

कें रे उ अ प्र सं-मैसूरु  
CSRTI-MYSURU

वार्षिक प्रतिवेदन  
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(आई एस ओ 9001 : 2015 प्रमाणित)

**CENTRAL SERICULTURAL RESEARCH & TRAINING INSTITUTE**  
(ISO 9001 : 2015 Certified)

केंद्रीय रेशम बोर्ड, वस्त्र मंत्रालय, भारत सरकार, मैसूरु-570 008  
Central Silk Board, Ministry of Textiles, Government of India, Mysuru-570 008



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

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## CONTENT

PARTICULARS	PAGE NO.
Foreword	vi
About CSRTI-Mysuru	x
Highlights of Research, Training & Extension Activities	xvi
Activities regarding Official Language Implementation	xxi
<b>Progress of Research Projects &amp; Programmes</b>	
Mulberry Breeding and Genetics Laboratory	1
Mulberry Molecular Biology Laboratory	11
Soil Science & Chemistry	12
Agronomy Section	14
Mulberry Pathology	16
Mulberry Physiology	18
Bivoltine Silkworm Breeding Laboratory	19
Multivoltine Breeding Laboratory	28
Silkworm Genetics Laboratory	33
Satellite Silkworm Breeding Station-Coonor	37
P4 Basic Seed Farm-Hassan	37
Silkworm Physiology Laboratory	38
Rearing Technology & Innovation	41
Grainage Section	44
Technology Validation and Demonstration Centre	44
Pest Management Laboratory	45
Silkworm Pathology Section	52
Post Cocoon Evaluation Unit	56
Sericultural Engineering Division	57
Sericultural Extension, Economics and Management Division	60
Capacity Building & Training	82
Farm Management Section	86
Bioinformatics Center (Sub-DIC Under BTISNET)	86
RSRS-Kodathi	87
RSRS-Chamarajanagar	91
RSRS-Salem	97
RSRS-Anantapur	101
Administrative Report	105
Research Advisory Committee	108
Meteorological Data	111
Publications	112
Highlights of Research Framework Document (RFD)	120

## प्रस्तावना

केंद्रीय रेशम बोर्ड के विज्ञान 2020 का सर्वप्रमुख लक्ष्य हमारे देश का कच्चा रेशम उत्पादन वर्ष 2017 में 5000 मी. ट. द्विप्रज (बाइवोल्टाइज) के आंकड़े को पार करना है। इस लक्ष्य की प्राप्ति में, सी एस आर टी आई मैसूरु ने अपनी सुव्यवस्थित कार्य प्रणाली और उत्साह द्वारा महत्वपूर्ण योगदान दिया है। सी एस आर टी आई मैसूरु ने राज्य सरकार के रेशम केंद्र तथा अपने अधीनस्थ विभिन्न राज्यों यथा कर्नाटक, आंध्र प्रदेश, केरल, तमिल नाडु, तेलंगाना, महाराष्ट्र और मध्य प्रदेश के सहयोग से द्विप्रज समूह उन्नयन, रेशम आदर्श गाँव और प्रौद्योगिकी स्थानांतरण कार्यक्रम के कार्यान्वयन द्वारा यह संभव किया है।



सी एस आर टी आई मैसूरु के वर्ष 2016-17 के वार्षिक प्रतिवेदन में विभिन्न क्षेत्रों में विशेषज्ञता हासिल करने के लिए विकास और अनुसंधान कार्यक्रम पर बल दिया गया है। इससे शहतूत रेशम उत्पादन क्षेत्र तथा इससे जुड़े सभी हितधारकों के उत्तरोत्तर सुधार में गति प्रदान होगा। सी एस आर टी आई मैसूरु ने प्रधानमंत्री मृदा स्वास्थ्य परीक्षण योजना के अंतर्गत 10,007 रेशम उत्पादकों को मृदा स्वास्थ्य कार्ड जारी किया, जिसमें शहतूत कृषि हेतु मृदा की उर्वरता को बनाए रखने के लिए आवश्यक दिशा निर्देश दिए गए हैं। शहतूत डी यू एस (विशिष्टता, एकरूपता, स्थायित्व) दिशा निर्देश, पौधा विविधता संरक्षण एवं कृषक अधिकार प्राधिकरण (पी पी वी एवं एफ आर ए) – नई दिल्ली द्वारा विकसित किया गया है। साथ ही इसे राजपत्र में भी अधिसूचित किया गया और डी यू एस बोधक डेटाबेस को इंडस के साथ सम्मिलित किया गया है। अखिल भारतीय शहतूत समन्वित प्रयोग-चरण III द्वारा जी 4 शहतूत प्रजाति की पहचान एक उच्च कोटि के जीनोटाइप के रूप में हुई है, जो कि अधिक पत्ती देने वाली और अधि कोसा उत्पादक प्रजाति है। जैव सूत्रकृमिनाशी (निमाटिसाइड) निमाहारी का मूल्यांकन किया गया, जो मूल गांठ रोग का प्रभाव 70-80% तक कम करती है तथा पत्ती उपज को 18-26% बढ़ाती है। चामराजनगर में आदर्श रेशम और लैक कृषि उत्पादन का सफलतापूर्वक प्रदर्शन किया गया, जिसके तहत 150 कि.ग्रा. सूखा लैक एकड़/प्रतिवर्ष उत्पादित किया जा सकता है। 1:2.06 लागत लाभ अनुपात में वंशानुगत रेशमकीट को रेशम और कृषि प्रयोग स्टेशन (एस ए ई एस) और बुल्यारिया से एम ओ यू एवं एम ए टी के द्वारा इसे प्राप्त किया गया था। यह रेशमकीट संकर को विकसित करने का एक प्रथम प्रयास है जिसमें रेशम की अधिकतम मात्रा यानी 4ए श्रेणी रेशम होती है। आंध्रप्रदेश और तमिलनाडु के तटवर्ती क्षेत्रों में स्थान विशेष के मूल्यांकन द्वारा उच्च तापमान आद्रता के अनुकूल द्विप्रज संकर की पहचान के लिए अभिनव प्रयास का आरंभ हुआ। उप अनुकूलतम स्थिति के लिए उपयुक्त द्विप्रज द्विसंकर जी11 x जी19 का प्राधिकरण सफलतापूर्वक समाप्त किया गया (5 लाख डी एफ एल, 68 कि ग्रा उपज और 2ए-3ए कोटि का रेशम)। विद्यमान पैतृक नस्लों से हृष्ट पुष्टता (एस एच आर1xडी एच आर4) और उच्च उत्पादकता (एस एच पी 2 एवं डी एच पी 5) हेतु दो नए द्विप्रज संकरों को विकसित किया गया। एस एस आर चिह्नों के सहारे उच्च तापमान सहनशील संकर टी टी 21 x टी टी 56 विकसित किया गया, जिसकी प्यूपीकरण क्षमता >90% है और 20-21% रेशम प्राप्त होता है। क्षेत्रीय एककों में कृषकों के साथ कई नए उच्च उत्पादक रेशमकीट संकरों का सफलतापूर्वक मूल्यांकन करके श्रेष्ठ संकरों की सूची में जोड़े गए। उच्च उत्पादकता (62-78 कि ग्रा डी एफ एल: 6.5 - 7.0 रैंडिट्टा) एवं रेशम गुणवत्ता (2ए) के लिए उन्नत कोसा नस्ल कावेरी गोल्ड (एम वी1 x एस7) का भी मूल्यांकन किया गया। एन बी ए आई आर, बेंगलूरु के सहयोग से जल पैन आकर्षित पद्धति के आधार पर सेक्स फेरोमोन विकसित करने पर ऊजी मक्खी प्रबंधन के लिए एक नया आयाम मिल गया। रेशमकीटों में पेब्रिन रोग की पहचान हेतु आशोधित

लैम्प (लूप - पोषण पदार्थ समतापीय प्रवर्धन) आमापन को मानकीकृत किया गया, जिसमें डी एन ए पृथक्करण, पी सी आर एवं इलेक्ट्रोफोरेसिस सम्मिलित नहीं है। साबित किया गया कि एंथाल्पि के आधार पर रेशमकीट पालन गृहों की संरचना करने पर प्रतिकूल परिस्थितियों में अनुकूलतम उत्पादकता हेतु उपयुक्त सूक्ष्म जलवायु उपलब्ध होता है। रेशम उत्पादन विभाग, कर्नाटक की आर्थिक सहायता से 44 कृषकों को लेकर स्व विसंक्रमण प्रौद्योगिकी का सफलतापूर्वक मान्यकरण किया गया। कें रे अ प्र सं, मैसूरु में शहतूत जीनसार (जीनोमिक्स) पर अनुसंधान करने हेतु प्रतिष्ठित रेशम उत्पादन प्रौद्योगिकी एस ई आर वी रामानुजम फेलोशिप के तहत शोध कार्य किया जा रहा है, जो कें रे बो में एक नया प्रयास है। यह उल्लेखनीय उपलब्धि संस्थान और इसके कार्मिकों के स्वर्णिम इतिहास के द्वारा ही संभव हुआ है।

कर्नाटक में रेशम उत्पादकों के संगठन की स्थापना से भारतीय रेशम उत्पादन में नए युग का आरंभ हुआ है और कें रे अ प्र सं, मैसूरु एवं रेशम उत्पादन विभाग - कर्नाटक के संयुक्त प्रयासों से यह संभव हुआ। केंद्रीय क्षेत्र योजना की आर्थिक सहायता के तहत कृषकों के कौशल विकास हेतु गावों में 4 रेशम उत्पादन संसाधन केंद्रों की स्थापना हुई। 5 वाणिज्यिक चॉकी कीटपालन केंद्रों की अवसंरचना हेतु सहायता राशि दी गई। विस्तृत अंतराल में शहतूत वृक्ष कृषि हेतु चामराजनगर के सं ग्रा सं का के कृषकों के साथ कम लागत की सूक्ष्म सिंचाई प्रौद्योगिकी की स्थापना की गई। गुणवत्ता वाले द्विप्रज कोसा उत्पादन पर 2350 विस्तारण संचार कार्यक्रमों के माध्यम से 1.5 लाख रेशम उत्पादकों को उन्नत प्रौद्योगिकियों से अवगत कराया गया। एम किसान, आदर्श रेशम ग्राम, कृषि मेला जैसे विभिन्न कार्यक्रमों के माध्यम से रेशम उत्पादन प्रौद्योगिकी का प्रचार-प्रसार किया गया। विभिन्न क्षमता निर्माण एवं उद्यमी विकास कार्यक्रमों के अधीन 3000 लाभार्थियों को प्रशिक्षित करके शहतूत रेशम उत्पादन क्षेत्र में कुशल मानवशक्ति विकसित करने का काम जारी रखा गया।

कृषकों के लाभ के लिए उत्पादों का सूत्रीकरण कें रे अ प्र सं, मैसूरु के महत्वपूर्ण कार्यकलापों में से एक है। तदानुसार, शहतूत में मूल विगलन रोग नियंत्रण हेतु पौधों को 65-80% पुनर्जीवित करने वाला सूत्रीकरण रॉट-फिक्स और मृदा उर्वरता, शहतूत पत्ती उपज एवं कोसा उपज बढ़ाने का सूत्रीकरण डॉ. साँडल विकसित करके प्रयोग में लाया गया। स्फुर्ति (शहतूत स्वास्थ्य पेय) के लिए और प्लास्टिक सिमटने वाली चंद्रिका से कोसा प्राप्त करने हेतु एक मशीन, पारि-अनुकूल एवं कीटपालन शय्या विसंक्रामक अंकुश और शहतूत में पोषक तत्वों की कमियाँ सुधारने हेतु बहु-पोषक सूत्रीकरण पोषण को वाणिज्यीकृत किया गया।

अंत में, मैं कें रे बो के प्राधिकारियों, कें रे अ प्र सं, मैसूरु के कर्मचारियों और अग्रणी राज्यों के रेशम उत्पादन विभाग तथा सभी हितधारकों को उनके सतत उत्साह, सहयोग और प्रतिबद्धताओं के लिए धन्यवाद देता हूँ। कें रे अ प्र सं, मैसूरु भारत के द्विप्रज कच्चे रेशम की माँग पूरा करते हुए रेशम उत्पादन में आत्म निर्भर होने तथा सुस्थिर शहतूत रेशम उत्पादन हेतु अनुकूल शहतूत उपजातियाँ, अधि उत्पादक एवं स्वस्थ रेशमकीट संकरों, कृषकों के लिए हितकर एवं लागत प्रभावी रेशम उत्पादन प्रौद्योगिकियों को विकसित करने तथा काम में नीरसता दूर करने हेतु यंत्रों की परिकल्पना करने, बेहतर प्रौद्योगिकी स्थानांतरण करने और हितधारकों को रेशम उत्पादन में कुशल बनाने की दिशा में कार्य करते रहेंगे। हम रेशम उत्पादन उद्योग के लिए और समाज के हित में अच्छा काम करते रहेंगे, क्रियाशील रहेंगे और इस दिशा में निरंतर दृढ़ता से आगे बढ़ते रहेंगे।

वी. शिवप्रसाद  
(डॉ. वी शिवप्रसाद)  
निदेशक

## FOREWORD

The most demanding target identified in Central Silk Board's Vision 2020 states that our country has to cross 5000MT bivoltine raw silk production by 2017 for which CSRTI-Mysuru had contributed handsomely (4285MT) through its well-established machinery and zeal. This was possible through the implementation of Bivoltine Cluster Promotion, Seri Model Village and Transfer of Technology programmes by CSRTI-Mysuru in coordination with State Department of Sericulture in the command area including Karnataka, Andhra Pradesh, Kerala, Tamil Nadu, Telangana, Maharashtra and Madhya Pradesh.

CSRTI-Mysuru Annual Report for the year 2016-17 represents the R&D activities undertaken in various fields of specialization and outcome to fuel further improvements in mulberry sericulture sector benefiting all the stakeholders. CSRTI-Mysuru is augmenting PMs Soil Health Mission by issuing Soil Health Cards to 10007 sericulture farmers with an information on how to improve soil fertility status for successful mulberry cultivation. Mulberry DUS (Distinctiveness, Uniformity, Stability) guidelines were developed and duly approved through a gazette notification (Plant Variety Journal of India) by Protection of Plant Varieties & Farmers' Rights Authority (PPV&FRA)-New Delhi and DUS descriptors database was incorporated into INDUS. G4 mulberry variety was identified as superior genotype for leaf yield and cocoon production through AICEM-Phase III. "Nemahari", a bio-nematicide was evaluated for the management of root knot disease with an efficacy of 70-80% reduction in root knot incidence and improved leaf yield by 18-26%. Silk & Lac Farming Model was successfully demonstrated in Chamarajanagar to produce 150kg stick-lac/acre/year with a cost-benefit ratio of 1:2.06. Silkworm genetic resources were procured from Sericulture & Agriculture Experiment Station (SAES)-Bulgaria through MoU and MAT, one of the first of its kind to develop new silkworm hybrids with higher silk content and >4A grade silk. A novel way to identify bivoltine hybrids suitable for high temperature and high humidity was initiated through hot-spot evaluation in the coastal regions of Andhra Pradesh and Tamil Nadu. G11 x G19, a bivoltine double hybrid suitable for sub-optimal conditions (5 lakh dfls; 68 kg/100 dfls yield with 2A-3A silk) authorization trials were concluded successfully. Two new sets of bivoltine hybrids for robustness (SHR1 & DHR4) and higher productivity (SHP2 & DHP5) were identified utilizing existing parental breeds. Generated data for regulatory approval of transgenic bivoltine hybrid, CSR2 (T) x CSR4 exhibiting BmNPV tolerance through RNAi approach (900 dfls; Yield/100 dfls: 62.14kg). A thermo-tolerant hybrid, TT21 x TT56 was evolved with >90% pupation and 20-21% silk content utilizing SSR marker assisted selection with an ability to survive at higher temperatures. Several new silkworm hybrids were also evaluated at farm-based units and with farmers successfully to add to the list of superior hybrids for the improved productivity. Cauvery Gold (MV1 x S8), an ICB for productivity (62-78 kg/100 dfls; 6.5-7.0 renditta) and silk quality (2A) was further evaluated. A major breakthrough in Uzi-fly management was accomplished through the development of a sex pheromone based water pan trap in collaboration with NBAIR-Bengaluru. Modified LAMP (Loop-Mediated Isothermal Amplification) assay was standardized for the detection of pebrine in silkworms which does not involve DNA isolation, PCR and Electrophoresis. It was revelation to find that enthalpy based designing of silkworm rearing houses would provide suitable micro-climate for optimal productivity in adverse conditions. Automated Disinfection Technology was validated successfully with 44 farmers through financial assistance from DoS-Karnataka. CSRTI-Mysuru also hosts a prestigious DST-SERB Ramanujan Fellowship to carry out research on mulberry genomics, which is a first of its kind in Central Silk Board. These remarkable achievements are due to the systematic path that was threaded into institute's history and its employees.

A new era has dawned in Indian Sericulture with the establishment of Seri-Farmers Producers Organization (FPO) in Karnataka and CSRTI-Mysuru joined hands with DoS-Karnataka in making this happen. As a part of Central Sector assistance, established 4 Sericulture Resource Centres (SRC) in the villages to improve the farmers skills at their own place; Assisted for equipping 5 Commercial Chawki Rearing Centres (CRC); established Affordable Micro-Irrigation Technology (AMIT) with IVLP farmers in Chamarajanagar for tree mulberry cultivation under wider spacing. As usual, 1.5 lakh sericulturists were empowered with improved technologies through 2350 extension communication programmes on quality bivoltine cocoon production. Various media were utilized to spread the sericulture technology including m-KISAN, Adarsh Resham Gram, Krishimelas. Generation of skilled manpower for mulberry sericulture sector was continued vigorously with the training of around 3000 beneficiaries under various capacity building and entrepreneurship development programmes.

Product formulation for the benefit of farmers is one of the important activities for CSRTI-Mysuru; accordingly Rot-fix, a formulation for the control of root rot disease in mulberry with 65-80% revival and Dr. SOIL, a formulation for improvement of soil fertility, mulberry leaf yield & silkworm cocoon yield were developed and introduced. Patent was obtained for Spoorthi (a mulberry health drink) and a machine for harvesting cocoons from plastic collapsible mountages; Ankush, an eco and user-friendly silkworm body and rearing seat disinfectant and Poshan, a multi-nutrient formulation for correcting nutrient deficiencies in mulberry were commercialized.

Finally, I would like to thank the CSB authorities; employees of CSRTI-Mysuru and of State Sericulture Department in the commanding states; and all stakeholders for their consistent encouragement, cooperation and commitment, engagement in our journey and for accompanying us on the exciting journey ahead. CSRTI-Mysuru will continue to focus on R&D for evolving adaptive mulberry varieties, productive and robust silkworm hybrids, farmer-friendly and cost-effective sericulture technologies, designing of machines for drudgery reduction, executing active transfer of technology and assist in developing sericulture skills to the stakeholders to attain self-sufficiency in India's bivoltine raw silk demand and drive sustainable mulberry sericulture. We will continuously seek and strive to do good, act better and do what is best for the sericulture industry and society at large.



(Dr. V. Sivaprasad)  
Director

## कें रे अ प्र सं, मैसूरु के बारे में

केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, मैसूरु केंद्रीय रेशम बोर्ड, वस्त्र मंत्रालय, भारत सरकार के 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 अच्छी सेवाएँ समर्पित कर रहा है। संस्थान को आई एस ओ 9001:2008 से प्रमाणित (2013) किया गया है जो रेशम उत्पादन उद्योग के विकास हेतु अनुसंधान व विस्तारण में गुणवत्ता प्रबंधन और समर्थन सेवाओं में उत्कृष्टता के लिए हमारी वचनबद्धता का प्रमाण है।

आज यह संस्थान अनुभवी वैज्ञानिकों, समस्त आधुनिक सुविधाओं एवं अवसरचनयुक्त रेशम उत्पादन अनुसंधान के उत्कृष्ट प्रमुख संस्थान के रूप में विख्यात है। इस संस्थान ने देश तथा विदेश में उष्णकटिबंधीय रेशम उत्पादन में अग्रणी अनुसंधान व विकास संस्थान के रूप में यश प्राप्त किया है और इसे 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 करने हेतु रेशम उत्पादन अनुसंधान व विकास संबंधी सभी कार्यकलापों को करता है। अभी तक इस संस्थान ने रेशम उत्पादन प्रौद्योगिकी के विभिन्न पहलुओं में 800 विदेशियों सहित करीब 50,000 व्यक्तियों को प्रशिक्षित किया है। यह संस्थान अनुसंधान, प्रशिक्षण एवं विस्तारण कार्य संचालित करने के अलावा राष्ट्रीय एवं अंतर्राष्ट्रीय अभिकरणों को परामर्श एवं सलाहकारी सेवाएँ भी प्रदान करता है।

दृष्टि	
द्विप्रज रेशम उत्पादन में श्रेष्ठ अंतर्राष्ट्रीय रेशम उत्पादन संस्थान बनाना	
लक्ष्य	उद्देश्य
भारतीय रेशम उत्पादन उद्योग को आजीविका स्तर के उत्पादन से वाणिज्यिक उत्पादन के आधार में परिणत करने हेतु अनुप्रयोग आधारित अनुसंधान में श्रेष्ठता हासिल करना।	<ul style="list-style-type: none"> <li>• भारतीय रेशम का उत्पादन, उत्पादकता एवं गुणवत्ता बढ़ाने हेतु अनुसंधान।</li> <li>• शहतूत एवं रेशम कीटपालन के लिए पैकेज प्रणाली विकसित करना।</li> <li>• उत्पादों और प्रौद्योगिकियों का वाणिज्यीकरण।</li> <li>• प्रौद्योगिकी स्थानांतरण।</li> <li>• प्रौद्योगिकी स्थानांतरण के माध्यम से आयातित रेशम के बदले रेशम उत्पादन बढ़ाना।</li> <li>• प्रशिक्षण।</li> <li>• अनुसंधान कार्यक्रमों के समर्थन के लिए संस्थान के ढाँचे को मजबूत बनाना।</li> <li>• प्रजनक स्टॉक का अनुरक्षण।</li> <li>• रोग पूर्वानुमान एवं पूर्वसूचना।</li> <li>• अनुसंधान एवं विकास अभिनवों और पैकेज प्रणाली का प्रकाशन।</li> <li>• भारत और विदेश में अन्य अनुसंधान व विकास संगठनों के साथ सहयोगी अनुसंधान।</li> </ul>

### 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, समाज शास्त्रियों एवं अर्थशास्त्रियों सहित करीब 150 वैज्ञानिकों से समर्थित है। ये कार्मिक कर्नाटक, तमिलनाडु, आंध्र प्रदेश, तेलंगाना, केरल, महाराष्ट्र और मध्यप्रदेश राज्यों के मुख्य संस्थानों और संबद्ध एककों के माध्यम से समुचित प्रौद्योगिकियों के विकास और उनके स्थानांतरण हेतु समन्वय से कार्य कर रहे हैं। अनुसंधान व विकास कार्यकलाप और प्रौद्योगिकी विकास कार्य चार प्रमुख प्रभागों यथा पोषी पादप, रेशमकीट, 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

कार्यकलाओं की प्रगति का अनुवीक्षण करते हैं। राष्ट्रीय एवं अंतर्राष्ट्रीय पत्रिकाओं में प्रकाशित तकनीकी एवं अनुसंधान शोध – पत्रों के अलावा 77 पुस्तकें भी प्रकाशित की गई हैं। संस्थान को अंतर्राष्ट्रीय ख्याति की द्वि वार्षिक पत्रिका इंडियन जर्नल ऑफ सेरिकल्चर और रेशम उत्पादन विज्ञान पर दस्तावेज़ी सहित्य सेरिडॉक प्रकाशित करने की प्रतिष्ठा प्राप्त हुई।  
**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 (कें रे अ कें), अनुसंधान विस्तारण केंद्र और उप एकक दक्षिणी राज्यों के मुख्य रेशम उत्पादन आँचलों 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, 106 समूहों (समूह संवर्धन कार्यक्रम) और ग्यारह सं ग्रा सं का केंद्रों का समन्वयन करता है। राज्य रेशम उत्पादन विभागों के तकनीकी कार्मिकों के समन्वयन में 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 पी एच डी कार्यक्रम संचालित करने हेतु मैसूर विश्वविद्यालय से संबद्ध है। यह संस्थान ग्रामीण गरीब लोगों, कमजोर वर्गों और महिला रेशम उत्पादकों के सामाजिक-आर्थिक विकास के लिए और प्रौद्योगिक सशक्तीकरण हेतु जैव प्रौद्योगिकी विभाग एवं विज्ञान व प्रौद्योगिकी विभाग, भारत सरकार द्वारा प्रायोजित विभिन्न प्रशिक्षण कार्यक्रम संचालित करते हैं। यह संस्थान राज्य रेशम उत्पादन विभागों की मानव संसाधन विकास आवश्यकताओं को पूरा करने के अलावा जापान अंतर्राष्ट्रीय रेशम उत्पादन प्रशिक्षण कार्यक्रम भी 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 बाग और कीटपालनगृह।
- प्रौद्योगिकी मान्यकरण एवं किसानों को प्रशिक्षण देने हेतु बड़े पैमाने पर कीटपालन गृह।
- चाँकी कीटपालन केंद्र संकल्पना को बढ़ावा देने हेतु आदर्श चाँकी कीटपालन केंद्र।
- यंत्रों/उपस्करों के अभिकल्प एवं विकास तथा संरचना को समर्थित करने हेतु सभी सुविधाओं से युक्त रेशम उत्पादन अभियांत्रिकी प्रभाग।
- संबद्ध एककों, रेशम उत्पादन विभागों और अन्य संगठनों के साथ प्रभावी पारस्परिक संपर्क के लिए कें रे अ प्र सं, मैसूरु में संस्थापित विडीयो सम्मेलन स्टुडियो, प्रौद्योगिकी का तेजी से संप्रेषण एवं प्रभावी स्थानांतरण सुनिश्चित करता है।
- कंप्यूटर सेन्टर द्वारा लान के माध्यम से प्रिंट/फाइल शेयर समर्थन सहित सभी को इन्टरनेट कनेक्शन दिया गया है।
- जैव सूचना विज्ञान केंद्र आंकड़े संचय की पुनः प्राप्ति सेवा प्रदान करता है।
- पुस्तकालय सेवाएँ (11048 पुस्तकें, 7582 वैज्ञानिक पत्रिकाओं का बंध खंड, 70 पत्रिकाएँ, शोध पत्र 293, प्रबंध - 47 तकनीकी रिपोर्ट एवं सी डी राम डेटा बेस-एग्रिस, बयोसिस बयोटेक्नॉलजी साइटेशन इन्डेक्स, एकस्व)।

## ABOUT CSRTI-MYSORE

The Central Sericultural Research & Training Institute (CSRTI), Mysore was established under the aegis of Central Silk Board, Ministry of Textiles: Govt. of India. The institute started functioning at Channapattana in the year 1961 after taking over the Sericulture Research Institute of erstwhile Mysore province and later shifted to Mysore in the year 1963. With the inclusion of training component, the Institute was renamed as 'Central Sericultural Research & Training Institute (CSRTI), Mysore' in the year 1965. The Institute has completed >60 years of dedicated service for the development of sericultural industry in the country. The Institute is accredited with ISO 9001: 2008 certification (2013) as a testimony of excellence in quality management in R & D, training and service support to sericulture Industry.

