NS	36.752 ***	28.372 **	3.460 NS	4.076 NS	6.030 **	3.974 NS	1.768 NS	5.209 **	3.307 NS

Each value is the mean±SD of five separate observations, PC: Percent change over control values

***Significant at 0.05% level (P value <0.05) ; **Significant at 0.1% level (P value <0.1) NS- Non Significant

Average of 500 dfls in 5 trial locations

BPC 07015-**CN: Development of mulberry sericin powder for nutraceutical applications [in collaboration with CSTRI Bengaluru** & CFTRI, Mysuru] (Oct. 2020 - Sep. 2022)

Coordinating institute: CSTRI Bengaluru

Abhilasha R and Radhalakshmi Y [CSTRI, Bengaluru]; Sridevi A Singh and NM Sachindra [CFTRI, Mysuru]; Yeruva Thirupathaiah [CSRTI, Mysuru]

CSRTI, Mysuru

Silkworm rearing was conducted by supplying organic mulberry leaf to silkworm and without using any bed disinfectants and harvested organic cocoons and conducted the heavy metal analysis.

Table 10.3: Analysis of heavy metal content in cocoon shell

Heavy metals	Cocoon Shell		Permissible levels for food and nutraceuticals (ppm) FDA/FSSAI
	Control(ppb)	Organic(ppm)	
Lead	135	60	<10
Cadmium	BDL	BDL	<5
Arsenic	4.0	BDL	<3
Mercury	58	20.00	<1
Chromium	162	60.00	<30
Nickel	168	0.066	<30

Continuous/Other activities

Maintenance of Cordyceps strains

Y. Thirupathaiah

Maintenance of thirteen strains of *Cordyceps* species were done on potato dextrose agar (PDA) as well as on silkworm pupae powder based agar media by providing optimal growth conditions.

The HPLC analysis revealed that biologically active substances such as cordycepin and adenosine levels were found to be higher in *Cordyceps* fruiting bodies grown on live silkworm pupae than pupae powder and potato dextrose agar.

11. TECHNOLOGY VALIDATION AND DEMONSTRATION CENTRE

Bhagya R

Continuous/Other activities

Large scale in-house evaluation and multiplication of MV1 X S8 under the project

AIB 1001: Evaluation of Cauvery Gold (MV1 x S8) An improved cross breed for cocoon productivity and silk quality (June 2018 to May 2020)

Under the large scale in house evaluation and multiplication programme, 50 dfls of MV1 and 100 dfls of S8 breeds were reared and generated 39 kg (24,520 Nos) of cocoons. The rearing performance was evaluated and the data revealed that they are in confirmation for its original breed characters.

Table 11.1: Rearing performance of silkworm breeds at TVDC during 2020-21

Breed	No. of dfls	Fec.	Actual yield		ERR/10,000 larvae		SCW (g)	SSW (g)	SR%	Coc/ kg	Yield/ 100 dfls (kg)
			No.	Wt. (kg)	No.	Wt. (kg)					
S8	50	460	82801	19.0	3729	22.94	1.52	0.332	21.84	640	38.00
MV1	100	445	16240	20.0	3901	12.31	1.44	0.289	20.06	812	20.00

Source: MBL; S8 B/on: 08.05.2020; MV1 B/o: 21.05.2020

Table 11.2: Cocoon supplied during 2020-21

Race	Supplied to	Cocoons		Total Revenue generated (Rs)
		By No.	By Wt. (kg)	
S8 MV1	SSPC, Mallavalli	12160 16240	12.0 20.0	17575

* including 7 kg marketed at APMC, Mysore.

Evaluation of new productive bivoltine hybrid at farmer's level (OFT)

Under the project, Evaluation of new productive Bivoltine hybrid at farmer's level (OFT) 3 rearings were conducted during month of July, October 2020 and February 2021.

Table 11.3: Rearing performance of productive bivoltine hybrids (OFT)

Race	No. of Dfls	Fec	Actual yield		ERR		SCW (g)	SSW (g)	SR%	Coc/ kg	Yield/100 dfls (kg.)
			No.	Wt. kg.	No.	Wt. kg.					
BFC25 (oval)	25	445	5626	8.13	5265	7.60	1.51	0.331	21.80	692	32.5
BFC10 (Dumb)	25	442	8840	13.0	8947	13.15	1.57	0.343	21.81	680	42
BFC01 (oval)	25	461	4298	7.26	4641	7.84	1.62	0.355	21.83	582	29.9
BFC11 (Dumb)	25	396	8198	12.20	7600	11.31	1.42	0.295	20.73	672	48.8
432 (Bmv1xBmo10)	50	456	18225	27.0	7993	9.45	1.53	0.36	23.36	675	54
223 (Bmd3xBmfd)	25	436	6300	10.0	5779	9.17	1.50	0.34	22.65	830	40
244 (Bmd2xBmfd)	25	440	6165	9.0	5604	8.18	1.54	0.34	21.94	685	36
220 (Bmd2xBmfd)	50	456	20748	28.5	9100	12.5	1.40	0.283	20.19	728	57
5 (Bmv1xBmo11)	50	461	18921	25.5	8208	11.06	1.357	0.307	22.62	742	51

Rearings were conducted during 7.7.2020, 15.10.2020 and 15.2.2021

MV1 hybrids such as MV1 x S8 are found to be an excellent alternative with superior qualities for traditional multivoltine races.

12. PEST MANAGEMENT

Concluded Research Project

PRE 01005 CN: Demonstration and popularization of pheromone trap against silkworm uzi fly, *Exorista bombycis* (In collaboration with NBAIR, Bengaluru) (Nov. 2018 - Oct. 2020)

S. Mahiba Helen (from 17.07.2019), J. B. Narendra Kumar (up to 16.07.2019), N. Bakthavatsalam [NBAIR, Bengaluru], M. Noble Morrison [REC-Madivala], N. Dhahira Beevi [RSRS-Salem], B. Vijaya Naidu [RSRS Anantapur]

Objectives:

- To know the efficacy of pheromone based trap against uzi fly
- Patenting and commercialization of the pheromone based trap for the uzi fly

Demonstration and popularization of uzi fly pheromone trap trials have been conducted with 1350 farmers (Karnataka: 425, Tamil Nadu: 330, Andhra Pradesh: 415 and Maharashtra: 180) against the target of 1000 farmers.

Patent of the technology has been filed: "A pest attractant composition and method of preparation thereof for Uzi fly, *Exorista bombycis*" on August 12, 2020 - Application No: 202011034663 by NBAIR, Bengaluru.

Analysis for comparing the performance of pheromone trap (Fig. 12.1) with control was done for each state separately and finally it was done for combined group. In Karnataka, Mean number of uzi flies trapped per trap (53.88) was significantly higher in treatment group compared to control group (8.90). Mean cocoon yield (86.52) was significantly higher in treatment group compared to control group (76.50). In Tamil Nadu, Mean number of uzi flies trapped per trap is higher in treatment group (858.32) compared to control group (91.29). Average cocoon yield/100 dfls) also was higher in treatment group (81.11) compared to control group (75.43). In the case of combined sample, both the variables shown significant difference between control and experimental groups. Mean number of uzi flies trapped per trap (368.16) was significantly higher in treatment group compared to control group (71.20).

Commercialized the technology to AG Organicz, 2nd Cross, No.51/5, Bikasipura Main Road, JC Industrial Area,, Yelachenahalli, Bengaluru, Bengaluru Urban Karnataka, 560062 and Pure Chemicals Laboratories Pvt. Ltd., 82, Ist Avenue, Teachers Colony, Koramangala, Bengaluru -560034.

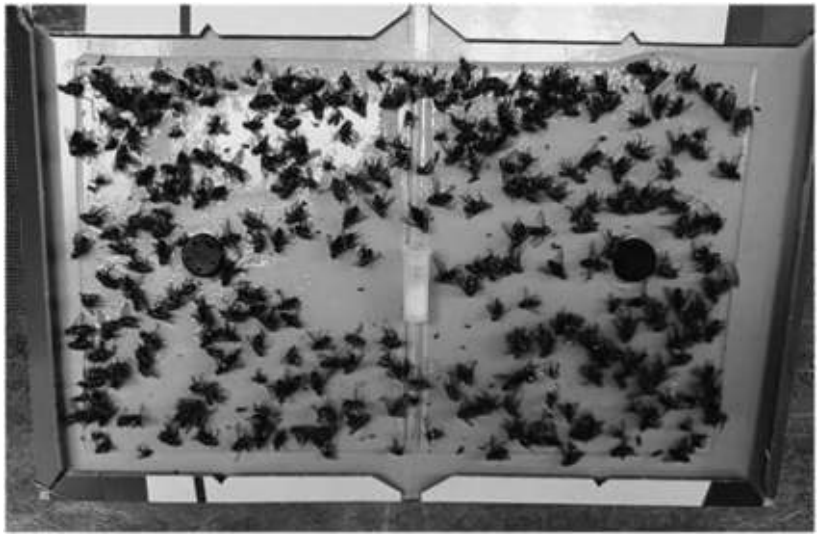


Fig. 12.1: Uzi flies attracted 24 h after installation of the pheromone trap

On-going Research projects

PRE 01010 SI: Development of Integrated Pest Management (IPM) module for leaf roller *Diaphania pulverulentalis* (Lepidoptera: Pyralidae) in mulberry (Mar. 2020 – Feb. 2022)

Mahiba Helen S, Mary Josepha Shery AV

Objectives:

- Evaluation of *Diaphania pulverulentalis* Nucleopolyhedrovirus (DpNPV) for the management of leaf roller in mulberry.
- Evaluation of Egg, Larval and pupal parasitoids for the management Leaf roller in mulberry.
- Screening of efficacy of selected botanicals and chemical insecticides against Leaf roller and their bio-safety to silkworms.

Standardized mass production of leaf roller on mulberry leaves. Continuous leaf roller culture have been maintained in the laboratory. Studies on the effect of residual toxicity of three botanicals *viz*., VIDI GREENPATH (Pongamia seed extract) : KOPPERT Biological systems , two neem products and four systemic insecticides viz., Imidacloprid 17.80% SL.;Lambda Cyhalothrin 2.5%EC; Emamectin Benzoate 5% SG; Acetamiprid 20% SP have been tested against first instar silkworm larvae 2, 5, 10 and 15 days after spraying. Safety period of botanical VIDI GREENPATH to silkworms is 7 days after treatment and that of Imidacloprid 17.80% SL is 15 days after treatment. Two larval parasitoids *Phanerotoma* sp. and *Dolichogenidea* sp. of *D. pulverulentalis* have been collected from the field. Laboratory evaluation of two insecticides Thiamethoxam 75% W/W SG and Emamectin Benzoate 3.0% + Thiamethoxam 12.0% WG were tested against *D. Pulverulentalis* third and fifth instar larvae. 100% mortality observed in both insecticides after 12 hrs of treatment. Initiated mass production of leaf roller pupal parasitoid *Tetrastichus howardi*i (Hymenoptera: Eulophidae) on leaf roller pupae. Parasitization efficiency of *T. howardii* on leaf roller pupae in different depth 1-7 cm soil was studied. The results indicated that *T. howardii* is able to parasitise leaf roller pupae up to 7 cm depth of soil.

Continuous/Other Activities

Maintenance of mother culture for production of recommended bio-control agents

S. Mahiba Helen

Objective:

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

Nucleus cultures of two pupal parasitoids of uzi fly *viz., Nesolynx thymus*, and *Tetrastichus howardii* sp.; and two predators of mealy bug (*Cryptolemous montrouzieri* & *Scymnus coccivora*) maintained. Host culture of Housefly and pink mealy bug were carried out throughout the year. Mass production of *Corcyra cephalonica* host culture for the production of egg parasitoid (*Trichogramma chilonis*) and larval parasitoid (*Bracon brevicornis*) for the management of leaf roller in mulberry.

- Supplied 130 units of *T. chilonis* and 67 units of *B. brevicornis* (one unit = 250 adults/pupae) to farmers from Karnataka, Tamil Nadu and Andhra Pradesh.

Mass production of predators, *Chrysoperla zastrowi sillemi* and *Blaptostethus pallescens* for the management of thrips in mulberry were carried out.

- Supplied 68 units (1 unit = 1000 nymphs/adults) of *B. pallescens* to Karnataka and Tamil Nadu farmers.
- Following the introduction of the predator the thrips incidence reduced from 43 per cent to below 10 per cent.
- The release of bio-control agents along with other components of IPM was effective in keeping the major mulberry pests and silkworm pest incidence below ETL in the field.

Table 12.1: Details of production of bio-control agents at CSRTI Mysuru (2019-20)

Biological control agents	Quantity Produced	Quantity sold	Total Revenue (Rs)
Nesolynx thymus pouches (1 pouch = 50 ml or 10,000 parasitoids)	1750	1724	86,200/-
Trichogramma chilonis (1 unit = 1 cc/1 card)	185	130	6500/-
Bracon brevicornis (1 unit = 250 Nos.)	80	67	3350/-
Blaptostethus pallescens (1 unit = 1000 grubs/adults)	45	38	5,700/-
Total			1,02,400/-

13. SILKWORM PATHOLOGY

On-going Research projects

ARP 01012SI: Development of a knowledge base on the silkworm diseases and pests and their management (Mar. 2020 – Feb. 2022)

Mary Josepha Shery AV, Mallikarjuna G, Amit Saha, Guneswar Kumar Churendra, Justin Kumar J, Mahiba Helen S

Objectives:

- To develop a knowledge base on silkworm diseases and pests
- A web based silkworm disease and pests diagnosis system and calendar for the silkworm disease and pest occurrence in south India will be developed
- A model for forewarning and forecasting of silkworm diseases will be developed and the forewarning will be issued regularly
- To develop a virtual interaction platform for the sericulturists and scientists on the silkworm diseases and pests and management of silkworm diseases and pests.

Prepared the Home page of the web portal. Collected papers published up to 2016 from journals *viz*., Indian Journal of Sericulture, Indian Silk, Journal of Economic Entomology, Bulletin of the Indian Academy of Sericulture, Journal of Invertebrate Pathology, The Journal of Sericulture Science Japan and International Journal of Industrial Entomology. Downloaded 300 papers available online and its doi link was embedded with the citation. Details of Research Projects carried out on Silkworm Pathology, by various research institutes, universities and departments up to 2014 were collected. Downloaded all the disease survey data from the Seri DM website and

arranged the data for analysis. Procured weather data pertaining to 6 states (Monthly average, minimum and maximum temperature and monthly rainfall data) from IMD. Scanned papers related to silkworm diseases and pests published in Indian Journal of Sericulture from 1962 to 1990 and converted to PDF.

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)

Mallikarjuna G and Madhusudhan KN

Objectives:

- To screen different commercial drugs and their analogues 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 proteins that are actively involved in viral multiplication process were identified by undertaking a thorough literature survey (Fig. 13.1). The protein sequences of the identified proteins were downloaded from NCBI database. By using *in silico* techniques the 3 dimensional structures of the major proteins involved in the PI3K-Akt pathway for the multiplication of virus such as, Akt, BmSTAT, mTOR, P143, PI3K, PIP3, RTK and VATPase proteins were developed using MODELLER 9.25. The stability of the protein structures of the 8 targeted proteins was confirmed by analyzing the Ramachandran plot through PROCHECK. Further, the docking between 93 targeted proteins and drugs was completed using AUTO DOCK VINA (Fig. 13.2). Among the 93 drugs, 10 effective drugs were short listed based on their binding affinity, number of hydrogen bonds and energy efficiency (Fig.13.3).

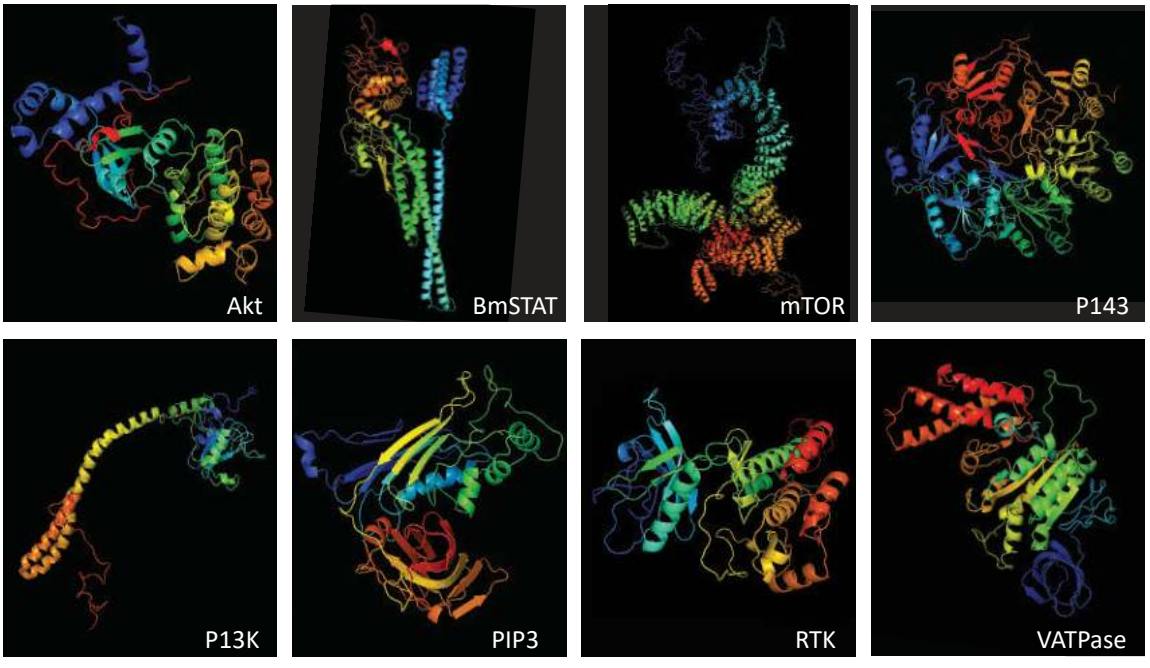
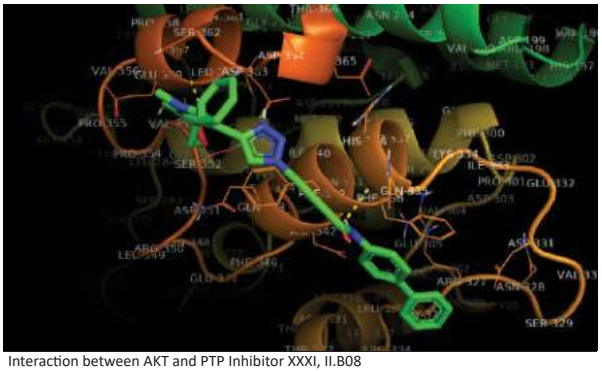
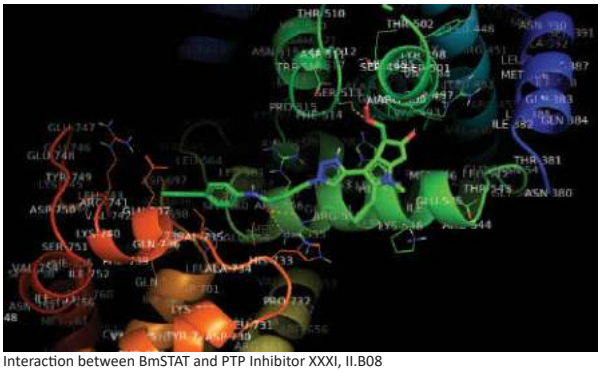


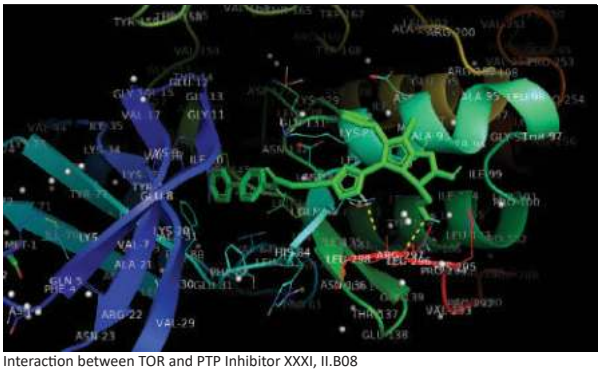
Fig. 13.1: Identified proteins involved in the viral multiplication process in the PI3K-Akt pathway