The Institute has the distinction of being premier institution for sericulture research par excellence with all modern facilities and infrastructure including experienced scientific personnel. CSRTI has made mark as a leading R & D institution for quality research and services on tropical sericulture in the country and abroad and is well recognized as center for higher learning and advanced training. CSRTI caters to the need of on-farm sector of mulberry sericulture in Karnataka, Andhra Pradesh, Tamil Nadu, Telangana, Kerala, Maharashtra and Madhya Pradesh. To date CSRTI trained about 52,100 persons including 820 foreign nationals in various aspects of sericulture technology. The institute besides conducting research, training and extension activities, also offers consultancy and advisory services to national and international agencies.

<b>Vision</b>	
To become an International Sericulture Institute par-excellence in Bivoltine Sericulture	
<b>Mission</b>	<b>Objectives</b>
To achieve excellence in application oriented research to transform Indian Sericulture industry from the subsistence level of production to a vibrant competitive commercial production base	<ul style="list-style-type: none"> <li>● Research to enhance production, productivity and quality of Indian silk</li> <li>● Development of package of practices for mulberry and silkworm rearing</li> <li>● Commercialization of products and technologies</li> <li>● Transfer of technology</li> <li>● Enhance production of import substitute silk through transfer of technology</li> <li>● Training</li> <li>● Strengthening institutional framework to support research programmes</li> <li>● Maintenance of breeders stock</li> <li>● Disease forecasting and forewarning</li> <li>● Publication of R&amp;D innovations and package of practices</li> <li>● Collaborative research with other R&amp;D organizations in India and abroad</li> </ul>

### Organization Setup

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

bulletins, leaflets and technical pamphlets. Over 77 books have been brought out so far in addition to large number of technical and research papers published in leading national and international journals. The institute has the distinction of publishing Indian Journal of Sericulture, a biannual journal of international repute and Seridoc - documenting literature on sericultural sciences.

### **Extension Network**

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

### **Training Centre**

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

### **Infrastructure Facilities**

- Well-equipped laboratories, mulberry gardens and rearing houses to carry out advanced research
- Large scale rearing houses for technology validation and farmers' training
- Model chawki rearing centre (CRC) to promote the concept of CRC
- Engineering Division with excellent facilities to support designing, development and fabrication of machines /equipments
- Video Conference Studio @ CSRTI, Mysore ensures faster communication and efficient transfer of technology for effective interactions with nested units, DOSs and other organizations
- Computer center provides internet connectivity to all through LAN with print/file share support
- Bioinformatics Center (NBN Sub-DIC: DBT) provides database retrieval services
- Library Services (11048 books; 7582 bound volumes of scientific journals; 70 journals; dissertations- 293; theses-47; technical reports and CD-ROM database-AGRIS, BIOSIS, BIOTECHNOLOGY CITATION INDEX, EKASWA)

## वर्ष 2016-17 की उपलब्धियों के मुख्यांश

आंध्र प्रदेश, कर्नाटक, केरल, तमिल नाडु, तेलंगाना, महाराष्ट्र एवं मध्य प्रदेश राज्यों के शहतूत रेशम उत्पादन कृषकों की आवश्यकताओं की पूर्ति करने हेतु प्रौद्योगिकियाँ विकसित करने के लिए शहतूत और रेशमकीट प्रजनन, फसल उत्पादन एवं संरक्षण, प्रौद्योगिकी स्थानांतरण, विस्तारण एवं प्रशिक्षण कार्यक्रमों पर अनुसंधान एवं विकास कार्यक्रम संचालित किए गए हैं। मुख्य संस्थान तथा संबद्ध इकाओं की प्रमुख उपलब्धियाँ निम्नानुसार हैं।

### शहतूत फसल सुधार, उत्पादन एवं संरक्षण

- अखिल भारतीय शहतूत समन्वित प्रयोग चरण-111 के अंतर्गत जी-4 शहतूत उपजाति ने अधिक पत्ती उपज दर्ज की और अन्य परीक्षण उपजातियों की अपेक्षा कीटपालन जैव आमापन में उनका निष्पादन अच्छा रहा।
- पी पी वी एवं एफ आर ए (पादप उपजाति संरक्षण एवं कृषक अधिकार प्राधिकारी) द्वारा प्रामाणिक निरूपकों एवं तैतालीस उपजातियों से शहतूत के लिए (विशिष्टता, समानता, स्थिरता) दिशा निर्देश राजपत्र (प्लान्ट वेराइटी जर्नल ऑफ इंडिया, खंड-10, सं.10) में प्रकाशित किया गया। शहतूत के लिए डी यू एस निरूपकों का आँकड़ा संचय और दिशा निर्देश विकसित किए गए और इन्डस, में सम्मिलित किया गया कें रे अ प्र सं, बहरमपुर के साथ कें रे अ प्र सं, मैसूरु नोडल डी यू एस परीक्षण केंद्रों के रूप में कार्य करेगा।
- मूल विगलन रोग प्रतिरोध शक्ति के अभिलक्षण हेतु अपसारी (डाइवेर्जेंट) जीनप्ररूप (आर) मोरस मल्टिकौलिस (एम ई 0006) x (एस) थाइलैंड मेल (~1900 संतति) x (आर) ए मल्टिकौलिस (एम ई 0168) x (एस) थाइलैंड मेल (~1700 संतति) (एस) पंजाब लोकल (आर) एम काथियाना संकर (~1000 संतति) का उपयोग करते हुए मूल विगलन प्रतिरोध शक्ति का मानचित्रण जीव संख्या विकसित की गई।
- मूल विगलन एवं मूलगाँठ प्रतिरोध शक्ति दर्शाने वाले >10,000 संकर जीव संख्या में से कृत्रिम संरोप द्वारा साठ आशाजनक संकरों का चयन किया गया।
- मेलॉइडोगाइन इनकानिटो द्वारा उत्पन्न मूल गाँठ रोग के प्रबंधन के लिए जैव – सूत्र कृमिनाशी “निमाहारी” का क्षेत्र पर मूल्यांकन किया गया, जिसे मूल गाँठ रोग को 70-80% कम करने तथा पत्ती उपज को 18-26% बढ़ाने की क्षमता है।
- मूल विगलन रोग के विरुद्ध वनस्पतिकों और वैकल्पिक फफूँद नाशियों से युक्त नया सूत्रीकरण रोट – फिक्स विकसित किया गया, जिससे मूल विगलन रोग ग्रस्त शहतूत पौधों को 65-80% रोग मुक्त कर दिया गया और संक्रमण के प्रारंभ में अनुप्रयोग किए जाने पर 100% रोग मुक्त हो गया।
- चामराजनगर (कर्नाटक) में विस्तृत अंतराल की वृक्ष शहतूत कृषि के लिए आर्द्रता प्रतिबल उपजाति (एस-13) को लेकर संस्थान ग्राम संबद्ध कार्यक्रम कृषकों के साथ 80:20 पैटर्न में सूक्ष्म सिंचाई प्रौद्योगिकी की स्थापना की।
- चामराजनगर (कर्नाटक) में 1:2.06, के लागत लाभ अनुपात में सिल्क व लैक कृषि नमूने का सफल प्रदर्शन किया गया (1:1.74)। लगभग 150 कि.ग्रा. स्टिक-लैक (एकड़/वर्ष) का फसल काटकर रु. 46750 की अतिरिक्त आय प्राप्त की जो मात्र शहतूत कृषि करने से प्राप्त होने वाले आय से अधिक है।
- कर्नाटक, आं प्र, तेलंगाना, महाराष्ट्र एवं तमिलनाडु के जल प्रतिबल क्षेत्रों में जी4, एस 13 एवं वी1 उपजातियों को लेकर वृक्ष शहतूत कृषि को लोकप्रिय बनाया जा रहा है। शहतूत कृषि, सिंचाई एवं कनोपि प्रबंधन पर श्रव्य दृश्य साधन विकसित किया गया।
- प्रधानमंत्री मृदा स्वास्थ्य मिशन के अंतर्गत कर्नाटक, आं प्र, तेलंगाना, महाराष्ट्र, मध्य प्रदेश और तमिल नाडु में 10,007 रेशम उत्पादन कृषकों को मृदा स्वास्थ्य कार्ड जारी किए गए।
- डॉ सोइल एक जैव द्रव उर्वरक है जो सूक्ष्म एवं स्थूल पोषक तत्वों से युक्त सूक्ष्म जैविक संकाय है। सर्वश्री माइक्रोबि एग्रोटेक प्राइवेट लिमिटेड, बेंगलूरु के साथ बनाई परामर्शी परियोजना द्वारा) मृदा स्वास्थ्य एवं उर्वरता

स्थिति सुधारने के अलावा शहतूत पत्ती उत्पादकता बढ़ाने हेतु भी डॉ सोइल की सिफारिश की गई

- नई शहतूत उपजातियों को लोकप्रिय बनाने हेतु जी 2, जी 4, एम एस जी 2 एवं ए जी बी-8 के बीच बागानों की स्थापना की।

### रेशमकीट फसल विकास, उत्पादन एवं संरक्षण

- आंध्र प्रदेश, कर्नाटक, तमिल नाडु, तेलंगाना एवं महाराष्ट्र में उप अनुकूलतम स्थितियों के लिए उपयुक्त द्विप्रज द्विसंकर जी 11 x जी 19 के 5.01 लाख रो मु बी चकत्तों का प्राधिकरण परीक्षण करने पर 68 कि ग्रा / 100 रो मु बी चकत्तों की औसतन उपज दर्ज की गई जिसकी 2ए-3ए कोटि का रेशम उत्पादित करने की क्षमता है।
- बी एम एन पी वी सहनशील (> संरोपित स्थिति के अधीन > 60% उत्तरजीविता) दो द्विप्रज संकरों (एस एच: सी एस आर 52 एन x सी एस आर 26 एन ; डी एच: सी एस आर 52 एन. एस 8 एन x सी एस आर 16 एन.सी एस आर 26 एन) को पहचाना गया।
- हृष्ट-पुष्टता (एस.एच.आर 1 एवं डी एच आर 4) एवं उच्च उत्पादकता (एस.एच.पी 2 एवं डी एच पी5) के लिए विद्यमान संकरों के पैतृक नस्लों का उपयोग करते हुए प्रचलित वाणिज्यिक द्विप्रज संकरों से श्रेष्ठ नए बहुप्रज संकर संयोजनों को पहचाना गया।
- आर एन ए आई प्रणाली द्वारा बी एम एन पी वी सहनशीलता दर्शाने वाला ट्रान्सजेनिक द्विप्रज संकर, सी एस आर (टी)x सी एस आर4 का मूल्यांकन किया गया। (गैर ट्रान्सजेनिक संकर, सी एस आर2 x सी एस आर4 की 58.75 की तुलना में 900 रो मु बी चकत्ते: उपज/100 रो मु बी च 62.14 कि ग्रा) जिससे कि क्षमता निर्धारित की जा सके और रेगुलैटरी अनुमोदन हेतु आँकड़ा बनाए जा सके।
- रेशम उत्पादन एवं कृषि केंद्र (एस ए ई एस), बलगेरिया से द्विप्रज रेशमकीट आनुवंशिक संसाधन (5 नस्ल एवं 2 संकर) खरीदे गए और उनका संगरोध कीटपालन पूरा किया गया। नस्लों की विशेषता है 90-94% प्यूपीय दर और > 24% कोसा कवच।
- उच्च तापमान एवं बी एम एन पी सहनशील उन्नत संकर नस्लों (आई सी बी) (एल 3 x एस. 8 एवं एच बी 4 x एस 8) का क्षेत्र परीक्षण करने पर >90% प्यूपीय दर, 20-21% कोसा कवच एवं 14-15% कच्चा रेशम दर्ज किया गया।
- आंध्र प्रदेश, कर्नाटक एवं तमिलनाडु के तटवर्ती क्षेत्रों में 77 संकरों का हॉट स्पॉट मूल्यांकन करके उच्च तापमान एवं उच्च आर्द्रता सहनशील 35 द्विप्रज द्वि संकरों का चयन किया गया।
- आंध्र प्रदेश, कर्नाटक एवं तमिलनाडु में एक उच्च उत्पादक द्वि संकर एस8 x सी एस आर16 के 57,900 रो मु बी चकत्तों का मूल्यांकन करने पर 73.38 कि ग्रा/100 रो मु बी चकत्तों की औसतन उपज दर्ज की गई। उच्च कोसा कवच (23.75%) प्रतिशत एवं कम रेंडिट्टा (5.0-5.5) उक्त संकर की विशेषताएँ हैं।
- अनुकूल मौसम के लिए उपयुक्त उत्पादक द्विप्रज द्वि संकर एस एस बी एस5 x एस एस बी एस6 का तमिल नाडु के कृषकों के साथ परीक्षण किए जाने पर 70-75 कि.ग्रा/1400 रो मु बी चकत्तों की औसतन उपज दर्ज की गई।
- कर्नाटक एवं आंध्र प्रदेश के कृषकों को लेकर उत्पादकता एवं रेशम गुणवत्ता (2 ए) के लिए उन्नत संकर नस्ल कावेरी गोल्ड (एम वी1 x एस8) का मूल्यांकन किए जाने पर 62-78 कि.ग्रा/100 रो मु बी चकत्ते की औसतन उपज दर्ज की गई।
- ताप सहनशील द्विप्रज संकरों (डी एच: टी टी 21 x टी टी 56 एवं टी टी 23 x टी टी 67, एस एच:टी टी 21 x टी टी 56) का क्षेत्र परीक्षण करने पर उच्च उत्तर जीविता (>90% प्यूपीय दर) एवं कोसा कवच प्रतिशत (20-21%) के लिए टीटी21 x टी टी56 का निष्पादन बेहतर रहा। एस एस आर चिह्नक के सहारे इन संकरों को विकसित किया गया जो उच्च तापमान (36° से तक) सहनशील है।
- जल पैन ट्रेप द्वारा ऊर्जा मक्खी (एक्सोरिस्टा बोम्बाइसिस) को आकर्षित करने के लिए दो गौण यौगिकों के

साथ (ट्राइकोसेन एवं एन्टाकोसेन) सेक्स फेरोमोन, ट्राइकोसेन को प्रभावी पाया गया।

- संदूषित रेशमकीट अंडों, कीटपालन ट्रे तथा कीटपालन गृह का विसंक्रमण करने हेतु एक नए विसंक्रामक सेरिफिट को दक्षिण भारत के कृषकों के साथ मूल्यांकन किया गया।
- रेशम कीटों में डी एन ए पृथक करण, पी सी आर एवं इलेक्ट्रोफोरेसिस के बिना लैप प्राइमरों का उपयोग करते हुए नोसेमा बोम्बाइसिस को पहचानने हेतु आशोधित लैप (लूप-पोषण पदार्थ समतापीय प्रवर्धन) आमापन का मानकीकरण किया गया।
- दक्षिण भारत के मूल बीज फार्म, रेशम उत्पादन विभाग, कें रे बो एवं समूह संवर्धन केंद्र क्षेत्रों में किए रेशम कीट रोग अनुवीक्षण से पाया गया कि ग्रैस्सरी, फ्लैचरी एवं मस्कार्डिन रोग प्रकोप कम है। किसी भी मूल बीज फार्म या समूह में पेब्रिन प्रकोप दर्ज नहीं किया गया।
- पूर्ण ऊष्मा (एन्थैल्पी) के आधार पर रेशम कीटपालन गृहों की परिकल्पना करने पर कृषक लोग प्रतिकूल परिस्थितियों में उचित सूक्ष्म जलवायु स्थिति प्रदान करते हुए अधिकतम उत्पाद प्राप्त कर सकते हैं।
- कें रे अ प्र सं मैसूरु के क्षेत्रों में यंत्रवत विसंक्रमण प्रौद्योगिकी अपनाकर सफलतापूर्वक मान्यकरण (70.5 कि.ग्रा. कोसा उपज/100 रो मु बीज चकत्ते) किया गया। रेशम उत्पादन विभाग, कर्नाटक की वित्तीय सहायता से 44 कृषकों के यहाँ यूनिट संस्थापित की गई।
- कर्मियों की सुविधा के लिए रेशमकीट बीज उत्पादन केंद्रों में (एस एस पी सी) धूल एकत्रित करने हेतु प्रोटोटाइप मशीन विकसित की।

### प्रौद्योगिकी स्थानांतरण

- आंध्र प्रदेश, कर्नाटक, केरल, तमिलनाडु, तेलंगाना और महाराष्ट्र में द्विप्रज समूह संवर्धन कार्यक्रम (106 समूह) के माध्यम से 291.99 लाख रो मु बी चकत्तों को पालने पर 71.38 कि.ग्रा/100 रो मु बी चकत्तों की औसतन कोसा उपज सहित 3186 मी ट द्विप्रज कच्चे रेशम का रिकार्ड उत्पादन हुआ।
- कर्नाटक, तमिल नाडु, आंध्र प्रदेश, तेलंगाना, महाराष्ट्र एवं मध्य प्रदेश में सं ग्रा सं का (सेरि आदर्श ग्राम) के अंतर्गत विशेष प्रौद्योगिकियाँ अपनाते हुए 8.69 लाख रो मु बी चकत्तों को पालने पर कोसा उपज 14.12% बढ़कर 88 मी ट द्विप्रज कच्चा रेशम उत्पादन हुआ।
- द्विप्रज कीटपालन, शहतूत एवं रेशमकीट रोग प्रबंधन और गुणवत्ता वाले कोसा उत्पादन में 2350 विस्तार संचार कार्यक्रम संचलित करके 1.511 लाख रेशम उत्पादकों को प्रभावित किया।
- जागरूकता कार्यक्रम एवं प्रदर्शन कार्यक्रमों के माध्यम से द्विप्रज रेशम उत्पादन प्रौद्योगिकी को बढ़ावा देने हेतु चार रेशम उत्पादन संसाधन केंद्र संस्थापित (एस आर सी) किए गए।
- दक्षिण भारत के कृषकों को द्विप्रज चाँकी कीटों की आपूर्ति करने हेतु 5 चाँकी कीटपालन केंद्रों को अवसंरचना हेतु आर्थिक सहायता दी गई।
- शहतूत रेशम उत्पादन में एकीकृत सूखा प्रबंधन प्रौद्योगिकियों पर जागरूकता कार्यक्रम आयोजित करने पर उन्हें अपनाने वालों का स्तर 25-30% बढ़ गया और पत्ती एवं कोसा उत्पादकता में वृद्धि हुई।
- दक्षिण भारत के द्विप्रज समूहों में पीड़क एवं रोग प्रबंधन पद्धतियों के प्रभाव से फसल संरक्षण में पर्याप्त विकास हुआ और निवेश आपूर्ति करने हेतु एककों के अभाव के कारण प्रौद्योगिकी को 100% अपना नहीं सकते हैं।
- कर्नाटक में सेरि एफ पी ओ (रेशम उत्पादन कृषक उत्पादक संगठन) संस्थापित किया गया और रेशम उत्पादन विभाग, कर्नाटक के सहयोग से तकनीकी साझेदारी पर प्रशिक्षण एवं कार्य संबंधी दिशानिर्देश पुस्तिकाएँ विमोचित की गई।
- एम-किसान के माध्यम से 50,900 कृषकों को क्षेत्रीय भाषाओं में 96 संदेश भेज दिए गए।

- आंध्र प्रदेश और तेलंगाना के दो जिलों में पीडक एवं रोग प्रबंधन पर साप्ताहिक सेरि एग्रो मेट परामर्श जारी किए गए।
- आकाश वाणी में रेशम उत्पादन प्रौद्योगिकियों पर 39 सप्ताह का प्रायोजित कार्यक्रम रेशमे वाहिनी (08.03.2017 से 29.11.2017 तक) प्रसारित किया गया।
- राष्ट्रीय अनुसंधान विकास निगम, भारत सरकार द्वारा प्रायोजित उद्यमी विकास कार्यक्रम के तहत दस लाभार्थियों को कोसा हार्वेस्टों की आपूर्ति की गई।
- रेशम उत्पादन की संभावनाओं एवं चुनौतियों पर विस्तृत समीक्षा करने हेतु ए ए आर डी ओ (अफ्रीकी-एशियाई ग्रामीण विकास संगठन, नई दिल्ली) एवं आई एस ओ (अंतर्राष्ट्रीय रेशम उत्पादन आयोग) के प्रायोजन में ए ए आर डी ओ के सदस्य राष्ट्रों में रोजगार एवं आय सृजन हेतु रेशम उद्योग की संभावनाओं पर अंतर्राष्ट्रीय कार्यशाला आयोजित की गई (12-16 अप्रैल 2016)।
- दोड्डुबल्लापुरा (कर्नाटक), पेनुकोडा (आं प्र) दिंडिगल (तमिल नाडु) और बारामती (महाराष्ट्र) के कृषकों के लिए रेशम उत्पादन कृषक कार्यशाला आयोजित की गई और कृषकों को उन्नत शहतूत रेशम उत्पादन प्रौद्योगिकियों से अवगत किया गया।
- रेशम उत्पादन कृषकों तथा पदधारियों के हितलाभ के लिए दक्षिण भारत में रेशम उत्पादन के लिए टेकनॉलजी डिस्ट्रिक्टर क्षेत्रीय भाषाओं में प्रकाशित किया गया।
- कें रे अ प्र सं, मैसूरु के प्रारंभ से लेकर "रेशमकीट रोग विज्ञान प्रयोगशाला की उपलब्धियों की झलक" सार संग्रह प्रकाशित किया गया।

## एकस्व और वाणिज्यीकरण

एकस्व एकस्व प्राप्त प्रस्तुत एकस्व रेशम कीटपालन के दौरान सफाई एवं विसंक्रमण हेतु मशीन।	स्फूर्ति, शहतूत स्वास्थ्य पेय  रा आ वि कें (दिनांक 29.08.16 का एकस्व आवेदन पत्र सं. 201641029413)
वाणिज्यीकरण प्लास्टिक सिमटने वाली चंद्रिकाओं से रेशमकीट कोसा एकत्रित करने की मशीन। अंकुश-पारिस्थिति व उपयोगकर्ता अनुकूल रेशमकीट शरीर एवं शय्या विसंक्रमणहारी। पोषण-शहतूत में पोषण तत्वों की कमियाँ दूर करने हेतु बहु पोषक सूत्रीकरण।	सर्वश्री एम ए जी सोल्विक्स प्राइवेट लिमिटेड, कोयंबतूर (20.09.2016) सर्वश्री भोपाल ब्लिच प्राइवेट लिमिटेड (08.11.2016) भोपाल सर्वश्री लिंगा केमिकल्स, मदुरै (15.12.2016)
उत्पाद विकास मृदा उर्वरता, शहतूत पत्ती उपज एवं रेशमकीट कोसा उपज बढ़ाने हेतु सूत्रीकरण-डॉ. सॉइल	सर्वश्री माइक्रोबि एग्रोटेक प्राइवेट लिमिटेड, बंगलूरु (परामर्शी सेवा : 11.01.2017)
रॉट-फिक्स-शहतूत में मूल विगलन रोग नियंत्रण हेतु उत्पाद	रा अ चि न द्वारा वाणिज्यीकृत किया जाना है।

## क्षमता निर्माण एवं प्रशिक्षण

- क्षमता निर्माण एवं प्रशिक्षण के अंतर्गत प्रौद्योगिकी परिचायक कार्यक्रम (टी ओ पी) एवं कृषक कुशलता प्रशिक्षण, (एफएस पी) के माध्यम से 2811 लाभार्थियों (रेशम उत्पादक एवं पदधारी) को प्रशिक्षित किया गया।
- गहन द्विप्रज प्रौद्योगिकी, चॉकी कीटपालन, जैव नियंत्रण कारक उत्पादन, एकीकृत पीड़क एवं रोग प्रबंधन समेत आवश्यकता आधारित कार्यक्रमों में 199 लाभार्थियों (कृषक उद्यमी एवं पदधारी) को प्रशिक्षित किया गया।
- उद्यमियों को चॉकी कीट पालन में प्रशिक्षित कराने हेतु आदर्श चॉकी कीटपालन केंद्र एकक को सम्मिलित किया गया। 73,500 रो मु बी चकत्तों का चॉकी कीटपालन (32 बैच) करके 429 कृषकों को आपूर्ति किया गया जिससे 72.30 कि. ग्रा/रो मु बी चकत्तों की औसतन कोसा उपज दर्ज की गई।
- रेशमकीट प्रजाति अनुरक्षण कार्यक्रम के अंतर्गत रेशम उत्पादन विभाग के पदधारियों को 45 दिन का प्रशिक्षण दिया गया।
- कें रे बो में भर्ती किए गए नए 11 वैज्ञानिकों और क्षेत्र सहायकों समेत सतावन कार्मिकों को एकीकृत द्विप्रज प्रशिक्षण कार्यक्रम में प्रशिक्षण दिया गया।
- जापान समुद्रोपरि सहकारिता (जे ओ सी वी) से दो स्वयं सेवकों को रेशम उत्पादन कार्यकलापों में 30 दिवस का प्रशिक्षण दिया गया।
- बीज अधिनियम पंजीकरण क्रियाविधि के तहत चवालीस उद्यमियों को चॉकी कीटपालन केंद्र के क्रियाकलापों में तीन माह का प्रशिक्षण दिया गया।

## HIGHLIGHTS OF RESEARCH, TRAINING AND EXTENSION ACTIVITIES

### Highlights of Achievements

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

### Mulberry Crop Improvement, Production and Protection

- G4 mulberry variety recorded superior leaf yield and performed better in rearing bioassay than the remaining test varieties under AICEM-Phase III.
- DUS (Distinctiveness, Uniformity, Stability) guidelines for Mulberry were gazetted (Plant Variety Journal of India, Vol.10, No.10) by PPV & FRA (Protection of Plant Varieties & Farmers' Rights Authority), New Delhi with validated descriptors and forty three example varieties. A database of DUS descriptors for mulberry and guidelines were developed and incorporated into INDUS. CSRTI-Mysuru along with CSRTI-Berhampore would function as nodal DUS-test centres.
- Mapping population for root rot resistance utilizing divergent genotypes:(R) *Morus multicaulis* (ME-0006) x (S) Thailand Male (~1900 progeny); (R) *M. multicaulis* (ME-0168) x (S) Thailand Male (~1700 progeny); (S) Punjab Local x (R) *M. cathayana* hybrid (~1000 progeny) was developed for further characterization of root rot resistance.
- Sixty promising hybrids were short-listed through artificial inoculation from >10,000 hybrid populations exhibiting root rot and root knot resistance.
- "Nemahari", a bio-nematicide was evaluated in the field for the management of root knot disease caused by *Meloidogyne incognita* with an efficacy of 70-80% reduction in root knot and improved leaf yield by 18-26%.