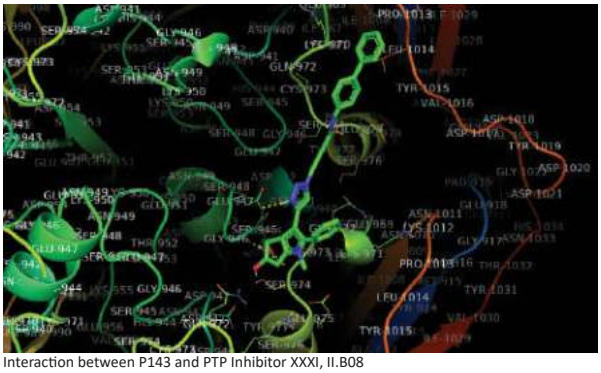
Interaction between AKT and PTP Inhibitor XXXI, II.B08
Binding Affinity: -9.8
Number: 6
Total Contacts: 14



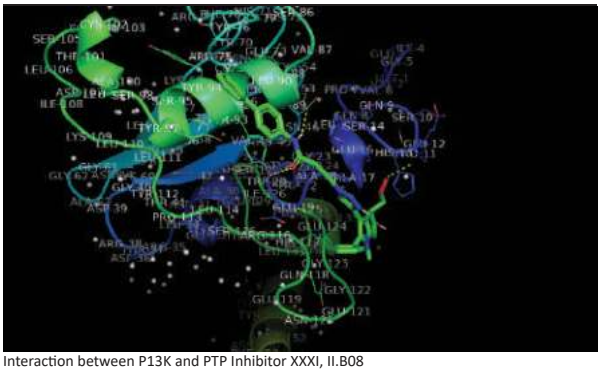
Interaction between BmSTAT and PTP Inhibitor XXXI, II.B08
Binding Affinity: -10.5
Number: 6
Total Contacts: 3



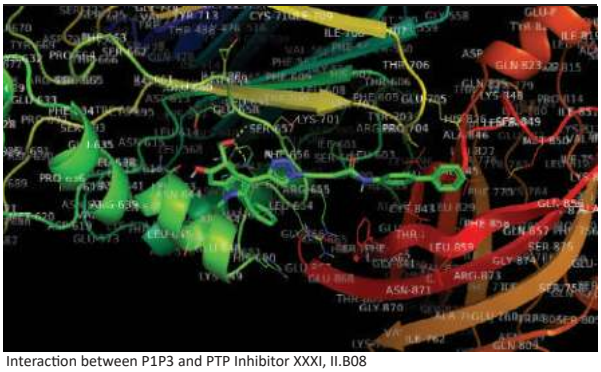
Interaction between TOR and PTP Inhibitor XXXI, II.B08
Binding Affinity: -11.7
Number: 6
Total Contacts: 14



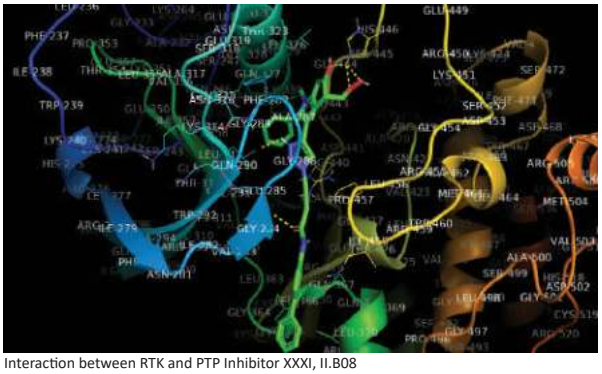
Interaction between P143 and PTP Inhibitor XXXI, II.B08
Binding Affinity: -9.5
Number: 6
Total Contacts: 11



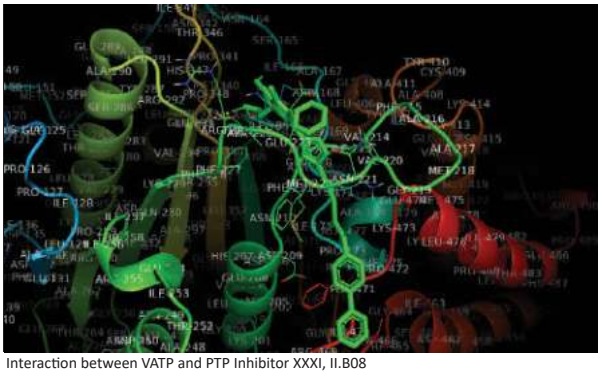
Interaction between P13K and PTP Inhibitor XXXI, II.B08
Binding Affinity: -9.2
Number: 3
Total Contacts: 11



Interaction between P1P3 and PTP Inhibitor XXXI, II.B08
Binding Affinity: -9.8
Number: 3
Total Contacts: 10



Interaction between RTK and PTP Inhibitor XXXI, II.B08
Binding Affinity: -9.6
Number: 4
Total Contacts: 12



Interaction between VATP and PTP Inhibitor XXXI, II.B08
Binding Affinity: -9.5
Number: 1
Total Contacts: 9

Fig. 13.2: Protein and drug interactions:

AKT				BmSTAT				Mtor				P143			
Drug	Binding Affinity	No. of Hydrogen bonds	Total Contacts	Drug	Binding Affinity	No. of Hydrogen bonds	Total Contacts	Drug	Binding Affinity	No. of Hydrogen bonds	Total Contacts	Drug	Binding Affinity	No. of Hydrogen bonds	Total Contacts
82.PTP Inhibitor	-9.8	3	14	70.Ritonavi	-10.8	3	12	82.PTP Inhibitor XIX	-11.7	6	14	72.Saquin	-10	4	14
7.Baloxavir	-9.3	2	3	82.PTP Inh	-10.5	6	13	78.LY 294002	-10.2	0	9	7.Baloxavi	-9.7	2	4
72.Saquinavir	-9.3	4	6	91.PIK-294	-10.5	4	13	87.GSK 1059615 sod	-10.1	1	7	14.Doluteg	-9.5	2	7
36.Nelfinavir	-9.2	3	13	87.GSK 105	-10.3	2	7	47.Remdesivir	-9.9	2	7	70.Ritonav	-9.5	1	3
49.Rilpivirine	-9.1	1	10	72.Saquina	-10.1	4	17	72.Saquinavir	-9.8	4	17	82.PTP Inh	-9.5	3	10
47.Remdesivir	-9	8	19	81.PI 3-KPD	-9.5	1	7	18.endoxudin	-9.6	3	13	29.Indinav	-9.4	4	8
70.Ritonavir	-9	5	11	7.Baloxavi	-9.1	1	3	56.Tipranavir	-9.2	2	11	91.PIK-294	-9.4	6	11
83.AS604850	-8.9	1	7	8.Boceprev	-9.1	6	10	12.Delavirdine	-9.1	5	10	46.Raltegr	-9.2		
91.PIK-294	-8.9	6	11	29.Indinavi	-9.1	4	16	43.Pleconaril	-9.1	1	12	81.PI 3-KP	-9	3	6
78.LY 294002	-8.8	0	7	31.Letermo	-8.9	5	11	67.Imunovir	-9.1	6	12	36.Nelfina	-8.7	4	11
29.Indinavir	-8.7	2	17	73.Telaprev	-8.9	2	13	91.PIK-294	-9	4	8	56.Tipran	-8.7	3	9
33.maraviroc	-8.7	5	14	43.Plecona	-8.8	7	12	1.Abacavir	-8.8	4	10	73.Telapre	-8.7	6	10
43.Pleconaril	-8.6	2	9	66.Daclata	-8.8	5	14	86.CZC24832	-8.8	3	9	69.Lopinav	-8.6	4	9
73.Telaprevir	-8.6	4	10	33.maravir	-8.6	0	10	79.Akt Inhibitor XVIII	-8.7	1	8	8.Boceprev	-8.5	6	13
80.PI 3-K_ Inhib	-8.6	3	8	20.Etravirir	-8.5	5	10	37.Nevirapine	-8.6	1	7	15.Doravir	-8.4	6	7
66.Daclatasvir	-8.4	6	11	46.Raltegra	-8.5	5	10	70.Ritonavir	-8.6	5	11	51.Sofosbu	-8.4	7	12
87.GSK 1059615	-8.4	3	8	11.darunav	-8.3	5	14	85.AS-252424	-8.6	3	7	60.Vicrivir	-8.4	4	7
46.Raltegravir	-8.3	8	11	19.entecavi	-8.3	11	12	14.Dolutegravir	-8.5	1	5	66.Daclatz	-8.4	5	10
85.AS-252424	-8.3	2	6	36.Nelfinav	-8.3	5	14	28.Imiquimod	-8.5	2	12	84.AS6052	-8.4	4	6
44.Podofilox	-8.2	2	8	60.Vicrivirc	-8.3	0	10	66.Daclatasvir	-8.4	4	11	33.maravi	-8.3	1	7
68.Docosanol	-8.2	5	15	64.Zanamiv	-8.3	10	12	81.PI 3-KPDK-1 Inhib	-8.3	2	4	75.ampligi	-8.3	9	11
79.Akt Inhibitor	-8.2	2	7	89.S14161	-8.3	6	13	83.AS604850	-8.2	1	4	31.Letermc	-8.2	2	8
81.PI 3-KPDK-1	-8.2	3	9	78.LY 2940	-8.2	1	6	7.Baloxavir	-8.1	0	6	47.Remdes	-8.2	10	14
55.Tenofovir ala	-8.1	10	17	85.AS-2524	-8.2	3	5	29.Indinavir	-8.1	3	14	11.daruna	-8.1	3	6
60.Vicriviroc	-8	1	12	14.Dolutegr	-8.1	4	8	46.Raltegravir	-8.1	7	10	43.Plecona	-8.1	5	12
69.Lopinavir	-8	2	13	56.Tiprana	-8.1	3	4	49.Rilpivirine	-8.1	4	10	68.Docosa	-8.1	3	10
88.PF-04691502	-7.9			69.Lopinav	-8.1			84.AS605240	-8.1			86.CZC248	-8.1		
92.DNA-PK Inhib	-7.9			28.Imiquim	-8			16.Efavirenz	-7.9			87.GSK 10	-8		

PI3K					PIP3				RTK				V.ATPase			
Total Contacts	Drug	Binding Affinity	No. of Hydrogen bonds	Total Contacts	Drug	Binding Affinity	No. of Hydrogen bonds	Total Contacts	Drug	Binding Affinity	No. of Hydrogen bonds	Total Contacts	Drug	Binding Affinity	No. of Hydrogen bonds	Total Contacts
14	70.Ritonav	-10.1	1	10	70.Ritonav	-10.2	4	9	70.Ritonav	-10.7	3	13	91.PIK-294	-10.1	5	13
4	81.PI 3-KP	-9.4	3	9	82.PTP Inh	-9.8	5	10	91.PIK-294	-10.2	4	10	82.PTP Inh	-9.5	1	9
7	56.Tiprana	-9.3	5	16	85.AS-252	-9.7	5	11	82.PTP Inh	-9.6	4	12	70.Ritonav	-9.4	2	11
3	7.Baloxavi	-9.2	2	6	91.PIK-294	-9.4	6	11	7.Baloxavi	-9.4	3	9	81.PI 3-KP	-9.1	1	9
10	31.Letermc	-9.2	4	10	29.Indinav	-9.1	3	11	72.Saquin	-9.4	4	11	29.Indinav	-8.9	3	17
8	82.PTP Inh	-9.2	3	11	36.Nelfina	-9	5	16	78.LY 2940	-9.4	3	11	7.Baloxavi	-8.6	3	8
11	91.PIK-294	-9.1	2	10	87.GSK 10	-8.8	6	10	87.GSK 10	-9.4	6	12	14.Doluteg	-8.5	4	7
	29.Indinav	-9	0	15	66.Daclatz	-8.7	5	9	85.AS-252	-8.9	3	10	17.Elvitegr	-8.5	4	13
6	33.maravi	-8.9	1	10	75.ampligi	-8.6	9	10	68.Docosa	-8.8	6	17	66.Daclatz	-8.5	6	17
11	72.Saquin	-8.9	3	13	60.Vicrivir	-8.5	2	6	8.Boceprev	-8.7	5	13	68.Docosa	-8.5	4	19
9	36.Nelfina	-8.8	5	15	78.LY 2940	-8.5	1	7	44.Podofil	-8.7	4	9	88.PF-046	-8.5	6	8
10	66.Daclatz	-8.8	3	10	46.Raltegr	-8.4	3	8	46.Raltegr	-8.7	4	11	33.maravi	-8.4	0	7
9	47.Remdes	-8.5	5	11	7.Baloxavi	-8.3	2	5	56.Tipranu	-8.7	3	10	56.Tipranu	-8.3	5	15
13	12.Delavir	-8.4	2	8	68.Docosa	-8.3	2	12	92.DNA-PK	-8.7	0	4	46.Raltegr	-8.2	5	12
7	8.Boceprev	-8.2	3	13	72.Saquin	-8.3	6	15	31.Letermc	-8.6	2	11	47.Remdes	-8.2	7	15
12	69.Lopinav	-8.2	5	15	33.maravi	-8.2	1	12	33.maravi	-8.6	2	6	31.Letermc	-8.1	1	7
7	73.Telapre	-8.2	6	13	69.Lopinav	-8.2	4	12	36.Nelfina	-8.6	7	14	72.Saquin	-8.1	2	7
10	78.LY 2940	-8.2	2	9	14.Doluteg	-8.1	4	8	66.Daclatz	-8.6	2	5	51.Sofosbu	-8	4	9
6	60.Vicrivir	-8.1	2	9	47.Remdes	-8.1	8	14	51.Sofosbu	-8.5	6	12	86.CZC248	-7.9	4	8
7	87.GSK 10	-8.1	3	5	81.PI 3-KP	-8.1	3	8	60.Vicrivir	-8.5	2	6	87.GSK 10	-7.9	1	9
11	22.Fosamp	-8	5	15	12.Delavir	-7.9	6	9	83.AS6048	-8.5	4	12	12.Delavir	-7.8	5	13
8	68.Docosa	-8	5	10	51.Sofosbu	-7.9	7	12	73.Telapre	-8.3	2	7	36.Nelfina	-7.8	1	12
14	15.Doravir	-7.9	2	5	56.Tiprana	-7.9	7	16	84.AS6052	-8.3	6	9	49.Rilpivir	-7.8	3	7
6	14.Doluteg	-7.8	2	6	11.daruna	-7.8	4	11	14.Doluteg	-8.2	3	5	60.Vicrivir	-7.8	1	8
12	11.daruna	-7.7	4	11	5.amprena	-7.7	3	9	29.Indinav	-8.2	5	14	79.Akt Inhi	-7.8	1	5
10	16.Efavirer	-7.7	3	4	15.Doravir	-7.7	6	7	30.lamivu	-8.2	5	6	11.daruna	-7.7	4	13
	88.PF-046	-7.7			31.Letermc	-7.6			75.ampligi	-8.2			73.Telapre	-7.7		
	51.Sofosbu	-7.6			83.AS6048	-7.5			81.PI 3-KP	-8.2			78.LY 2940	-7.7		

Fig. 13.3: Details on the molecular docking between different proteins and drugs

Continuous/Other activities:

Silkworm Disease Monitoring in South Indian States

Objectives:

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

Periodical survey on disease incidence was conducted in BSFs and cluster areas in southern states and data revealed that the average disease incidence was 0.75%, 0.53% and 0.25% for grasserie, flacherie and muscardine respectively. In Chebrolu cluster of Andhra Pradesh, grasserie incidence recorded was 2.57%, flacherie incidence 3.55% and muscardine incidence 0.34%. The grasserie incidence in Amaravati and Satara in Maharashtra was 0.82% and 0.05% respectively whereas in Nanded no grasserie disease incidence was recorded. However, the flacherie incidence was recorded as 0.32% and 0.02% in Amaravati and Nanded respectively. The muscardine incidence was reported only from Amaravati. In Tamil Nadu data collected from Thenkasi and Dindigul shows 0. 04 % and 0.02% grasserie, 0.19 %and 0.39% flacherie and 0.84 % and 0.47% of muscardine respectively.

OST Programme: Validation of the M-LAMP technology in Mulberry and *Vanya* sector (April 2020-March 2022)

Mallikarjuna G and Mary Josepha Shery AV

Objective:

- To validate the technology in Mulberry, Tasar, Eri and Muga silkworms

Table 13.1: Validation of the M-LAMP technology at different institutes

Name of the Institute/ Center	Target	No. of Samples	No of +ve Samples		+ve samples in both methods
			M-LAMP assay	Microscopy	
P4 BSF, Hassan	500	395	-	-	-
P3 BSF Mysuru	500	390	02	-	-
CSRTI, Berhampore	500	500	03	05 +ve	03
CSRTI, Pampore, RSRS, Dehradun	500	280	56	-	-
CTRTI, Ranchi,	500	183	174	182 +ve	170
BSMTC, Chennuru		317	135	94 +ve	32
CMERTI, Lahdoigarh	1000	*	*	*	*
Total	3500	2065	370	281	205

*Due to COVID-19 pandemic could not conduct the work at CMERTI, Lahdoigarh

Auxiliary Works

a. Maintenance of the pathogens

Maintained the BmDNV, BmIFV and BmNPV viral stocks, pathogenic bacteria viz., *Staphylococcus aureus, Streptococcus faecalis, Bacillus thuringiensi*s and *Serratia marcescens* and fungal pathogens *Beauveria bassiana* and different strains of microsporidia. Sub culturing of the bacteria and fungal pathogens and re-inoculation of

the viruses and microsporidia were done periodically. Virulence of all the pathogens tested periodically as per the procedure.

b. Survey of the incidence of BmDNV

Conducted survey of incidence of BmDNV in H. D. Kote in Mysuru district, Karnataka and Bagalur in Krishnagiri District, Tamil Nadu for two seasons. The disease incidence with typical symptoms of viral flacherie was 0.95% in the month of May 2020 in H.D. Kote. There was no incidence during the month of October 2020. The incidence was 1.0% in Bagaloor village of Krishnagiri district during the same period.

c. Field Problems Resolved

Resolved 24 field problems related to silkworm diseases and provided technical guidance to the farmers for proper disease management. Follow up action was also done, by contacting the farmers. Inspected the farmer's field.

d. Sensitization of stakeholders

25 farmers were sensitized on disease management aspects in silkworm rearing

e. Pebrine monitoring

Conducted the 20th meeting of Pebrine Monitoring Committee at CSRTI, Mysuru. Director CSRTI, Mysuru chaired the meeting. Director NSSO and the team leaders of all BSFs attended the meeting virtually. Further, Pebrine monitoring at Bivoltine and multivoltine breeding laboratories, P4 BSF Hassan, P3 BSF Mysuru and P2 Farm Ambuga (DoS) were conducted by the scientists of Silkworm Pathology.

f. Quality analysis

Issued 18 quality analysis reports for the different disinfectants and bed disinfectants developed by the Institute.

14. POST COCOON EVALUATION

Shivakumar M Hukkeri & Chandra Shekar MN

A total of 479 cocoon lots were test reeled from the main institute: 330 cocoon lots from extension wings of CSRTI units: 77 lots for mono cocoon assessment: 23 cocoon lots tested by cold reeling: 30 cocoon lots were tested for degumming loss %.

Table 14.1: Cocoon lots received from CSRTI, Mysuru and other centers

#	Division/Unit	Cocoon lots
1	MBL	317
2	BBL	52
3	SWG	99
4	SWP	11
5	RSRS, Kodathi	105
6	RSRS, Ananthpur	75
7	RSRS, Chamarajnagar	56
8	RSRS, Salem	64
9	REC, Chitradurga	30
	Total	809

15. SERICULTURE ENGINERING

Ongoing Research Projects

MFM 01020-CN: Development of artificial intelligence empowered multisensory approach for gender classification and separation of silkworm cocoons (Dec. 2020 - Nov. 2021) [in Collaboration with NIE-Mysuru]

Shivakumar M Hukkeri, Madhusudhan KN, Nitin KS (NIE-Mysuru)

Objectives:

- To develop an appropriate tool for gender identification in pupae stage.
- To develop an appropriate tool for non-destructive gender classification in cocoon stage.

Execution MoU with NIE and transfered fund to NIE during the last week of Jan 2021. As proposed, a JRF has been appointed at NIE. A thorough literature survey on gender classification tools was done. A new tool towards gender classification was identified and standardized it with mulberry silkworm pupae .