- Rot-fix, a new formulation consisting of botanicals and alternative fungicides was developed against root rot disease revived root rot-diseased mulberry plants by 65-80% and the revival was upto 100% in case of early infections.
- Affordable Micro-Irrigation Technology (AMIT) was established with IVLP farmers in Chamarajanagar (Karnataka) on 80:20 sharing pattern for tree mulberry cultivation under wider spacing utilizing moisture stress-tolerant variety (S13).
- Silk & Lac Farming model was demonstrated successfully in Chamarajanagar (Karnataka) with a cost-benefit ratio of 1:2.06, which is higher than mulberry solo crop (1:1.74). About 150kg stick-lac (acre/year) was harvested with an additional income of Rs.46750.
- Tree mulberry cultivation is being popularized in water-stress areas of Karnataka, Andhra Pradesh, Telangana, Maharashtra and Tamil Nadu with G4, S13 and V1 varieties. Audio-visual aid on tree mulberry cultivation, irrigation and canopy management was developed.
- Soil Health Cards were issued to 10007 sericulture farmers in Karnataka, Andhra Pradesh, Telangana, Maharashtra, Madhya Pradesh and Tamil Nadu under PM's Soil Health Mission.
- Dr Soil is an organic liquid fertilizer containing microbial consortia with macro- and micro-nutrients. Dr Soil was recommended for improved mulberry leaf productivity besides improving the soil health and fertility status through a consultancy project with M/S. Microbi Agrotech Pvt. Ltd., Bangalore.
- Established seed gardens of G2, G4, MSG2 and AGB8 for popularizing new mulberry varieties.

### **Silkworm Crop Improvement, Production and Protection**

- Authorization trials of 5.01 lakh dfls of G11 x G19, bivoltine double hybrid suitable for sub-optimal conditions recorded an average yield of 68 kg/100 dfls with 2A-3A graded silk in Andhra Pradesh, Karnataka, Tamil Nadu, Telangana and Maharashtra.
- Two bivoltine hybrids (SH: CSR52N x CSR26N; DH: CSR52N.S8N x CSR16N.CSR26N) tolerant to BmNPV (>60% survival under inoculated conditions) were identified.
- New bivoltine hybrid combinations superior than the popular commercial bivoltine hybrids were identified for robustness (SHR1 & DHR4) and higher productivity (SHP2 & DHP5) utilizing the parental breeds of existing hybrids.
- Transgenic bivoltine hybrid, CSR2 (T) x CSR4 exhibiting BmNPV tolerance through RNAi approach was evaluated (900 dfls; Yield/100 dfls: 62.14kg against 58.75 in non-transgenic hybrid, CSR2 x CSR4) for establishing efficacy and generating data for regulatory approval.
- Bivoltine silkworm genetic resources (5 breeds & 2 hybrids) were procured from Sericulture & Agriculture Experiment Station (SAES), Bulgaria and their quarantine rearing was completed. The breeds are characterized by 90-94% pupation and >24% shell.
- OST of ICBs (L3 x S8 & HB4 x S8) tolerant to high temperature & BmNPV recorded >90% pupation, 20-21% shell & 14-15% raw silk.
- 35 bivoltine double hybrids exhibiting tolerance to high temperature and high humidity were short-listed through hot-spot evaluation of 77 hybrids in the coastal regions of Andhra Pradesh and Tamil Nadu.
- S8 x CSR16, a productive bivoltine single hybrid was evaluated in the field recorded an average yield of 73.38 kg/100 dfls in Andhra Pradesh, Karnataka and Tamil Nadu covering 57900 dfls. The hybrid is characterized by higher shell (23.75%) and lower renditta (5.0-5.5).
- SSBS5 x SSBS6, a productive bivoltine double hybrid suitable for favourable seasons (16500 dfls) recorded an average yield of 70-75kg/100 dfls with farmers in Tamil Nadu.
- Cauvery Gold (MV1 x S8), an ICB for productivity (6.5-7.0 renditta) and silk quality (2A) recorded a cocoon

yield of 62-78 kg/100 dfls at an average of 70kg/100 dfls covering 62,300 dfls with farmers in Karnataka and Andhra Pradesh.

- OST of thermo-tolerant bivoltine hybrids (DH: TT21 x TT56 & TT23 x TT67; SH: TT21 x TT56) showed that TT21 x TT56 performed better for higher survival (>90% pupation) and shell content (20-21%). These hybrids were developed employing SSR marker assisted selection with an ability to survive at higher temperatures (upto 36°C).
- Sex pheromone, Tricosene was found effective in attracting the uzi fly (*Exorista bombycis*) in association with two minor compounds (Tricosane & Pentacosan) through water pan trap.
- SERIFIT, a new general disinfectant for the disinfection of contaminated silkworm eggs, rearing trays and rearing house was evaluated effectively with the farmers in South India.
- Modified LAMP (Loop-Mediated Isothermal Amplification) assay was standardized for the detection of *Nosema bombycis* in silkworms using LAMP primers without involving DNA isolation, PCR and Electrophoresis.
- Silkworm disease monitoring in the BSFs DoS and CSB and CPP areas in South India revealed very low incidence of grasserie, flacherie and muscardine. No pebrine incidence was recorded in any of the BSFs and clusters.
- Enthalpy based designing of silkworm rearing houses would benefit the farmers to achieve optimal productivity by providing suitable micro-climate in adverse conditions.
- Automated Disinfection Technology was fine-tuned and validated successfully (70.5kg cocoon yield/100 dfls) at RSRs of CSRTI-Mysuru. The units were also established with 44 farmers through financial assistance from DoS-Karnataka.
- A prototype machine for collection of dust in Silkworm Seed Production Centres (SSPCs) was developed for the well-being of working personnel.

### Transfer of Technology

- A record quantity of 3186MT bivoltine raw silk was produced through Bivoltine Cluster Promotion Programme (106 clusters) in Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, Telangana, Maharashtra and Madhya Pradesh from 291.99 lakh dfls rearing with an average cocoon yield of 71.38 kg/100 dfls.
- 88MT bivoltine raw silk was produced by rearing 8.69 lakh dfls with an improvement in cocoon yield by 14.12% by 100% adoption of specified technologies under IVLP (Seri Model Village) Programme in Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Madhya Pradesh and Maharashtra.
- 1.511 lakh sericulturists were sensitized with new technologies through 2350 extension communication programmes in bivoltine rearing, mulberry and silkworm disease management and quality cocoon production.
- Four Sericulture Resource Centres (SRCs) were established to promote bivoltine sericulture technology through awareness and demonstration programmes.
- Infrastructure assistance was provided to 5 CRCs to promote supply of bivoltine chawki worms to the farmers in South India.
- Awareness programmes conducted on integrated drought management technologies in mulberry sericulture improved the adoption level by 25-30% and resulted in improved leaf and cocoon productivity.
- Impact of pest & disease management practices in South Indian bivoltine clusters revealed significant improvement in crop protection and lack of input supply units as major constraint in 100% adoption of technologies.
- Establishment of Seri-FPO (Sericulture Farmer's Producers Organization) in Karnataka, development of

Manuals on Training and Working Guidelines and technical partnering with Dos-Karnataka.

- 96 messages in regional languages were communicated to 50900 farmers through m-Kisan.
- Weekly Seri Agro Met advisories on pest & disease management are issued for two districts each in Andhra Pradesh & Telangana.
- Reshme Vaahini, a 39-week sponsored programme on Sericulture Technologies was initiated through All India Radio (08-03-2017 to 29-11-2017).
- Entrepreneurial development programme sponsored by the National Research Development Corporation (NRDC), Govt. of India was implemented supplying cocoon harvesters to ten beneficiaries.
- International Workshop sponsored by AARDO (African-Asian Rural Development Organization, New Delhi) and International Sericulture Commission (ISC, Bangalore) on Potential of Silk Industry for Employment & Income Generation in AARDO Member Countries was organized (12-16th April 2016) for a comprehensive review on potentials and challenges in sericulture.
- Sericulture Farmers' Workshops were organized in Doddaballapur (Karnataka), Penukonda (Andhra Pradesh), Dindigul (Tamil Nadu) and Baramati (Maharashtra) and farmers were enlightened with improved mulberry sericulture technologies.
- Technology Descriptor for Mulberry Sericulture in South India in regional languages was published for the benefit of sericulture farmers and officials.
- A compendium on Glimpses of achievements of Silkworm Pathology Laboratory since the inception of CSRTI-Mysuru was published.

### Patents and Commercialization

<b>PATENTS</b> Patent Granted Patent Submitted A machine for cleaning and disinfection of trays for rearing silkworms	SPOORTHI, Mulberry Health Drink  NRDC- (Patent App. No.201641029413-29.08.2016)
<b>COMMERCIALIZATION</b> A machine for harvesting silkworm cocoons from plastic collapsible mountages  Ankush, an eco & user friendly silkworm body and rearing seat disinfectant  Poshan, a multi-nutrient formulation for correcting nutrient deficiencies in mulberry	M/s. MAG Solvics Private Limited, Coimbatore (20.09.2016)  M/s. Bhopal Bleach Private Limited, Bhopal (08.11.2016)  M/s Linga Chemicals, Madurai (15.12. 2016)
<b>PRODUCT DEVELOPMENT</b> Dr. Soil, a formulation for improvement of soil fertility, mulberry leaf yield & silkworm cocoon yield  Rot-fix, a product for control of root rot disease in mulberry	M/s Microbi Agrotech Private Ltd., Bangalore (Consultancy; 11.01.2017)  To be commercialized through NRDC

### Capacity Building & Training

- 2811 beneficiaries (sericulturists and officials) were trained under Capacity Building & Training (CBT) through Technology Orientation Programme (TOP) & Farmer Skill Training (FST).
- 199 beneficiaries (farmers, entrepreneurs and officials) were trained under need-based programmes including Intensive bivoltine technology, Chawki Rearing, Bio-Control Agent Production, Integrated Pest & Disease Management.
- Model CRC unit was involved in training entrepreneurs in chawki rearing. 73,500 dfls were chawki reared (32 batches) and supplied to 429 farmers recorded an average cocoon yield of 72.30 kg/100 dfls.

- Three DoS officials were trained in Silkworm Race Maintenance programme for 45 days.
- Fifty seven personnel were trained under Intensive bivoltine training programme for 45 days including eleven newly recruited CSB Scientist-Bs and Field Assistants.
- Two volunteers from Japan Overseas Cooperation (JOCV) were trained in sericulture activities for 30 days.
- Forty four entrepreneurs were trained in CRC activities for three months as a part of seed act registration process.

## राजभाषा कार्यान्वयन संबंधी गतिविधियाँ

केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान, मैसूरु में वर्ष 2016-17 के दौरान राजभाषा नीति का पूरा अनुपालन किया गया। राजभाषा अधिनियम की धारा 3(3) का शत प्रतिशत अनुपालन सुनिश्चित किया गया है। संस्थान में हर तिमाही में राजभाषा कार्यान्वयन समिति की बैठक का आयोजन कर राजभाषा प्रगति के बारे में समीक्षा की गई।

हिंदी कार्यशालाओं का आयोजन, हिंदी दिवस और पखवाड़े का आयोजन तथा हिंदी टिप्पण-आलेखन प्रोत्साहन योजना का कार्यान्वयन किया गया है।

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

1. धारा 3(3) का अनुपालन: राजभाषा अधिनियम 1963 की धारा 3(3) के अधीन आने वाले सभी कागजात द्विभाषी में जारी किये गए।
2. नियम 11 का अनुपालन: सभी फार्म, पत्रशीर्ष, खड्ड मोहरे, सूचनापट्ट नाम पट्ट लिफाफे पहचान-पत्र, परिचय-पत्र आदि द्विभाषी है इन्हें सुनिश्चित करने हेतु जाँच बिंदु (भंडार अनुभाग, प्रेषण कक्ष और संबंधित अधिकारी के यहाँ) बनाए गए हैं।
3. हिंदी पत्राचार: वर्ष के दौरान क, ख तथा ग क्षेत्र स्थित केंद्रीय सरकारी कार्यालयों को क्रमशः 88%, 77% और 72% तथा क व ख क्षेत्र स्थित राज्य सरकार के कार्यालयों/व्यक्तियों को 100% पत्र हिंदी में भेज कर पत्राचार लक्ष्य से अधिक प्रतिशत प्राप्त किया है।
4. राजभाषा कार्यान्वयन समिति की बैठकों का आयोजन: संस्थान में हर तिमाही में राजभाषा कार्यान्वयन समिति की बैठक का आयोजन कर राजभाषा प्रगामी प्रयोग के बारे में समीक्षा की गई। वर्ष 2016-17 के अंतर्गत दिनांक 21.06.2016, 31.08.2016, 26.12.2016 एवं 08.03.2017 को राजभाषा कार्यान्वयन समिति की बैठकें आयोजित की गई तथा बैठकों में लिए गए निर्णय पर अनुवर्ती कार्रवाई की गई।
5. हिंदी कार्यशालाओं का आयोजन: संस्थान के पदधारियों को सरकारी काम-काज में हिंदी का प्रयोग करने और साथ-साथ राजभाषा नीति की जानकारी देने के लिए प्रत्येक तिमाही में हिंदी कार्यशाला का आयोजन किया गया। तकनीकी तथा प्रशासनिक पदधारियों के साथ-साथ वैज्ञानिकों के लिए भी इस वर्ष के दौरान दिनांक 14.06.2016, 20.09.2016, 27.10.2016 और 27.02.2017 को अलग-अलग एक दिवसीय हिंदी कार्यशाला का आयोजन कर कुल 43 अधिकारियों व 62 कर्मचारियों को प्रशिक्षित किया गया।
6. हिंदी टिप्पण-आलेखन प्रोत्साहन योजना का कार्यान्वयन: संस्थान एवं इसके अधीनस्थ केंद्रों में कार्यरत अधिकारियों तथा कर्मचारियों को हिन्दी में मूल रूप से काम करने को प्रोत्साहित करने के लिए केंद्रीय रेशम बोर्ड की उधारीकृत टिप्पण-आलेखन प्रोत्साहन योजना लागू की गई है जिसके अंतर्गत निर्धारित शब्द लिखने पर नकद पुरस्कार दिया जाता है।
7. हिंदी प्रकाशन: संस्थान की वार्षिक रिपोर्ट अंशतः द्विभाषी में और प्रशिक्षण कैलेंडर द्विभाषी में प्रकाशित किए गए। संस्थान द्वारा अर्धवार्षिक पत्रिका रेशम किरण प्रकाशित किया गया।

8. वैज्ञानिक क्षेत्र में हिंदी का प्रयोग: रिपोर्टाधीन वर्ष के दौरान संस्थान के कुछ वैज्ञानिकों ने मूल रूप में हिन्दी में शोध पत्र और लेख तैयार किए जिन्हें संस्थान द्वारा प्रकाशित अर्धवार्षिक पत्रिका रेशम किरण में प्रकाशित किया गया।
9. राजभाषा नियम 10(4) के अंतर्गत अधीनस्थ कार्यालयों को अधिसूचित किया जाना: जिन कार्यालयों में हिंदी में कार्यसाधक ज्ञान का प्रतिशत 80 हो जाता है उन कार्यालयों को मंत्रालय द्वारा राजभाषा नियम 10(4) के अधीन अधिसूचित किया जाता है। इस दिशा में इस संस्थान के अलावा 06 अधीनस्थ कार्यालयों को अधिसूचित कराया जा चुका है।
10. हिंदी प्रतियोगिताओं का आयोजन: संस्थान में दिनांक 01.09.2016 से 15.09.2016 तक राजभाषा पखवाड़ा मनाया गया जिस दौरान 10 विभिन्न हिंदी प्रतियोगिताओं यथा सही लेखन, श्रुत लेखन, स्मृति परीक्षण, सामूहिक चर्चा, वाक् प्रतियोगिता, टिप्पण-आलेखन एवं प्रशासनिक शब्दावली, गीत, तस्वीर क्या बोलती है? और अंत्याक्षरी प्रतियोगिताओं का आयोजन किया गया। प्रत्येक प्रतियोगिता के विजेताओं को प्रथम, द्वितीय, तृतीय एवं सांत्वना पुरस्कार नकद रूप में दिया गया।
11. कंप्यूटर पर हिंदी में कार्य: धारा 3(3) का अनुपालन, फार्म/प्रपत्र, मानक मसौदे, तिमाही रिपोर्ट तथा मूल्यांकन रिपोर्ट, बैठकों की कार्यवाही संबंधी कार्य कंप्यूटर पर सुचारु रूप से किया जा रहा है। संस्थान में सभी अभिकलित्रों में यूनिकोड की व्यवस्था है जिससे हिंदी, अंग्रेजी तथा अन्य भारतीय भाषाओं में काम करने में सुविधा हुई है।

### ACTIVITIES REGARDING OFFICIAL LANGUAGE IMPLEMENTATION

During 2016-17, Official Language policy has been implemented well at Central Sericultural Research and Training Institute, Mysuru. Compliance of section 3(3) of the Official Languages Act has been ensured. The progress in implementation of Hindi was reviewed by conducting quarterly meeting of the Official Language Implementation Committee.

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

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

1. **Compliance of Section 3(3):** All the papers coming under section 3(3) of the Official Language Act 1963 have been issued in bilingual.
2. **Compliance of Rule 11:** All types of forms, letter heads, Rubber Stamps, Sign Boards, Name plates, Envelopes, Identity Cards, Visiting cards etc are bilingual. Check points (at Xerox Cell, Stores Section, Despatch Section and the concerned officer) have been devised to ensure the same bilingual.
3. **Hindi Correspondence:** During the year the prescribed targets for correspondence of Hindi were achieved by sending 88%, 77% and 72% letters in Hindi to Central Govt. Offices of A, B and C regions respectively and 100% letters in Hindi to State Govt. Offices and individuals of A & B regions.
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 2016-17 Official Language Implementation Committee meetings were organised on 21.06.2016, 31.08.2016, 26.12.2016 and 08.03.2017 and follow up action was taken on the decisions of the meeting.
5. **Organisation of Hindi Workshops:** Hindi workshop was organised in every quarter for the officials of the Institute to provide information as to use of Hindi in the Official work and extend information about Official Language Policy. During the year, 43 Officers and 62 Staff have been trained in Hindi workshops organised on

14.06.2016, 20.09.2016, 27.10.2016 and 27.02.2017 separately for technical and administrative officials and scientists.

6. **Implementation of noting-drafting incentive scheme:** To encourage the officers and staff of this Institute and its subordinate offices to do their work originally in Hindi. CSB's liberalised noting-drafting incentive scheme was implemented in which cash awards are given for writing prescribed words in Hindi.
7. **Publications in Hindi:** Annual report of the Institute was published partly in bilingual and the training calendar was published in bilingual. Half yearly house magazine Resham Kiran was released.
8. **Use of Hindi in Scientific field:** During the year some of the Scientists prepared research papers and articles originally in Hindi and also they were published in Resham Kiran, half yearly magazine in Hindi brought out by CSRTI, Mysuru.
9. **Notification of the sub-ordinate offices under 10(4) of the Official Languages rules:** The Offices in which 80% of the staff are having working knowledge in Hindi are notified under 10(4) of the official languages rules. In this direction, apart from this office, 6 sub-ordinate offices have also been notified.
10. **Organisation of Hindi competitions:** Official Language Fortnight was organised from 01.09.2016 to 15.09.2016 during which 10 different Hindi competitions viz. 1. Correct writing 2. Dictation, 3. Memory test, 4. Group discussion, 5. Elocution, 6. Noting-drafting and administrative glossary. 7. Technical glossary, 8. Songs, 9. what does the picture speak ? and 10. Antyakshari competitions were organised. The winners of the competitions were awarded with first, second, third and consolation prizes.
11. **Work on computers in Hindi:** Compliance of Section 3(3), forms, standard drafts, quarterly progress report and evaluation report, work related to meetings carried out smoothly on computers. Unicode system is activated in all computers which facilitate to do work in Hindi, English and other Indian languages.

## MULBERRY BREEDING AND GENETICS LABORATORY

### Concluded Research Project

#### All India Coordinated Experimental Trial in Mulberry [AICEM (Phase-III)] (Jul. 2011-Dec. 2016)

**Regional Coordinator:** V. Sivaprasad, Director & Zonal Coordinator

S. Gandhi Doss, K. Rajashekar, M. Rekha, C. Sathynarayana Raju<sup>1</sup>, M. A. Shantahan Babu<sup>1</sup>, M. Venkatachalapathi<sup>2</sup> (upto 31-05-2016), A. Venugopal<sup>2</sup> (from 01-06-2016), B. N. Murthy<sup>3</sup> (upto 30-06-2014), B. Srinath<sup>3</sup> (from 01-07-2014), S. Balasaraswathi<sup>4</sup>, S. Masilamani<sup>4</sup>, M. S. Eswar Rao<sup>5</sup> (upto 31-05-2016), R. S. Mallikarjunappa<sup>5</sup> (upto 01-06-2013) and R. M. Shivaprakash<sup>5</sup> (from 01-06-2016)

<sup>1</sup>RSRS Anantapur, <sup>2</sup>REC Rayachoti, <sup>3</sup>REC Vikarabad, <sup>4</sup>REC Krishnagiri, <sup>5</sup>KSSRDI, Thalaghattapura

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

The experiment was laid out in RBD with three test varieties (MV-1: C2038, MV-2: G-4 and MV-3: Suvarna-2) along with National check, MV-4: Vishala and Local check, MV-5: V1 in six replications @ 81 plants in 90 × 90 cm spacing. The test and check varieties were maintained with fertilizer input of N:P:K (300:120:120 Kg/ha/year; in 5 split doses after 25th day of each harvest) and FYM (20 mt/ha/year). Initially, evaluation was proposed at nine test centres in south zone. However, three centres (AP: APSSRDI; Tamil Nadu: TNAU; Karnataka: REC-Madivala) were discontinued due to certain technical shortcomings during the establishment of experimental plots. The evaluation of test and check varieties was continued in six test centres and data on leaf yield, growth, rooting parameters, major pest and disease incidences and bioassay were recorded periodically as per the pre-determined schedule.

**CSRTI-Mysuru:** None of the test varieties exhibited significant superiority in leaf yield (mt/ha/year) over the national check, Vishala. The varieties, C2038 (53340) and G4 (48409) yielded significantly higher leaf over local check, V-1 (43380). No significant difference among the test varieties was observed for total shoot length. The leaf moisture was significantly higher in all the three test varieties (Suvarna-2: 77.37%; G-4: 76.74%; C-2038: 76.56%) over V-1 and moisture retention capacity was at par among the test and check varieties. All the cocoon characteristics were on par with V-1. All the major foliar diseases were reported besides incidences of leaf roller during the trial. Highest incidence of tukra was on V-1 (8.92) followed by G-4 (5.73); while leaf rust was highest in Vishala (10.40). Leaf roller incidence was highest in V-1 (12.45). The rooting was highest in G4 (92.97 %) followed by Suvarna-2 (89.50 %) and C-2038 (85.49 %).

**KSSRDI-Bengaluru:** Highest leaf yield (mt/ha/year) was recorded in G4 (56718) followed by Suvarna-2 (53693) and C-2038 (52782) which is at par with both the check varieties. However, G4 showed significant superiority over the other two test varieties (C-2038 & Suvarna-2). The yield contributing characters such as number of leaves per meter length (19.25) and leaf shoot ratio was significantly higher in G4 (0.62) and total shoot length, moisture content, moisture retention capacity, days to sprout were at par with the check varieties. All the test varieties exhibited significantly higher leaf/shoot ratio over the check varieties. Larval duration was higher in G4 (590.50 h) and C-2038 (590.42 h) than the check varieties. The cocoon characteristics reared with all the test varieties were at par with

the check varieties. Moderate incidence of tukra and root knot diseases were reported in all the varieties. Rooting was highest in C-2038 (75%) followed by Suvarna-2 (74.10 %) and G4 (70.50 %).