CED 07005-MI: Development of an Apparatus to estimate the reelability of cocoons (Jul. 2018 - Apr. 2020) [in Collaboration with CSRTI-Bengaluru]

Sangappa N Shillin*, Prakash N Bhat*, Hiremath SA*, Manthira Moorthy S, Shivakumar M Hukkeri

*CSTRI-Bengaluru

Objectives:

- Study the chemistry behind the spectrophotometric analysis of cocoon reelability using sericine dissolution
- Study the sericin dissolved water by Nephelometric Turbidity Units (NTU)
- Development of an apparatus to estimate the reelability of the silkworm cocoons
- Development of an sample preparation unit
- Validation & optimization of apparatus and its output results

CSTRI Bangalore developed an apparatus to estimate the reelability of mulberry silkworm cocoons . Validation of the equipment will be done at CSRTI, Mysuru.

Pilot Studies

Design, development and fabrication of horizontal cocoon harvesting machine for plastic collapsible mountages (Mar. 2020 - May 2020 [Extn. Up to Jul. 2020]) [Approval No. CSB/CSRTI/PMCE/Pilot Studies/2020-21/84 dtd. 04.07.2020]

Shivakumar M Hukkeri, Madhusudhan KN and Chandrashekhar MN

Objectives:

- Development of harvesting machine suitable for exclusively seed cocoons
- Better and simultaneous deflossing essential for cutting of seed cocoons

Under the study, developed three models *viz*.,

1. Horizontal Harvesting without deflossing (for reeling of cocoons)
2. Horizontal Harvesting with two rods system of deflossing
3. Horizontal Harvesting with three rods system of deflossing

Fig. 15.1: A simple and manual harvester, fixable between racks without deflossing

Fig. 15.2: Harvesting with three rod system of deflossing exclusively for silkworm seed cocoons

Fig. 15.3: Harvesting with two rod system of deflossing for both seed and reeling **cocoons**

The newly developed machines were demonstrated at BBL, CSRTI, Mysuru and P3 BSF, NSSO, Mysuru. In one hour, cocoons from 150 to 170 plastic mountages (100 dfls) can be harvested. One machine can harvest 450-600 kg cocoons in a day. Three workers are required for harvesting the cocoons with machine. The harvesting cost of the cocoons with machine is worked out to be Rs. 5 per kg of cocoons, against manual harvesting, which costs Rs. 10-15 per kg. The cost of the equipment is worked out to be Rs.25,000/-.

Design & development of motor/hand operated portable deflossing machines suitable for laboratory use (Aug. 2020 - Nov. 2020 [Extn. up to Jul. 2020]) [Approval No. CSB/CSRTI/PMCE/Pilot Studies/2020-21/134 dtd. 25.08.2020]

Shivakumar M Hukkeri, Madhusudhan KN and Chandrashekhar MN

Objectives:

- Design & Development of different types of motor/hand operated cocoon deflossing machine fitted on trolley with wheels suitable for the laboratory uses/small quantity /cellular bed rearing houses. One machine using rods another cylinder with emery sheeting

Two different types of machines are developed. One is with rod system and another with cylinder system with emery sheeting. The two machines developed under the study are quite handy and can be fitted on any table or trolley. Hand operating machine is provided in the absence of power. The cost of the equipment is worked out to be Rs.15,000/-.

Fig. 15.4: Deflossing machine with two rods mounted on trolley with wheels

Fig. 15.5: Deflossing machine with cylinder and emery paper mounted on trolley with wheels

Continuous/Other Activities

- Technical support to the farmers was provided as and when required in the field of sericulture mechanisation.
- Two equipments - one tray washing machine and one dusting machine worth 1.50 Lakh were manufactured and supplied.

- License of three equipments for commercial production was renewed viz., Leaf chopping machine, Cocoon harvesting machine, Battery operated duster.
- More than one thousand farmers visited the section and they were sensitized on mechanization in sericulture.

16. CAPACITY BUILDING AND TRAINING

Purushotham S, Anuradha H Jingade and Geetha GS

A total of 2032 persons were trained under various training programmes including CBT and NBT for the year 2020-21 from various fields such as officials from DOS, sericulture farmers, young entrepreneurs, sericulture start up trainees, researchers, employment seekers on compassionate ground and students. Under CBT programme, conducted two batches of Intensive Bivoltine Training and two batches of STEP trainings. Under NBT 18 batches and under SEED Act 10 batches were also conducted. A total of 67 trainees under CBT, 132 under NBT and 67 trainees under SEED Act were trained. Under Farmers Training Programme 1,766 farmers were trained by the nested units through Sericulture Resource centres.

Table 16.1: Details of Capacity Building and Training (CBT) Programmes conducted at CSRTI-Mysuru & 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	2	40	2	28
1.2	Farmers Skill Training	50	1100	67	1136
1.3	MDP under STEP	2	30	2	39
1.4	Sericulture Resource Centres (SRCs)	5	400	26	630
1.5	Need Based Training Programmes	2	40	8	27
2	Non-CBT: Training programme funded by agencies other than CSB	12	250	18	132
2.1	Training on Seed Act	2	40	2	40
	Total	73	1860	125	2032

Table 16.2: Details of training programmes conducted at CSRTI Mysuru

#	Name of training	Area of Training	Date		No of Trainees
			From	To	
1	NBT	ITBS	25.09.2020	23.12.2020	2
2	NBT	Awareness programme[1]	29.09.2020	03.10.2020	1
3	NBT	ITBS	05.10.2020	02.01.2021	1
4	NBT	IBT	07.10.2020	10.11.2020	3
5	NBT	ITBS	16.11.2020	13.02.2021	4
6	NBT	ITBS	25.11.2020	22.02.2021	1
7	NBT	IBT	03.12.2020	06.01.2021	6
8	SEED ACT	Refresher	29.09.2020	05.10.2020	5

#	Name of training	Area of Training	Date		No of Trainees
			From	To	
9	SEED ACT	Refresher	29.10.2020	04.11.2020	8
10	SEED ACT	Refresher	23.11.2020	29.11.2020	6
11	SEED ACT	CCRC (90 days)	02.12.2020	01.03.2020	22
12	NBT	Virtual visit	14.07.2020	14.07.2020	54
13	SEED ACT	Refresher	14.12.2020	20.12.2020	1
14	CBT	STEP	18.12.2020	19.12.2020	19
15	SEED ACT	Refresher	02.01.2021	08.01.2021	1
16	SEED ACT	Refresher	11.01.2020	17.01.2021	4
17	CBT	STEP	19.01.2021	20.01.2021	20
18	NBT	Awareness Prog[2]	20.01.2021	24.01.2021	19
19	NBT	ITBS	25.01.2021	24.04.2021	1
20	CBT	IBT	28.01.2021	03.03.2021	16
21	NBT	IBT	28.01.2022	03.03.2022	6
22	SEED ACT	Refresher	01.02.2021	07.02.2021	1
23	NBT	Awareness Prog[3]	11.02.2020	20.02.2021	22
24	NBT	Awareness Prog[4]	17.02.2021	22.02.2021	3
25	NBT	IBT	22.02.2021	28.02.2021	4
26	CBT	IBT	22.02.2022	28.02.2022	12
27	SEED ACT	Refresher	22.02.2021	01.03.2021	1
28	NBT	Awareness Prog[5]	03.03.2021	08.03.2021	2
29	NBT	Awareness Prog[6]	04.03.2021	13.03.2021	1
30	NBT	Awareness Prog[7]	16.03.2021	20.03.2021	1
31	NBT	Awareness Prog[8]	18.03.2021	20.03.2021	1
32	SEED ACT	CCRC (90 days)	15.03.2021	12.06.2021	18
33	Student Project	Internship/Project work	1.01.2020	28.02.2021	52
		Total			318

[1]Production of Bio control agents-5 days; [2] UP farmers-5 days; [3]Chawki rearing for MH farmers-10 days; [4]SW Disease Management-5 days; [5]Production of Bio control agents-5 days; [6]Chawki rearing-10 days; [7]Mulberry and Silkworm Pest Management-5 days; [8]Soil analysis and mulberry cultivation-3 days

Table 16.3: Unit wise details of Farmers Skill Training (FST) and SRC Training during 2020-21

#	Unit	Annual Target				Achievement			
		FST		SRC		FST		SRC	
		Physical (nos)	Benef. (nos)	Physical (nos)	Benef. (nos)	Physical (nos)	Benef. (nos)	Physical (nos)	Benef. (nos)
1	RSRS Salem	12	280	3	200	18	305	20	490
2	RSRS Kodathi	07	150	2	200	09	150	6	140
3	RSRS Ananthapur	13	300	-	-	16	285	NA	NA
4	RSRS Ch'anagar	02	40	-	-	02	40	NA	NA
5	RSRS Mulugu	06	150	-	-	09	159	NA	NA
7	REC Parbhani	02	30	-	-	02	32	NA	NA

#	Unit	Annual Target				Achievement			
		FST		SRC		FST		SRC	
		Physical (nos)	Benef. (nos)	Physical (nos)	Benef. (nos)	Physical (nos)	Benef. (nos)	Physical (nos)	Benef. (nos)
8	REC Baramathi	02	30	-	-	02	30	NA	NA
9	REC Aurangabad	03	75	-	-	06	90	NA	NA
10	REC Amaravathi	02	30	-	-	02	30	NA	NA
11	REC Hoshangabad	01	15	-	-	01	15	NA	NA
Total		50	1100	5	400	67	1136	26	630

Table 16.4: State wise details of CBT and NBT trainings conducted during 2020-21

#	State	CBT (Nos)	Non-CBT (Nos)
1	Tamil Nadu	804	00
2	Karnataka	389	68
3	Telangana	159	05
4	Andhra pradesh	292	03
5	Maharashtra	189	22
6	Madhya Pradesh	27	00
7	Uttarapradesh	00	73
8	Kerala	00	01
	Total	1860	172

Commercial Chawki Rearing Training Programme for potential entrepreneurs under SEED Act

A total of 40 persons from Karnataka were trained including 7 women for establishing CRC for 90 days. 26 Commercial CRC owners were also trained for renewal of existing registration as per the SEED Act.

Commercial chawki rearing activity

During the year, a total of 56,550 dfls were chawki reared and distributed to 426 rearers and generated revenue of Rs. 5,65,550/- towards the cost of Chawki charges.

Table 16.5: Brushing details of CRC during 2020-21

Month	Dfls distributed	No. of farmers	Cocoon Yield/100 dfls
Apr. 20	Nil	Nil	-
May	4300	31	76.75
Jun.	6950	47	69.95
Jul.	7050	49	52.17
Aug.	5450	43	61.52
Sep.	6600	47	53.91
Oct.	5450	40	62.71
Nov.	3200	26	68.80
Dec.	4650	38	64.01
Jan. 21	3850	32	75.11
Feb.	3750	31	82.51
Mar.	5300	42	78.74
Total	56550	426	62.18

Feedback evaluation

Feedback evaluation was conducted for few training programmes after completion of the training through a questionnaire. The course-wise feedback of the same is tabulated below:

Table 16.6: Feedback Analysis 2020-21

Course	Training Utility Index	Training Efficiency Index	Training Facilities Index	Course Coverage Index	Training Mngt. Index	Variance
STEP-Batch-1	83.60	87.08	78.30	88.00	84.24	19.24
STEP-Batch-2	77.78	73.35	74.26	76.67	75.51	10.51
IBT	91.31	94.37	83.92	90.43	90.01	25.13
NBT	81.00	80.50	67.75	75.00	76.06	11.06

The overall training Management Index for the training program (TMI) ranged from 75.51 to 90.01% against 65% required indicating 10.51 to 25.13% 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, their knowledge level, study tour, co-ordination & co-operation and efforts of faculty and staff were most appreciated.

Technology demonstration

Sri. Karibasappa, Farmer inventor from Davanagere, Karnataka demonstrated “Solar Trap” technology for natural control of insects and pests in agriculture crops to the trainees and staff of CSRTI, Mysuru. Wolkus Technology Solutions Pvt. Ltd., Bengaluru demonstrated “Smart Farming”, AI backed intelligence and advisory for the precise irrigation management, disease management, pest management, monitor climate, whether forecast and micro climatic forecast which is being widely used in horticulture crops to the trainees and staff of CSRTI, Mysuru.

Table 16.7: Student Dissertations/Projects conducted during 2020-21

#	Name of Student Degree	Title	University/Institution to which Submitted	Name of Guide & Co-Guide
1	Indusree JR M.Sc.	Feeding of different mulberry leaf to silkworm *bombyx mori*: its effect on biochemical composition of Hemolymph	Department of Biochemistry, JSS Academy of Higher Education and Research, Mysuru	Ravindra
2	Keerthanan M M.Sc.	Screening of some defense enzymes in hemolymph of different breeds of silkworm *bombyx mori*	Dep. of Biochemistry, JSS Academy of Higher Education & Res., Mysuru	Ravindra
3	Bindu R M.Sc.	First report of pathogenic fungi S*yncephalastrum* sp. from *Bombyx mori* L.	JSS Academy of Higher Education & Research, Mysuru	Mary Josepha Shery AV
4	Ramya B M.Sc.	A comparative study of the morphology and pathogenicity of different strains of *Beauveria* and one *Isaria* species isolated from *Bombyx mori* L	Manonmaniam Sundaranar University, Rajakkamangalam 629502, Tamil Nadu	Mary Josepha Shery AV
5	Madhu kumar S M.Sc.	Candidiasis in silk worm, *Bombyx mori* L.- Isolation and pathogenicity study of the fungus	JSS Academy of Higher Education & Research, Mysuru	Mary Josepha Shery AV
6	Sharvani M M.Sc.	Pathogenicity study of S*copulariopsis sp*. isolated from silk worm, *Bombyx mori* L.	JSS Academy of Higher Education & Research, Mysuru	Mary Josepha Shery AV

#	Name of Student Degree	Title	University/Institution to which Submitted	Name of Guide & Co-Guide
7	Md Syed Uvaiz M.Sc.	Mucormycosis an emerging threat to *Bombyx mori* L. - a study on its symptoms and pathogenicity	JSS Academy of Higher Education & Research, Mysuru	Mary Josepha Shery AV
8	Yogeshwari B M.Sc.	Isolation characterization and pathogenicity study of *Fusarium verticilloides* species from *Bombyx mori* L.	JSS Academy of Higher Education & Research, Mysuru	Mary Josepha Shery AV
9	Sindhu DG M.Sc.	Analysis of genetic variations in silkworm breeds through Inter Simple Sequence Repeat markers	JSS Academy of Higher Education & Research, Mysuru	Kusuma L
10	Harshitha C M.Sc.	Genetic analysis of silkworm breeds through Simple Sequence Repeat markers	JSS Academy of Higher Education & Research, Mysuru	Kusuma L
11	Nischitha BR M.Sc.	Screening of multiviral disease resistance bivoltine silkworm breeds using SSR markers	JSS Academy of Higher Education & Research, Mysuru	Satish L
12	Sinchana M.Sc.	Impact of starvation stress in few bivoltine silkworm breeds	JSS Academy of Higher Education & Research, Mysuru	Ranjini MS
13	Suhail T M.Sc.	Studies on biochemical analysis of ten mulberry genotypes for drought-resistant traits (Relative water content, Water potential and Epicuticular wax)	JSS Academy of Higher Education and Research, Mysuru	Gayathri T
14	Chethan Kumar BG M.Sc.	Comparative physio-biochemical analysis of few mulberry genotypes for changes in carbohydrate accumulation, chlorophyll and stomatal frequency at different maturity stages of leaves	JSS Academy of Higher Education and Research, Mysuru	Gayathri T
15	Tsering Dorjee M.Sc.	Effect of soil and soil-less culture on physiological and biochemical properties of mulberry	JSS Academy of Higher Education and Research, Mysuru	Divya Singh
16	Prakrithi Kamat M.Sc.	Evaluation of growth response of two mulberry varieties in soil, sand and coco peat	JSS Academy of Higher Education and Research, Mysuru	Divya Singh
17	Usha PR M.Sc.	Comparison of growth response of two mulberry varieties in soil and sand	JSS Academy of Higher Education and Research, Mysuru	Divya Singh
18	Shifa Khanum M.Sc.	Comparison of physio-biochemical characteristics of two mulberry varieties in soil and soil-less cultivation	JSS Academy of Higher Education and Research, Mysuru	Divya Singh
19	Danamma Daddi M.Sc.	Production of Bioethanol from Mulberry shoots and silkworm excreta using *Saccharomyces cerevisiae*	Department of Microbiology, JSS Academy of Higher Education and Research, Mysuru	Thirupathaiah Y
20	Harsitha KN M.Sc.	Screening and Evaluation of Protease Producing Bacteria from Spent pupae of Silkworm, *Bombyx mori*	Department of Microbiology,JSS Academy of Higher Education and Research, Mysuru	Thirupathaiah Y

#	Name of Student Degree	Title	University/Institution to which Submitted	Name of Guide & Co-Guide
21	Jayashree SG M.Sc.	Evaluation of Bacterial Supplementation on *In-vivo* probiotic characteristics of Silkworm, *Bombyx mori*	Department of Microbiology, JSS Academy of Higher Education and Research, Mysuru	Thirupathaiah Y
22	Bhargavi TN M.Sc.	Screening for probiotic bacteria to improve the productivity in silkworm, *Bombyx mori*	Department of Microbiology, JSS Academy of Higher Education and Research, Mysuru	Thirupathaiah Y
23	Sushmita NS M.Sc., Bio Chemistry	Handmade paper making28 from mulberry fibres	Autonomous College of the University of Mysuru	Shivakumar M Hukkeri
24	Soundarya HE M.Sc., Bio Chemistry	Handmade paper making from mulberry fibres	Autonomous College of the University of Mysuru	Shivakumar M Hukkeri
25	Oshin A M.Sc., Bio Chemistry	Handmade paper making from mulberry fibres	Autonomous College of the University Of Mysuru	Shivakumar M Hukkeri
26	Akshitha DN M.Sc., Chemistry	Carbon pools and its indices in soils of mulberry garden	JSS Science & Technology University, Mysuru	Dhaneshwar Padhan
27	Dhanushree S M.Sc., Chemistry	Sulphur fractions in soils of mulberry garden	JSS Science & Technology University, Mysuru	Dhaneshwar Padhan
28	Charan Pavan V M.Sc., Chemistry	Potassium fractions in soils of mulberry garden	JSS Science & Technology University, Mysuru	Dhaneshwar Padhan
29	Sindhu G M.Sc., Chemistry	Chemical speciation of Zn in soils of mulberry garden	JSS Science & Technology University, Mysuru	Dhaneshwar Padhan
30	Harshitta S M.Sc., Chemistry	Chemical speciation of Fe in soils of mulberry garden	JSS Science & Technology University, Mysuru	Dhaneshwar Padhan
31	Shivaswamy MB M.Sc., Chemistry	Chemical speciation of Cu in soils of mulberry garden	JSS Science & Technology University, Mysuru	Dhaneshwar Padhan
32	Archana BM M.Sc., Chemistry	Chemical speciation of Mn in soils of mulberry garden	JSS Science & Technology University, Mysuru	Dhaneshwar Padhan
33	Harshitha D M.Sc., Chemistry	Evaluation of extractants for potassium availability in soils of mulberry garden	JSS Science & Technology University, Mysuru	Dhaneshwar Padhan
34	Amina A M.Sc.	Techniques for extraction, isolation and identification of bioactive compounds from silkworm *Bombyx mori* excrement	Department of Biochemistry, JSS Academy of Higher Education and Research, Mysuru	Bhuvaneswari E

35	Fariya Anjum M.Sc.	Biochemical variations in the endogenous defense mechanism of silkworm *Bombyx mori* during spinning and non-spinning conditions	Department of Biochemistry, JSS Academy of Higher Education and Research, Mysuru	Bhuvaneswari E
36	Shaeeza Anjum M.Sc.	Biochemical alterations in the carbohydrate and amino acid metabolism in spinning and non spinning silkworm *Bombyx mori*	Department of Biochemistry, JSS Academy of Higher Education and Research, Mysuru	Bhuvaneswari E
37	Arya NR Monika BM Dolma Chhuden Sherpa and Anupama C M.Sc.	Characterization of *Curvularia lunata*; a new mulberry leaf spot causing fungal pathogen in india	Department of Biochemistry MMK and SDM Mahila Maha Vidyalaya, Krishnamurthypuram, Mysuru	Arunakumar GS
38	Ranjeetha MS M.Sc.	Study on leaf quality parameters and enzymatic activities of high yielding mulberry varieties under varied nutrient management practices	Department of Biochemistry, JSS Academy of Higher Education and Research, Mysuru	Sobhana V
39	Bhavana T M.Sc.	Effect of varieties and nutrient management practices on leaf quality and enzymatic activity of Mulberry leaf	Department of Biochemistry, JSS Academy of Higher Education and Research, Mysuru	Sobhana V
40	Anusha CK M.Sc.	Evaluation of Biopolymers coating on antimicrobial properties of silk fibroin	JSS Academy of Higher Education, Mysuru	Madhusudhan KN
41	Rajesh Reddy P M.Sc.	Isolation and characterization of silver nanoparticles, conjugated silver nanoparticles with leaf extract (*Azadirachta indica)* and its antimicrobial activity	JSS Academy of Higher Education, Mysuru	Madhusudhan KN
42	Vibha S M.Sc.	Isolation and characterization of protease producing bacteria	JSS Academy of Higher Education, Mysuru	Madhusudhan KN
43	Monisha Mahesh M.Sc.	Studies on morphological, anatomical, physiological, biochemical characters and molecuklar markers in response to artificial inoculation of root rot pathogen (*Lasiodiplodia thebromae*) in mulberry	JSS Academy of Higher Education, Mysuru	Ghandhi Doss S
44	Arunkumar Hiremath	Estimation of total phenols, flavanoids and alkaloids of mulberry leaf	Sri Jayachamarajendra College of Engineering, Mysuru	Gnanesh BN
45	Monisha Patel JC	Biochemical analysis of photochemical and enzymes of six different varieities of mulberry leaves	JSS Academy of Higher Education and Research, JSS University, Mysuru	Gnanesh BN
46	Madappa BM	Genetic diversity of *Morus* species as revealed by simple sequence repeat markers	Yuvaraja's College, University of Mysuru	Gnanesh BN
47	Adhithi LH	Molecular characterisation of mulberry polyploids using SSR markers	Yuvaraja's College, University of Mysuru	Gnanesh BN
48	Sruthi S	Isolation, identification and molecular characterisation of bio control agents and pathogens associated with root rot of mulberry in Karnataka	JSS Academy of Higher Education and Research, JSS University, Mysuru	Arunakumar GS

49	Akhil Suresh S	Green biosynthesis of metal nano particles from bio control angents to manage root rot disease of mulberry	JSS Academy of Higher Education and Research, JSS University, Mysuru	Arunakumar GS

Table 16.8: Revenue generated during the year 2020-21

Particulars	Amount (Rs)
Sale of chawki worms	5,65,500
Course Fee (trainees)	4,26,500
Registration Fee (Students)	4,08,000
Sale of cocoons	19,570.00
Hostel Rentals	2,68,550
Total	16,88,120

17. SERICULTURAL EXTENSION, ECONOMICS AND MANAGEMENT

Selvaraju NG, Muthulakshmi M, Ravindra M Mattigatti, Joycy Rani Dasari (up to 23.02.2021) and Amit Saha

On-going Research projects

PPF 01017 SI: Economics of Mulberry Sericulture in South India (Nov. 2020 – Oct. 2022)

Joycy Rani D (), Amit Saha (fm 24.02.2021), Raveendra M Mattigatti and M Muthulakshmi

Objectives

- Scientific estimation of state-wise cost of mulberry cultivation & 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

Four Project Assistants (PA) were recruited. Orientation Training to the PAs were given at different sections of CSRTI-Mysuru. Schedule for collecting data on sericulture and non sericulture activities has been prepared and pre-testing has been carried out.

One District-One Product Scheme in South Zone

For implementation of Sericulture Development Project under 'One District-One Product' vision of Hon'ble Prime Minister of India, 15 districts were selected in South zone by Central Silk Board, Bengaluru in coordination with the State Department of Sericulture based on geography, climatic conditions, cropping pattern, socio-economic status of people, sericulture infrastructures available, scope for development of sericulture, *etc*.

Andhra Pradesh

1. West Godavari
2. Kadapa

Karnataka

1.Bagalkot
2. Raichur

Kerala

1. Wayanad

Madhya Pradesh

1. Jhabua

Maharashtra

1. Kohlapur
2. Thane
3. Dhule
4. Nagpur

Tamil Nadu

1. Theni
2. Pudukkottai

Telangana

1. Jogulamba Gadwal
2. Nirmal
3. Kamareddi

Cluster Promotion Programme (CPP)

The Cluster Promotion Programme (CPP) initiated during XII plan (2012-2017) is being implemented by Central Silk Board in collaboration with the Departments of Sericulture (DoS) of southern states. The programme was extended for another three years and is continued in 2020-21 also. The CPP clusters in the southern zone are monitored by CSRTI-Mysuru. The southern zone includes 26 Mega Clusters (Andhra Pradesh: 5, Karnataka: 11, Maharashtra: 2, Tamil Nadu: 6 & Telangana: 2) and 6 Clusters in non-captive area. Targets of the clusters for 2020-21 were fixed based on the farmers profile and potential. The Director, CSRTI-Mysuru is the south zone Coordinator; the heads of SEEM division and RSRS are the Nodal Officers for effective implementation of CPP. Each Cluster is directly monitored by two Cluster Development Facilitators (CDFs) nominated by Central Silk Board and State Department of Sericulture. The name and designation of the CDFs are shown in Table 17.1 & 17.2.

Table 17.1: CDFs of Cluster Promotion Programme in the Captive area for 2020-21

Clusters	CSB	DoS
ANDHRA PRADESH		
1. Atmakur (MG)		
1. Atmakur	P. Sudhakar, Sci-D, RSRS-Anantapur	Somasekhar, SO, Atmakur
2. Pathikonda	P. Sudhakar, Sci-D, RSRS-Ananthapur	K. Sravani, SO, TSC, Pathikonda
3. Giddalur	A. Venugopal, Sci-D, REC-Rayachoty	Rama Rao, ADS, Markapur
2. Chebrole (MG)		
1. Bhimadole	T. V. S. Srinivasa Rao, Sci-D, REC-Eluru	K. Ranga Rao, ASO, TSC, Bhimadole
2. Chebrole	T. V. S. Srinivasa Rao, Sci-D, REC-Eluru	K. Appa Rao, SO, TSC, Chebrolu
3. Vijayawada	T. V. S. Srinivasa Rao, Sci-D, REC-Eluru	L. K. V. D. Prasada Rao, ASO, Challapalle
3. Hindupur (MG)		
1. Hindupur	B. Vijaya Naidu, Sci-D, RSRS-Anantapur	R. Kalyani, SO, TSC, Hindupur
2. Madakasira	B. Vijaya Naidu, Sci-D, RSRS-Anantapur	S. Mehtaz Sulthana, SO, Madakasira
4. Kalyandurgam (MG)		
1. Kalyandurg	K. P. Kiran Kumar, Sci-D, RSRS- Anantapur	I. Vijay Kumar, ADS, Kalyandurg
2. Penukonda	K. P. Kiran Kumar, Sci-D, RSRS- Anantapur	K. N. Vijay Kumar, SO, Penukonda.
5. Palamaner (MG)		
1. Chittoor	B. T. Srinivas, Sci-D, REC-V. Kota (up to Jun. 2020) M. Venkatachalapathy, Sci-D, REC-Palamaner (fm Nov. 2020)	G. Babu, ADDS, Chittoor.
2. Palamaner		Shahida Begum, ADS, Palamaner
3. V. Kota		Hanumantharaya, SO, V.Kota
KARNATAKA		
1. Bangalore Rural (MG)		
Andarlahalli	M. Venkatachalapathy, Sci-D, RSRS-Kodathi (up to Oct. 2020) & S. B. Kulkarni, Sci-D, RSRS-Kodathi (fm Nov. 2020)	Sundar Raj, ADS, Chikballapura
Channarayapatna		Gayathri, ADS, (up to Dec. 2019) & Bojanna, ADS, Beerasandra (fm Jan.2020)
Gowribidanur		Muralidhar, ADS, Gowribidanur
Harohalli (B)		Prabhakar, Deputy Director M. Ramakrishna Reddy, ADS, Hosakote
Tubugere		Udaya Kumar, ADS, Doddaballapura
2. Bidar (MG)		
Aurad		B. G. Shelke, Sericulture Inspector, Aurad
Gulbarga	S. Ramesh Kumar, Sci-C, REC SU-Bidar	S. Prakash Babu, ADS, Gulbarga
Humnabad		Jaganath Palapure, ADS, Humnabad

3. Chitradurga (MG)		
Challakere	Y. Srinivasulu, Sci-D, REC-Chitradurga	K. Kenchojirao, ADS, Challakere
HB hally		Bheemappa, ADS, Kudligi
Hiryur		C. D. Usha, ADS, Chitradurga
Kudiligi		Bheemappa, ADS, Kudligi
4. Haveri (MG)		
Davanagere	Y. Srinivasulu, Sci-D, REC-Chitradurga	A. Sreeharsha, ADS, Davanagere
Haveri	G. Papaiah, STA, REC-Chitradurga	M. S. Patil, ADS, Haveri
Rannebennur	G. Papaiah, STA, REC-Chitradurga	Pujar, SEO, Ranebennur
5. Jamakhandi (MG)		
Belagavi	A Umesha, Sci-C, REC-Koppal	G. B. Mallannavara, ADS, Belagavi
Bijapur	A. P. Raghavendra, FA, REC-Koppal	B. Y. Biradar, ADS, Bijapur
Jamakhandi	A. P. Raghavendra, FA, REC-Koppal	S. M. Dheshpande, ADS, Jamakhandi
6. Kolar (MG)		
Ithandahalli	M. Noble Morrison, Sci-D, (up to Jul. 2020) & JB Narendra kumar, Sci-D, REC-Madivala (fm Aug. 2020)	S. N. Sreenivas, ADS, Bangarpet
Kurudumalai		& JB Narendra kumar, Sci-D, REC-Madivala (fm Aug. 2020)
Shapur (Kolar)		Anjaneya Gowda, DD, Kolar Manjunatha, ADS, Kolar
Sidlaghatta		Byrappa, DD, Chikballapura H. Ramakrishnappa, ADS, Sidlaghatta
Tekal		K. M. Ashwathnarayana, ADS, Malur
Yeldur		Nagaraj, ADS, Srinivasapur
7. Koppal (MG)		
Lingasugur	J. Justin Kumar, STA,REC-Koppal	S. Rajendra Kumar, ADS, Lingasugur
Shirahatti	A. Umesha, Sci-C, REC-Koppal	C. H. Mudagal, ADS, Gadag
Yelburga	A. Umesha, Sci-C, REC-Koppal	C. Anjanamurthy, DDS, Koppal
8. Maddur (MG)		
Bevuru	D. Guruswamy, Sci-D, REC SU-Maddur	D. G. Manjunath, ADS, Channapattana
Bidarakote		Madesh, SEO, TSC, Koppal
D Halasahalli		Surendra Murthy, SEO, TSC, D Halasahalli
Gajanuru		M. P. Umesh, ADS, Malavally
Toresettahalli		Madesh, SEO, I/c, TSC, Toresettahalli
9. Mysuru (MG)		
B R Koppalu	K. N. Madhusudhan, Sci-D, CSRTI-Mysuru	S. Siddaraju, ADS (in charge), K R Nagar
H D Kote		N. Mahesh Kumar Vage, ADS, S R Patna
K R Nagar		C. R. Krishna, ADS, T Narasipura
T Narsipura		C. Umesh, SEO, H D Kote
10. Ramanagara (MG)		
Banniguppe		Kumarasubramanya, ADS, Ramanagara
Doddalahalli	P. Saraswathi, Sci-D, RSRS-Kodathi	Muthuraj, ADS, Kanakapura
Harohalli (KKP)		
Kanakapura		
11. Tumkur (MG)		
Sira	H. K. Hanumantharayappa, Sci-D, RSRS-Kodathi	Sri D Mohan, ADS, Sira
Tumukur		Sri KN Srinivasaiah, ADS, Tumkur
Y.N. Hosakote		Sri R Ranganath, ADS, Pavagada

MAHARASHTRA		
1. Aurangabad (MG)		
Beed	Ramprakash Sci-D, REC-Aurangabad	Vinit pawar SDO,Beed
Jalna		Ajay mohit, SDO,Jalna
2. Satara (MG)		
Satara	Y. Humayun Sharief, Sci-D, REC-Baramati	Sanjay Shinde, SDO, Baramati
TAMIL NADU		
1. Alangeyam (MG)		
Alangeyam	S. Balasaraswathi, Sci-D, RSRS, Salem	A. Meenakshi Sundari, AIS, Alangeyam
2. Dindigul (MG)		
Dindigul	S. Rajaram, Sci-D, REC-Samayanallur	S. Megala, ADS, Dindigul
3. Gobichettipalayam (MG)		
Annur	E. Rajalakshmi, Sci-D, REC-Gobi	N. Chandran, AIS, Annur
Dharapuram		S. Muneeswaran, AIS, Dharapuram
Gobi		M. Sangavi, IS, Gobi
Manurpalayam		M. Mythili, AIS, Manurpalayam
4. Krishnagiri (MG)		
Berigai		P. Karpagam, AIS, Berigai
Dharmapuri	K. Jhansilakshmi, Sci-D, REC-Krishnagiri	R. Ilangovan, AIS, Dharmapuri
Krishnagiri		R. Ashok, TA, Krishnagiri
5. Tenkasi (MG)		
Tenkasi	S. Mahimashanthi, Sci-D, REC-Samayanallur	K. Nishanthi, ADS, Tenkasi
6. Udumalpet (MG)		
Gudimangalam	P. Samuthiravelu, Sci-D, REC-Udumalpet	P. Geethapriya, AIS, Gudimangalam
Pollachi		R. Shobana, AIS, Pollachi
Pongalur		R. Ramesh, AIS, Pongalur
Udumalpet		T. Prabu, AIS, Udumalpet
TELANGANA		
1. Karimnagar (MG)		
Karimnagar	Vinod Kumar Yadav, Sci-C, RSRS-Mulugu	Shri.Muralidhar Reddy, ADS, Warangal.
2. Siddipet (MG)		
Siddipet	K. Praveen Kumar, Sci-D, RSRS-Mulugu	Indrasena Reddy, ADS (FAC), Siddipet
		Venkatewsarulu, SO, Janagoan
		K. Laxmaiah, ADS, Nalgonda
		S. Veera Kumar, SO, Suryapet

Table 17.2: CDFs of Cluster Promotion Programme in the Non-Captive area for 2020-21

Clusters	CSB	DoS
MADHYA PRADESH		
Hoshangabad	A. G. K. Daniel, Sci-D, REC- Hoshangabad	Lal Singh Narganwa, Field Officer, Betul Navneet Gour, JSI, Hoshangabad Jagdish Vishwakarma, Field Op., Hoshangabad
MAHARASHTRA		
Akola	R. V. Kushwaha, Sci-D, REC-Amravati	A. L. More, SDO, Akola
Buldana	R. V. Kushwaha, Sci-D, REC-Amravati	S. P. Phadke, SDO, Buldana

Clusters	CSB	DoS
Nanded	A. J. Karande, Sci-D, REC-Parbhani	A. V. Wakure, SDO, Nanded
Osmanabad	A. L. Jadhav, Sci-B, REC SU-Osmanabad	S. B. WARAT, SDO, Osmanabad
Wardha	R. V. Kushwaha, Sci-D, REC-Amravati	P. S. Padvi, SDO, Wardha
Telengana		
Zaheerabad	B.Srinath, Sci-D, REC- Vikarabad	Indrasena reddy, SO, Zaheerabad
Kerala		
Palakkad*	K.Sarala, Sci-D, REC- Palakkad	Sreekumari, ASO, Palakkad

* Up to August 2020

Performance of Clusters

During the year, south zone clusters recorded a production of 5006.60 MT bivoltine raw silk, which is 86.02% of set target of 5819.94 MT.

Table 17.3: Raw silk production in south zone clusters

Year	Target (MT)	Production (MT)	Achievement (%)
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
Total	28415.73	28968.07	101.94

Table 17.4: Bivoltine raw silk production (MT)

State	Target (MT)	Production (MT)	Achievement (%)
Karnataka	2161.00	1763.17	81.59
Andhra Pradesh	1507.69	1276.62	84.67
Telangana	142.15	90.82	63.89
Tamil Nadu	1607.31	1358.14	84.50
Maharashtra	233.50	340.09	145.65
Non-Captive	168.29	177.76	105.62
Total	5819.94	5006.60	86.02

Crop Performance

A total of 449.75 lakhs dfls were distributed to the farmers in the south zone against the target of 553.31 lakhs with an achievement of 81.28%. A total of 32560.71 MT bivoltine cocoons were produced with an average cocoon yield of 73.83 kg/100 dfls.

Table 17.5: State wise dfls distribution - target vs achievement

#	State	Dfls Target Lakhs)	Silkworm crops (Nos.)	Dfls brushed (Lakhs)	Dfls harvested	Cocoon Produced (kg)	Achievement (%)
1	AP	140.00	47025	115.97	11099510	8298005.00	82.84
2	KA	216.10	99657	167.75	16686885	11460634.80	77.63
3	MH	23.35	11000	27.92	2818200	2210562.40	119.56
4	TN	139.30	62727	111.38	10906188	8827924.00	79.95
5	TS	13.20	2946	8.80	823950	590408.00	66.67
6	Non-Capt.	21.90	9425	17.94	1768970	1173185.34	84.00
	Total	553.85	232780	449.76	44103703	32560719.54	81.28

Table 17.6: State wise average cocoon yield/100 dfls (kg) in captive & non-captive clusters

#	State	XI Plan	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
1	AP	61.56	66.69	66.68	69.93	70.68	73.47	76.38	75.46	74.76
2	KA	62.73	65.83	65.23	66.74	67.49	67.62	66.05	66.37	68.68
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
6	TN	71.13	74.46	75.54	77.86	78.33	80.32	79.59	79.78	80.94
7	TS	-	-	65.08	66.11	70.62	70.89	68.08	67.35	71.65
	N-C	-	-	-	-	-	-	-	68.79	66.32
	Average	64.98	68.45	68.27	70.16	71.33	72.15	71.79	72.62	73.83

Table 17.7: Performance of Mega clusters in Andhra Pradesh for the year 2020-21

Mega cluster	Dfls Annual Target (Lakhs)	Dfls brushed	Dfls Achv. (%)	Cocoon yield (MT)	Yield/ 100 dfls (kg)	Rate/ kg (Rs)	New plantation	
							Farmers (No.)	Area (ac)
Atmakur	15.60	1026455	65.80	661777.0	72.71	295.18	242	343.50
Chebrolu	13.90	1080450	73.25	745663.0	70.05	274.02	134	312.30
Hindupur	37.10	3179400	85.70	2281838.0	73.17	300.63	1324	1550.00
K'durgam	18.70	1795400	96.01	1209703.0	72.37	278.33	574	850.00
Palamaner	54.70	4515245	82.55	3399024.0	78.30	306.31	1021	1657.80
Total/Avg	140.00	11596950	82.84	8298005.0	74.60	290.89	3295	4713.60

Table 17.8: Performance of Mega clusters in Karnataka for the year 2020-21

Mega cluster	Dfls Annual Target (Lakhs)	Dfls brushed	Dfls Achv. (%)	Cocoon yield (MT)	Yield/ 100 dfls (kg)	Rate/ kg (Rs)	New plantation	
							Farmers (No.)	Area (ac)
B'lore Rural	12.00	827546	68.96	589596.00	68.98	331.68	457	562.40
Bidar	10.00	572700	57.27	388797.00	66.93	278.61	215	323.83
Chitradurga	35.05	2569655	73.31	1770675.00	69.11	306.21	546	885.16
Haveri	25.70	1846044	71.83	1297380.00	68.85	306.39	248	389.50
Jamkhandi	19.60	1421382	72.52	965426.00	68.82	278.92	670	860.15
Kolar	29.40	2284300	77.70	1448293.00	64.73	328.88	1170	780.36
Koppal	13.25	922825	69.65	627877.08	68.73	281.78	251	396.69

Mega cluster	Dfls Annual Target (Lakhs)	Dfls brushed	Dfls Achv. (%)	Cocoon yield (MT)	Yield/ 100 dfls (kg)	Rate/ kg (Rs)	New plantation	
							Farmers (No.)	Area (ac)
Mysuru	18.10	1687770	93.25	1113388.00	66.75	313.02	152	242.00
Ramnagara	13.05	1352174	103.61	989218.00	77.71	329.67	1163	1185.85
Tumkur	26.60	1917240	72.08	1323764.00	66.28	317.14	189	461.34
Total/Avg	216.10	16775124	77.63	11460634.08	68.68	308.34	5416	6469.53