**REC-Krishnagiri:** Leaf yield (mt/ha/year) recorded was significantly higher in C-2038 (50062) followed by G4 (43733) and Suvarna-2 (41594) than the local check, V1 (39858); while C-2038 and G-4 significantly yielded higher than the national check, Vishala (42322). Number of leaves per meter length (23.7), moisture retention capacity (56.8 %) recorded were significantly higher in G4, while leaf shoot ratio was significantly higher in G4 (0.62) followed by C-2038 (0.60). Total shoot length was significantly higher in C-2038 and Suvarna-2 over the national check. The cocoon characteristics recorded were significantly higher in G4 over national check. Cocoons harvested and shell percentage was significantly superior in G4 over V1. No incidence of major foliar pest and diseases was recorded. Rooting was highest in G4 (97.80 %) followed by C-2038 (97.00 %) and Suvarna-2 (96.20 %).

**RSRS-Anantapur:** The variety G4 yielded (mt/ha/year) significantly highest (56589) over the national (51958) and local (48402) check varieties. The total shoot length (1155.52 cm) and no. of leaves per meter length (20.55) of G-4 variety were significantly higher than the check varieties. Larval duration (608.16 h) and the number of cocoons harvested (468.66) of G4 was on par with check varieties. Cocoon yield was significantly highest in Suvarna-2 (518.36g) followed by G-4 (503.59g) over the check variety, V-1; the cocoon yield and shell percentage were significantly higher in Suvarna-2 and G4 over national check and on par with the local check. Moderate incidence of tukra was reported (31.66 - 54.76) on the test varieties, while no incidence of major pests and diseases were reported. The rooting was highest in G4 (88%) followed by Suvarna-2 (82.35 %) and C-2038 (75.33%).

**REC-Vikarabad:** Significantly higher leaf yield (mt/ha/year) was recorded in G4 (54734) followed by C-2038 (45581) over Vishala (41214) and G4 significantly out-yielded V-1 (50832). G4 recorded significantly higher values for total shoot length/plant (1140.18 cm), No. of leaves per meter length (25.72), moisture content (71.39 %) and moisture retention capacity (85.68 %) over the national check. The cocoon characteristics such as cocoon yield (949.0 g), single cocoon wt. (1.963 g) and single shell wt. (0.443 g) were significantly higher in G4 over the national and local check varieties; while the other characters were at par with the test and check varieties. No incidence of major foliar pests and diseases were recorded during the trial. Highest rooting was recorded in G4 (92.3 %) followed by C-2038 (86.3 %) and Suvarna-2 (78.0 %).

**REC-Rayachoty:** All the three test varieties recorded significantly higher leaf yield over both national and local checks. G4 exhibited significantly higher yield contributing parameters like total shoot length/plant (1255.46 cm), no. of leaves per meter length (26.00), moisture retention capacity (83.63%) over national check (82.43%) and local check (83.31%). Most of the economic characters of cocoon (no. of cocoons harvested/500 larvae, cocoon yield, single cocoon wt., single shell wt. and shell content) were significantly higher in G4 over the national and local check varieties. Moderate incidence of tukra disease (4.94 - 8.58) was recorded in test varieties than the check varieties (7.91 – 10.18). Rooting was highest in G4 (93.30 %) followed by Suvarna-2 (92.00 %) and C-2038 (81.60 %).

Growth & Yield Performance of Mulberry Varieties – AICM III Phase

Variety	Total shoot length/ Plant (cm)	No. of leaves/ meter length of shoot	Fresh wt. of leaf (kg)	Leaf/ Shoot Ratio	Leaf Moisture Content (%)	MRC (%)	Days taken to sprout	Leaf yield (Kg/ha/ Year)
<b>CSRTI-Mysuru</b>								
C-2038	1283.26	16.29	0.849	0.68	76.56	73.42	12.47	53340
G-4	1142.05	19.72	0.697	0.66	76.74	69.83	12.71	48409
Suvarna-2	1307.37	16.86	0.754	0.61	77.37	69.33	12.91	46653
Vishala	1244.33	15.63	0.765	0.57	76.75	71.30	11.60	49800
V-1	1216.20	18.68	0.667	0.63	76.12	73.70	13.37	43380
CD @ 5%	NS	0.77	0.08	0.01	0.50	1.53	0.72	4445
CV (%)	13.79	9.70	12.60	6.32	1.36	3.36	8.18	9.91
<b>KSSRDI-Thalaghattapura</b>								
C-2038	1129.86	16.61	0.871	0.63	73.77	89.54	14.87	52782
G-4	1212.81	19.25	0.924	0.62	74.85	88.50	14.76	56718
Suvarna-2	1295.82	16.33	0.880	0.60	75.10	87.88	14.77	53692
Vishala	1336.36	15.50	0.920	0.56	74.40	88.80	14.27	56618
V-1	1452.16	17.36	0.901	0.58	74.79	89.82	14.75	54923
CD @ 5%	43.14	0.35	NS	0.016	0.32	0.90	0.17	2371
CV (%)	10.49	7.84	6.259	4.78	0.74	1.17	1.78	7.16
<b>REC-Krishnagiri</b>								
C-2038	1865.07	18.84	0.823	0.60	70.77	50.70	13.37	50062
G-4	1677.81	23.70	0.729	0.62	70.61	56.82	12.90	43733
Suvarna-2	1803.37	20.86	0.692	0.59	70.04	48.34	13.63	41594
Vishala	1666.84	19.91	0.705	0.55	70.05	48.59	13.40	42332
V-1	1917.75	21.13	0.672	0.58	70.30	54.73	13.80	39858
CD @ 5%	48.86	0.11	0.011	0.003	NS	1.91	NS	817.84
CV (%)	6.06	7.90	7.507	3.91	1.03	8.33	6.46	8.33
<b>RSRS-Anantapur</b>								
C-2038	951.13	18.67	0.68	0.63	72.19	79.11	12.0	44656
G-4	1155.52	20.55	0.76	0.62	72.83	78.98	12.0	56589
Suvarna-2	981.40	19.64	0.68	0.62	71.12	78.40	12.5	48366
Vishala	1056.84	19.63	0.70	0.61	72.21	78.51	13.5	51958
V-1	1103.30	20.46	0.70	0.62	72.36	79.43	11.3	48402
CD @ 5%	51.61	0.52	0.019	NS	0.85	NS	1.44	2451
CV (%)	8.48	4.11	5.37	2.15	1.25	2.26	11.97	9.39

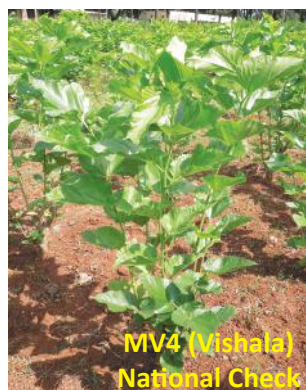
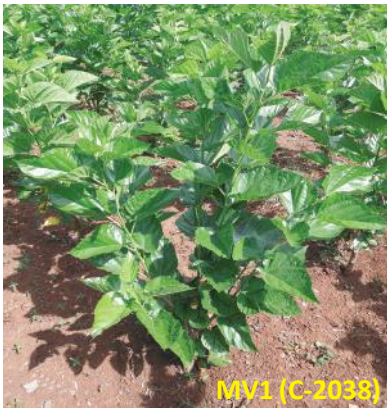
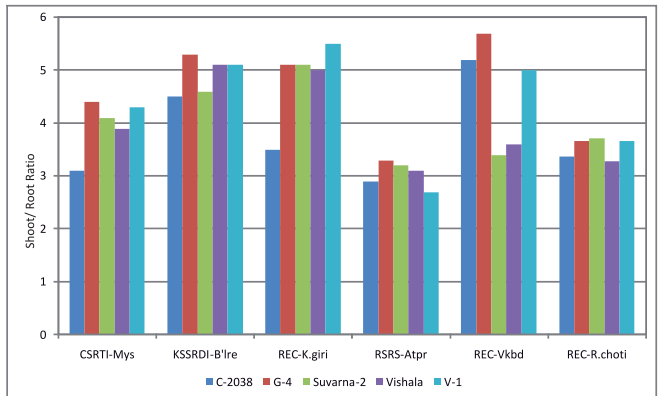
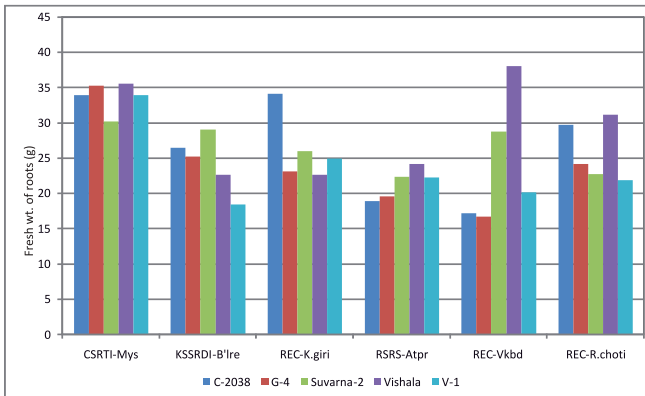
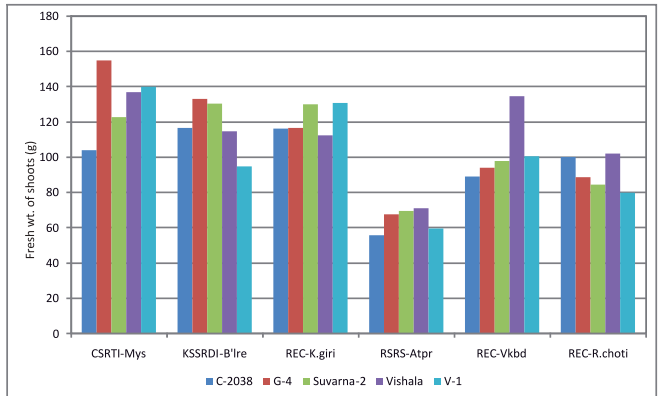
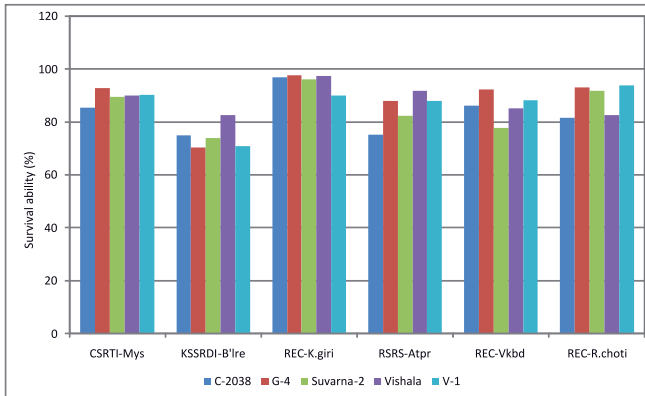
Variety	Total shoot length/ Plant (cm)	No. of leaves/ meter length of shoot	Fresh wt. of leaf (kg)	Leaf/ Shoot Ratio	Leaf Moisture Content (%)	MRC (%)	Days taken to sprout	Leaf yield (Kg/ha/ Year)
<b>REC-Vikarabad</b>								
C-2038	895.54	20.46	0.50	0.57	71.25	81.66	19.09	45581
G-4	1140.18	25.72	0.71	0.60	71.39	85.68	18.32	54734
Suvarna-2	818.16	18.24	0.44	0.51	70.16	80.03	19.28	38850
Vishala	921.55	18.23	0.50	0.53	69.62	79.48	20.67	41214
V-1	1189.72	20.93	0.66	0.60	72.41	84.56	18.48	50832
CD @ 5%	29.85	1.18	0.024	0.01	1.75	2.42	0.63	1514
CV (%)	15.05	14.16	19.70	6.54	2.44	3.74	5.28	13.18
<b>REC-Rayachoty</b>								
C-2038	1187.46	19.95	0.58	0.53	66.59	84.24	12.3	37718
G-4	1255.46	26.00	0.59	0.53	68.77	83.63	11.9	37282
Suvarna-2	1185.14	21.25	0.60	0.55	69.38	81.64	12.2	37067
Vishala	1124.69	21.86	0.57	0.50	69.24	82.43	11.5	34899
V-1	1072.89	27.44	0.48	0.53	68.96	83.31	12.8	31724
CD @ 5%	15.58	2.62	0.01	0.01	0.32	0.52	0.50	503.28
CV (%)	5.41	15.23	8.07	3.39	1.53	1.19	0.29	6.35

#### Rearing Performance of Mulberry Varieties – AICEM III Phase

Variety	Larval Duration (h)	No. of cocoons harvested/ 500 larvae	Cocoon Yiled (kg)	Single Cocoon Wt. (g)	Single Shell Wt. (g)	Shell (%)
<b>CSRTI-Mysuru</b>						
C-2038	608.89	456.82	611.53	1.520	0.348	22.77
G-4	608.11	455.26	589.07	1.435	0.326	22.55
Suvarna-2	606.89	457.10	604.93	1.431	0.323	22.44
Vishala	607.67	469.17	630.47	1.540	0.358	22.99
V-1	607.89	460.23	610.98	1.544	0.353	22.63
CD @ 5%	NS	5.29	24.10	0.045	0.012	NS
CV (%)	0.29	1.78	4.32	4.644	6.165	2.53
<b>KSSRDI-Thalaghattapura</b>						
C-2038	590.42	475.44	0.745	1.573	0.370	23.56
G-4	590.50	464.17	0.719	1.544	0.357	23.20
Suvarna-2	589.42	473.11	0.763	1.612	0.365	22.74
Vishala	588.75	476.00	0.744	1.563	0.371	23.82

Variety	Larval Duration (h)	No. of cocoons harvested/ 500 larvae	Cocoon Yiled (kg)	Single Cocoon Wt. (g)	Single Shell Wt. (g)	Shell (%)
V-1	589.42	471.56	0.745	1.588	0.370	23.28
CD @ 5%	0.675	5.78	0.023	0.044	0.010	NS
CV (%)	0.142	1.30	3.240	2.709	2.569	3.22
<b>REC-Krishnagiri</b>						
C-2038	607.00	415.17	0.624	1.505	0.258	17.02
G-4	584.50	481.33	0.915	1.911	0.403	21.08
Suvarna-2	599.00	437.75	0.789	1.809	0.350	19.35
Vishala	599.00	440.08	0.801	1.824	0.351	19.20
V-1	582.00	474.67	0.917	1.938	0.413	21.33
CD @ 5%		5.58	0.012	0.010	0.008	0.44
CV (%)	1.60	5.58	13.296	8.590	15.623	8.14
<b>RSRS-Anantapur</b>						
C-2038	609.20	461.00	474.70	1.528	0.314	20.62
G-4	608.16	468.66	503.59	1.631	0.351	21.65
Suvarna-2	610.66	461.33	518.36	1.607	0.349	21.72
Vishala	609.77	464.33	475.09	1.682	0.354	21.10
V-1	608.83	466.61	477.55	1.745	0.373	21.38
CD @ 5%	NS	NS	13.71	0.038	0.007	0.45
CV (%)	0.29	1.19	4.22	4.90	5.97	2.60
<b>REC-Vikarabad</b>						
C-2038	579.44	476.94	0.862	1.807	0.398	22.04
G-4	584.94	483.39	0.949	1.963	0.443	22.57
Suvarna-2	581.89	481.50	0.848	1.761	0.377	21.43
Vishala	582.89	480.89	0.863	1.795	0.379	21.14
V-1	582.28	480.22	0.911	1.896	0.414	21.87
CD @ 5%	NS	NS	0.025	0.052	0.011	0.86
CV (%)	0.73	1.25	4.83	4.661	6.499	3.97
<b>REC-Rayachoty</b>						
C-2038	570.00	470.28	811.444	1.773	0.379	21.41
G-4	560.00	480.00	880.722	1.844	0.404	21.93
Suvarna-2	568.00	473.72	838.778	1.777	0.381	21.51
Vishala	568.00	470.28	836.444	1.786	0.386	21.68
V-1	586.00	473.33	848.389	1.801	0.387	21.52
CD @ 5%	-----	6.09	22.319	0.021	0.005	0.23
CV (%)	1.49	1.24	3.394	1.668	2.418	1.14

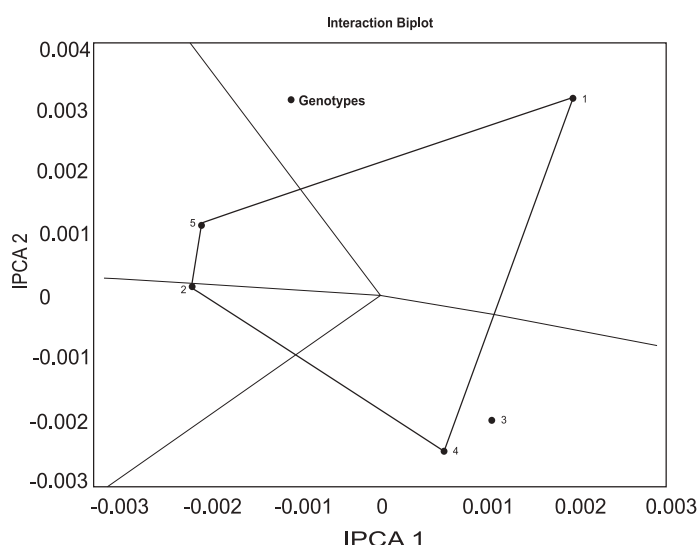
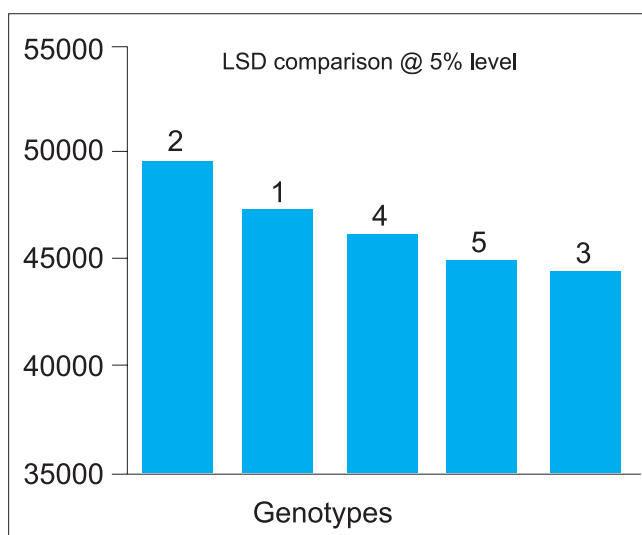
### Rooting of Mulberry Varieties - AICEM III Phase



Leaf Yield & Stability Analysis of Mulberry Varieties in South Zone (AICEM III Phase)

Variety	Leaf Yield* (Kg/ha/ yr)	$\beta_i$	$S^2Di$	Rank
MV1 (C2038)	47356.50	0.677	71863.34	5
MV2 (G4)	49578.00	1.092	33225.15	1
MV3 (Suvarna)	44370.67	0.875	78836.70	2
MV4 (Vishala)	46137.34	1.177	23651.21	3
MV5 (V1)	44853.84	1.179	86120.47	4

\* Values indicate mean of 15 crops



Conclusion

- MV1 (C-2038) showed significantly superior leaf yield over national check (MV4 - Vishala) and local check (MV5 - V1) at three test centres
- MV2 (G4) showed significantly higher leaf yield over national check (MV4 - Vishala) and local check (MV5 - V1) at four and five test centres, respectively
- MV2 (G4) performed better at all test centres followed by MV1 (C-2038) with regard to the cocoon productivity
- MV2 (G4) exhibited higher mean leaf productivity in all the six test centres and yielded higher than the other test and check varieties
- MV2 (G4) showed regression coefficient of  $\beta_i=1.08$  and minimum deviation from regression (as per Eberheart & Russel Model (1966) and thus G4 is more stable across the test locations followed by V1
- Stability analysis (AMMI Model) for leaf yield performance of test and check varieties, MV2 (G4) stood at first rank and had  $\beta_i > 1$  and less deviation from regression
- MV2 (G4) variety is recommended for the southern zone

The data collected and analyzed from the six test centres under AICEM III pahse would be presented to the Mulberry Variety Authorization Committee for variety approval.

## Ongoing Research Projects

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

S. Gandhi Doss, Rajashekar, K., T. Mogili, P.M. Pratheesh Kumar, T. Sarkar and T. Gayathri

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

In an effort to develop varieties resistant to major mulberry root diseases (root rot & root knot), 979 promising hybrids were short-listed from a population of over 10000 hybrids generated by effecting crosses between 10 resistant and 5 high yielding mulberry varieties. Following the establishment of hybrids in PRT, data on above ground biomass and shoot diameter were recorded and hybrids were shortlisted. These 112 hybrids were evaluated for rooting ability and it ranged from 46 to 92%. 63 hybrids exhibiting higher rooting ability (>60%) were identified for further evaluation under artificial inoculation studies. The hybrid progeny evaluated in PRT for growth data (number of shoot/plant, length of longest shoot, total shoot length, leaf yield and leaf/shoot ratio) for five crops.

Growth & Yield data of Hybrid Progeny in PRT (average of 5 crops)

Progeny from Hybrid	No .of shoots/ Plant	Longest Shoot Length (cm)	Total Shoot Length (cm)	Leaf Yield (g/Plant)	Leaf: Shoot ratio
Punjab local x V1	7.79	140.69	853.53	290.21	0.64
Himachal local x C776	8.89	149.57	1022.10	375.83	0.61
English black x V1	7.67	129.79	809.73	297.64	0.66
RC2 x V1	11.85	151.15	1356.80	635.25	0.67
S36 x V1	10.30	142.94	1091.70	486.07	0.65
S30 x Mysore local	9.71	144.06	862.50	394.68	0.71
Roso x V1	8.09	128.44	998.10	426.40	0.66
<i>M. multicaulis</i> x Mysore local	8.95	140.58	659.41	330.86	0.65
K2 (4n) x China white	6.19	127.21	1176.32	545.33	0.67
<i>M. multicaulis</i> x C776	7.93	134.39	906.95	428.67	0.62
G2 x C776	10.20	141.03	867.50	378.98	0.67
S36 x Mysore local	8.15	131.67	1119.44	508.33	0.68
S36 (4n) x Almora local	5.57	130.46	584.40	231.43	0.72
Punjab local x Mysore local	7.27	125.90	757.69	315.87	0.63
Punjab local x C776	6.08	130.54	650.62	280.81	0.67
Punjab local x Almora local	5.41	121.07	566.03	229.93	0.62
Grand Mean	892.68	135.59	892.68	384.77	0.66

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

T. Gayathri, S. Gandhi Doss, K. Rajashekar and Tanmoy Sarkar

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

Biochemical Analysis of Different Mulberry Genotypes under Optimal Conditions

Variety	SOD (units/g)	POX (Units/g)	Phenols (mg/g)	Ascorbic Acid (mg/g)	Reduced GT (mg/g)	Proline (µmole/g)	Soluble Sugar (mg/g)
V1	87.7±3.9	227.3±27.1	2.2±0.13	2.9±0.02	0.54±0.01	6.73±0.28	37.85±0.26
RC1	110.9±6.3	441.3±19.5	6.0 ±0.1	2.9±0.07	0.35±0.01	4.57±0.23	42.62±0.29
RC2	108.5±2.7	211.0±11.5	6.4±0.1	2.4±0.10	0.34±0.01	5.28±0.18	41.74±0.43
Mysore Local	81.3±1.5	194.8±0.8	7.9±0.04	3.5±0.12	0.46±0.03	6.16±0.38	42.70±0.45
Sahana	79.6 ±1.4	334.3±21.1	4.8±0.18	2.2±0.07	0.43±0.01	6.88±0.25	33.87±0.42
S13	81.3±0.9	419.4±5.7	4.1±0.03	3.5±0.06	0.54±0.01	5.14±0.17	21.66±0.11
RFS135	30.2±2.6	414.9±8.3	4.5±0.03	2.8± 0.04	0.52±0.01	7.08±0.37	32.35±0.19
RFS 175	78.1±2.4	375.0±2.9	3.8±0.03	3.1±0.04	0.61±0.01	8.57±0.33	39.93±0.12
MSG2	73.6±2.6	372.7±5.1	3.5±0.03	2.6±0.03	0.32±0.01	6.35±0.42	35.82±0.15
G4	72.9±2.1	325.6±3.9	4.5±0.05	2.8±0.02	0.33±0.01	6.51±0.35	24.89±0.15
AR11	26.6±0.68	405.6±33.7	4.1±0.03	2.8±0.05	0.54±0.01	6.34±0.13	34.16±0.13
AR12	48.7±4.1	255.5±4.5	4.4±0.03	2.4±0.08	0.57±0.01	6.17±0.22	33.50±0.11
S1635	27.9±4.5	444.7±11.0	4.1±0.05	3.6±0.09	0.56±0.01	5.19±0.27	34.46±0.25
S34	8.3±2.2	418.3±7.3	3.5±0.09	4.2±0.03	0.49±0.04	6.51±0.27	33.87±0.31
K2	17.5±0.7	224.8±0.71	3.6±0.06	3.4±0.02	0.57±0.01	4.45±0.23	33.68±0.29

Biochemical analysis of 15 mulberry genotypes was carried out for estimating the levels of antioxidant enzymes (superoxide dismutase: SOD; peroxidase: POX), non-enzymatic antioxidants (phenols, ascorbic acid & reduced glutathione) and osmolytes (proline & soluble sugars) under optimal conditions. Highest superoxide dismutase activity (units/g) was recorded in RC1 (110.91) and RC2 (108.55); and maximum peroxidase activity (units/g) recorded in S1635 (444.7) and RC1 (441.3). Antioxidants and osmolytes varied among genotypes (Phenols: 2.22 - 7.98mg/g; acorbic acid: 2.44 - 4.02mg/g; reduced glutathione: 0.32 - 0.61 mg/g; proline: 4.45 - 8.57 µmole/g; soluble sugars: 32 - 42 mg/g).