Table 17.9: Performance of Mega clusters in Maharashtra for the year 2020-21

Mega cluster	Dfls Annual Target (Lakhs)	Dfls brushed	Dfls Achv. (%)	Cocoon yield (MT)	Yield/ 100 dfls (kg)	Rate/ kg (Rs)	New plantation	
							Farmers (No.)	Area (ac)
A'gabad	17.35	2190700	126.27	1731355.0	79.03	298.67	520	545.00
Satara	6.00	601000	100.17	479207.4	76.37	267.58	74	74.50
Total/Avg	23.35	2791700	119.56	2210562.4	78.44	283.13	594	619.50

Table 17.10: Performance of Mega clusters in Tamil Nadu for the year 2020-21

Mega cluster	Dfls Annual Target (Lakhs)	Dfls brushed	Dfls Achv. (%)	Cocoon yield (MT)	Yield/ 100 dfls (kg)	Rate/ kg (Rs)	New plantation	
							Farmers (No.)	Area (ac)
Alangayam	10.60	985425	92.96	735207.0	77.63	282.92	189	318.75
Dindigul	22.30	2050235	91.94	1601885.0	80.73	286.83	372	664.80
Gobi	32.80	2632961	80.27	2144158.0	82.42	305.00	185	363.50
Krishnagiri	30.25	2146750	70.97	1752624.0	82.71	307.06	534	924.90
Tenkasi	10.35	950405	91.83	734348.0	80.49	280.00	149	288.50
Udumalpet	33.00	2371925	71.88	1859702.0	79.41	277.41	147	287.50
Total/avg.	139.30	11137701	79.95	8827924.0	80.94	289.87	1576	2847.95

Table 17.11: Performance of Mega clusters in Telangana for the year 2020-21

Mega cluster	Dfls Annual Target (Lakhs)	Dfls brushed	Dfls Achv. (%)	Cocoon yield (MT)	Yield/ 100 dfls (kg)	Rate/ kg (Rs)	New plantation	
							Farmers (No.)	Area (ac)
Karimnagar	6.60	426800	64.67	281266.0	71.44	273.64	65	172.00
Siddipet	6.60	453250	68.67	309142.0	71.85	277.08	61	158.00
Total/Avg	13.20	880,050	66.67	590408.0	71.65	275.36	126	330.00

Table 17.12: Performance of Non-captive clusters for the year 2020-21

Cluster	Dfls annual target (lakhs)	Dfls brushed	Dfls Achv. (%)	Cocoon yield (MT)	Yield/ 100 dfls (kg)	Rate/ kg (Rs)	New plantation	
							Farmers (No.)	Area (ac)
Palakkad[1]	1.20	25095	38.02	20604.00	82.10	162.50	0	0.00
Akola, Buldana, Wardha[2]	5.00	373675	74.74	262875.00	71.24	225.78	509	520.00
Nanded[2]	3.00	185500	61.83	124824.00	67.29	342.50	219	219.00
Osmanabad[2]	5.00	522250	104.45	405843.30	69.11	280.90	438	458.00
Hoshangabad[3]	3.70	382500	103.38	162424.00	52.48	260.30	0	0.00
Zaheerabad[4]	4.00	305150	76.29	196615.00	67.18	254.10	11	25.00
	21.90	1794170	84.00	1173185.30	66.32	254.35	1177	1222.00

[1]Kerala, [2]Maharashtra, [3]Madhya Pradesh, [4]Telangana

New Plantation in clusters

More emphasis was given on horizontal expansion and 12,184 farmers were motivated to plant improved mulberry varieties to the extent of 16,202.58 acres in the mega clusters and non-captive area clusters.

Table 17.13: State wise new plantation details for 2020-21

State	New plantation	
	No. of Farmers	Area (acres)
Andhra Pradesh	3295	4713.60
Karnataka	5416	6469.53
Maharashtra	594	619.50
Tamil Nadu	1576	2847.95
Telangana	126	330.00
Non-Captive	1177	1222.00
Grand Total	12184	16202.58

CPP-Meeting

CPP Review Meeting of South Zone clusters for the period from April to November 2020-21 to monitor the performance for promoting Bivoltine raw silk production, was held on 28th & 29th December 2020 at CSRTI, Mysuru through online. Dr. Pankaj Tewary, Director, CSRTI, Mysuru chaired the meeting. Officers from DoS, Karnataka. DoS, Tamil Nadu DoS, Telangana DoS, Maharashtra and DoS Andhra Pradesh participated.

***m-Kisan* portal**

A total of 96 SMS messages, covering 76200 farmers over different states were sent during the year through m-*Kisan* portal.

Continuous/Other Activities

Extension Communication Programmes (ECP)

During 2020-21 a total of 246 Extension Communication Programmes were conducted and sensitized 15,541 farmers. The main topics of ECPs covered were: wider spacing/tree mulberry, leaf roller and its control measures, awareness on use of rot fix, soil testing & its importance in mulberry cultivation, INM practices for mulberry, integrated pest management practices, disinfection & hygiene in silkworm rearing, popularization of new silkworm hybrids, demonstration of rotary mountages, mounting & spinning care, *etc*.

Table 17.14: Extension Communication Programmes conducted

ECP	Events	Farmers Sensitized
Resham *Krishimela* cum Exhibition	3	932
Farmers Field day	39	3816
Awareness programme	104	8151
Technology demonstration/ Enlightenment programmes	99	2427
Workshop/ Seminars & Conferences	1	215
Total	246	15541

Resham Krishimela

Regional Sericultural Research Station, Anantapur, AP organized a *Resham Krishimela* at Palamaneru, Chittoor District on 20.03.2021. Regional Sericultural Research Station, Salem, Tamil Nadu organized a *Resham Krishimela* cum Farmers Workshop in coordination with Department of Sericulture, Tamil Nadu at Bagalur, Krishnagiri district, on 19.02.2021 with the theme, *Grow bivoltine for sustainable income*. In coordination with the department of Horticulture and Sericulture, Govt. of Telangana, R.O., CSB, Hyderabad and RSTRS, Dharmavaram, RSRS Mulugu had organized a *Krishimela* on 28.03.2021.

Activities of units attached to SEEM Division, CSRTI-Mysuru

The performance of RECs and Sub RECs attached to SEEM Division, CSRTI-Mysuru in Karnataka, Maharashtra and Madhya Pradesh are presented in Table 17.15.

Table 17.15: Performance of RECs attached to SEEM Division, CSRTI-Mysuru

Unit	New Plantation		Dfls (No.)	Yield/ 100 dfls (kg)	Awareness Programme	Demo. of techno-logy
	Farmers (Nos)	Area (Ac)				
REC SU-Maddur (KA)	356	382.25	1373488	72.09	5	7
REC-Amaravathi (MH)	509	520.00	373675	71.24	7	4
REC-Aurangabad (MH)	520	545.00	2190700	79.0 3	7	4
REC-Baramathi (MH)	74	74.50	601000	76.37	7	4
REC-Parbhani (MH)	219	219.00	185500	67.29	4	4
REC SU-Osmanabad (MH)	438	458.0	522250	69.11	4	4
REC-Hoshangabad (MP)	-	-	382500	52.48	4	4

Organization of Virtual Workshop

A Virtual Workshop was organized on 24th February 2021, on Webex platform with the theme, ***Technologies to enhance Bivoltine Silk Production in South India*.** Scientists of CSB institutions, officials of State Sericulture Department, farmers, CRC entrepreneurs and reelers have registered and participated in the workshop. Nine scientific papers covering latest sericulture technologies were presented by subject experts of different Universities and CSB Institutions. E-certificates were issued to the participants.

***Swachh Bharat Abhiyan* Programmes**

Conducted three awareness programmes

- **Planting of tree saplings at Gopalapura village on 20.01.2021**

Tree plantation programme was conducted at Govt. High School in Gopalapura, an adopted village of CSRTI-Mysuru on 20.01.2021. It was advised to adopt a tree by every student till its establishment. Saplings of Jack fruit, Badam, Jamoon, and pongamia were planted.

- **Awareness programme at D.K. Koppal on 12.02.2021**

An awareness programme under *Swachh Bharat Abhiyan* was organized at D. K. Koppal village under K. R. Nagar Cluster on 12-02-21. 36 sericulture farmers attended the programme. The main aim of the programme is to make the country open defecation free, to provide safe and clean drinking water and create awareness among the villagers and public about waste segregation and management.

- **Awareness programme at Doddaharohalli village on 10.03.2021**

An awareness programme under *Swachh Bharat Abhiyan* was organized by CSRTI-Mysuru at Doddaharohalli village under B. R. Koppal cluster on 10.03.2021 for the benefit of Sericulture farmers and weavers. The main aim of the programme is to make the country open defecation free and keep the home and surroundings clean.

Publication of Sericulture Success Stories Vol. 2

A book titled ***Sericulture Success stories Vol. 2*** was published by incorporating 66 success stories of sericulturists from Andhra Pradesh, Karnataka, Kerala, Maharashtra, Madhya Pradesh, Tamil Nadu and Telangana. The book was released by Dr. Mahadev B Chetti, Vice-Chancellor, University of Agricultural Sciences, Dharwad and Dr. Pankaj Tewary, Director, CSRTI, Mysuru, on 23rd December, 2020 at CSRTI, Mysuru.

Visitors' Service

During the year, a total of 180 personnel visited the Institute, including farmers, students, entrepreneurs, departmental staff, *etc*.

Category	No. of Persons visited
Farmers	79
Students	80
Others	21
Total	180

18. REGIONAL SERICULTURAL RESEARCH STATION (RSRS) - KODATHI

In-charge Officers	M.G. Sabitha, Sci-D (28.02.2020 to 16-10-2020) M. Venkatachalapathy (17.10.2020 to 26.10.2020) S. B. Kulkarni (from 27-10-2020)
Scientists	06
Technical Staff	08
Administrative staff	04

Units	Total area	Mulberry acreage
RSRS-Kodathi	66.90	11.00
REC- Bidaraguppe *	7.00	2.07
REC-Chitradurga	7.00	2.41
REC-Madivala	8.00	3.50
RECSU-Koppal	8.00	1.50
Total	96.90	20.48

* Handed over to DoS on 14.06.2020

Table 18.1: Rearing performance evaluation of bivotine hybrids at RSRS Kodathi

Hybrid	Dfls	Brushing %	Actual yield (kg)	ERR by No.	ERR by wt.	SCW (g)	SSW (g)	Shell %
DHP5	20	94.47	16.92	8635	17.24			
DHR4	25	94.40	14.84	8392	15.39	1.763	0.374	21.29
G11 x G19	13	89.70	6.86	7057	15.80	1.789	0.395	22.11
MV1	8	86.80	4.00	8550	14.62	1.71	0.335	19.59
MV2	8	90.90	4.00	8806	14.21	1.614	0.325	20.14
FC1 x FC2	5	98.10	3.00	7023	12.80	1.822	0.378	20.75
RDN1	18	87.95	7.65	9140	9.54	1.440	0.24	18.33
RDN2	9.5	72.05	3.18	7815	7.32	1.501	0.277	19.09
FC1 x FC2	3	88.00	2.00	7777	14.85	1.910	0.41	21.5

Table 18.2: Evaluation of parent seed testing and generation of seed cocoon at RSRS Kodathi

Hybrid	Dfls	Brushing %	Actual yield (kg)	ERR by No.	ERR by wt.	SCW (g)	SSW (g)	Shell %
435	30	91.00	19.50	9978	17.21	1.725	0.339	19.65
437	41	93.25	26.50	9314	12.70	1.643	0.377	22.93
442	25	93.50	14.00	9301	14.79	1.59	0.365	22.93
253	8	92.52	6.10	9262	16.45	1.776	0.409	23.03
223	53	91.36	38.20	9014	15.50	1.72	0.380	22.05
26 x16	10	60.20	3.50	8909	15.93	1.788	0.378	21.13
443	15	87.70	6.00	7272	11.40	1.568	0.354	22.58
244	30	95.00	12.00	6890	10.80	1.567	0.338	21.59
255	28	95.70	14.00	6862	11.74	1.711	0.331	19.35
431	42	88.55	17.50	6426	11.22	1.728	0.387	22.33
241	28	88.50	6.30	3756	6.20	1.651	0.377	22.83
N20	40	92.10	26.00	9920	15.28	1.54	0.313	20.32
N51	25	90.5	13.00	9355	13.85	1.48	0.335	22.60
N6	15	91.00	5.00	9283	10.30	1.11	0.196	17.57
N5	20	93.00	8.00	9202	11.04	1.2	0.254	21.11
N1	5	92.00	2.00	9159	9.25	1.01	0.197	19.58
N4	7	91.00	3.00	8703	10.18	1.17	0.249	21.28
BFC-433	10	88.00	6.20	9101	13.9	1.53	0.370	24.18
BFC-221	10	80.20	6.15	8814	13.2	1.5	0.300	20.00
BFC-254	10	93.00	6.20	8754	14.9	1.7	0.350	20.59
BFC-252	10	93.50	4.50	7041	10.9	1.55	0.375	24.19
BFC-436	20	85	7.20	6460	10.0	1.55	0.350	22.58
BFC-431	20	80.4	6.10	5704	8.8	1.54	0.355	20.52
BFC-261	20	80	6.30	5613	9.1	1.62	0.370	21.76

Table 18.3: Popularization of new hybrids

Centre	Name of the breed	No. of Dfls	No. of farmers	Yield/ 100Dfls (kg)	Rate/kg (Rs)	Total yield (kg)
REC Chitradurga	S8 x CSR16	6000	20	57.90	309.00	3474
REC Madivala	Cauvery gold - ICB	1600	8	80.63	290.00	1290
	BH 1-3	1590	15	93.38	299.00	1485
	Total/Avg.	12380	69	77.3	1192.05	9024

Extension Communication Programmes: 15 Demonstrations, 06 Field Days and 15 awareness programmmes were conducted in cluster/mega cluster area. 4,106 farmers have participated and an expenditure of Rs. 2,46,075 was incurred.

Farmers Skilled Training Programmes: Nine FST programmes were conducted for 150 farmers and an expenditure of Rs. 4,76,018 was incurred.

Table 18.4: Farmers Skill Development Training Programme

#	Centre	Progress for 2020-21	
		Physical	Financial
1	RSRS, Kodathi	90	266597.00
2	REC, Chitradurga	45	168750.00
3	REC, Koppal	15	40671.00
	TOTAL	150	4,76,018.00

Farmers Training at SRCs: During the year six training programmes were carried out at Sericulture Resource Centers (SRC) for the benefit of farmers. One programme at B.G. Kere under Chitradurga cluster has trained 20 farmers in one batch. Another 100 farmers were trained in 5 batches at B.S. Doddi under Kanakapura cluster. An expenditure of Rs. 44,047/- was Incurred to conduct the programmes.

Table 18.5: Training Programmes at Sericulture Resource Centres

SRC	No. of Prog.	No. of farmers	No of staff	Exp. (RS.)	Gen	SC/ST	Total
B.S. Doddi (Kanakapura)	5	100	15	36547	97	3	100
B.G. Kere (Chitradurga)	1	20	5	7500	12	8	20
Total	6	120	20	44047	109	11	120

Table 18.6: Income generated at RSRS and Nested units

Centre	Source of revenue by sale of (Rs)					Total (Rs)
	Cocoons	Chawki worms	mulberry leaf	mulberry saplings	NT/ earth worms	
RSRS Kodathi	13985	-	8550	2320	600	25455
REC Chitradurga	34880	5250	-	-	-	40130
REC Madivala	21362	-	6430	4800	12900	45492
REC Koppal	10999	21000	-	-	-	31999
Total	81226	26250	14980	7120	13500	143076

- Worked out the Cost of Cocoon Production and income level of 10 farmers each from clusters of RSRS, Kodathi & its units and submitted to CSRTI, Mysuru.
- Collected the data on Impact of Covid-19 on Sericulture Industry from the farmers of Koppal mega cluster, Ramanagara mega cluster, Chitradurga and Kolar .

19. REGIONAL SERICULTURAL RESEARCH STATION (RSRS) - CHAMARAJANAGAR

In-charge Officers	Somaprakash DS
Scientists	03
Technical Staff	04
Administrative staff	02
Others	03

	Total area	Mulberry acreage
RSRS-Chamarajanagar	14.02	7.8

On-Station Trials (OSTs)

Evaluation silkworm breeds and hybrids

Somaprakash DS and Sivasubramonian T

Under the OST programme three trials of DHR4 and DHP5 were test reared along with G11 x G19 as control. Similarly, RDIN1 and RDIN2 was also test reared with FC2 x FC1 as control. The rearing performance is given below:

19.1: Rearing performance of new hybrids

Race	Dfls	ERR By No.	ERR by Wt.(kg)	Yield/ 100 dfls	Larval Wt. (g)	SCW (g)	SSW (g)	SR%
DHR4	40	9541	16.818	85.66	4.12	1.77	0.377	21.29
DHP5	40	9568	17.589	81.30	4.55	1.824	0.401	21.98
G11xG19	30	9503	16.291	85.40	3.79	1.705	0.355	20.82
RDIN1	20	6789	11.460	41.00	4.04	1.69	0.362	21.4
RDIN2	20	7873	13.390	37.12	3.91	1.70	0.351	20.6
FC2 x FC1	10	7816	14.770	52.45	4.33	1.89	0.441	23.3

Continuous/Other activities:

Extension Communication Programme

Table 19.2: Extension Communication Programme

Place	Date	No. of farmers	Expenditure (Rs)
Technology Demonstration Programme			
1. Mutigae	05.11.20	15	1000.00
2. Killallipura	13.11.20	18	1000.00
Farmers Field Day			
1. Kurubarahundi	12.01.21	71	8105.00
2. Malaiyur	03.02.21	60	8095.00
3. T. Doddapura	10.02.21	89	9463.00

4. Udigala	19.02.21	60	7878.00
5. Thammadahally	04.03.21	60	8000.00
6. Kadubeguru	10.03.21	69	8318.00
Awareness Programme			
1. Mudunukudu	30.01.21	68	6150.00
2. Kilagere	22.03.21	65	6478.00
Total		575	64487.00

Table 19.3: Details of Farmers Skill Training programme

Date	Place	No. of farmers	Exp. (Rs)
11.01.21 to 13.1.21	Harave	20	22500.00
04.02.21 to 06.02.21	Udigala	20	22500.00
Total		40	89757.00

Table 19.4: Farm rearing details for the year 2020-21

Month	Hybrid	Dfls	Yield/ 100 dfls	Amount (Rs.)
Apr. '20	FC5 X FC6	110	8.41	1228.00
Jul. '20	FC1 X FC2	50	75.96	7781.00
Oct. '20	FC1xFC2	50	73.6	9898.00
	Total	210	52.65	18907.00

Table 19.5: Revenue generation for the year 2020-21

Particulars	Amount (Rs)
1 .Mulberry seed cuttings	2111.00
2. Mulberry leaf	1290.00
3. Mulberry dry shoot	450.00
4. Cocoon marketing	50501.00
Total	54352.00

Farmers Advisory Cell

Farmers' advisory cell was established with technology charts and exhibits. During the year, 24 persons including farmers and officials visited the center. Various bivoltine sericulture technologies were explained to them for improvement of mulberry garden and silkworm rearing.

20. REGIONAL SERICULTURAL RESEARCH STATION (RSRS) - SALEM

In-charge Officer	N. Dhahira Beevi
Scientists	10
Technical Staff	12
Administrative & Supporting Staff	11

Units	Total area	Mulberry acreage
RSRS-Salem	20.0	3.40
REC-Krishnagiri	2.77	2.50
REC-Samayanallur	2.62	0.60
REC-Gobichettipalayam	-	-
REC-Udumalpet	-	-
REC-Palakkad*	-	-
Total	25.39	6.50

* Closed on 30. 07. 2020

On-going Research projects

PIN 01018 SI: Effect of Potassium Mobilising Bacteria *Frateuria aurentia* on growth and development of mulberry (December 2020 to September 2022)

Objectives

- 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

Farmers' field identified and lay out for the experiment made in the field with V1 and G4 mulberry varieties. Completed the first crop harvest and the garden is pruned and imposed the treatments as per the experimental plan for second crop.

Continuous/Other Activities

Silkworm Disease survey

Silkworm Disease survey was conducted under the project ARP 3519: Silkworm Disease Monitoring of Seed and Commercial Crop Rearing of South Indian States. Disease survey data from 10 selected farmers' rearing (in each CPP cluster) was collected and uploaded in the web site SeriDM.

On-Station Trials

Testing of newly developed bivoltine hybrids at RSRS Salem

Table 20.1: First trial with 30 dfls (Season: Aug. - Sep. 2020)

Hybrid	Fecun-dity	ERR No.	ERR Wt. (kg)	Yield/ 50,000 eggs (kg)	SCW (g)	SSW (g)	Shell (%)
DHR4	447	5721	7.679	38.393	1.527	0.283	18.541
DHP5	458	6650	8.754	43.768	1.598	0.351	22.106
G11 x G19	448	5096	6.082	30.411	1.424	0.273	19.289

Table 20.2: Second trial with 30 dfls (Season: Oct. - Nov. 2020)

Hybrid	Fecun-dity	ERR No.	ERR Wt. (kg)	Yield/ 50,000 eggs (kg)	SCW (g)	SSW (g)	Shell (%)
DHR4	464	9710	18.077	90.385	1.870	0.391	20.909
DHP5	413	8683	18.059	90.296	2.161	0.457	21.148
G11 x G19	530	6742	11.648	58.242	2.026	0.383	18.904

Table 20.3: Second trial with 30 dfls (Season: Jan. - Feb. 2021)

Hybrid	Fecun-dity	ERR No.	ERR Wt. (kg)	Yield/ 50,000 eggs (kg)	SCW (g)	SSW (g)	Shell (%)
DHR4	538	9764	17.780	88.900	1.796	0.376	20.948
DHP5	519	9312	18.190	90.950	1.962	0.412	21.047
G11 x G19	547	6387	11.982	59.910	1.706	0.341	20.109

Table 20.4: Performance of multi-viral tolerant bivoltine double hybrids
(Dfls: 20; First trial; Season: Jan. - Feb. 2021)

Hybrid	Fecun-dity	ERR No.	ERR Wt. (kg)	Yield/ 50,000 eggs (kg)	SCW (g)	SSW (g)	Shell (%)
RDIN1	492	7309	8.501	42.505	1.230	0.225	18.293
RDIN2	496	8270	11.696	58.480	1.638	0.310	18.926

Testing of technologies at Farmers' level

First trial of new bivoltine double hybrids suitable for high temperature and high humidity conditions were conducted with four farmers in Villuppuram and Cuddalore Districts.

Table 20.5: Performance of double hybrids suitable for high temperature and high humidity
(Dfls: 500; First trial; Season: Jan. - Feb. 2021)

Hybrid	Fecun-dity	ERR No.	ERR Wt. (kg)	Yield/ 50,000 eggs (kg)	SCW (g)	SSW (g)	Shell (%)
HSDH1	538	4427	7.632	38.160	1.943	0.340	17.499
HSDH2	531	9482	13.546	67.730	1.786	0.375	20.997
HSDH3	532	7404	10.547	52.735	1.528	0.305	19.961
HSDH4	544	4490	4.962	24.810	1.403	0.247	17.605
FC1 x FC2 (C)	536	4869	7.500	37.500	1.821	0.387	21.252

Table 20.6: Validation of chawki feed supplement formulation

Particulars	Wt. of 100 larvae (g)	Missing larvae (%)	Under sized larvae (%)	Health status of larvae
First trial; Dfls: 200; Season: Oct. - Nov. 2020				
Treatment	3.625	1.403	0.873	No disease
Control	3.583	2.408	0.988	No disease

Second trial; Dfls: 200; Season: Jan. - Feb. 2021				
Treatment	3.813	1.277	0.898	No disease
Control	3.621	1.677	1.006	No disease
Third trial; Dfls: 200; Season: Feb. - Mar. 2021				
Treatment	4.698	0.676	0.393	No disease
Control	4.065	0.916	0.933	No disease

Table 20.7: Validation of chawki feed supplement formulation

Particulars	Wt. of 10 larvae (g)	SCW (g)	SSW (g)	SR (%)	Pupation (%)	Yd/100 Dfls (kg)	Rate/kg (Rs.)
First Trial							
Treatment	45.33	1.939	0.417	21.49	91.72	82.00	310
Control	44.76	1.821	0.387	21.28	91.00	78.00	304
Second Trial							
Treatment	46.18	1.928	0.407	21.18	95.13	84.00	310
Control	46.63	1.800	0.378	21.01	95.00	82.50	310
Third Trial							
Treatment	40.88	1.838	0.403	22.08	93.90	82.50	380
Control	37.19	1.657	0.349	21.07	91.00	79.50	377

Table 20.8: Validation of *chawki* feed supplement formulation

Name of the Farmers	Dfls	Yield/ 100 dfls (kg)	SCW (g)	SSW (g)	Shell (%)	Rate/kg
Sri Shankar, Manupatty	100	82.00	1.720	0.363	21.10	377.00
Sri Radhakrishnan, Manupatty	100	80.00	1.781	0.374	20.99	363.00
Sri Chinnaiah Goundar, K.Naickanur	100	81.00	1.742	0.369	21.18	365.00
Sri Ramaswamy Naicker, JN Playam	125	79.20	1.864	0.388	20.81	360.00
Sri Kanagaraj JN Playam	75	84.00	1.889	0.401	21.22	378.00
Total/Avg.	500	81.00	1.799	0.379	21.06	368.00

On-Farm Trials

Newly developed bivoltine silkworm hybrids were test verified in farmer's field by RSRS, Salem and its nested units.

Table 20.9: Performance of various hybrids at Farmers' field

Name of centre	Hybrid	No. of farmers	Dfls	Actual cocoon yield (kg)	Yield/100 dfls (kg)
RSRS-Salem	TT21 x TT56	136	24550	16458.00	67.038
	Bulgarian hybrids	48	9310	6234.00	66.960
REC-Udumalpet	Bulgarian hybrids	6	1000	786.00	78.600

Extension Communication Programme

Table 20.10: Extension Communication Programmes by RSRS-Salem and its nested units

Centre	Tech. Demo	Awareness Prog./ Field day	Farmers Day	Resham *Krishimela*	Success Stories Video
RSRS-Salem	82 (4)	332 (4)	644 (6)	302 (1)	
REC-Krishnagiri	140 (5)	428 (4)	-	-	
REC-Samayanallur	162 (7)	638 (8)	-	-	5 (685)
REC-Udumalpet	103 (4)	561 (6)	-	-	-
REC-Gobi	81 (4)	317 (4)	-	-	-
Total	568 (24)	2276 (26)	644 (6)	302 (1)	

Figures in parentheses denotes number of programmes

***Resham Krishimela*:** A farmers' Resham Krishimela was organized at Lingapuram, Bagalur, Hosur, Krishnagiri district on 19.02.2021. 302 farmers and 87 officials of CSB and DoS, Tamil Nadu participated in the Resham Krishimela. A Tamil booklet titled *New Sericulture Technologies* was released on the occasion.

Transfer of Technology Programme

Table 20.11: Sericulture technologies undertaken under Transfer of Technology programme

Unit	Rot Fix (kg)	G2 (ac)	G4 (ac)	RC1 (ac)	RC2 (ac)	V1 (ac)	PTU	*Serifit*
RSRS-Salem	24 (15)	-	5.5 (4)	-	-	1.5 (1)	60 (12)	-
REC-Gobi	67.65 (125)	-	-	-	-	-	50 (10)	3875 (423)
REC-Udumalpet	125 (120)	-	-	-	-	-	75 (15)	500 (45)
REC-Samayanallur	-	-	0.36 (2)	-	-	0.02 (1)	-	-
REC- Krishnagiri	58 (36)	0.03 (1)	3.5 (4)	-	-	0.05 (1)	100 (20)	-
REC- Palakkad	20 (14)	-	-	-	-	-	-	-

PTU: Pheromone trap for uzifly control; Values in parentheses denote number of farmers covered

Adharshgram (IVLP)

A total of 2.057 lakh dfls of bivoltine hybrids were reared with 100 farmers of Sathyamangalam cluster and recorded an average yield of 83.98 kg/100 dfls with 17.35% improvement on productivity against the bench mark.

Table 20.12: Institute Village Linkage Programme in Sathyamangalam cluster of Tamil Nadu

Dfls brushed	% of achvmnt.	Dfls harvested	Actual cocoon yield (kg)	Yield/ 100 dfls (kg)	% improve-ment through IVLP	Rate / kg (Rs.)
205745	128.591	204750	171697	83.98	18.98	370.0

Capacity Building Farmers Training Programme

Table 20.13: Capacity Building under Farmers Training Programme

Unit	Prog. (No.)	Farmers	Male	Female	SC	ST	OBC	Gen.
RSRS-Salem	5	105	71	34	7	25	53	20
REC-Krishnagiri	3	50	45	5	1	-	31	18
REC-Samayanallur	2	50	48	2	5	-	45	-
REC-Gobi	3	50	32	18	1	-	48	1
REC-Udumalpet	5	50	44	6	3	3	30	14
Total	15	305	240	65	17	28	207	53

Mass multiplication and distribution of Bio-control Agents

Name of the Biocontrol agents	Units supplied	No. of Farmers
Acerophagus papayae (1 unit=250 nos.)	906	220

Sericulture Resource Centers (SRC)

Sericulture Resource Centers at Manupatty, under Udumalpet mega cluster (REC-Udumalpet) and Maangadu, Alangudi potential cluster (REC-Samayanallur), conducted Sericulture training in co-ordination with the lead farmers and 402 farmers were trained on mulberry cultivation and silkworm rearing.

Name of the Unit facilitated	Name of the SRC Owner & Cluster	No. batches	No. of farmers trained	Male	Female	Expenditure (Rs)
REC- Udumalpet	Sri Ponnusamy, Manupatty, Udumalpet	10	201	184 (Gen)	17 (Gen)	75,000.00
REC-Samayanallur	Sri A. Kalaichezhian, Maangadu, Alangudi	10	201	178 (Gen)	23 (Gen)	75,000.00
	Total	20	402	362	40	1,50,000.00

Survey and surveillance for Pests and Diseases in RSRS-Salem Command area

Fortnightly survey was conducted for monitoring pest and disease of mulberry and silkworm. Remedial measures demonstrated/suggested for prevention and control.

Incidence of mulberry/ silkworm pests and diseases (%) under RSRS-Salem

Month	Thrips	Tukra	Leaf webber	PMB	White fly	Powdery mildew	Root rot	Grass-erie (%)	Flach-erie (%)
Apr. '20	-	-	-	-	-	-	-	-	-
May '20	-	-	-	-	-	-	-	-	-
Jun. '20	12.63	9.85	-	3.93	-	-	3.00	1.25	3.57
Jul. '20	9.16	6.79	-	6.10	-	-	-	0.63	2.12
Aug. '20	3.36	3.28	-	7.566	-	-	-	-	3.25
Sep. '20	1.77	1.35	-	2.75	-	-	2.53	-	1.63
Oct. '20	-	0.66	0.63	-	-	-	3.33	-	-
Nov. '20	-	-	2.88	1.33	-	-	-	-	0.83
Dec. '20	-	-	10.63	-	8.67	11.40	-	-	1.52
Jan. '21	-	-	13.30	-	12.43	9.17	-	-	-
Feb. '21	-	-	12.27	-	13.39	6.83	-	-	0.63
Mar. '21	-	-	-	-	-	-	-	-	-
Mean	6.73	4.39	7.94	4.34	11.49	9.14	2.95	0.94	1.94

Visitors

- 166 ATMA farmers of different districts of Tamil Nadu also visited this station and near by farmers to have exposure in the field of bivoltine sericulture.
- Coordinated the visit of sericulture farmers from Erode District to visit the bivoltine areas of Salem & Seri Tourism Corridor, Yercaud.

RSRS-Salem: Centre for Higher Studies in Botany and Sericulture

Periyar University, Salem has recognized RSRS-Salem as Centre for higher studies in Botany and Sericulture for M.Phil. and Ph.D. At present 9 students are pursuing Ph.D., under Periyar University, Salem.

Thesis submitted

Name of the candidate	Name of the Guide	Year of Joining	Research of Topic
G. Punithavathy	Dr. D. S. Chandrashekar Sci-D (Rtd)	2008	Studies on fertility of Commercial Chawki Rearing Centres and its impact on bivoltine cocoon production.

Miscellaneous Events/Activities

- Observed *Swachha Bharat Pakwada* at RSRS-Salem and it Nested Units
- Vigilance Awareness week was observed between 28.10.2020 and 02.11.2020.

Implementation of Official Language (OL)

- Organized Hindi Quarterly meetings
- Conducted three Hindi Workshop at RSRS, Salem on 28.09.2020, 11.12.2020 and 19.03.2021
- Attended the TOLIC date Meetings and TOLIC hindi workshop date organized by O/O Divisional Railway Manager, Southern Railway, Salem.

21. REGIONAL SERICULTURAL RESEARCH STATION (RSRS) - ANANTAPUR

In-charge Officer	Sudhakar P
Scientists	08
Technical Staff	11
Administrative & Supporting Staff	12

Units	Total area	Mulberry acreage
RSRS- Anantapur	40.73	6.00
REC- Rayachoti	5.00	2.10
REC-Eluru	-	-
REC- Vikarabad (TS)	5.50	2.50
REC SU-Bidar (KA)	11.33	4.50

Collaborative Research Projects/Programmes

RSRS-Anantapur and its nested units are involved in the following collaborative projects with the main institute and other RSRSs.

Project/Programme	Unit
PIB 3632: Evaluation of superior triploid genotypes for yield and adaptability under varied agro-climatic conditions (Mar. 2018 - Feb. 2024)	RSRS-Anantapur
AICEM Phase IV: All India Coordinated Experimental Trial in Mulberry (South Zone) Apr. 2019 - Mar. 2025)	RSRS-Anantapur

Continuous/Other activities

Cluster Promotion Programme (CPP)

Maintained 13 clusters and disseminated the Bivoltine sericulture technologies to the farmers. A total of 119.02 lakhs dfls of bivoltine hybrids were reared with an achievement of 81.15% against the target of 144 lakh with an average cocoon yield of 72.91 kg/100 dfls. The raw silk production achievement was 1306.950 MT against the target of 1550.81 MT.

On-Station Trials (OST)

Evaluation of new bivoltine double hybrids under on station trail

Two newly developed bivoltine double hybrids, three OST trials were conducted in different seasons from August 2020 to March, 2021,

Trial 1; Date of brushing: 15.08.2020

#	Hybrid	Hatching (%)	Fecun-dity (No.)	Yield/10000 Larvae		SCW (g)	SSW (g)	SR%
				By No.	By Wt. (kg)			
1	DHR4	95.4	409	2813	3.99	1.562	0.321	20.55
2	DHP5	94.8	412	2873	3.18	1.429	0.304	21.27
3	G11 x G19	96.0	429	2054	2.34	1.403	0.303	21.6

Trial 2; Date of brushing: 16.01.2021

#	Hybrid	Hatching (%)	Fecundity (No.)	Yield/10000 Larvae		SCW (g)	SSW (g)	SR%
				By No.	By Wt. (kg)			
1	DHR4	96.69	492	8268	17.28	2.09	0.422	20.18
2	DHP5	97.80	511	8234	15.56	1.89	0.393	20.78
3	G11 x G19	96.31	490	8225	15.78	1.919	0.387	20.20

Trial 3; Date of brushing: 14.10.2020

#	Hybrid	Hatching (%)	Fecundity (No.)	Yield/10000 Larvae		SCW (g)	SSW (g)	SR%
				By No.	By Wt. (kg)			
1	DHR4	95.15	436	9420	18.95	2.012	0.405	20.10
2	DHP5	94.92	423	8756	17.21	1.966	0.414	21.05
3	G11 x G19	92.49	415	7409	11.52	1.555	0.315	20.25

Validation of Chawki Feed Supplement Formulation (CFSF)

Three OST trials of newly developed *Chawki* feed supplement formulation were conducted in different seasons from August 2020 to March, 2021.

Table 21.1: Validation of chawki feed supplement formulation: Parameters observed during chawki stage

Particulars	Wt. of 100 larvae (g)	Missing larvae (%)	Under sized larvae (%)	Health status of larvae
First trial; Dfls: 200; Season: Oct. - Nov. 2020				
Treatment	3.62	1.82	2.7	No disease
Control	3.63	1.95	2.5	No disease
Second trial; Dfls: 200; Season: Jan. - Feb. 2021				
Treatment	3.73	2.00	3.0	No disease
Control	3.74	2.00	2.0	No disease
Third trial; Dfls: 200; Season: Feb. - Mar. 2021				
Treatment	3.85	3.00	3.0	No disease
Control	3.92	3.00	2.0	No disease

Table 21.2: Validation of chawki feed supplement formulation:
Parameters observed during late age and cocoon stage

Particulars	Wt. of 10 larvae (g)	SCW (g)	SSW (g)	SR (%)	Pupation (%)	Yd/100 Dfls (kg)	Rate/kg (Rs.)
First Trial							
Treatment	46.32	1.85	0.388	20.97	93.4	76.04	324
Control	46.67	1.89	0.393	20.79	93.2	77.24	324
Second Trial							
Treatment	46.53	1.82	0.382	20.98	93.6	78.03	337
Control	46.69	1.85	0.391	21.13	94.1	79.37	338
Third Trial							
Treatment	43.63	1.89	0.412	21.79	94.32	80.57	353
Control	44.32	1.93	0.421	21.81	95.76	82.34	355

Validation of Pheromone based Uzi Trap

The technology was test verified with 300 sericulture farmers under CPP, Kalyandurg and Athmakuru. The data was collected on total uzi flies trapped, Uzi incidence on 4th day 5th instar and Yield/100 DFLs. The data sent to the PI for further evaluation. The Pheromone based Uzi Trap technology is found effective based on the results obtained.

Extension communication programmes (ECPs)

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

Table 21.10: Extension Communication Programmes by RSRS-Anantapur and its nested units

Centre	Group Discussion	Farmers Day	Awareness Prog./ Field day	Resham *Krishimela*
RSRS-Anantapur	91 (2)	715 (6)	715 (6)	430 (1)
REC-V. Kota	162 (4)	444 (4)	-	-
REC-Eluru	166 (4)	232 (4)	-	-
REC-Rayachoty	89 (4)	386 (4)	-	-
REC-Vikarabad	54 (2)	299 (4)	-	-
REC SU-Bidar	63 (2)	214 (2)	-	-
Total	625 (18)	1782 (20)	715 (6)	430 (1)

Resham *Krishimela*/ Farmers' workshop

The Resham *Krishimela* was conducted at Palamaneru on 20.03.2021. There were 430 Farmers including DoS & CSB officials staff attended the programme. Dr. Babu Lal, Director I/C, CSR-TI, Mysuru, Smt C Aruna Kumari, Additional Director of Sericulture, Govt. of Andhra Pradesh, Dr. S. Purusotham, Dr. N. G. Salvaraju, Scientist-D, CSRTI, Mysuru and Smt. D. Shoba Rani, Joint Director of Sericulture, Chittoor were participated.

Training Programmes under Capacity Building and Training [Farmers Skill Training (FST)]

Unit	Beneficiaries
RSRS-Anantapur	140 (4)
REC-V.Kota	50 (2)
REC-Eluru	50 (3)
REC-Rayachoty	20 (1)
REC-Vikarabad	15 (1)
Total	285 (12)

Radio/ TV programmes

RSRS-Anantapur participated in 5 radio programmes, for the benefit of sericulturists as part of technology dissemination.

Revenue generation

#	Unit	Amount (Rs.)
1	RSRS-Anantapur	34,261.00
2	REC-Vikarabad	22,500.00
3	REC-Rayachoty	41,451.00
Total		98,212.00

22. REGIONAL SERICULTURAL RESEARCH STATION (RSRS) - MULUGU

In-charge Officer	Praveen Kumar K
Scientists	2
Technical Staff	2
Administrative & Supporting Staff	2

Continuous/Other activities

Extension Communication Programmes (ECPs) conducted

Name of the event	Annual Target (No. of events)	No. of programs conducted	No. of farmers sensitized	Expenditure (Rs.)
Farmers Field Day	6	6	447	89,853/-
Awareness Prog	2	3	92	19,744/-
Technology Demonstration / Enlightenment programme	2	2	45	1,790/-
Resham Krishimela	1	1	200	1,25,000/-
Total	11	12	784	2,36,387/-

CBT performance

Trained 159 beneficiaries in five batches and programs were organized at different parts of Telangana in coordination with DoS, Govt. of Telangana. An expenditure of $w. 5,41,896 was incurred to conduct the programs.

Cluster Promotion Programme

Maintained two mega clusters in Telangana and Bivoltine sericulture technologies were disseminated to the farmers. A total of 12.66 lakh dfls were distributed and harvested an average cocoon yield of 74.36 kg/100 dfls.