**PIB 3507: (PPV & FRA Phase II): Development of Distinctness, Uniformity and Stability (DUS) descriptors for Mulberry (*Morus* spp.) and their Validation (Apr. 2016 - Mar. 2018)**

V. Sivaprasad, V. Girish Naik and P. Sowbhagya (SRF)

**Objectives**

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

A Task Force meeting was organized on 14/06/2016 at CSRTI-Mysuru and the committee approved the DUS test guidelines for mulberry after incorporating the suggestions/modifications. The DUS test guidelines was notified by

the PPV & FRA-New Delhi (Plant Variety Journal of India Vo. 10, No. 10. Oct 4, 2016). Mulberry INDUS database with DUS descriptors and test guidelines was developed using MySQL and web interfaced by HTML, PHP and Javascript etc. CSRTI-Mysuru would continue as Nodal Test Centre for mulberry DUS testing and action has been initiated for the establishment of co-nodal centre at CSRTI-Berhampore. Example and reference varieties would be maintained further in the Institutes.

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

G. S. Arunakumar and T. Mogili

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

Root-knot nematode disease of mulberry caused by *Meloidogyne incognita* is the most devastating soil-borne disease as infected roots can also become disease complexes with other root rot causing pathogens. Cultivated mulberry varieties are highly susceptible to root knot and it is very essential to identify genetic resources resistant to root knot nematode (RKN). The project envisages evaluating about 400 mulberry germplasm accessions in four different batches. In the first batch, four months old saplings of 88 mulberry germplasm were evaluated in earthen pots (RKN inoculation) with four replications for each accessions under glass house condition and controls without RKN inoculum were also maintained. Mass multiplication of the RKN inoculum was undertaken utilizing the infected root galls from susceptible mulberry plants and inoculated to highly susceptible tomato and pumpkin plants. The RKN inoculation was carried out at three different intervals to maintain sufficient inoculum load (three J2 nematodes/g soil). Four months after the inoculation, the accessions were uprooted and data was recorded on biomass (g), longest shoot length (cm) and number of galls/5g root mass. Eight germplasm accessions exhibited resistance (0-10 galls) and rest of the accessions showed varied resistance/susceptibility (100 – 1000 galls) to RKN. The accessions which exhibited resistance to RKN were replanted for further confirmation. A second set of 127 accessions including exotic and indigenous origin were collected from CSGRC-Hosur and are being multiplied for further evaluation.

**Continuous/Other Activities**

**Maintenance of mulberry germplasm, mother cultures & demonstration plots**

Rajashekar, K., T. Mogili, S. Gandhi Doss, T. Sarkar and T. Gayathri

A working mulberry germplasm with 62 accessions was maintained for carrying out hybridization programmes. Sixteen elite varieties were also maintained in the demonstration plot for the benefit of sericulturists, students and other stakeholders. Breeders seed plots of four newly evolved varieties viz., G4, (late age silkworm rearing), G2 (young age silkworm rearing), MSG2 (soil moisture stress environments) and AGB8 (sub-optimal irrigated conditions)



were maintained for seed supply. Eleven transgenic lines of K2 OPH (open-pollinated hybrid) with HVA1 gene and a transgenic line of V1 with DREB2A and SHN1 genes were also maintained under net-house containment facility.

### MULBERRY MOLECULAR BIOLOGY LABORATORY

#### Ongoing Research Projects

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

B.N. Gnanesh

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

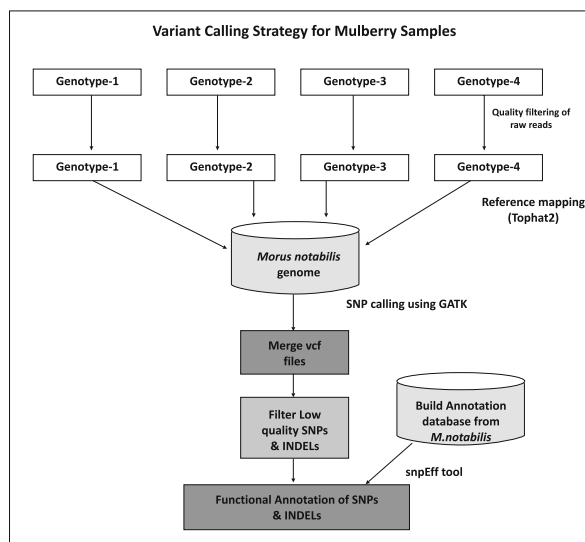
#### Estimation of mulberry genome size using flow cytometry

Flow cytometry is a commonly used for estimating the genome size. Six mulberry accessions with varied ploidy level were included in the present study to determine the relative 2C genome size using flow cytometer and to identify substantial genome size variation. *Pisum sativum* (2C=9.0 pg) was found to be the most suitable reference standard. Samples were prepared for analysis following two step procedure described by Otto and involving propidium iodide staining. The results indicate substantial genome size variation, with the 2C-value ranging 0.77 to 1.15pg. The mean amount of 2C nuclear DNA of the diploid mulberry sample was calculated as 0.79 pg. Conversion between DNA content and genome size (1 pg DNA=980 Mbp) indicate that the haploid genome size (1C) of mulberry is 387.1 Mbp. The study highlights the necessity for optimizing the flow cytometry.

Estimation of Haploid Genome Size in Mulberry		
Genotype	DNA Content pg (2C)	DNA Content (Mbp)
Control ( <i>Pisum sativum</i> )	9	4342.50
V1	0.84	407.29
K2	0.77	372.01
KPG-2	0.77	369.60
S-1635	1.03	496.72
AR12	0.96	463.42
V1 Triploid	1.15	556.28

#### Development of SNP markers using Transcriptome sequences in mulberry

Application of modern genomic approaches in mulberry is limited due to the lack of sufficient molecular markers. Single nucleotide polymorphism (SNP) discovery is an important for mulberry molecular breeding. SNPs were mined from the transcriptome data generated from leaf tissue of four mulberry genotypes obtained from Dr Karaba's lab, University of Agricultural Sciences, Bengaluru (UAS-B). Analysis of transcriptome data and variant calling revealed 105115 SNPs. Two hundred unique SNPs have been chosen for validation using competitive allele specific PCR, which are being validated with 94 diverse mulberry accessions using KASP assay.



#### Phenotypic and molecular characterizations of root rot causing fungi in mulberry

Root rot is a serious menace in mulberry (*Morus spp.*) and is prevalent in several sericultural areas in India. *Fusarium solani*, *F. oxysporum*, *Lasiodiplodia theobromae* and *Macrophomina phaseolina* were found associated with root rot disease. Forty six mulberry root rot samples were collected from farmers fields in South India based on wilting symptoms. Morphological characterization of fungi associated with root rot (growth & spore morphology)

was recorded for each isolate (35 *F. solani*, 5 *F. oxysporum* and 6 *L. theobormae* isolates). Molecular characterization of fungal isolates based on ITS sequences was carried out for species identity. Six isolates were sequenced and the sequences were deposited in NCBI data base under GenBank accession numbers KY884641, KY884642, KY884643, KY964307, KY964308, KY964309.

### Continuous/Other Activities

Maintenance of mapping resources

- Yield and yield contributing traits (Mysore Local x V1 progeny - 350 Nos)
- Water use efficiency (WUE) trait (Himachal Local x MS-3 progeny - 200 Nos; Muki x S34 progeny - 432 Nos; G4 x MS-3 progeny - 182 Nos)
- Root trait (Dudhia White x UP progeny - 560 Nos; Punjab Local x Thaimale progeny - 35 Nos)
- Alkaline tolerance (Sujanpur 5 x V1 progeny - 169 Nos)
- Introgressed lines for WUE and root traits (20 Nos)
- Maintenance of Panel of Diverse Germplasm (~270)

## SOIL SCIENCE & CHEMISTRY

### Continuous/Other activities

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

V. Sobhana, S. Sen, M. Munirathnam Reddy, P. Sudhakar<sup>1</sup>, Dahira Beevi<sup>2</sup> and B. Vijay Naidu<sup>3</sup>

<sup>1</sup>RSRS, Kodathi, <sup>2</sup>RSRS, Salem, <sup>3</sup>RSRS, Anantapur

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

Soil fertility plays an important role in quality mulberry leaf production. Imbalanced use of fertilizers, low addition of organic matter and non-replacement of depleted micro and secondary nutrients over the years, has resulted in decrease in soil fertility. Site-specific nutrient management involving soil test based application of fertilizers is critical to maintain good soil health and hence 'Soil Health Card' scheme is rolled out for the benefit of sericulture farmers. Soil testing is conducted to determine the status of soil with respect to pH, EC, OC, N, P, K, S, Zn, Fe, Cu, Mn & B and based on test results, the fertilizer recommendations and soil amendments to be undertaken are recommended for the farmer. CSRTI-Mysuru envisages issuing soil health cards (30000 in 3 years) for the sericulture farmers in Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Kerala, Maharashtra and Madhya Pradesh. The soil testing would be conducted at the main institute and RSRSs at Anantapur, Kodathi and Salem.

10007 soil samples were collected from sericulture farmers of Karnataka, Tamil Nadu, Andhra Pradesh,

Critical Levels of Soil Parameters for Mulberry			
pH	< 6.5 Acidic	6.5 – 7.5 Neutral	> 7.5 Alkaline
Electrical Conductivity (dS/m)	< 1.0 Normal	1.0 – 2.0 High	> 2.0 Harmful
Organic Carbon (%)	< 0.65 Low	0.65 – 1.00 Moderate	> 1.00 Sufficient
Primary Nutrients (kg/ha)	Low	Moderate	Sufficient
Available Nitrogen	< 280	280 – 560	> 560
Available Phosphorus	< 15	15 – 25	> 25
Available Potassium	< 120	120 – 240	> 240
Other Nutrients (ppm)	Low	Moderate	Sufficient
Available Sulphur	< 10	10 – 20	> 20
Available Boron	< 0.5	0.5 – 1.0	> 1.0
Available Zinc	< 0.6	0.6 – 1.2	> 1.2
Available Iron	< 4.5	4.5 – 9.0	> 9.0
Available Manganese	< 2.0	2.0 – 4.0	> 4.0
Available Copper	< 0.2	0.2 – 0.4	> 0.4

Telangana, Kerala, Maharashtra and Madhya Pradesh in coordination with CSB field units and DoSs during 2016-17. These soil samples were analyzed for pH, electrical conductivity, organic carbon, available N, P, K, S and micronutrients (Cu, Fe, Mn, Zn, B). Maximum soils with alkalinity problems were observed in Tamil Nadu (81%) followed by Andhra Pradesh (61%) and Karnataka (30%). 66% of soils samples analysed were of neutral range in Karnataka. The electrical conductivity of most of the soils (>90%) in all the states come under the normal range. More than 70% of the soils in the analyzed states are low in organic carbon content (<0.65%) and maximum in Andhra Pradesh (84%) followed by Karnataka (79%), Maharashtra (78%) and Tamil Nadu (75%).

The status of available N follows the same trend as soil OC and ranges from low to moderate values. The soils of

Andhra Pradesh (90%), Tamil Nadu (80%) and Karnataka (75%) are under low category. Nearly 50% of soil samples analysed in Karnataka, Tamil Nadu and Andhra Pradesh are low in available phosphorus (<15 kg/ha); whereas most of the soils of Maharashtra and Madhya Pradesh comes under moderate to sufficient category. With regard to the available K content, most of the soils have moderate to sufficient contents. Soils with sufficient levels of available K are observed maximum in Maharashtra (90%) followed by Andhra Pradesh (85%), Tamil Nadu (71%) and Karnataka & Madhya Pradesh (68%). The status of available sulphur was 10 - 40% in low (L), 27 - 70% in moderate (M), 10 - 61% in sufficient (S) category. Maximum sulphur deficiency was observed in Madhya Pradesh (40%) followed by Andhra Pradesh (30%), Maharashtra (17%) and Karnataka (16%).

Inputs/ Products	Samples
Water	57
Vijetha	6
Vijetha (S)	4
Asthra	19
Ankush	15
Poshan	13
Soils	536
Leaf	49

Micronutrient analysis shows that most of the soils in Tamil Nadu and Andhra Pradesh were deficient in available boron, whereas the available boron is low to moderate in Karnataka, Maharashtra and Madhya Pradesh. Soils analysed in South Indian states are mostly deficient in Zn and maximum deficiency was found in Tamil Nadu (55%) followed by Andhra Pradesh (45%) and Karnataka (40%); Mn and Fe also follow the same trend. The highest deficiency of Fe and Mn was observed in Tamil Nadu (38% & 35 %) followed by Andhra Pradesh (35% & 25%) and Karnataka (32% & 20%) respectively. All the soils analysed have shown sufficient levels of Cu.

#### Status of Available N, P, K, S & B

State	Soil Samples Analysed	% Soil Samples Analysed														
		Available N			Available P			Available K			Available S			Available B		
		L	M	S	L	M	S	L	M	S	L	M	S	L	M	S
KA	4197	75	25	0	47	22	31	2	30	68	16	27	57	38	45	17
TN	3172	80	20	0	57	36	7	5	24	71	10	29	61	77	14	9
AP	2138	90	10	0	51	16	33	3	12	85	30	35	35	67	15	18
MH	300	84	16	0	30	46	24	0	10	90	17	70	13	30	45	25
MP	200	83	17	0	0	95	5	0	32	68	40	50	10	35	40	25

The soil analysis in the mulberry growing areas are neutral to alkaline in soil reaction, low to moderate in OC and available N, low in available P and sufficient levels of available K. With respect to micronutrient status, the soils are deficient in Zn, Fe and Mn; whereas Cu is sufficient in the soils. Based on the soil test results, recommendations of manures and fertilizers were given to the farmers to maintain the soil health and fertility.

## Continuous/Other Activities

### Quality Testing of disinfectants and inputs used in sericulture

The disinfectants, critical inputs and samples of mulberry leaf were analysed for assisting the stakeholders of sericulture industry by assessing the quality norms.

Bore-well water samples were found moderately suitable for irrigation purposes in 89.3% cases and 5 samples were not suitable. Excessive hardness (>400ppm) was detected in 29 samples and higher values of Sodium Adsorption Ratio (SAR) were recorded in 11 borewell water samples which indicate corrective measures need to be adopted for utilization of the same. Several batches of Vijetha, Vijetha Supplement, Ashtra, Ankush and Poshan were evaluated for active ingredients content as per quality norms and certificates were issued accordingly. An amount of Rs.7.647 lakhs were collected towards testing charges.

## AGRONOMY SECTION

### Ongoing Research Projects

#### PPA 3552: Development of Technology for Production of Organic Silk (Jan. 2016 - Dec. 2018)

Dasappa (PI), V.K. Yadav, Sibayan Sen, P.C. Santha, M. Balavenkatasubbaiah (upto Dec. 2016) and Kariyappa

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

The experimental plots were complied with the recommended mulberry cultivation practices including organic cultivation. Soil samples collected from the experimental plots designated for organic (T1) and inorganic treatments (T2) were analysed and data was recorded. The samples were also sent to the identified authorized agency for organic certification analysis (1st year). The leaf yield in the plots was collected for the record purpose and utilized to rear silkworms and data on rearing performance and economic parameters were recorded. The silkworm crop protection measures practised includes eco- and user-friendly disinfectants/bed disinfectants and with in the permissible limits (chemicals) for effective silkworm disease management. The reeling and further process was conducted by eco-friendly methods which are being standardized.

#### Soil Chemical Properties - Organic Cultivation

Treatments	pH	EC (mmhos/cm)	OC (%)	P (kg/ha)	K (kg/ha)	Cu (ppm)	Zn (ppm)	Fe (ppm)	Mn (ppm)
T1	7.51	0.21	0.83	48	475	4.23	0.95	9.53	35.25
T2	7.52	0.32	0.68	32.27	395	3.94	0.83	8.62	34.01
SE	0.06	0.03	0.05	4.9	80.12	0.26	0.15	1.78	3.3
CD@5%	0.18	0.1	0.15	15.73	144.6	NS	NS	NS	NS
Initial Status	6.86	0.0.21	0.74	37.49	445	4.7	2.6	8.67	8.5

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

V. Gunasekhar (upto Oct. 2016), K. Rajashekar, K. Vedavyas and Sibayan Sen

**Objectives**

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

Mulberry cultivation for silk production is practiced in over two lakh hectares in India. The package of practices includes extensive tillage coupled with large inputs of inorganic and organic nutrients. The project is initiated with split plot design, main plot as irrigation (furrow and drip irrigation) and sub plot (control: recommended practices and treatment: recommended practice with reduced tillage and cover crops) in six replications. Fodder maize was sown and harvested for homogenization of the experimental plot. Soil samples were collected and analysed for soil properties and microbial populations. Four mulberry crops were harvested in the 1st year and growth parameters including biomass yield was recorded. Slight increase in yield was observed in treatment plot (12586kg/ha/crop) than control (12268kg/ha/crop). Soil analysis has indicated increase in organic carbon, available phosphorous and potassium in treated plot as compared to control. The microbial populations (fungal, bacterial, actinomycetes and Azatobactor) increased in treated plot than control.

Soil Analysis									
Plot	pH	EC (mmhos/cm)	OC (%)	Available		Microbial Population (CFU/ g soil)			
				P (kg/ha)	K (kg/ha)	Fungi (x 10 <sup>4</sup> )	Bacteria (x 10 <sup>6</sup> )	Actinomycetes (x 10 <sup>6</sup> )	Azatobactor (x 10 <sup>6</sup> )
Treated	6.89	0.26	1.20	102.23	548.88	32.82	30.26	62.20	54.40
Control	7	0.51	0.79	56.24	356.85	14.15	26.20	20.40	30.30

Mulberry Leaf Yield Data (four crops avg. data)					
Plot	Avg. Plant Height (cm)	Avg. Length of Longest Shoot (cm)	Leaves/ Shoot (Nos)	Branches (Nos)	Leaf Yield (kg/ha/crop)
Treated	165	175	36	11	12586
Control	158	168	32	9	12268

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

Vinod Kumar Yadav (PI), Dasappa and M. Noble Morrison

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

Thirty farmers adopting different wider spacing (90 cm x 90 cm; (150 +90 cm) x 60 cm; 180 cm x 60 cm; 240 cm x 60 cm; 270 cm x 60cm) in three districts of Karnataka (Ramanagara, Kolar, Chikkaballapura) were identified for estimating the leaf productivity and amiability to mechanization. Data on five crops was collected and maximum mulberry leaf yield was recorded with spacing of (150+90)cm x 60cm (13174.83 kg/ha/crop) and minimum with 270 cm x 60 cm.

## MULBERRY PATHOLOGY

### Concluded Research Projects

#### PRP 3530: Development of a broad-spectrum formulation for effective management of mulberry root rot disease (Jan. 2015 - Dec. 2016)

P. M. Pratheesh Kumar and T. Thippeswamy (upto February 2016)

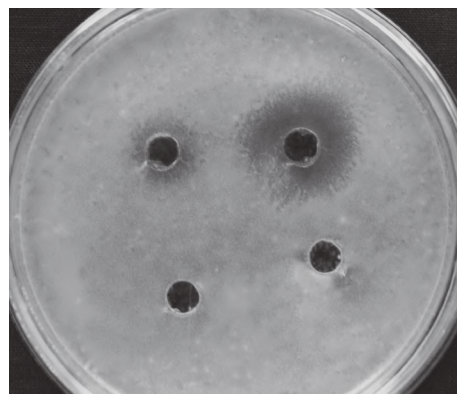
**Objective:** To develop a broad spectrum formulation for effective management of root rot disease of mulberry

#### **In vitro Screening for Antifungal Activity against Root Rot Associated Pathogens of Mulberry**

The root rot associated pathogens of mulberry viz., *Rhizoctonia bataticola*, *Fusarium oxysporum*, *F. solani* and *Botryodiplodia theobromae* were isolated and maintained in the laboratory. *In vitro* screening of extracts of 11 plant species, 12 alternative fungicides and 10 fungicides was conducted for antifungal activity in solid and liquid media. The plant species, *Allium sativum*, *Cinnamomum camphora* and *Azadirachta indica* were highly effective in suppressing the fungi associated with root rot in terms of radial growth. Among the fungicides, Mancozeb and Benomyl completely suppressed *R. bataticola*; *F. oxysporum* and *F. solani* did not grow in Carbendazim and Benomyl; while the growth of *B. theobromae* was completely suppressed by Captan, Tricyclozole, Mancozeb and Benomyl. In case of alternative fungicides, complete fungal suppression except *B. theobromae* was observed in presence of Trichloroisocyanuric acid (TCCA), Phosphorus acid and Naphthalene. The effectiveness of best materials from each group (plant extracts, alternative fungicides, fungicides) was evaluated for their least effective concentration in antifungal activity. The identified plant extracts (2%) and alternative fungicides as well as fungicides (100ppm) effectively controlled root rot associated fungi.

Plant Extracts				
Plant Species	Radial Growth (mm)			
	<i>R. bataticola</i>	<i>F. oxysporum</i>	<i>F. solani</i>	<i>B. theobromae</i>
<i>Allium sativum</i>	0.00	0.00	0.00	0.00
<i>Guizotia abyssinica</i>	23.00	33.08	29.44	23.69
<i>Ferula asafoetida</i>	0.00	2.22	2.33	34.75
<i>Azadirachta indica</i>	0.47	0.00	0.00	1.31
<i>Capsicum annum</i>	41.28	43.78	44.28	13.67
<i>Tamarindus indica</i>	37.11	18.67	13.78	1.92
<i>Pongamia pinnata</i>	31.44	12.11	19.58	21.36
<i>Calotropis procera</i>	43.97	43.04	44.44	22.36
<i>Cinnamomum camphora</i>	0.00	0.00	0.00	0.00
<i>Lawsonia inermis</i>	40.97	43.14	43.53	27.33
<i>Brassica nigra</i>	25.83	14.31	26.11	10.86
Control	38.54	32.83	27.28	32.28
CD (P<0.05)	1.27	0.94	1.01	1.34
Fungicides				
Mancozeb	0.00	6.24	1.75	0.00
Tricyclozole	2.00	4.24	5.53	0.00
Chlorothalonil	9.06	12.48	13.03	8.56
Metalaxyl	26.08	22.19	9.15	9.22
Thiophanate methyl	36.03	14.30	7.08	3.25
Carbendazim	40.83	0.00	0.00	7.36
Copper oxychloride	9.25	10.40	17.97	11.25
Fosetyl aluminum	38.33	14.89	34.37	13.00
Captan	3.08	0.67	3.28	0.00
Benomyl	0.00	0.00	0.00	0.00
Control	37.25	31.19	30.89	34.44
CD (P<0.05)	2.15	1.17	1.04	0.45
Alternative Fungicides/Chemicals				
Sulphur	41.94	26.14	16.92	31.11
Boric acid	39.31	29.25	17.42	25.97
Calcium hydroxide	38.89	33.08	27.14	31.28
Sodium bicarbonate	33.83	35.33	29.94	32.11
TCCA	0.00	0.00	0.00	0.00
Paraformaldehyde	32.50	19.56	24.03	12.81

Salicylic acid	25.86	14.44	16.06	0.00
Potassium bicarbonate	34.25	34.53	27.75	29.00
Ammonium bicarbonate	15.00	23.03	32.03	13.69
Sodium chloride	38.64	30.86	30.42	0.00
Naphthalene	0.00	0.00	0.00	0.00
Phosphorus acid	0.00	0.00	0.00	34.61
Control	38.54	32.83	27.28	31.11
CD (P<0.05)	1.82	1.04	8.79	0.96



Efficacy of Different Formulations on Wilting & Rotting of Mulberry		
Formulation	Wilting (%)	Rotting (%)
F1 (Rot-fix)	10.79 ± 2.31 (18.42)	8.73 ± 2.05 (15.47)
F2	23.99 ± 2.17 (26.79)	15.15 ± 2.02 (21.00)
F3	25.81 ± 6.85 (27.82)	12.99 ± 3.34 (20.04)
F4	24.42 ± 5.69 (27.03)	24.42 ± 5.69 (27.03)
F5	29.45 ± 6.31 (29.24)	17.27 ± 6.27 (22.66)
Navinya	36.29 ± 2.27 (32.31)	25.57 ± 3.19 (27.20)
Control	90.33 ± 5.23 (77.00)	74.04 ± 6.49 (59.38)
CD (P<0.05)	7.06	10.55

Figures in parentheses indicate Arc Sin Transformed Values

### Evaluation under simulated conditions

Five formulations were evaluated with short-listed effective botanicals, alternative fungicides and fungicides with kaolin as carrier on plants grown in earthen pots under artificial simulation of root rot disease. Five replications were maintained against each combination and control. Untreated plants and plants treated with existing recommendation, *Navinya* were maintained for comparison. The formulation, F1 was highly effective and controlled 89.21% root rot and 90.20% wilt in comparison to *Navinya* (71.21% and 62.72%, respectively). The most effective formulation to control root rot in mulberry was named as Rot-fix.

### In vivo evaluation of effective formulations in hotspot areas

The effectiveness of Rot- fix has been evaluated in various hotspot areas of Kanakapura (Karnataka), Kadapa (Andhra Pradesh) Gopichettipalayalam and Salem (Tamil Nadu). The data was collected 30 days after application of the formulation and Rot- fix was effective in reducing the disease severity and revived the root rot affected plants by 78.77% at farmers' fields. In all the cases, the spread of the disease was controlled considerably and farmers were able to rear silkworms without any hindrance from the root rot affected gardens. Rot- fix did not show any adverse/residual effects on growth and development of silkworms and mulberry plants. Similarly, Rot-fix does not show significant variation with regard to soil microbial populations as compared to healthy soils.