Resham Krishimela

In coordination with the department of Horticulture and Sericulture, Govt. of Telangana, R.O., CSB, Hyderabad and RSTRS, Dharmavaram, RSRS Mulugu had organized a Krishimela on 28.03.2021 by following strict guidelines issued in containing the spread of covid-19 pandemic. Sri Rajit Ranjan Okhandiar, IFS, Member Secretary, CSB; Sri L. Venkatram Reddy, Director of Horticulture and Sericulture, Govt. of Telangana; Dr. Babu Lal, Director, CSRTI, Mysuru; Dr. Subhash V. Naik, Director, CSTRI, Bengaluru; Chittipolu Vijaya Laxmi Srinivas, Municipal Chairperson, Pochampally; Prof. M. A. Aariff Khan, Senior Prof. (Retd.), PJTS Agricultural University Hyderabad and many more participated. As a part of Krishimela an exhibition was also organized for the benefit of farmers as well as entrepreneurs.

23. ADMINISTRATIVE REPORT

CSRTI-Mysuru & Nested Units

State	RSRS	REC	REC-SU	P4 BSF	SSBS
Andhra Pradesh	Anantapur	Eluru Rayachoty V. Kota Vikarabad			
Karnataka	Kodathi Ch'rajanagar	Bidaraguppe* Chitradurga Koppal Madivala	Bidar Maddur	Hassan	
Kerala		Palakkad#			
Madhya Pradesh		Hoshangabad			
Maharashtra		Amaravati Aurangabad Baramati Parbhani	Osmanabad		
Tamil Nadu	Salem	Gob'palayam Krishnagiri Samayanallur Udumalpet			Coonoor
Telangana	Mulugu	Vikarabad			

* Handed over to DoS, Karnataka 0n 14.06.2020

Closed on 30. 07. 2020

Staff list of CSRTI-Mysuru & Nested Units

CSRTI-Mysuru

Pankaj Tewary (Dr), Director [Rtd on 31.12.20]
Babulal (Dr), Director I/c (from 15.01.21)
Vineet Kumar (Dr), Sci-D [VRS on 15.01.20]
Mary Shery (Joseph) AV (Dr), Sci-D
Chandra Shekar KB (Dr), Sci-D
Selvaraju NG (Dr), Sci-D
Bhagya R (Dr), Sci-D
Manthira Moorthy S (Dr), Sci-D
Balachandran N (Dr), Sci-D
Muthulakshmi M (Dr), Sci-D
Babu CM (Dr), Sci-D
Gandhi Doss S (Dr), Sci-D
Purushotham S (Dr), Sci-D
Anuradha H Jingade, Sci-D
Meenal R (Dr), Sci-D
Raveendra M Mattigatti (Dr), Sci-D
Santha PC (Dr), Sci-D
Soudaminy PV, Sci-D
Mahiba Helen S, (Dr) Sci-D
Madhusudhan KN, (Dr) Sci-D
Shivakumar M Hukkeri, Sci-D (R&S)
Chandra Shekar MN, Sci-D (R&S)
Mohan, DD (A&A)
Surendra Kr Upadhyay, DD (OL)
Ganesan V, DD (Comp.)
Singh OPN, Lib. & IO
Rekha M, DD (Stat.)
Sanath Kumar YN, Sci-C
Arun Kumar 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
Gayathri T (Dr), Sci-C
Mallikarjuna G (Dr), Sci-C
Munikrishnappa HM, AD (SM)
Venkata Reddy GR, Asst.Ex. Egr. [Rtd on 31.05.20]
Sujatha BC, Asst. Dir (A&A) [Rtd on 31.12.20]
Dhaneshwar Padhan (Dr), Sci-B
Bhavya MR, Sci-B
Amit Saha, Sci-B
Divya Singh (Dr), Sci-B
Syed Salaruddin, Supdt. (Admn) [Rtd on 31.05.20]
Shashi Rekha Mary, Suptt. (Admn) [Rtd on 31.07.20]
Patnaik KL, Supdt. (Admn)
Suresh AN, Supdt. (Admn)
Manjunatha MR, Supdt. (Admn)
Guneshwar Kr Churendra, Comp. Progr.
Sachi K, Sr. Transl. (Hindi)
Geetha GS (Dr), SRA (SS)
Nuthan HM, Asst. Supdt. (Admn.)
Preethi B, Asst. Supdt. (Admn.)
Suresh S, Asst. Supdt. (Admn.)
Suresh K, Asst. Supdt. (Admn.)
Raghu YR, Asst. Supdt. (Admn.)
Venkatesh, A Asst. Supdt. (Admn.)
Unnikrishnan N, Asst. Supdt. (Admn.)
Raja Shekar NR, Asst. Supdt. (Admn.)
Sathya Anantha Kr MN, Asst. Supdt. (Admn.)
Govindaraj K, Asst Supdt. (Admn.)
Keshav Prakash, Jr. Engr. [Rtd on 31.07.20]
Ramakrishna V, Library & Inf. Asst.
Manjula S, Steno-Gr-I
Sampath Kumari KS, Steno-Gr-I
Ganesh KR, TA [Rtd on 31.05.20]
Basava Setty, TA [Rtd on 30.06.20]
Manjunath NK, TA [Rtd on 31.07.20]
Prakasha C, STA
Umapathy, STA
Nagaraju, STA
Venkatesh Rao B, STA
Vaikuntavasa, STA
Chickkamahadeva Naik, STA
Nanjundaswamy N, STA
Narendraswamy MN, STA
Mahesha J (Dr), STA
Mahadeva Swamy N, STA [Rtd on 31.03.21]
Mruthunjaya Rao K, STA
Nanjundaswamy K, STA
Neelakanthaiah TM, STA
Satish Chandra Babu M, STA
Nirmala B, STA
Muthappa, STA
Chandrappa S, STA
Krupa Shankar R, STA
Jayamma HB, STA
Gausia Kauser, STA
Nagashree MN, STA
Kalaiah B, STA
Mahadevamma MN, STA
Hemavathi KR, STA
Shivappa, STA
Mruthyunjaya M, STA
Mahendra Prasad KS, STA
Pushpavathy N, STA
Md. Zafar Iqbal, Jr. Engineer
Kiran Kumar PN, Jr. Engineer
Janardan Tiwari, Jr.Transl. (Hindi)
Chandrakanth HT, SCD Gr-I
Nataraju L, SCD Gr-I
Venkatesh Murthy N, SCD Gr-I
Nagamallappa P, SCD Gr-I
Mahesha J, SCD Gr-I
Azad Gull, Sr.FA
Shivanna, C UDC
Vasantha Kumari VC, UDC
Chandramma K, UDC
Shubha BS, UDC
Sunanda M, UDC

Venkatesha T, SCD Gr-II
Harish BM, FA
Mahadevaswamy S, Cook
Ramesha, Technician
Sundara Murthy Y, Technician
Arumugam S, Technician
Surendra MG, Technician
Imtiaz Pasha, Asst. Technician
Chandra Shekara HK, Asst. Technician
Sharadamma, MTS [Rtd on 31.07.20]
Rajashekara, MTS
Basavaraju, MTS
Kempamma, MTS
Mahadeva, MTS
Lokesh BM, MTS
Premamma, KG MTS
Gayathri D, MTS
Leelavathi, MTS
Nalini S, MTS
Hemavathi N, MTS
Mahadevamma, MTS
Manohara, MTS
Mohan D, MTS

REC SU-Maddur

Guruswamy D (Dr), Sci-D
Mahadevamma, TA [Rtd on 31.10.20]
Srinivas S, TA [Rtd on 31.12.20]
Shivakumara HB, STA

P4-Farm, Hassan

Nishitha Naik V (Dr), Sci-D
Dayananda (Dr), Sci-D
Onkara Murthy HN, STA
Rangaswamy BC, STA
Nagaraju KS, STA
Nagaraja, Asst. Technician

RSRS, Kodathi

Satish B Kulkarni, Sci-D
Sudhakara Rao P, (Dr) Sci-D [Rtd on 31.12.20]
Saraswathi P, Sci-D
Hanumantharayappa SK, Sci-D
Dhananjaya BR, Asst. Supdt.(Admn.)
Ramu UD, TA [Rtd on 31.05.20]
Gurusiddappa, TA [Rtd on 30.06.20]
Suryanarayana Rao R, STA
Jachhana Bijayee Patnaik, STA
Padmamma K, STA
Hemavathi R, STA
Ganesh L, STA
Suneetha S, STA
Rajashekaran C, SCD Gr-I [Rtd on 31.12.20]
Vimala C, U.D.C
Ashwini KJ, Field Assistant
Rajakumar G, MTS
Gangadharan D, MTS

REC-Madivala

Noble Morrison M (Dr), Sci-D [Rtd on 31.07.20]
Narendra Kumar J (Dr), Sci-D
Narayanaswamy BK, STA
Venkatarevanappa K, STA
Murthy NK, STA
Lakshminarayana M, MTS

REC-Chitradurga

Srinivasulu Y (Dr), Sci-D
Papaiah G, STA
Niranjanamurthy GN, STA
Shivanna KB, STA
Vasanthi J, STA
Mufeedulla, Staff Car Driver (Sg)

REC-Koppal

Umesha A (Dr), Sci-C
Justin Kumar J, STA
Raghavendra AP, FA
Shivagangamma, MTS [exp. on 30.01.2021]
Nazeera Begum, MTS

RSRS-Chamarajanagar

Somaprakash DS (Dr), Sci-D
Sivasubramonian T, Sci-D
Sibayan Sen (Dr), Sci-D
Sarani Nagendra, Sci-C [Rtd on 31.12.20]
Sudha U, Supnt.(Admn)
Rupakumar HN, TA [Rtd 30.04.20]
Nagendra DK, TA [Rtd 31.05.20]
Rajashekara Murthy KA, STA
Chinnaswamy C, STA

Shayana R, STA
Shivamma L, STA
Nagesh S, SCD Gr-I
Shobha Rani S, U.D.C
Javaraju J, MTS [Rtd on 30.09.20]
Kambe Gowda, MTS
Srinivasa C, MTS

REC SU-Bidar

Rameshkumar S, Sci-C
Sambha, STA

RSRS, Ananthapur

Sudhakar P (Dr), Sci-D
Boya Vijaya Naidu, Sci-D
Kiran Kumar KP (Dr), Sci-D
Kalipi Babanna, Indira Asst. Supdt.(Admn.)
Matra Manohara, Asst. Supdt.(Admn.)
Venkata Reddy C, Asst. Supdt.(Admn.)
Geetha K, Steno-Grade-I
Surendra Reddy D, TA [Rtd on 30.04.20]
Shivaiah A, STA
Suryaprakash Rao SK, STA
Shaik Mohamad Arif, STA
Lakshmidevamma Sugali, STA
Alivelu Mangamma Mannala, STA
Sreenivasulu Anamala, STA
Krishna Veni N, STA
Ramappa C, Staff Car Driver Grade-I
Sreenivasulu J, Staff Car Driver Grade-Ii
Krishna Murthy K, MTS
Pedda Narashimhudu T, MTS

REC-Venkatagiri Kota

Venkatachalapathy M (Dr), Sci-D
Gopal A, STA
Anuradha P, STA
Anitha BS, STA
Suresh Babu Gona Sujin, STA
Lomada Haribabu, Staff Car Driver Grade-I

REC-Rayachoty

Venugopal A (Dr), Sci-D
Alekhya Byreddi, Field Assistant
Devangam Aparna, Field Assistant
Rownak S, MTS
Venkatanarayana B, MTS [Rtd on 31.03.21]

REC-Eluru

Srinivasa Rao TVS (Dr), Sci-D
Rani Srinivas, STA [Rtd on 31.03.21]
Uma Maheswara Rao G, STA
Kota Nirmala Kumari, STA

SSBS-Coonoor

Mohan B, Sci-D
Gunavathy R, STA
Sarada TT, STA
Lalitha KK, STA
Rubasundari A, STA
Jesantha M, MTS [Rtd on 30.06.20]
Marudhammal B, MTS

RSRS-Salem

Dhahira Beevi N (Dr), Sci-D
Bala Saraswathi S (Dr), Sci-D
Sakthivel N (Dr), Sci-D
Jessy Daniel, Sci-D
Kamaraj S, Sci-C
Balasubramaniam G, Supnt.(Admn)
Manivannan TK, Asst. Supdt.(Admn.)
Balu S, Asst. Supdt.(Admn.)
Chendur Kumar S, STA
Matheswaran T, STA
Vijayakumari S, STA
Muthusami N, STA
Sheik Sadhik Ali R, SCD Gr-I
Narayanan A, SCD Gr-I
Sellamuthu V, Asst. Technician
Shivalingam V, MTS
Ashok Kumar D, MTS [Rtd on 31.08.20]
Vijayan K, MTS

REC-Krishnagiri

Jhansi Lakshmi K (Dr), Sci-D
Sulochana S, STA
Ranganayaki R, STA
Basavalingappa D, MTS

REC-Samayanallur

Rajaram S (Dr), Sci-D
Mahima Santhi A (Dr), Sci-D
Kasi R, Asst. Supdt.(Admn.) [Rtd on 30.06.20]

Thangaraj K, TA [Rtd on 31.07.20]
Bhaskaran KVT, STA
Krishna Moorthy R, STA
Vijayalakshmi G, STA
Chellaiah M, STA
Alagarsamy P, MTS

REC-Gobichettipalayam

Rajalakshmi E, Sci-D
Aparna G, FA

REC-Udumalpet

Samuthiravelu P (Dr), Sci-D
Gnanaprakash B, FA
Palaniswamy S, Asst. Technician

RSRS-Mulugu

Praveen Kumar K (Dr), Sci-D
Vinod Kumar Yadav (Dr), Sci-C
Gnaneswar R, Asst. Supdt.(Admn.)
Gandla Chalapathi, STA
Tuyamani NK, STA
Rauf MA, Asst. Technician

REC-Vikarabad

Srinath B (Dr), Sci-D
Bhagya Lakshmi G, STA
Shoba Rani U, UDC
Munirathnam Reddy C FA
Buchaiah Papagari, AT

REC-Palakkad

Sarala K, Sci-D [Rtd on 31.07.20]

REC SU-Osmanabad

Jadhav AL, Sci-B
Uday Sureshrao P, FA

REC-Amravati

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

REC-Parbhani

Karande AJ, Sci-D
Sidhartha Pandurang Ingle, STA
Rakeshkumar NV, STA
Sabale SV, FA
Dineshkumar BP, MTS
Abdul Salam SI, MTS

REC-Baramati

Humayun Sharief Y, Sci-D
Neethaben MD, STA
Harish Kumar TT, SCD G-II
Vilas Bhujangrao Nagre, MTS
Patel Aratsinh Bhalabhai, MTS

REC-Aurangabad

Ram Prakash (Dr), Sci-D
Anjali Prakash Nage, STA
Pushpa BG, STA
Nirmala SP, STA
Anwarkhan MP, SCD G-II
Kantilal CS, MTS

REC-Hoshangabad

Gnana Kumar Daniel A, Sci-D
Gamer Singh Kitawat, STA
Arjun Singh Kitawat, STA
Kanhaiya Lal J, STA
Tilak Ram Chowhan, FA

BUDGET (Rs. in lakhs)

Budget Head	Grants Received	Grants Surrendered	Expenditure Incurred
1. Plan: Salaries-36	3987.61	-	3987.61
2. Plan: SC Salaries-36	880.85	-	880.85
3. Plan: ST Salaries-36	341.94	-	341.94
4. Plan: Gen-31	550.42	-	550.42
5. Plan: Cap-35	221.51	3.69	217.82
Total	5982.33	3.69	5978.64

24. RESEARCH ADVISORY COMMITTEE

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

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

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

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

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

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

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

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

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

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

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

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

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

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

The Director (Member Convener)
Central Sericulturual Research and Training
Institute, Central Silk Board, Manadavadi road,
Srirampura,Mysore-570 008

Details of Review Meetings at CSRTI-Mysuru

64th Research Council	:	23rd October 2020
45th Research Advisory Committee	:	23rd December 2020
65th Research Council	:	22nd March 2021

Conference/Webinar/Workshop Attended

Conference/Webinar/ Workshop	Organized by	Date	Name & Designation
BIOQUIZ-2020	Department of Biochemistry, Biotechnology and Microbiology, St. Aloysius College, Mangalore	01.07.2020	Madhusudan KN, Sci-D
Online webinar on experimental research in social science	Bihar Agricultural University, Sabour	13.07. 2020	Mahima Shanthi A, Sci-D
Impact of Covid-19 on Silk Production	Department of Studies in Sericulture Science, University of Mysore, Mysuru	13.08.2020	Umesha A, Sci-C
Transgenic Silkworm (*Bombyx mori*) - An Epoch Making Technology	Department of Studies in Sericulture Science, University of Mysore, Mysuru	25.08.2020	Umesha A, Sci-C Madhusudan KN, Sci-D Kusuma L, Scientist-C Balasaraswathi S, Sci-D
Online webinar on Sustaining Agriculture through collectives, Cooperatives and farmer producer organizations- post COVID 19	Ministry of Agriculture and Farmers welfare, GOI, Pune	08.09.2020	Mahima Shanthi A, Sci-D
International e-conference on Advances in microbial Biotechnology and Biotherapeutics	Department of microbiology, Osmania university, Hyderabad	10-12.09.2020	Thirupathaiah Y, Sci-C
Integrated Disease Management in Silkworm, *Bombyx mori* – An Insight	Department of microbiology, Osmania university, Hyderabad	18.09.2020	Umesha A, Sci-C
Automated Recognition of Silkworm Races and Breeds for Potential Breeding Programme	Department of microbiology, Osmania university, Hyderabad	23.09.2020	Umesha A, Sci-C
international e-conference on "Multidisciplinary approaches for plant disease management in achieving sustainability in agriculture"	College of Horticulture, Bengaluru, University of Horticulture Sciences,Bagalkot, Karnataka	6-9.10.2020	Arunakumar GS, Sci-C
Current prospective in Microbiology	Department of Microbiology, University of Mysuru	09.11.2021	Dr.K.N.Madhusudan, Scientist-D
Extension Management Approaches for Promotion of Sericulture	Faculty of MANAGE, Hyderabad and CSB, Bengaluru.	11-13.11.2020	Umesha A, Sci-C
Webinar on Enterprise opportunities in Mulberry Silkworm Seed	Department of studies in Sericulture Science, University of Mysore, Manasagangotri, Mysuru	12.11.2020	Mary Josepha Shery AV, Balasaraswathi S, Santha PC, Maliikarjun G

International webinar on Seri Startups for Sustainable Development	Department of Biosciences and Sericulture, Sri Padmavati Mahila Visvavidyalayam, Tirupati	20-21.11. 2020	Muthulakshmi M, Sci-D, Joycy Rani D, Sci-C, Umesha A, Sci-D
Webinar on Management of Root rot and leaf roller/ Webber Management in mulberry plantations	Silk association of India (SAI), Bengaluru	23.11. 2020	Dr. M. Muthulakshmi, Scientist-D and Smt. Joycy Rani, Scientist-C, CSRTI, Mysore
Webinar on Integrated Nutrient Management in Mulberry	Department of studies in Sericulture Science, University of Mysore, Manasagangotri, Mysuru	24.11. 2020	Muthulakshmi M, Sci-D, Joycy Rani D, Sci-C
Young Scientists conference	India International festival Science fest 2020	22-24.12.2020	Satish L, Sci-C, Kusuma L, Sci-C
National webinar on Technologies to enhance Bivoltine silk production	CSR&TI, Mysuru	24.02. 2021	All scientists of CSRTI-Mysuru & its nested units
Online workshop on Artificial Intelligence based Smart Agriculture for Sustainable Development	Centre for Artificial Intelligence, ISI, Kolkata	26-28. 02.2021	Amit Saha, Sci-B

Training Programme Undergone

Training Programme	Organized by	Date	Name & Designation
ONLINE National training course on Technology interventions towards transformation agriculture, sericulture, animal husbandry & allied sectors in to sustainable enterprises for *atmanirbhar bharat*	Agro Environment Development Society	11-31.10. 2020	Praveen Kumar K
Extension management approaches for promotion of Sericulture Industry (online)	MANAGE, Hyderabad	10.11.20 to13.11.20	Srinivasulu Y
Extension management approaches for promotion of Sericulture Industry (online)	National Institute of Agricultural Extension Management (Manage), Hyderabad	15.12.2020 to 18.12.2020	Muthulakshmi M Mahima Shanthi A Joycy Rani D Kirankumar KP Ram Prakash Humayun Sherief Y Gnanakumar Daniel A
Skill training and entrepreneurial development programme	CSRTI, Mysuru	18.12.20 to 19.12.20	Niranjan Murthy Vasanthi J

ONLINE training programme on Extension management approaches for promotion of Sericulture industry	MANAGE, Hyderabad	19.01.21 to 22.01.21	Vasanthi J Narayanasamy BK Justin Kumar J Samba Sreenivasalu Krishnamoorthy Gnanaprakash
Skill training and entrepreneurial development programme	CSRTI, Mysuru	19.01.21 to 20.01.21	Papaiah G
ONLINE training on Integrated scientific project management for women scientists	COD Hyderabad	18-22.01.2021	Soudhamini P Sobhana V

Guest lecture delivered

Programme	Organized by	Date	Name & Designation
Mulberry cultivation Practices for Bivoltine sericulture	Sericulture Training Institute, Kuderu, Chamarajanagar	10.11.2020	Arunakumar GS
Mulberry cultivation Practices	Sericulture Training Institute, K. R. Pet, Mandya	13.11.2020	Arunakumar GS
Root rot management in mulberry	Silk Association of India	23.11.2020	Arunakumar GS

25. PUBLICATIONS

Book/Book Chapter

Akhileshwar Kumar Srivastava, Arpana Yadava, Divya Singh (2020) Evolutionary mechanism for biosynthesis of diverse molecules. In: Evolutionary Diversity as A Source for Anticancer Molecules (eds) Akhileshwar Kumar Srivastava, Vinod Kumar Kannaujiya, Rajesh Kumar Singh, Divya Singh, Academic Press, United Kingdom, pp: 1-28.