Effect of Rot-fix on Microbial Population in the Soil & Mulberry Leaf Yield				
Sample	Microbial Colonies (x104 Nos)		Leaf Yield (g/plant)	
	Treat	Ctrl	Treat	Ctrl
1	62	61	868.5	891.5
2	37	43	903.8	871.7
3	27	30	903.8	899.6
4	50	46	888.0	912.4
5	34	36	889.5	903.5
Mean	42.0	43.2	890.72	895.7
F-test	NS		NS	

Rot-fix has been released in the Farmers Workshop held on 17.02.2017 at Doddabalapura, Bangalore and necessary technical pamphlets have been published in Kannada and English.

**PRP 3535: Popularisation of Nemahari-a bionematicide for management of root knot disease in mulberry (Mar. 2015 - Feb. 2017)**

V. Nishitha Naik, (upto May 2016), P.M. Pratheesh Kumar, H. Jayaram<sup>1</sup>, S. Rajkumar<sup>2</sup>, M. A. Shanthan Babu<sup>3</sup>

<sup>1</sup>REC-SU Kanakapura, <sup>2</sup>RSRS Salem, <sup>3</sup>RSRS Ananthapur

**Objectives**

- To develop an entrepreneurship model for application and commercial production of Nemahari
- To demonstrate effective crop protection through Nemahari for management of root knot disease
- To popularise Nemahari among sericultuists

Nemahari is an eco-friendly formulation developed for the management of root knot disease of mulberry caused by nematode, *Meloidogyne incognita*. As a part of Nemahari popularization programme, large-scale field evaluation studies were conducted in Karnataka, Andhra Pradesh and Tamil Nadu. Mild to severe incidence of root knot disease results in stunted growth and reduces leaf yield.

Nemahari was distributed and demonstrated to the farmers for application in the infected fields (4243kg; 132 acres root knot infected mulberry gardens; 167 farmers). The data was collected from the treated and untreated plots three months after application of Nemahari. Pooled data showed significant ( $P < 0.05$ ) reduction of root knot due to the application of Nemahari with 69.23% disease severity over the untreated control plants. Similarly, significantly higher mean leaf yield (874.55g/plant) was recorded with the application of Nemahari (26.02% increase) over untreated plants.

Technical pamphlets on Nemahari have been published in Kannada, Telugu, Tamil, Hindi and English and distributed to the farmers for wider popularisation. Nemahari has been commercialized to M/S. Rainbow Agri Life India Pvt. Ltd., Kadapa through NRDC.

Field trial of Nemahari			
States	Nemahari (kg)	Area (acre)	Farmers (Nos)
KA	1660	51	60
TN	1200	38	70
AP	1383	43	37
Total	4243	132	167

Effect of Nemahari for the Control of Root Knot & Mulberry Yield						
States	No. of knots/ 50g root		Leaf Yield (g)/ plant		Disease Control (%)	Yield Increase (%)
	Treat	Ctrl	Treat	Ctrl	Treat	Ctrl
AP	1.58	4.72	901.32	723.41	66.52	24.59
	±0.11	±0.49	±7.71	±7.20	±0.22	±0.49
TN	2.41	6.91	894.99	708.39	65.12	26.34
	±0.52	±3.17	±39.53	±41.32	±14.27	±3.49
KA	1.18	4.93	827.34	629.67	76.06	27.15
	±0.42	±1.09	±37.69	±32.29	±7.47	±2.00
Mean	1.72	5.52	874.55	687.16	69.23	26.02
	**			**		
	18.61			22.53		

## MULBERRY PHYSIOLOGY

### Pilot Study

**Efficacy of antitranspirants on moisture retention capacity and mulberry production under deficit irrigation condition (Feb. 2016 to Jun. 2017)**

M.G. Sabita, Sibayan Sen and M. Munirathnam Reddy

**Objective:** To identify suitable antitranspirants for improving moisture retention capacity and productivity under deficit irrigation

The pilot project did not materialize further, as no significant results were obtained from the two crops.

## BIVOLTINE SILKWORM BREEDING LABORATORY

### Concluded Projects

#### AIB 3536: Development of new bivoltine silkworm hybrids for commercial exploitation (Mar. 15 - Feb 17)

C.M. Kishor Kumar, N. Mal Reddy and S. Manthira Moorthy

**Objective:** To develop improved bivoltine hybrids for sustainable productivity

Several bivoltine breeds developed by different research institutions for productivity, silk quality, disease(s), stress and thermo-tolerance were collected for undertaking large scale combining ability test to develop new bivoltine hybrids. Foundation crosses (oval & dumbbell FCs), single hybrids (oval x dumbbell) and double hybrids (oval FCs x dumbbell FCs) were evaluated and promising new hybrid combinations were selected based on overall performance with respect to important economic traits.

Eleven oval breeds (CSR2, CSR17, CSR27, CSR50, CSR52, S8, NB1, D2, GEN1, 2C & EC1) and thirteen dumbbell breeds (CSR4, CSR6, CSR16, CSR26, CSR51, CSR53, 4D, 4S, SK6, SK7, DUN17, DUN18 & PAM117) were used for the hybrid evaluation study (147 single hybrids of straight crosses; oval x dumbbell) were evaluated under uniform rearing conditions. Based on survival and quantitative cocoon traits, 10 productive and 5 robust single hybrids were shortlisted. Further, these shortlisted hybrids were evaluated to study the stability in different seasons. The bivoltine hybrids, SHP2, SHP3 & SHP5 for productivity and SHR1 & SHR2 for robustness were identified as promising combinations on the basis of evaluation index (EI) scores as well as cocoon uniformity with better qualitative parameters and recommended for OST trials.

#### Rearing and Reeling Performance of Short-listed Productive Bivoltine Single Hybrids

Hybrids	Yield/10000 L		Coc. Wt. (g)	Shell Wt. (g)	Shell Ratio (%)	Reel-ability (%)	Fil. Length (m)	Denier	Raw Silk (%)	Neat-ness	Mean EI
	Nos.	Wt (kg)									
SHP1 (CSR2 x CSR26)	9100	17.76	1.952	0.469	24.0	82.7	1140	2.94	18.9	96.0	57.8
SHP2 (CSR17 x CSR26)	9200	17.41	1.893	0.450	23.8	87.7	1050	3.00	18.3	96.0	61.3
SHP3 (CSR27 x CSR53)	9400	18.00	1.915	0.442	23.1	83.7	1153	2.80	18.6	94.0	59.7
SHP4 (CSR50 x CSR53)	9400	17.47	1.858	0.428	23.0	84.4	1003	2.76	16.4	94.0	55.2
SHP5 (NB1 x CSR53)	9100	17.86	1.903	0.437	23.0	82.6	1017	2.96	16.8	96.0	56.9
SHP6 (CSR52 x CSR51)	9100	17.12	1.881	0.432	22.9	85.0	1012	2.74	16.2	96.0	54.2
SHP7 (CSR52 x 4D)	9300	17.02	1.811	0.420	23.2	89.6	958	2.82	16.4	96.0	56.6
SHP8 (S8 x CSR6)	9400	17.36	1.867	0.424	22.7	84.3	952	2.88	16.1	96.0	58.4
SHP9 (CSR52 x CSR6)	9150	17.17	1.877	0.437	23.3	88.0	1059	2.75	17.1	94.0	57.7
SHP10 (D2 x CSR53)	9300	16.63	1.789	0.412	23.0	81.2	1006	2.79	17.2	96.0	52.3
CSR2 x CSR4 (Ctrl)	9350	17.75	1.878	0.426	22.7	86.0	950	2.79	17.9	95.0	53.7
Bench Marks: Survival >90%; Shell Wt. >0.4g; Shell Ratio >23%											

## Rearing and Reeling Performance of Short-listed Robust Bivoltine Single Hybrids

Hybrids	Yield/10000 L		Coc. Wt. (g)	Shell Wt. (g)	Shell Ratio (%)	Reel-ability (%)	Fil. Length (m)	Denier	Raw Silk (%)	Neat-ness	Mean EI
	Nos.	Wt (kg)									
SHR1 (D2 x SK6)	9550	18.10	1.898	0.400	21.1	82.4	1032	2.89	17.0	96.0	53.7
SHR2 (CSR50 x SK6)	9800	17.64	1.820	0.382	21.0	85.9	1007	2.76	17.0	96.0	54.2
SHR3 (CSR2 x SK6)	9500	18.79	1.978	0.409	20.7	79.2	1082	2.80	16.9	96.0	51.5
SHR4 (CSR52 x SK6)	9650	16.33	1.692	0.344	20.3	83.7	964	2.69	16.8	96.0	52.3
SHR5 (S8 x SK6)	9700	16.98	1.751	0.356	20.3	83.7	904	2.75	15.6	96.0	52.8
CSR2 x CSR4 (Ctrl)	9350	17.75	1.878	0.426	22.7	86.0	950	2.79	17.9	95.0	53.7
Bench Marks: Survival >95%; Shell Wt. >0.38g; Shell Ratio >21%											

By utilizing the above cited oval and dumbbell breeds, 52 (oval x oval) and 67 (dumbbell x dumbbell) foundation crosses were prepared and evaluated. On the basis of survival and quantitative cocoon traits, promising oval and dumbbell FCs were shortlisted for further double hybrid evaluation (183 double hybrids; oval FCs x dumbbell FCs). These hybrids were evaluated under uniform conditions to identify the promising combinations on the basis of quantitative and qualitative traits. 10 productive and 6 robust double hybrids were shortlisted to study the stability in different seasons. Based on evaluation index scores as well as cocoon uniformity with better qualitative characters, 3 double hybrids (DHP3, DHP4 & DHP5) for productivity and 3 double hybrids (DHR2, DHR4 & DHR5) for robustness were selected as promising and recommended for OST trials to identify the new superior double hybrids.

## Rearing and Reeling Performance of Short-listed Robust Bivoltine Double Hybrids

Hybrids	Yield/10000 L		Coc. Wt. (g)	Shell Wt. (g)	Shell Ratio (%)	Reel-ability (%)	Fil. Length (m)	Denier	Raw Silk (%)	Neat-ness	Mean EI
	Nos.	Wt (kg)									
DHR1 (CSR27xGEN1) x (CSR4xSK6)	9400	16.63	1.733	0.371	21.4	83.7	921	3.01	17.6	97.0	50.2
DHR2 (S8x2C) x (Dun18xCSR16)	9450	17.32	1.814	0.392	21.6	84.2	912	3.02	17.4	95.0	52.1
DHR3 (S8xD2) x (Dun18xCSR16)	9474	16.72	1.765	0.384	21.8	85.4	967	2.97	17.2	96.0	50.8
DHR4 (CSR27x2C) x (Dun18xCSR16)	9550	16.63	1.789	0.391	21.9	85.8	980	3.03	17.2	96.0	52.3
DHR5 (CSR17x2C) x (SK7xDUN17)	9750	17.36	1.781	0.380	21.3	80.3	968	2.74	16.8	97.0	52.7
DHR6 (CSR2xCSR52) x (Dun18xCSR16)	9600	16.51	1.757	0.388	22.1	80.0	992	3.06	17.1	95.0	51.8
Ctrl (CSR6 x CSR26) x (CSR2xCSR27)	9460	18.12	1.918	0.428	22.3	87.0	1005	2.97	18.9	95.0	58.2
Bench Marks: Survival >95%; Shell Wt. >0.38g; Shell Ratio >21%											

Rearing and Reeling Performance of Short-listed Productive Bivoltine Double Hybrids

Hybrids	Yield/10000 L		Coc. Wt. (g)	Shell Wt. (g)	Shell Ratio (%)	Reel-ability (%)	Fil. Length (m)	Denier	Raw Silk (%)	Neat-ness	Mean EI
	Nos.	Wt (kg)									
DHP1 (CSR2xCSR27) x CSR16xCSR51)	9400	17.87	1.901	0.439	23.1	82.2	1034	3.06	18.3	96.0	57.8
DHP2 (CSR17xS8) x (CSR16xCSR51)	9050	17.69	1.955	0.465	23.8	84.3	1060	3.03	18.2	94.0	61.6
DHP3 (CSR17x2C) x (CSR16xCSR51)	9167	17.64	1.918	0.469	24.5	85.4	1115	3.02	19.0	95.0	61.5
DHP4 (CSR52xGEN1) x (CSR16xCSR51)	9230	18.02	1.907	0.458	24.0	84.2	1150	3.08	19.8	95.0	62.2
DHP5 (S8xD2) x (CSR16xCSR51)	9100	17.51	1.925	0.473	24.6	86.2	1146	3.07	20.1	96.0	63.1
DHP6 (CSR2xCSR50) x (CSR6x4D)	9200	18.33	1.993	0.465	23.3	88.8	1048	2.90	16.9	92.0	58.5
DHP7 (CSR2xCSR52) x (CSR26x4D)	9000	17.05	1.894	0.419	22.1	86.1	1271	2.63	19.5	96.0	60.9
DHP8 (CSR17xS8) x (SSBS6xSSBS7)	9100	17.76	1.952	0.443	22.7	80.3	935	2.98	15.7	96.0	57.0
DHP9 (CSR27xGEN1) x (CSR6x4D)	9200	18.28	1.947	0.434	23.5	85.2	1100	3.02	19.5	96.0	60.7
DHP10 (CSR27x2C) x (CSR6x4S)	9100	18.15	1.995	0.468	23.5	79.0	1093	2.85	17.1	96.0	59.8
Ctrl (CSR6 x CSR26) x (CSR2xCSR27)	9460	18.12	1.918	0.428	22.3	87.0	1005	2.97	18.9	95.0	58.2
Bench Marks: Survival >90%; Shell Wt. >0.45g; Shell Ratio >23%											

**OST evaluation**

The selected single and double hybrids were reared at three RSRS units (Karnataka: Kodathi; Tamil Nadu: Salem; Andhra Pradesh: Ananthapur) for further evaluation in the filed conditions and identify superior hybrid combinations for commercial exploitation. The rearing data reveals that all the hybrids exhibited varied performance for the economic traits analyzed reflecting varied genetic constitution and response to different environmental conditions. Based on the mean and stability parameters, the new hybrids performed better and found promising to rear in all the regions.

## OST Performance of Short-listed Bivoltine Hybrids

Hybrid	Location	Fec.	Yield/ 10000 L (Nos)	Yield/ 100 dfis (kg)	Coc. Wt. (g)	Shell Wt. (g)	Shell Ratio (%)	Reel- ability (%)	Fil. Length (m)	Denier	Renditta	Raw Silk (%)	Neat- ness
SHP1	Salem	587	9019	77.3	1.682	0.389	23.1	89.5	982.8	2.62	5.91	16.9	98
	Kodathi	494	9615	70.3	1.640	0.358	21.8	80.8	894.1	2.91	5.31	18.9	98
	Ananthpur	480	9574	69.6	1.750	0.392	22.4	89.2	866.7	2.63	6.95	14.4	98
	Avg.	520	9403	72.4	1.691	0.380	22.5	86.5	914.5	2.72	6.06	16.7	98
SHP2	Salem	536	9459	74.2	1.628	0.389	23.9	95.2	915.1	2.64	6.09	16.4	97
	Kodathi	504	9896	73.7	1.608	0.355	22.1	81	834.3	2.65	6.50	15.4	98
	Avg.	520	9678	74.0	1.618	0.372	23.0	88.1	874.7	2.65	6.30	15.9	98
SHR1	Salem	680	7081	68.4	1.644	0.348	21.2	90.6	821.4	2.72	6.65	15.0	98
	Kodathi	471	9667	63.6	1.603	0.308	19.2	81.8	794.9	2.52	6.29	15.9	98
	Avg.	576	8374	66.0	1.624	0.328	20.2	86.2	808.15	2.62	6.47	15.5	98
DHP1	Salem	576	7655	70.7	1.755	0.403	23.0	88.9	939.5	2.83	5.97	16.7	98
	Kodathi	458	9873	63.3	1.603	0.329	20.5	85.7	842.3	2.67	6.38	15.7	98
	Ananthpur	502	2105	15.0	1.731	0.359	20.7	79.4	810.1	2.83	6.84	14.6	96
	Avg.	512	6544	49.7	1.696	0.364	21.4	84.7	864.0	2.78	6.40	15.7	97
DHP2	Salem	581	8939	82.5	1.565	0.359	22.9	94.8	931.7	2.57	5.90	17.0	98
	Kodathi	531	8186	57.4	1.493	0.327	21.9	81.4	805.7	2.55	6.87	14.6	98
	Ananthpur	507	7741	56.8	1.877	0.357	19.0	82.1	956.1	2.54	7.01	14.3	96
	Avg.	540	8289	65.6	1.645	0.348	21.3	86.1	897.8	2.55	6.59	15.3	97
DHP3	Salem	597	8445	79.5	1.632	0.387	23.7	94.5	1119.2	2.66	4.95	20.2	97
	Kodathi	506	8469	63.3	1.526	0.325	21.3	82.8	852.7	2.44	6.22	16.1	98
	Ananthpur	515	7283	59.6	1.479	0.329	22.2	83.6	918.6	2.66	5.48	18.3	98
	Avg.	539	8066	67.5	1.546	0.347	22.4	87.0	963.5	2.59	5.55	18.2	98
DHP5	Salem	631	7328	76.8	1.789	0.409	22.9	91.9	998.3	2.61	6.20	16.1	98
	Kodathi	545	7892	66.7	1.675	0.370	22.1	82.7	866.5	2.72	6.02	16.6	98
	Ananthpur	516	8620	61.0	1.570	0.341	21.7	80.9	964.6	2.58	5.69	17.6	96
	Avg.	564	7947	68.2	1.678	0.373	22.2	85.2	943.1	2.64	5.97	16.8	97
DHR3	Salem	709	7817	98.2	1.730	0.381	22.0	94.6	940.7	2.61	6.36	15.7	98
	Kodathi	542	7920	63.6	1.625	0.347	21.4	81.3	863.5	2.44	6.19	16.2	98
	Ananthpur	491	9548	79.0	1.446	0.330	22.8	88.2	962.2	2.58	5.27	19.0	96
	Avg.	581	8428	80.3	1.600	0.353	22.1	88.0	922.1	2.54	5.94	17.0	97
DHR4	Salem	691	8477	91.0	1.766	0.394	22.3	87.4	975.1	2.60	6.30	15.9	97
	Kodathi	566	7700	63.5	1.615	0.341	21.1	83.2	830.7	2.63	6.51	15.4	98
	Ananthpur	511	9737	72.4	1.631	0.366	22.4	86.2	895.1	2.70	6.09	16.4	98
	Avg.	589	8638	75.6	1.671	0.367	22.0	85.6	900.3	2.64	6.30	15.9	98

**Conclusion**

Based on OST performance as well as performance in the laboratory, the single hybrids: SHP2 & SHR1 and double hybrids: DHP5 & DHR4 were identified as superior hybrids for productivity and robustness, respectively. These hybrids would be further evaluated in large scale in different parts of the country as per the Breeders meet recommendations.

## On going Research Projects

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

N. Mal Reddy, M. Balavenkatasubbaiah (upto December 2016) and S. Manthira Moorthy

**Objective :** Development of productive bivoltine silkworm breeds/hybrids tolerant to BmNPV

Twelve breeding lines (oval: CSR2N, CSR17N, CSR27N, CSR50N, CSR52N, S8N & D2N; dumbbell: CSR4N, CSR6N, CSR16N, CSR26N & CSR51N) were developed utilizing recurrent productive bivoltine parental stocks and with BmNPV tolerant donor stocks (oval: MASN6; dumbbell: 5N). The breeding lines were screened (II moult larvae; per orally @ 2x10<sup>6</sup> PIB/larvae) for BmNPV tolerance as per the breeding plan upto BC<sub>6</sub>S<sup>3</sup> generation. Based on overall rearing performance, economic traits and BmNPV tolerance levels, 6 F1 hybrids and 3 double hybrids were prepared utilizing the selected parental stocks and evaluated. Based on rearing and reeling performance, CSR52N x CSR26N (single hybrid) and double hybrid, (CSR52N x S8N) x CSR16N x CSR26N were identified as most promising. Further laboratory and OST would be conducted to test verify the hybrid performance in all the seasons.

#### Performance of BmNPV Tolerant Bivoltine Single Hybrids

Hybrid	Pupation (%)	Coc. Yield (kg)	Coc. Wt. (g)	Shell Wt. (g)	SR (%)	Reela-bility (%)	Fil. Length (m)	Raw Silk (%)	Denier	Neatness
CSR52N x CSR6N	94.1	17.9	1.902	0.434	22.8	86	975	17.7	2.78	94
CSR52N x CSR16N	93.2	17.7	1.895	0.428	22.6	88	1002	18.6	2.99	95
CSR52N x CSR26N	96.9	18.9	1.955	0.465	23.8	89	1020	19.2	2.89	96
S8NxCSR6N	94.2	17.8	1.885	0.430	22.8	85	985	18.1	2.79	95
S8NxCSR16N	96.5	18.7	1.942	0.458	23.6	88	1046	18.8	2.78	94
S8NxCSR26N	95.2	18.2	1.916	0.429	22.4	87	1100	19.3	2.98	96
CSR2xCSR4 (Ctrl)	95.2	18.0	1.892	0.439	23.2	86	950	18.6	2.79	95

#### Performance of BmNPV Tolerant Bivoltine Double Hybrids

Hybrid	Pupation (%)	Coc. Yield (kg)	Coc. Wt. (g)	Shell Wt. (g)	SR (%)	Reela-bility (%)	Fil. Length (m)	Raw Silk (%)	Denier	Neatness
(CSR52N xS8N) x (CSR6N xCSR16N)	95.2	18.6	1.950	0.439	22.5	88	1022	18.2	2.98	94
(CSR52N xS8N x (CSR6N xCSR26N)	94.3	18.8	1.990	0.446	22.4	87	975	17.9	3.00	94
(CSR52N xS8N) x (CSR16N xCSR26N)*	96.3	20.0	2.080	0.489	23.5	89	1075	19.2	2.89	96
(CSR6 x CSR26) x (CSR2 xCSR27) (Ctrl)	96.1	19.0	1.978	0.451	22.8	87	1005	18.9	2.97	95

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

V. Sivaprasad and S. Manthira Moorthy

#### Objectives

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

Five silkworm genotypes (Kom-2, CV-1071-2, ShV, Vr2012 and JH4) and two hybrids [(H1 x KK) x (G2 x V2)] & Super1 x Hessa2 were collected from Sericulture & Agriculture Experiment Station (SAES), Vratza, Bulgaria as a part of collaborative research project and MoU with Bulgaria. The quarantine rearing of the imported stocks was conducted following appropriate procedures under the supervision of Quarantine Department, NBAIR-ICAR, Bangalore. The breeds/hybrids have performed true to the characteristics as prescribed in the Material Transfer Agreement (pupation ranged from 90-94% and shell was >24%). Utilizing the Bulgarian germplasm stocks and indigenous stocks, new breeding programmes including inbreeding and hybridization were initiated to develop silkworm breeds with high silk content.

## Rearing Performance of Silkworm Genetic Resources from SAES-Bulgaria

Breed/Hybrid	Fec.	Yield/10000 L		Coc. Wt. (g)	Shell Wt. (g)	SR (%)
		No.	Wt. (kg)			
KOM-2	585	9100	15.349	1.725	0.430	24.90
CV-10712	568	9200	16.024	1.758	0.437	24.83
JH4	612	9145	15.152	1.729	0.423	24.44
ShV	625	9410	16.154	1.722	0.444	25.77
Vr 2012	545	9010	15.028	1.679	0.397	23.67
(H1 x KK) x (G2 x V2)	635	9350	18.378	2.019	0.478	23.68
Super1 x Hessa2	654	9250	18.122	2.024	0.482	23.81

**AIT 3556: To conduct multi-locational field trials on transgenic BmNPV resistant silkworm strains to establish their efficacy and generate data for their regulatory approval (DBT-BIRAC Inter-Institutional Collaborative Project with CFDH-Hyderabad and APSSRDI-Hindupur) (Nov. 2015 - Sep. 2017)**

V. Sivaprasad and S. Manthira Moorthy

**Objective:** To conduct multi-locational field trials on transgenic BmNPV resistant silkworm strains to establish their efficacy

BmNPV resistant transgenic silkworm hybrid, [CSR2(T) x CSR4] and control hybrid, CSR2 x CSR4 were evaluated by following Standard Operating Procedure (SOP) and Biosafety measures prescribed by RCGM. Six crops were reared at CSRTI-Mysore and one crop each at RSRS-Ananthapur, RSRS-Salem, RSRS-Kodathi and REC-Bidaraguppe in exclusive rearing facilities and rearing/reeling performances were documented. The crops were monitored periodically by the committee nominated by RCGM. Both hybrids were also challenged with BmNPV to determine the efficacy against BmNPV infection. The transgenic hybrid yielded 62.14kg/100 dfls with shell of 21.38% as compared to 58.75kg and 21.64% in the control hybrid.