Akhileshwar Kumar Srivastava, Rajesh Kumar Singh, Divya Singh (2020) Microbe-based bioreactor system for bioremediation of organic contaminants: present and future perspective. In: Microbe mediated remediation of environmental contaminants (eds.) Ajay Kumar, Vipin Kumar Singh, Pradeep Singh, Virendra Kumar Mishra, Woodhead Publishing, United Kingdom, pp: 241-254.

Akhileshwar Kumar Srivastava, Vinod Kumar Kannaujiya, Rajesh Kumar Singh, Divya Singh 2020 Evolutionary Diversity as A Source for Anticancer Molecules (eds), ISBN: 9780128217108: Elsevier Science Publishing Co Inc., San Diego, United States Academic Press, pp: 390.

Divya Singh, Sandeep Kumar Singh, Vipin Kumar Singh, Akanksha Gupta, Mohd Aamir, Ajay Kumar (2020) Plant growth-promoting bacteria and their role in environmental management. In: Abatement of Environmental Pollutants Trends and Strategies (eds) Pardeep Singh, Ajay Kumar, Anwesha Borthakur, Elsevier, pp: 161-175.

Divya Singh, Sandeep Kumar Singh, Vipin Kumar Singh, Hariom Verma, Manisha Mishra, Kumari Rashmi, Ajay Kumar (2020) Plant growth-promoting bacteria: application in bioremediation of salinity and heavy metal-contaminated soils. In: Microbe mediated remediation of environmental contaminants (eds) Ajay Kumar, Vipin Kumar Singh, Pradeep Singh, Virendra Kumar Mishra, Woodhead Publishing, United Kingdom, pp: 73-78.

Divya Singh, Sandeep Kumar Singh, Vipin Kumar Singh, Sougata Ghosh, Hariom Verma, Ajay Kumar (2020) Plant growth promoting bacteria as biocontrol agents against diseases of cereal crops. In: Food Security and Plant Disease Management (eds) Ajay Kumar and Samir Droby, Woodhead Publishing, United Kingdom, pp: 221-239.

Pankaj Tewary (2020) Sericulture Success Stories Vol. 2. - N. G. Selvaraju, G. S. Geetha, J. Justin Kumar, Joycy Rani Dasari [eds.] Central Sericultural Research & Training Institute, Mysuru, pp: 1-140.

Research Papers

International Journals

Amit Saha, Singh KN, Mrinmoy Ray and Santosha Rathod (2020) A hybrid spatio-temporal modeling: an application to space-time rainfall forecasting, *Theoretical and applied Climatology* (Springer-Nature), 142: 1271-1282.

Arunakumar GS, Gnanesh BN, Manojkumar HB, Doss Gandhi S, Mogili T, Sivaprasad V and Pankaj Tewary (2021) Genetic Diversity, Identification and Utilization of Novel Genetic Resources for Resistance to *Meloidogyne incognita* in Mulberry (*Morus* spp.). *Plant Disease*. PDIS-11-20-2515-RE.R1.

Dhahira Beevi N and Devamani M (2020) Soil fertility status of five major mulberry cultivated districts in Tamil Nadu. *Int. J. Adv. Res*., 8(06): 1-5.

Gnanesh BN, Tejaswi A, Arunakumar GS, Supriya M, Manojkumar HB and Pankaj Tewary (2020) Molecular phylogeny, identification and pathogenicity of *Rhizopus oryzae* associated with root rot of mulberry in India. *J. Applied Microbiol*. https://doi.org/10.1111/jam.14959.

Kiran Kumar KP, Sudhakar P, Vijaya Naidu B and Teotia RS (2019) Cluster Promotion Programme (CPP), A novel method for the upliftment of socio-economic conditions of scheduled castes and schedule tribe farming community. *Innovative Farming,* 5(3): 124-130.

Kiran Kumar KP, Vijaya Naidu B, Sudhakar P, Vijaya Kumar I and Teotia RS (2019) Cluster promotion programme (CPP) - A boon for Development of bivoltine sericulture in Kalyandurg, Ananthapur district of Andhra Pradesh. *Innovative Farming,* 5(3): 110-116.

Narendra Kumar JB and Manjunath D (2020) Effect of age, size, and mating combinations in *Trichomalopsis uziae*, a pteromalid ecto-pupal parasitoid of the tachinid fly, *Exorista bombycis*, on its reproductive performance. *Global J. Science Frontier Res.,* 20(2): 39-48.

Nazeer Ahmed Saheb S, Mogili T, Reddy PS, Sashank Reddy S, Sudhakar P, Vijaya Naidu B and Pankaj Tewari (2020) Bivoltine Sericulture enlargement in Venkatagiri Kota, Chittoor District, Andhra Pradesh through cluster promotion programme (CPP)- An accomplishment. *J. Bio. Innovations,* 9(4):485-498.

Rajalakshmi E and Sakthivel N (2020) Development of new bivoltine double hybrids of silkworm *Bombyx mori* (L) under semi temperate conditions of Nilgiris. *Sericologia*, 60(1&2) 62-74.

Rajesh Kumar Singh, Divya Singh, Arpana Yadav, Akhileshwar Kumar Srivastava (2020) Molecular fossils pseudogenes as functional signature in biological system. *Gene and Genomics*, 42:619-630.

Srinath B, Sudhakar P, Vijaya Naidu B and Pankaj Tewary (2020) Sericulture an inventive farming in transforming the socio economic conditions of the Zaheerabad cluster farmers of Telangana State. *Int. J. Res. in Biosciences,* 9(3): 1-6.

Sudhakar P, Gandhi Doss S, Vijaya Naidu B and Pankaj Tewary (2020) Assessment of high yielding mulberry varieties at nursery level under the tropical agro climatic conditions of Anantapur, Andhra Pradesh. *World. J. Pharma. & Life Sci*., 6(5):188-195.

Sudhakar P, Kiran Kumar KP, Vijaya Naidu B, Reddy PS, Nazeer Ahmed Saheb S, Rao TVSS, Ashok Kumar K, Balaji Chowdary N, Vidyunmala S, Venugopal A, Venkataramana P, Srinath B, Sanjeeva Rao BV, Praveen Kumar K,

Selvaraju NG and Teotia RS (2019) Development of bivoltine sericulture in Andhra Pradesh and Telangana states of India through cluster promotion programme (CPP). *Innovative Farming,* 4(2): 105-114.

Sudhakar P, Praveen Kumar K, Srinath B, Sanjeeva Rao BV, Vijaya Naidu B and Pankaj Tewari (2020) Sericulture development in Telangana State transpire in improving socio economic conditions of the farming community under Cluster Promotion Programme. *Int. J. Innov. In Agric.,* 2: 28-36.

Sudhakar P, Sobhana V, Swamy Gowda MR, Sibayan Sen, Sneha MV and Sivaprasad (2020) Soil fertility assessment of mulberry soils and suitable amelioration for sustainable quality leaf and cocoon production in Karnataka. *Research Biotica.* 2(1): 15-19.

Sudhakar P, Vijaya Naidu B, Kiran Kumar KP and Babulal (2021) Tree Mulberry: The future of Tropical Sericulture Farming. *Biotica Research Today.* 3(5): 297-302.

Sudhakar P, Vijaya Naidu B, Kiran Kumar KP and Pankaj Tewari (2020) Silk Milk - an ecofriendly and innovative method of Farming for value addition to sericulture. Biotica Research Today. 2(1): 1-3.

Sudhakar P, Vijaya Naidu B, Kiran Kumar KP, Selvaraju NG and Pankaj Tewary (2020) Impact of Capacity Building Trainings and Extension Communication Programmes on the Bivoltine Sericulture Development in Andhra Pradesh. *Int. J. Curr. Multi. Disci. Studies.* 6(02(A)):1227-31.

Thirupathaiah Y, Ravinder, Anushree K, Sinchana, Sumathy R, Moorthy SM and Tewary P (2020) Identification and characterization of sericin isoforms extracted from cocoons of silkworm, *Bombyx mori*. *Sericolgia* 60(1&2): 6-11.

Vijaya Naidu B, Sobhana V, Sudhakar P, Sibayan Sen, Obulapathi N, Sneha MV and Pankaj Tewari (2020) Impact of soil amelioration recommendations on bivoltine sericulture development during Cluster Promotion Programme in Andhra Pradesh. *Int. J. Innov. Sci. Res and Rev.,* 2(4): 180-184.

Vijaya Naidu B, Sudhakar P, Kiran Kumar KP, Rameswara Rao N and Pankaj Tewary (2020) Impact of bivoltine sericulture in improving socio economic conditions of sericulture farmers of Madakasira cluster through Cluster Promotion Programme (CPP). *Research Biotica,* 1(10): 9-15.

National Journals

Daniel AGK and Prabakaran V (2021) Studies on the effect of silkworm rearing structures on flacherie incidence in *Bombyx mori* L. *Uttar Pradesh J. Zool*., 42(3): 23-32.

Naleen, Bharath M, Sannappa B, Manjunath KG and Umesha, A (2020) Knowledge and Adoption Levels of Farmers on Sericulture Technologies in Srirangapatna Taluk of Mandya District of Karnataka. *Res. J. Agric. Sciences,* 11(4): 959-965.

Popular articles

Amit Saha, Manjunath GK, Pankaj Tewary, Selvaraju NG, Geetha GS and Joycy Rani D (2020) Role of Statistics in Sericultural research. *Food and Scientific Reports*, 1(12): 62-64.

Devamani M, Dhahira Beevi N and Sakthivel N (2020) Mulberry Tea and its medicinal properties. *Pattumalar* (Tamil monthly magazine) 9(11):10-12.

Dhahira Beevi N (2021) A brief note on Resham Krishi Mela cum Farmers workshop of RSRS, Salem. *Pattumalar* (Tamil monthly magazine): 10(5):7-8.

Kushwaha RV, Dhawle MB and Kasampure SG (2020) Awareness programme on 14.02.2020 at Silk park Amravati. *Indian Silk*, 11 (59 old) (1): 40.

Kushwaha RV, More AL and Kavitkar SS (2020) Pre plantation training programme on 05.02.2020 at Sericulture Training Centre Shirla Akola. *Indian Silk*, 11 (59 old) (1): 41.

Kushwaha RV, Padvi PS and Kasampure SG (2020) Farmers Skill Training programme on 05.02.2020 at Waigaon Wardha. *Indian Silk*, 11(59 old) (1): 41.

Narendra Kumar, J.B. 2020. Rules and regulations governing registration of chawki silkworm rearers. *Reshme Krishi*, December 2020 (In Kannada) Originally written in English by Dr BS Angadi & K Sashindran Nair, CSB), pp15-17

Narendra Kumar, J.B. and Pratheesh Kumar, P.M. 2020. Glyricidea: Excellent green mulch for mulberry cultivation. *Reshme Krishi*, December 2020 (In Kannada) Originally written in English by Dr PM Pratheesh Kumar, pp: 13-14.

E.Bhuvaneshwari and Thirupathaiah Y 2020 Circadian rhythm in Silkworm *Bombyx mori* Resham kiran, June 2020: 9 (1);4-6

Raghavendra KV, Daniel AGK, Sivasubramonian T and Chinnaiah C (2020) Spider mites: A Potential non insect pest of Mulberry. *Indian Silk*, (old 59)11(3): 14-15.

Sanotsha Rathod, Amit Saha and Kanchan Sinha (2020) Introduction to Survival Analysis and Application in Agricultural Research. *Food and Scientific Reports*, 1(4): 28-30.

Sanotsha Rathod, Amit Saha and Kanchan Sinha (2020) Particle Swarm Optimization and its applications in agricultural research. *Food and Scientific Reports*, 1(4): 37-39.

Sudhakar P, Vijaya Naidu B and Kiran Kumar KP (2020) SILK MILK - An eco-friendly and innovative method of farming for value addition to sericulture. *Research Today*, 2(1): 1-3.

Thulasy Gayathri, Subrahmaniam Gandhi Doss, Vipin Kumar and Divya Singh (2020) क्षारीयता के कारण शहतूत की पत्तियों में प्रकट होने वाले लक्षणण. *Resham Kiran* 9(1-2): 7-8.

Technical Bulletin

Dhahira Beevi N, Balasaraswathi S, Sakthivel N, Kamaraj S and Jessy Daniel (2021) New Technologies in Sericulture. Technical Bulletin (Tamil), Regional Sericultural Research Station, Salem.

Conferences/Webinars

Arunakumar GS, Gnanesh BN, Supriya M, Harshitha MM and Pankaj Tewary (2020) Emerging foliar fungal pathogens and host plant resistance of mulberry. In the international e-conference on "Multidisciplinary approaches for plant disease management in achieving sustainability in agriculture, from 6th to 9th October 2020, organized by College of Horticulture, Bengaluru, University of Horticulture sciences, Bagalkot, Karnataka.

Thirupathaiah Y, Anusha S, Manthira Moorthy S and Pankaj Tewary (2020) Utilization of Silkworm *Bombyx mori* pupae for culturing of *Cordyceps militaris* and production of Bioactive compounds. International e-conference on "Advances in microbial Biotechnology and Biotherapeutics" organized by department of Microbiology, Osmania university, Hyderabad held on 10-12.09.2020. p25.

Satish L., Kusuma L., Moorthy S. M., Sivaprasad V and Pankaj T, 2020. SSRs as a potential marker for development of Multi-Viral Disease Tolerant Bivoltine Breeds, Abstract presented in the young scientists' conference, organized during 22-24.12.2020 as part of India International Science fest 2020

Kusuma L, Satish L, Moorthy SM, Sivaprasad V, Pankaj T, 2020, An assessment of RNA biogenesis transcript expression in the silk gland of *B. mori* based on whole transcriptome analysis, Abstract presented in the young scientists' conference, organized during 22-24.12.2020 as part of India International Science fest 2020

Sequences submitted

Nucleotide sequences: 68

Eight nucleotide sequences of *Meloidogyne incognita* causing root-knot nematode in mulberry were deposited in GenBank with accession numbers MW187117, MW187113, MW187115, MW187116, MW181659, MW187114, MW193121 and MW183247.

Nucleotide sequences of 60 different fungal pathogens on mulberry were submitted to NCBI GenBank database and received accession numbers.

Submitted 31 sequences of pathogens isolated from silkworm to NCBI with accession numbers: 1-4: MT355425.1 - MT355428.1, MW599192.1, MW599197.1, MW599203.1, MW599222.1, MW599350.1, MW603605.1, 11-21: MZ018637 to MZ018656

NCBI gene deposits

Madhusudhan *et al*., MN892552

Madhusudhan *et al*., MW082828

Visit of foreign delegates to CSRTI-Mysuru
on 29.11.2020

Samarth Training Programme
Organised at KSIC, Mysuru
on 23.11.2020

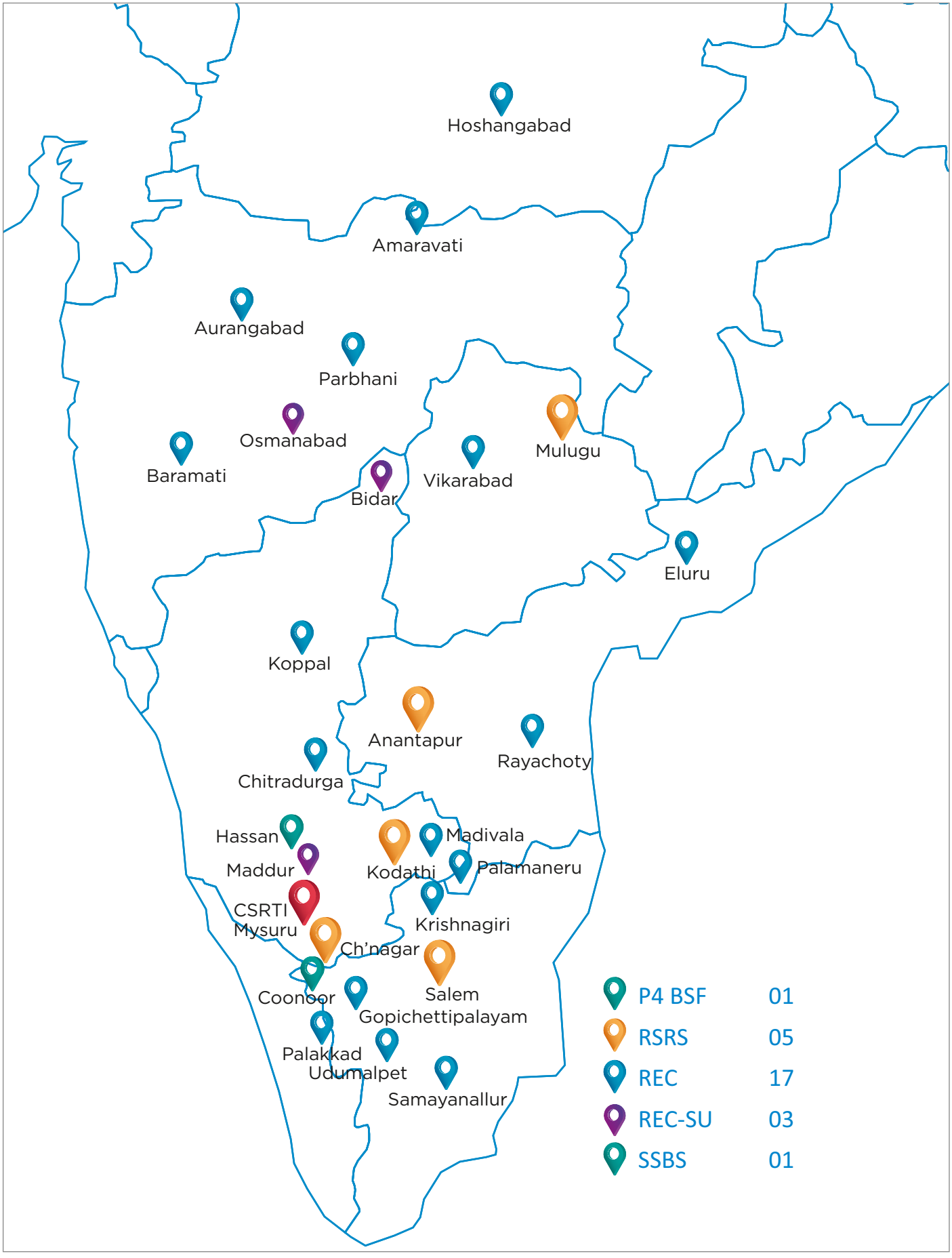
Visit of RAC Chairman
(VC, Agri. University, Dharwad)
on 23.12.2020

Visit of Hon. Minister (Hort. & Seri.) Telanagana on 30.01.2020

Visit of Chairman, APMC, Maharastra on 30.01.2020

An extenstion communication programme at Bellatti [Gadag Dist.] on 03.02.2021

CSRTI-Mysuru Extension/Field Units



Resham Krishimela
organized by RSRS Salem
at Bagalur on 19-02-2021

Resham Krishimela
oragnized by RSRS Ananthapur
at Palameneru on 20-03-2021

Resham Krishimela
oragnized by RSRS Mulugu
at Pochampalli on 28-03-2021