## Performance of BmNPV Tolerant Transgenic Bivoltine Hybrids Challenged with BmNPV

Hybrid	Location	Lar. Mort. due to BmNPV (%)	Pupa-tion (%)	Coc. Wt. (g)	Shell Wt. (g)	SR (%)
CSR2x CSR4 (Ctrl)	RSRS-Ananthapur	50	38	1.670	0.362	21.68
	RSRS-Kodathi	90	9	1.469	0.312	21.23
	RSRS-Salem	91	4	1.059	0.215	20.30
	REC-Bidaraguppe	52	45	1.498	0.343	22.89
	CSRTI-Mysore	31	42	1.604	0.340	21.16
		37	46	1.628	0.342	20.99
		43	43	1.657	0.341	20.62
	Mean ± SD	56 ± 24	32 ± 18	1.51 ± 0.21	0.32 ± 0.05	21.27 ± 0.8
CSR2(T) x CSR4	RSRS-Ananthapur	35	50.0	1.565	0.354	22.62
	x CSR4	76	21.0	1.655	0.340	20.57
	RSRS-Salem	86	6	1.025	0.22	21.46
	REC-Bidaraguppe	72	23	1.531	0.352	22.97
	CSRTI-Mysore	10	78	1.553	0.326	21.05
		23	56	1.568	0.324	20.67
		22	60	1.572	0.324	20.64
	Mean ± SD	46 ± 31	42 ± 26	1.50 ± 0.21	0.32 ± 0.05	21.42 ± 1.0

Performance of BmNPV tolerant transgenic hybrid and control hybrid

Hybrid	Location	Fec.	Yield/10000 L (Nos.)	Yield/100 dfls (kg)	Coc. Wt. (g)	Shell Wt. (g)	SR (%)	Fil. Length (m)	NBFL (m)	Reela-bility (%)	Ren-ditta	Raw Silk Rec.
CSR2 x CSR4 (Control)	RSRS-Anantapur	393	7924	47.70	1.834	0.393	21.44	792	756	82.9	7.58	65.0
		412	8254	51.63	1.720	0.340	19.76	833	722	87.0	7.00	70.0
		455	7528	47.39	1.379	0.298	21.61	748	617	82.5	6.38	73.0
	REC-Bidaraguppe	442	8851	64.79	1.840	0.417	22.66	769	588	76.4	7.26	62.0
	CSRTI-Mysore	554	8347	58.20	1.530	0.325	21.25	781	748	95.78	6.70	71.9
		528	7279	57.31	1.596	0.338	21.18	789	616	78.08	7.00	67.1
		536	8132	72.07	1.801	0.399	22.16	764	635	83.14	7.60	63.4
		477	7698	63.59	1.836	0.405	22.07	795	659	82.87	6.80	63.9
	628	8002	66.10	1.773	0.401	22.60	847	718	84.78	6.7	63.5	
	Mean ± SD	449 ±76	8002 ±470	58.75 ±8.6	1.701 ±0.20	0.368 ±0.04	21.64 ±0.90	791 ±32	673 ±64	83.72 ±5.54	7.00 ±0.4	67.0 ±4.15
	CSR2(T) x CSR4	RSRS-Ananthapur	365	8401	51.45	1.792	0.394	22.08	845	729	86.2	7.49
384			9042	53.56	1.790	0.360	20.15	807	741	89.0	6.70	76.0
RSRS-Salem		436	9250	52.75	1.339	0.290	21.66	820	710	86.7	6.26	78.0
REC-Bidaraguppe		405	9442	66.52	1.765	0.400	22.63	837	657	78.5	6.58	71.0
CSRTI-Mysore		557	8970	64.03	1.480	0.306	20.67	720	624	86.64	7.40	63.9
		556	8457	59.25	1.539	0.309	20.09	858	727	84.74	6.40	78.3
		474	8876	74.90	1.773	0.381	21.49	829	732	88.31	6.60	72.6
		453	8579	68.99	1.787	0.385	21.53	848	760	89.57	6.30	70.3
453		8435	67.83	1.700	0.377	22.14	830	718	86.22	6.70	71.7	
Mean ± SD		454 ±68	8828 ±381	62.14 ±8.3	1.663 ±0.20	0.356 ±0.04	21.38 ±0.90	830 ±50	718 ±49	86.22 ±3.27	6.70 ±0.44	72.0 ±5.18

**AIT 3596: Development of multi-viral disease tolerant (BmNPV, BmIFV & BmDNV1) bivoltine silkworm breeds/hybrids of *Bombyx mori* L. through marker-assisted selection (Sep. 2016 - Aug. 2020)**

L. Satish, L. Kusuma, N. Mal Reddy (upto March 2017) and M. Balavenkata Subbaiah (upto December 2016)

**Objectives**

- Identification of multi-viral tolerant bivoltine breeds using molecular markers
- Development of multi-viral disease tolerant bivoltine breeds through pyramiding of resistance
- OST of identified hybrids at RSRSs/RECs

Popular, productive, temperature-tolerant and exotic bivoltine genetic stocks (51) were evaluated for resistance to BmDNV1 by per oral inoculation (out of II moult larvae @ 10<sup>-2</sup> dilution/1ml per 100 larvae). The data on rearing performance and economic traits were recorded for the resistant populations. The resistant populations were subjected to PCR for DNV1 specific markers amplification. The BmDNV1 resistant population stocks (F2) were developed and maintained for further evaluation as per the desired objectives.

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

L. Kusuma, N. Mal Reddy, S. Manthira Moorthy and M.N. Chandrashekar

#### Objectives

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

Bivoltine silkworm breeds (CSR2 & CSR27) with superior silk quality and multivoltines (PM & Nistari) with inferior silk quality were reared for three generations to develop inbred lines. Tissue samples were collected and stored in liquid nitrogen for further use. The platform and criteria for transcriptome analysis have been finalized (avg. read length: 2×150bp; Mapping of transcriptome data on reference genome; DGE based on FPKM; Functional annotation of expressed genes; significant up- and down-regulated genes; KEGG Pathway analysis). RNA isolation by Trizol method was standardized and genomic correlation between bivoltine and multivoltine stocks have been initiated. Based on literature survey, 28 genes have been identified showing correlation to varied silk quality and the same would be utilized to establish gene-gene and gene-protein interaction pathway.

Transcript/ gene/Protein ID	Mode of action
BGIBMGA007720	Protease inhibitors could protect silk proteins from being degraded before secretion
BGIBMGA004374	Ribosomal protein S12
BGIBMGA006789	Malectin-like
gi_1377915	Enhanced green fluorescent protein (EGFP)
BGIBMGA008768	ferritin precursor
gi_187281708	Triosephosphate isomerase
BGIBMGA002689	Seroin 1 precursor
BGIBMGA014201	Cytosolic 10-formyltetrahydrofolate dehydrogenaselike
BGIBMGA013965	H+-transporting ATP synthase gamma subunit
gi_114052677	Phosphoserine aminotransferase 1
gi_164448672	silk fibroin heavy chain [ <i>Bombyx mori</i> ]
BGIBMGA009393	Fibroin light chain [ <i>Bombyx mori</i> ]
Forkhead	Forkhead/silk gland factor 1
POU-M1	POU-M1/silk gland factor 3
BGIBMGA009261	Fibrohexamerin
BGIBMGA011901	Sericin 2
BGIBMGA012002	Sericin 3
BGIBMGA006216	alanine-tRNA ligase
BGIBMGA007637	glycine-tRNA ligase
gi_282848475	Seroin2
gi_167860164	Seroin 1
SGF-2	SGF-2
miR-2b	miR-2b
Bmsage	Bmsage
FMBP-1	FMBP-1
Awh	Nucleotide binding activity, Transcription regulator
BGIBMGA008713	40S ribosomal protein S28
BGIBMGA004648	Involved in energy metabolism, ribosome assembly & function, protein folding, processing & transport, posterior silk gland growth & development

## Continuous/Other Activities

### Maintenance of bivoltine silkworm breeds

N. Mal Reddy, C.M. Kishor Kumar, S. Manthira Moorthy, L. Kusuma and L. Satish

**Objective:** To maintain various bivoltine genetic resources conforming to the original breed characteristics

Productive bivoltine breeds (10), robust bivoltine breeds (11), thin denier bivoltine breeds (2) and sex limited breeds (5) were maintained for conservation and evaluation. The values obtained for the traits were in conformity with the original breed characteristics.

Characteristics of Bivoltine Genetic Resources

Category	Breeds		Fec. (Nos)	Pupation (%)	Coc. Wt. (g)	Shell Ratio (%)	Fil. Length (m)	Raw Silk (%)	Denier
Productive	CSR2 CSR3 CSR4 CSR5 CSR6	CSR12 CSR16 CSR17 CSR26 CSR27	>500	>90	>1.70-1.80	>22-24	>900	>17.0	2.7-3.0
Robust	CSR18 CSR19 CSR46 CSR47 CSR50 CSR51	CSR52 CSR53 S8 D2 NB1	>500	>90	>1.60-1.80	>22-23	>900	>15.0	2.7-3.0
Thin Denier	CSR48 JPN7		>500	>90	>1.60-1.80	>22-23	>1200	>15.0	2.2-2.4
Sex-Limited	CSR2 (SL) CSR4 (SL) CSR8 (SL)	CSR27 (SL) CSR202 (SL)	>400	>90	>1.50-1.70	>20-21	>700	>13.0	2.6-2.9

## Transfer of Technology (ToT)

### Field testing of new bivoltine silkworm hybrids

N. Mal Reddy, C.M. Kishor Kumar, S. Manthira Moorthy, L. Kusuma and L. Satish

Silkworm hybrids (Jayachamaraja: CSR50.CSR52 x CSR51.CSR53 & S8xCSR16) developed by CSRTI-Mysuru were field tested to determine the yield potentiality systematically through ToT programme with the farmers of Karnataka, Tamil Nadu and Andhra Pradesh.

State	Dfls (Nos)	Farmers (Nos)	Yield/ 100 dfls (kg)
S8 x CSR16			
Karnataka	26600	80	67.6
Tamil Nadu	14000	78	81.1
Andhra Pradesh	8550	31	74.4
Total/Avg.	49150	189	74.3
FC3 x FC4 (Jayachamaraja)			
Karnataka	9800	35	65.2
Tamil Nadu	1500	10	69.3
Andhra Pradesh	1850	10	75.4
Total/Avg.	13150	55	70.0

## MULTIVOLTINE BREEDING LABORATORY

### Concluded Projects

#### AIB 3456: Development of Productive Polyvoltine Breeds of the Silkworm, *Bombyx mori* L. Tolerant to High Temperature and BmNPV (Oct. 2011 - Sep. 2016)

Dayananda, M. Balavenkatasubbaiah, S.B. Kulkarni,  
Kariyappa, V. Premalatha, K.P. Shivakumar,

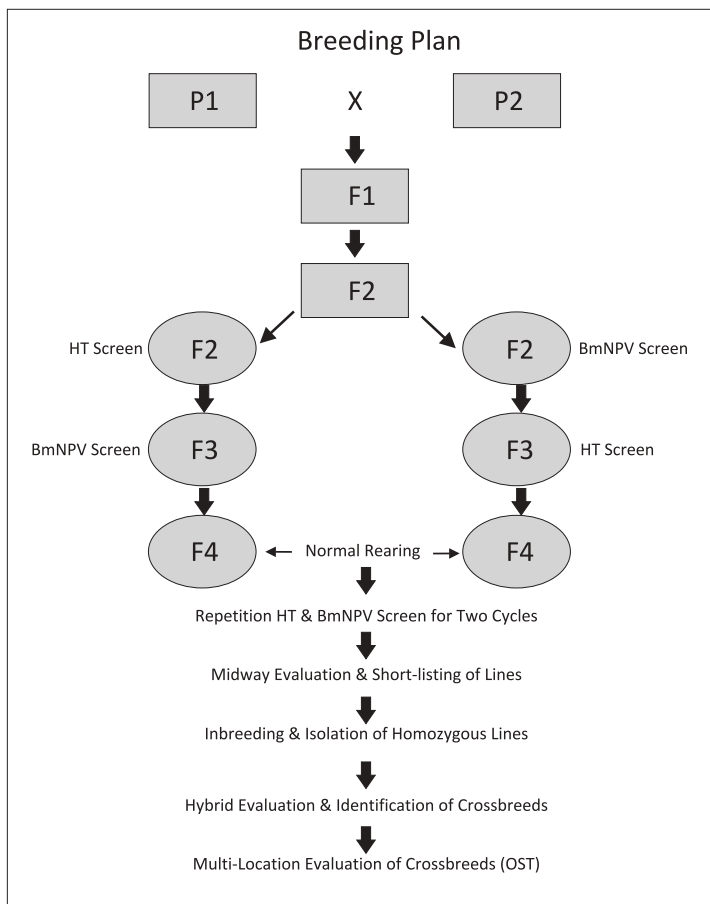
K. Chandrashekar and P. Rama Mohana Rao

#### Objectives

- Development of polyvoltine breeds tolerant to high temperature and BmNPV
- Identify their Crossbreeds for cocoon productivity and quality

Breeding programme was initiated with eight genetic stocks (ND7, NDV6, L14, NP1, 96E, 2000H, BL67 & BL69) identified based on cumulative score index of performance under high temperature ( $36 \pm 1^\circ\text{C}$  and humidity ( $85 \pm 5\%$ ) for a period of 6 hours/day from 3rd day of fifth instar till spinning and BmNPV (III instar larvae; 1 ml/100 larvae @  $1 \times 10^6$  PIBs/ml) from the 30 evolved germplasm breeds.

Five new polyvoltine breeding lines (L1: NP1×L14; L3: NP1×L14×ND7; HB1: NDV6×BL69; HB4: BL69×NDV6; HB6: BL67×L14) were identified based on Mean Evaluation Index (EI) of multiple traits and stabilized. The performance of new breeds is superior over PM & at par with MV1.



### Rearing Performance of New Polyvoltine Breeds

Breed	Fec.	Survival (%)	Coc. Wt. (g)	Shell Wt. (g)	Shell (%)	Reel-ability (%)	Fil. Length (m)	Raw Silk (%)	Neat-ness	Mean EI
L3	550	86.14	1.485	0.276	18.59	63.31	539	11.12	90	56.64
HB4	562	93.91	1.384	0.263	18.97	61.09	518	11.05	88	55.57
HB1	563	88.43	1.452	0.269	18.49	57.35	578	10.50	86	53.04
L1	533	79.74	1.420	0.255	17.93	58.08	515	10.11	86	46.78
HB6	481	83.94	1.383	0.260	18.77	58.00	506	9.93	86	46.67
PM	462	88.03	1.067	0.170	15.91	54.27	479	8.50	86	35.15
MV1	535	89.06	1.398	0.249	17.82	63.52	595	11.09	90	56.16

Similarly, two crossbreed combinations of new polyvoltine breeds with productive/robust bivoltine breed (S8) were identified as promising cross breeds based on laboratory performance. The performance of both the new crossbreeds are significantly superior ( $p < 0.05\%$ ) over PM × CSR2 and at par with MV1 × S8.

Rearing Performance of New Crossbreeds

Crossbreed	Fec.	Survival (%)	Coc. Wt. (g)	Shell Wt. (g)	Shell (%)	Reel-ability (%)	Fil. Length (m)	Ren-dita	RSR (%)	Neat-ness
L3 × S8	513	83.11	1.522	0.303	19.90	81.70	690	7.160	69.88	88
HB4 × S8	439	88.72	1.700	0.339	19.94	83.62	754	7.560	67.14	90
MV1 × S8	429	86.92	1.627	0.337	20.73	83.51	762	7.020	68.78	88
PM × CSR2	434	84.05	1.439	0.255	17.69	81.48	569	8.360	69.23	88
F value	1.76 NS	276NS	11.75**	27.53**	42.60**	20.70**	74.17**	31.48**	106.72**	8.70**
CD @ 5%	30.90	7.81	0.09	0.02	0.41	1.38	23.58	0.14	1.60	1.50

Further, the promising crossbreeds (L3 × S8 & HB4 × S8) were evaluated in RSRSs of southern region (Kodathi, Chamarajanagar, Anantapur & Salem) as OST. The newly developed crossbreeds performed at par with MV1 × S8 and found superior over PM × CSR2.

OST Performance of Promising Crossbreeds

Location	Crossbreed	Survival (%)	Coc. Wt. (g)	Shell Wt. (g)	Shell (%)	Reel-ability (%)	Fil. Length (m)	Ren-dita	RSR (%)	Neat-ness
RSRS-Kodathi	L3 × S8	91.82 ±4.59	1.737 ±0.12	0.360 ±0.03	20.75 ±0.44	85.82 ±3.08	769 ±49	7.150 ±0.07	66.07 ±0.33	88 ±0
	HB4 × S8	91.84 ±4.27	1.740 ±0.17	0.356 ±0.04	20.48 ±0.49	85.10 ±0.14	85.10 ±0.14	7.310 ±0.14	67.77 ±2.07	88 ±1
	MV1 × S8**	91.22 ±10.87	1.708 ±0.15	0.355 ±0.04	20.78 ±0.41	86.75 ±4.60	775 ±41	7.090 ±0.01	67.42 ±1.55	88 ±0
	PM × CSR2*	89.96 ±7.85	1.665 ±0.04	0.324 ±0.01	19.46 ±0.24	84.52 ±2.15	678 ±64	7.900 ±0.89	58.95 ±2.19	86 ±0
RSRS-Anantapur	L3 × S8	87.18	1.358	0.280	20.62	83.00	759	6.830	72.33	87
	HB4 × S8	85.93	1.326	0.270	20.36	86.74	741	6.860	71.90	88
	MV1 × S8**	85.38	1.392	0.290	20.83	84.93	729	6.790	70.90	86
	PM × CSR2*	85.01	1.354	0.250	18.46	83.87	693	8.430	64.10	87
RSRS-Chamarajanagara	L3 × S8	83.85 ±21.08	1.481 ±0.22	0.285 ±0.07	19.27 ±1.90	83.65 ±1.51	595 ±20	7.600 ±0.06	70.72 ±0.31	88 ±0
	HB4 × S8	80.70 ±25.97	1.499 ±0.28	0.287 ±0.07	19.15 ±1.33	85.40 ±0.41	632 ±24	7.250 ±0.35	69.83 ±0.24	88 ±0
	MV1 × S8**	86.94 ±19.90	1.430 ±0.24	0.284 ±0.08	19.88 ±2.37	85.62 ±1.90	649 ±110	7.620 ±0.40	70.48 ±0.17	88 ±1
	PM × CSR2*	85.38 ±22.75	1.388 ±0.14	0.256 ±0.02	18.45 ±1.33	84.20 ±3.53	577 ±16	8.555 ±0.40	64.49 ±2.67	87 ±1
RSRS-Salem	L3 × S8	85.03 ±3.87	1.580 ±0.12	0.326 ±0.02	20.63 ±0.38	86.17 ±1.87	874 ±67	6.640 ±0.18	72.78 ±3.76	88 ±0
	HB4 × S8	85.81 ±8.36	1.526 ±0.12	0.315 ±0.01	20.67 ±0.93	87.90 ±3.63	908 ±18	6.645 ±0.15	74.57 ±3.30	89 ±0
	MV1 × S8**	86.19 ±9.97	1.511 ±0.18	0.308 ±0.04	20.41 ±0.73	86.70 ±3.16	852 ±42	6.685 ±0.29	71.99 ±4.22	89 ±1
	PM × CSR2*	84.84 ±6.30	1.495 ±0.13	0.283 ±0.03	18.93 ±0.26	86.17 ±1.20	716 ±2.0	7.855 ±0.08	68.91 ±1.90	87 ±1

\*: Popular Crossbreed Control \*\*: Improved Crossbreed Control

### Inference/Recommendation

The five new polyvoltine breeds viz., L1, L3, HB1, HB4 and HB6 were developed through selection adopting high temperature and BmNPV pathogen as stress factors could be maintained and effectively utilized in further breeding programmes to develop polyvoltine breeds tolerant to biotic and abiotic stress. The new breeds need to be challenged for both the stresses at least once in a year to keep the trait alive. Two new crossbreeds viz., L3 × S8 and HB4 × S8 performed significantly superior over the existing popular crossbreed, PM × CSR2 with respect of quantitative and qualitative traits can be further tested and recommended for commercial exploitation to increase the quality crossbreed raw silk production in India.

### Ongoing Project

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

Chandrashekhar, K.B. (PI), Dayananda, S.B. Kulkarni, P.V. Soudaminy and Kariyappa

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

The Pure Mysore lines collected from the selected sources (CSB & DoS) were maintained for further selection based on visual appearance, shell compactness along with other critical characteristics of PM. Directional selection was followed for the isolation of improved PM lines based on cold mono-cocoon reeling. Eight improved PM lines with longer filament length were maintained for further characterization for silk fibre quality as per targeted objectives for five generations.

Source	Filament Length (m)		Avg. FIL (m)
	Female	Male	
PM-MBL	450	395	423
PM-DOS	510	428	469
PM-CMV	599	434	517
IPM-A	480	501	491
IPM-B	536	476	506
IPM-C	449	416	433
IPM-D	560	487	524
IPM-E	575	514	545

Performance of Pure Mysore Lines				
Parameter	Gen 1		Gen 8	
	Source I (MBL)	Source II (DoS)	Source I (MBL)	Source II (DoS)
Fecundity (No.)	430 - 521	459 - 506	436 - 518	478 - 528
Pupation Rate (%)	74.72 - 89.71	70.78 - 90.67	82.33 - 98.00	82.0 - 95.30
Single cocoon weight (g)	0.845 - 1.167	0.947 - 1.125	0.991 - 1.151	0.986 - 1.132
Single shell weight (g)	0.125 - 0.180	0.151 - 0.175	0.170 - 0.180	0.150 - 0.160
Shell (%)	14.79 - 15.42	15.49 - 15.56	16.3 - 17.7	15.7 - 15.9

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

Chandrashekhar, K.B. (PI), Dayananda, C.M. Kishor Kumar, P.V. Soudaminy, M. Balavenkatasubbaiah and Kariyappa

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

The project was initiated with 11 parental stocks (6 greenish yellow, 2 dark yellow & 3 white), from which 36 F1 crosses were evaluated for overall performance, cocoon uniformity and fibre quality. Twenty two selected F1s were inbred further to isolate pure multivoltine stocks. Five generations (F4-F8) of these lines were reared and evaluated for the targeted objectives based on economic traits, cocoon nature and visual appearance and 18 lines were retained for further evaluation.

Rearing Performance of Improved ICB lines @ F9

Breeding Lines	Parentage	Fec. (Nos)	ERR/1000L (Nos)	Cocoon Wt. (g)	Cocoon Wt. (g)	Shell Ratio (%)
1	L14*ND7	416	8278	1.485	0.279	18.78
2	L14*NDV6	434	9571	1.410	0.280	19.85
3	L14*NP1	525	8057	1.355	0.270	19.96
4	L14*ND5	441	9417	1.390	0.260	18.44
5	ND7*ND5	445	8600	1.169	0.218	18.67
6	ND7*AGL	424	7886	1.144	0.210	18.33
7	NDV6*ND5	502	7833	1.177	0.229	19.44
11	APDR15*FVB1	395	7693	1.232	0.235	19.05
13	FVB1*ND7	547	7653	1.174	0.192	16.34
14	APDR15*MH1	438	8371	1.354	0.235	17.38
15	APDR15*SARUPAT	455	7046	1.268	0.227	17.88
17	FVB1*MH1	445	7633	1.287	0.219	16.99
19	L14*SARUPAT*L14	630	8350	1.282	0.239	18.61
21	ND7*MH1*ND7	345	8717	1.303	0.243	18.68
23	NDV6*MH1*NDV6	488	7877	1.321	0.253	19.12
28	AGL*SARUPAT*AGL	568	7583	1.194	0.231	19.38
29	20A*S8xS8*20A	483	9480	1.569	0.302	19.22
30	20A*FC4xFC4*20A	528	8508	1.345	0.254	18.87

**Continuous and other Activities**

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

S.B. Kulkarni, Santha, P.C. and V. Sivaprasad

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

P1 seed cocoons for ICB, MV1 x S8 were generated (MV1: 111kg; S8: 96kg) in 5 batches for the production of 26750 dfls of Cauvery Gold. The layings were distributed to the farmers (115) in Karnataka, AP and Tamil Nadu under ToT throughout the year and an average yield of 70 Kg/100 dfls was recorded. 2A quality raw silk was recorded in the ICB as compared to B grade silk in the popular hybrid, PM x CSR2.

Field Performance of Cauvery Gold (MV1 xS8)			
State	Dfls (Nos)	Farmers (Nos)	Avg. Yield (kg/100 dfls)
KA	25320	75	71.54
AP	3450	16	66.31
TN	4680	24	67.17
Total	26750	115	70.00

**Maintenance of polyvoltine silkworm breeds**

Chandrashekhar, K.B., Dayananda , S.B. Kulkarni, P.V. Soudaminy and Kariappa

**Objective:** Maintenance of polyvoltine breeds conforming to their original characters

Thirty-five polyvoltine breeds were maintained conforming to their original breed characteristics for five generations.

Race / Breed	Race / Breed	Cocoon (g)	Shell (g)	Shell (%)	Reelability (%)	Fil. Length (m)	Raw Silk (%)	Neatness (p)
L14	82	1.270	0.232	18.070	82.63	497	10.88	87
ND7	81	1.368	0.249	18.149	66.22	386	10.66	87
NDV6	77	1.512	0.263	17.370	69.71	506	11.91	87
ND5	75	1.284	0.228	17.747	78.07	535	10.64	86
NP1	87	1.314	0.232	17.707	70.81	445	9.12	88
AGI3	87	1.281	0.222	17.343	82.40	437	11.73	90
AGL5	84	1.225	0.217	17.757	70.57	420	9.14	86
FVB1	76	1.235	0.211	16.890	74.33	361	8.44	87
Sarupat	46	1.337	0.220	14.538	65.18	480	10.67	90
MH1	74	1.323	0.245	18.450	65.87	431	9.16	96
L1	81	1.323	0.237	17.977	58.08	515	11.04	86
L3	81	1.312	0.236	17.980	63.52	539	8.51	90
HB1	86	1.290	0.214	16.606	57.35	431	9.93	86
HB4	77	1.304	0.234	17.952	65.02	518	11.09	88
HB6	84	1.380	0.236	17.084	63.83	506	10.50	86
96A	67	1.097	0.204	18.569	77.50	483	9.55	88
96E	79	0.920	0.170	18.463	72.70	654	10.41	86
2000H	75	1.138	0.195	17.123	69.44	490	9.98	89
NDV1	69	1.165	0.200	17.262	69.44	401	9.80	86
NDV7	81	1.178	0.210	17.096	64.17	446	10.59	90
ND2	78	1.219	0.223	18.234	54.06	457	9.72	87
ND10	55	1.163	0.195	16.738	54.05	542	11.26	87
BL24	82	1.116	0.195	17.527	66.71	432	11.73	88
BL27	68	1.125	0.190	16.773	53.58	542	7.64	87
BL67	75	1.347	0.230	17.070	53.58	542	11.09	87
BL65	62	1.137	0.220	19.306	77.40	458	9.81	87
BL68	86	1.155	0.219	19.082	73.39	514	10.66	87
BL69	62	1.226	0.200	16.358	78.27	514	9.16	88
MO6	64	1.204	0.220	18.289	76.37	452	10.55	90
BL67 SL	70	1.173	0.211	18.009	70.12	541	9.20	90
PV1	61	1.229	0.212	17.363	87.34	303	9.06	84
RD1	71	1.148	0.123	10.881	78.60	349	11.11	85
MV1	85	1.437	0.262	18.189	63.52	590	10.11	90
PM	81	0.981	0.149	15.283	54.27	479	10.00	86
L15	71	1.267	0.226	18.169	74.10	580	11.74	85

### SILKWORM GENETICS LABORATORY

#### Concluded Research Project

#### AIB 3528: Evaluation of G11 x G19 - A new bivoltine double hybrid for sub-optimal conditions (Jan. 2015 - Dec. 2016)

K. K. Sharmila (PI), B. Parthasarathi<sup>1</sup>, Madan Mohan<sup>2</sup>, Y. C. Radha Lakshmi and V. Sivaprasad

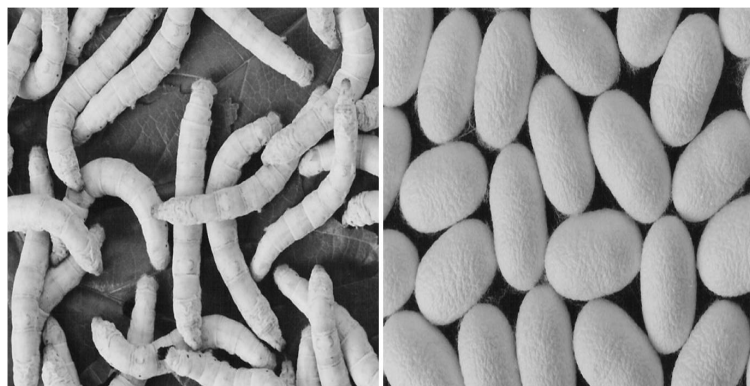
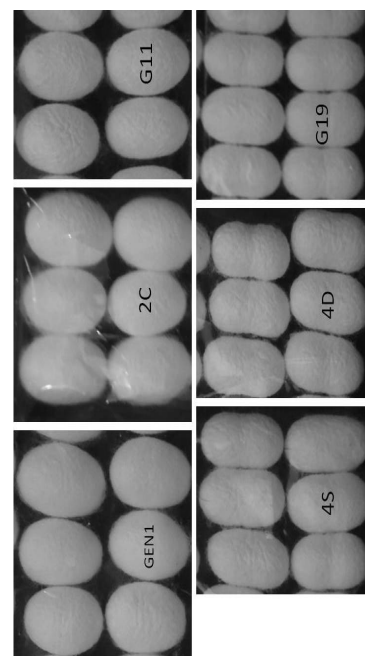
<sup>1</sup>SSPC- Bengaluru; <sup>2</sup>SSPC-Palakkad

**Objective:** To evaluate the field performance of newly evolved bivoltine double hybrid, G11 x G19 for productivity and silk quality.

**Production of G11 x G19 layings:** A quantity of 4170 P1dfls of foundation crosses, G11 (GEN1 x 2C) and G19 (4D x 4S) were distributed to the adopted seed rearers through SSPCs-NSSO for the generation of seed cocoons. The oval FC G11 (GEN1 x2C) recorded an average cocoon yield 81.44kg//100 dfls with 92.38% pupation rate and the dumbbell FC G19 (4D x 4S) yield recorded 72.24kg/100dfls with 90.83% pupation rate. Utilizing these cocoons, 5.067 lakh double hybrid layings (G11 x G19) was produced at SSPCs-NSSO with an average egg yield of 60g/kg cocoon.

Seed Crop Performance - G11 and G19

FC	Dfls (Nos)	Yield /100dfls (kg)	Pupation Rate (%)	Cocoon Wt. (g)	Shell Wt. (g)	Shell (%)
G11 (GEN1 x 2C)	675	72.80	93.06	1.627	0.361	22.13
	320	76.67	90.33	1.490	0.332	22.25
	255	86.00	94.00	1.511	0.339	22.43
	400	90.00	92.00	1.648	0.370	22.42
	475	81.75	92.50	1.692	0.377	22.26
Total/Mean	2125	81.44	92.38	1.594	0.356	22.30
	CV	7.59	0.01	0.05	5.61	0.49
G19 (4D x 4S)	675	67.35	92.00	1.655	0.356	21.55
	320	66.00	89.66	1.465	0.325	22.20
	200	82.50	91.00	1.459	0.328	22.48
	375	72.66	91.00	1.538	0.344	22.36
	475	72.68	90.50	1.606	0.358	22.32
Total/Mean	2045	72.24	90.83	1.545	0.342	22.18
	CV	8.02	0.83	0.98	2.92	1.48



Grainage Performance G11 & G19

Crop No	P1 dfls Brushed (Nos)	Hybrid Dfls Production (Nos)	Egg Yield/ kg Cocoon (g)
I	1350	164550	68.13
II	640	58550	63.00
III	455	68650	63.46
IV	775	114950	65.06
V	950	100000	66.00
Total	4170	506700	65.13
		CV	7.65

### Field Performance of Hybrids

501550 dfls of double hybrid, G11 x G19 were distributed to the farmers' (2907) around the the year through RSRS/RECs/DOSs of Karnataka, AP, TN and Maharashtra. The data on rearing performance of double hybrid was collected and documented. The farmers cocoon lots (20 Nos; 3kg/ each) were procured and evaluated for post-cocoon parameters with multi-end reeling machines at CSTRI-Bengaluru.

State	Dfls (Nos.)	Farmers (Nos)	Yield/ 100dfls (kg)	Cocoon wt. (g)	Shell wt. (g)	Shell (%)
Karnataka	116050	698	68.43	1.764	0.375	21.29
	SD		15.61	0.06	0.01	0.55
	CV		21	3.91	4.53	2.59
Tamil Nadu	116800	845	70.61	1.794	0.367	20.44
	SD		10.22	0.11	0.03	0.90
	CV		14.78	6.13	8.65	4.56
Andhra Pradesh	199800	1018	67.10	1.914	0.395	20.60
	SD		8.37	0.07	0.02	0.02
	CV		12.87	3.7251	5.31	3.75
Maharashtra	68900	346	62.69	1.652	0.362	21.90
	SD		8.91	3.82	0.02	0.82
	CV		14.34	0.07	0.03	4.41

The large scale evaluation of G11 x G19 (501550 dfls; 2907 farmers) recorded an average cocoon yields of 68.43, 70.61, 67.10 and 62.69 kg/100 dfls, respectively in Karnataka, Tamil Nadu, AP and Maharashtra. The analysis of yield frequency indicates that about 76% farmers recorded an average yield >60kg; only 5.7% farmers obtained <50 kg/100dfls and the crop failures were very marginal at 2.61%. Nineteen

Reeling Characteristics of G11 x G19			
Parameter	Karnataka (4)	Tamil Nadu (5)	Andhra Pradesh (11)
Single Cocoon Wt. (g)	1.473-1.662	1.415-1.880	1.563-1.79
Single Shell Wt. (g)	0.309-0.335	0.295-0.360	0.355-0.435
Shell Ratio (%)	19.66-22.79	19.2-21.6	21.2-23.7
Reelability (%)	70.74-79.79	79.7-87.7	76.1-88.6
Avg. Filament Length (m)	756-914	741-810	827-1011
Non-Breakable Filament Length (m)	504-681	616-690	666-780
Denier	2.55-2.79	2.74-2.80	2.63-2.83
Renditta (kg)	6.46-6.76	7.1-7.8	6.2-6.9
Raw Silk (%)	12.33-15.49	12.2-14.0	14.8-17.4
Raw Silk Recovery (%)	69.79-78.72	60.12-68.20	64.9-81.3
Neatness	94-96	91-93	90-97

cocoon lots out of twenty lots tested, yielded 2A quality raw silk. The consistency and sustainable cocoon yields of G11 x G19 double hybrid developed through amylase marker assisted selection confirms the robustness of the hybrid for the sub-optimal conditions of leaf quality and semi-irrigated conditions.

### Silk Quality of G11 x G19

Parameter	Karnataka (4)	Grade	Tamil Nadu (5)	Grade	AP (11)	Grade
Average Size	21.67-22.32		20.79-21.53		22.18-22.92	
Standard size deviation	1.51-1.6	2A	1.49-1.60	2A	1.45-1.79	2A
Evenness variation - I	14-18	4A	20-26	4A	6-26	4A
Evenness variation - II	0-2	4A	0-2	4A	0-2	2A-4A
Cleanness (%)	96-97	3A-4A	93-95	2A-3A	93-99	2A-4A
Neatness (%)	87-91	A-2A	90-93	2A-3A	90-95	2A-4A
Low Neatness (%)	83-89	2A-3A	83-85	2A	83-93	2A-3A

Parameter	Karnataka (4)	Grade	Tamil Nadu (5)	Grade	AP (11)	Grade
Maximum deviation	2.19-2.16	1	2.6-3.6	1-2	2.70-3.61	1-1
Evenness variation - III	0	1	0-1	1	0-1	1
Winding Breaks (/10skeins/hrs)	3	2	0-2	1-2	0-2	1-2
Tenacity (g/D)	3.7-3.8	1	3.7	1	3.7	1-2
Elongation (%)	20-22	1	19-21	1	19-24	1
Cohesion (Strokes)	62-65	1	61-73	1	60-72	1
Overall Grade	A-2A		2A		2A	

### Continuous/Other Activities

#### Maintenance of breeds developed through amylase marker assisted selection, NPV tolerance and morphological mutant stocks

K.K. Sharmila (upto July 2016) and Anuradha H. Jingade (from August 2016)

**Objective:** Maintenance of silkworm races conforming to their original characteristics

Silkworm breeds developed through amylase marker assisted selection (16), NPV tolerant breeds (15) and morphological mutants (26) were reared for maintenance, conforming to their original characteristics.

#### Characteristics of Silkworm Mutant Stocks

Marker Genes (Linkage Group)	Description
w-2 (10)	White egg 2, yellowish white eggs
Re (5)	Red egg, serosa cells red.
pe; re (5)	Pink eyed white egg
elp (18)	Ellipsoid egg
Ge (1)	Giant egg
b-2 (6)	Brown egg
sp (23)	Spindle shaped egg
ch (13)	Chocolate newly hatched larvae
pS (2)	Striped, black intersegmental bands
pM (2)	Moricaud larval markings
Ze (3)	Zebra larval markings
lem (3)	Lemon coloured larval skin
L (4)	Multilunar spots on dorsal side
K (11)	Knobbed dermal protuberances
Rb ( 21)	Red blood
U (14)	Ursa, dark brown pigment on dorsal and lateral sides of larva
st ( 8)	Stony, larval body hard & compact
tub (23)	Tubby, spindle shaped larva with short thorax & stout abdomen
E (6)	Extra abdominal legs
nb (19)	Narrow breast, short thorax & stout abdomen
e (1)	Elongated II abdominal segment
la ( 9)	Dominant chocolate newly hatched larva

Marker Genes (Linkage Group)	Description
lu (16)	Lustrous eye in moths
Ws (17)	Wild wing spot in moths
Pk (2)	Pink coloured cocoon
Y (2)	Yellow blood

#### Performance of Breeds developed through Amylase Marker Assisted Selection

Breeds	Fecundity	ERR/10000 Larvae		Cocoon Wt. (g)	Shell Wt. (g)	Shell Ratio (%)
		Nos.	Wt. (kg)			
GEN1	505±70	9041±490	13.818±0.38	0.325±0.03	1.535±0.11	21.14±0.72
GEN3	524±17	9098±527	15.510±1.30	0.370±0.73	1.398±0.64	21.80±0.86
2C	517±60	9044±265	13.139±0.45	0.395±0.15	1.426±0.11	21.61±0.57
2S	500±10	8340±848	12.755±1.00	0.314±0.02	1.429±0.11	21.96±0.52
2M	505±16	9027±613	15.452±2.30	0.323±0.03	1.575±0.22	20.61±1.72
3P	501±16	9107±605	15.179±2.22	0.332±0.02	1.586±0.16	21.01±0.66
3C	506±10	8247±711	13.049±0.57	0.335±0.03	1.546±0.12	21.66±0.26
3D	501±15	8560±454	13.653±0.83	0.345±0.03	1.522±0.22	20.52±0.65
3N	510±10	9160±593	13.962±0.67	0.341±0.04	1.589±0.09	21.42±1.00
GEN2	528±42	9096±698	14.980±1.58	0.349±0.01	1.657±0.05	21.04±0.82
4S	493±23	8692±335	14.181±0.74	0.342±0.03	1.563±0.11	21.43±0.38
4C	498±18	8900±282	14.122±1.33	0.332±0.00	1.567±0.06	21.23±0.50
4P	483±19	9078±368	13.555±2.07	0.326±0.02	1.530±0.11	21.3±1.28
6P	504±60	7790±296	13.054±1.04	0.307±0.04	1.505±0.17	20.34±0.30
6C	498±70	9330±202	14.518±1.35	0.313±0.03	1.497±0.11	20.89±1.53

#### Performance of NPV Tolerant Breeds

Breeds	Fecundity	ERR/10000 Larvae		Cocoon Wt. (g)	Shell Wt. (g)	Shell Ratio (%)
		Nos.	Wt. (kg)			
2N	496±70	9193±120	15.546±0.87	0.309±0.04	1.521±0.23	20.40±1.31
5N	481±24	8170±692	14.430±0.43	0.278±0.04	1.345 ±0.16	20.63±0.38
61N	514±20	9393±254	15.327±0.77	0.318±0.01	1.505±0.08	21.12±0.54
63N	511±20	8041±26	13.620±0.36	0.342±0.02	1.620±0.07	21.06±0.19
8	536±14	9070±297	12.375±0.81	0.294±0.01	1.363±0.04	21.60±1.21
21	536±60	8503±675	11.699±1.11	0.317±0.02	1.455±0.06	22.09±1.16
35	531±13	8744±518	12.805±0.48	0.316±0.01	1.467±0.04	21.15±1.12
42	554±70	8243±683	11.464±0.31	0.292±0.01	1.396±0.08	20.91±0.58
51	532±90	8427±341	12.772±1.11	0.326±0.02	1.513±0.10	21.56±0.51
62	555±15	8431±484	11.992±0.86	0.311±0.01	1.460±0.09	21.34±0.34
75	535±12	8470±467	12.213±0.50	0.296±0.01	1.439±0.01	20.59±0.20
87	550±27	8230±417	12.427±1.24	0.328±0.03	1.510±0.10	21.65±0.92
101	524±10	8259±394	11.614±0.47	0.306±0.00	1.401±0.00	21.82±0.29
118	557±39	8449±370	13.044±0.97	0.33±0.02	1.503±0.10	21.95±0.30
Rudra	528±21	8556±714	13.014±0.97	0.330±0.02	1.522±0.05	21.86±0.59

### SATELLITE SILKWORM BREEDING STATION-COONOOR

#### Maintenance of Bivoltine Silkworm Germplasm Stocks

Conservation rearing of 30 bivoltine germplasm stocks including breeding lines developed at SSBS-Coonoor from previous breeding programmes and few CSR breeds confirming to the original characteristics was undertaken in two crops and maintained for further utilization.

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

Preliminary field testing of SSBS5 x SSBS6 was carried out in Tamil Nadu with 25600 dfls with good adaptability. No significant variation in the rearing parameters was observed in the OST performance at SSBS-Coonoor.

Rearing Performance of SSBS5 x SSBS6 Preliminary Field Testing					
Dfls	Farmers (Nos)	Yield/100 dfls (kg)	Avg. Coc. Wt. (g)	Avg. Shell Wt. (g)	Avg. SR (%)
25600	225	62.30 - 73.60	1.85 - 1.92	0.30 - 0.39	19.10 - 22.0
50	SSBS	92.80	2.07	0.47	22.70



Rearing Performance of Bivoltine Germplasm Stocks					
Breed	Fec.	Pupation (%)	Coc. Wt. (g)	Shell Wt. (g)	Shell (%)
SSBS 2	599	93.12	1.404	0.294	20.92
SSBS 3	569	93.76	1.451	0.303	20.87
SSBS 4	566	80.00	1.519	0.333	21.92
SSBS 5	565	87.40	1.510	0.343	22.41
SSBS 6	552	88.80	1.193	0.246	20.60
SSBS 7	564	94.60	1.350	0.290	21.48
SSBS 8	571	79.80	1.335	0.290	21.72
SSBS9	572	84.72	1.460	0.305	20.85
SSBS10	584	88.64	1.439	0.310	21.56
SSBS11	605	78.64	1.461	0.313	21.40
SSBS12	553	80.56	1.447	0.314	21.67
SSBS16	543	94.40	1.375	0.286	20.77
SSBS17	545	94.80	1.403	0.300	21.38
CNR3	506	78.16	1.380	0.271	19.66
CNR4	535	93.04	1.399	0.306	21.85
CNR5	574	95.04	1.518	0.312	20.53
CNR15	527	95.11	1.355	0.290	21.40
SLD1	584	86.64	1.608	0.344	21.40
SLD4	515	74.30	1.578	0.334	21.17
SLD8	540	88.80	1.279	0.261	20.40
SLD9	504	90.13	1.269	0.260	20.48
D1	525	95.36	1.851	0.395	21.36
D2	516	86.00	1.622	0.362	22.30
D11	577	89.33	1.294	0.262	20.24
D13	528	83.87	1.298	0.251	19.33
D15	525	95.52	1.198	0.249	20.77
D17	504	84.56	1.331	0.287	21.55
CSR51	519	91.28	1.199	0.243	20.32
CSR202	460	83.80	1.344	0.300	22.32
CSR204	451	93.52	1.478	0.320	21.68

### P4 Basic Seed Farm-Hassan

#### Bivoltine Silkworm Race Maintenance and Multiplication

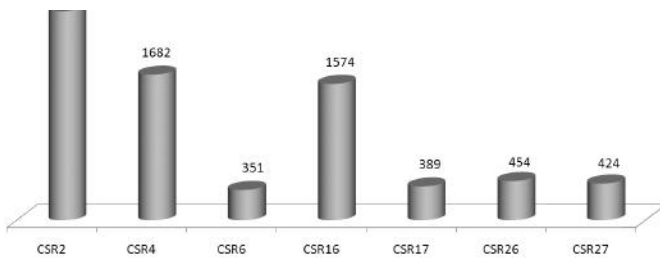
V. Nishitha Naik and Dayananda

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

The bivoltine breeds which are commercially exploited for hybrid dfls production in India were reared four

times-a-year following the well laid out Silkworm Race Maintenance Procedures. The rearing performance of pure lines was documented and maintained in conformity with the original breed characteristics. The hybrid vigour of commercial hybrid combinations was evaluated once-a-year to determine the stability of breeds and hybrids.

Performance of Bivoltine Breeds					
Breed	Pupation Rate (%)	Yield/10000 Larvae (kg)	Cocoon Wt. (g)	Shell Wt. (g)	Shell (%)
CSR2	97.37±0.6	17.12±1.59	1.722±0.11	0.403±0.01	23.45±0.88
CSR4	98.00±0.6	15.46±1.37	1.621±0.09	0.355±0.02	21.92±1.12
CSR6	96.79±0.7	16.50±1.01	1.733±0.06	0.377±0.02	21.77±1.03
CSR26	97.16±1.1	15.98±1.70	1.698±0.17	0.362±0.03	21.36±0.43
CSR27	94.12±0.6	16.43±2.71	1.717±0.17	0.409±0.03	23.85±0.79
CSR16	96.85±0.4	16.15±1.9	1.670±0.15	0.369±0.03	22.08±0.2
CSR17	97.04±0.8	17.39±1.33	1.787±0.12	0.393±0.03	21.95±0.63



A total of 7448 dfls basic seed (P4, P3 & P2) was prepared from the selected beds of seven bivoltine breeds for supply to P3 and P2 multiplication centres of DoS & CSB as per the requirement (3045 dfls). Pebrine monitoring of basic stocks was monitored systematically at pre-designed stages following stringent measures/methods.

## SILKWORM PHYSIOLOGY LABORATORY

### Ongoing Projects

**AIP 3568: Development of value added products from spent pupae of mulberry silkworm, *Bombyx mori* L. (Collaboration with NIANP-Bengaluru; Apr. 2016 - Mar. 2019)**

**CSRTI-Mysuru:** Y. Thirupathaiah, M. Munirathnam Reddy, E. Bhuvaneshwari &

**NIANP-Bengaluru:** M. Chandrashekaraiyah, N.M. Soren, K. S. Prasad

### Objectives:

- Isolation and characterization of  $\alpha$ -Linolenic acid from pupae oil and establishment of pilot production plant
- Development of SWP meal enriching cattle feed as supplement for bypass protein and fat

### Isolation and Characterization of $\alpha$ -Linolenic acid from Pupa Oil

The mulberry silkworm, *Bombyx mori* L. pupae oil was extracted with using different solvents from bivoltine (BV), multivoltine (MV) and spent pupae and analyzed for fatty acid profiles. The efficiency of oil extraction was examined with hexane and petroleum ether by both soxhlet and maceration extraction methods. Maximum oil yield was observed in multivoltine silkworm pupae followed by bivoltine and spent pupae (22 - 22.3%). Pupa oils were analyzed for fatty acid composition by TLC and GC and the  $\alpha$ -linolenic acid confirmed by Mass Spectrum analysis. 29-32%  $\alpha$ -linolenic acid was observed in all the silkworm pupae and bivoltines has more  $\alpha$ -linolenic acid.

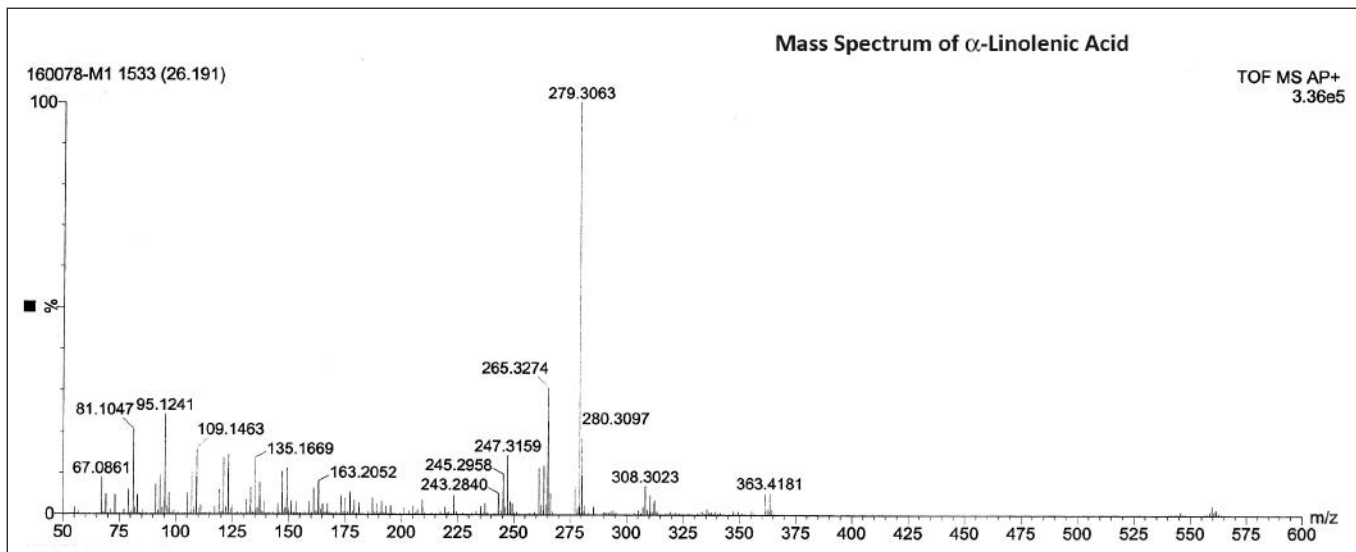
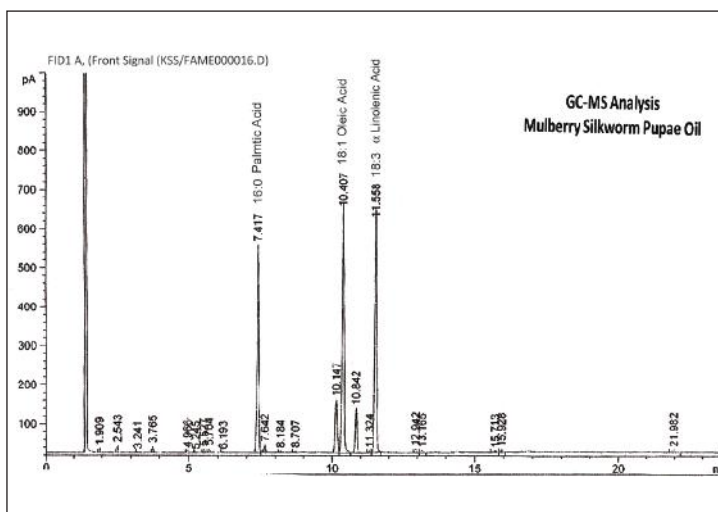




Fatty Acid	Soxhlet		Maceration		Spent Pupae (Soxhlet)
	BV	MV	BV	MV	
16:0 (Palmitic)	21.2	21.3	22.3	19.9	21.0
18:1 (Oleic)	30.4	30.4	31.2	29.9	32.0
18:2 (Linoleic)	5.9	6.6	4.7	4.3	4.5
18:3 ( $\alpha$ -Linolenic)	31.5	30.8	32.2	30.0	29.8

### Silkworm Pupal Oil Extraction

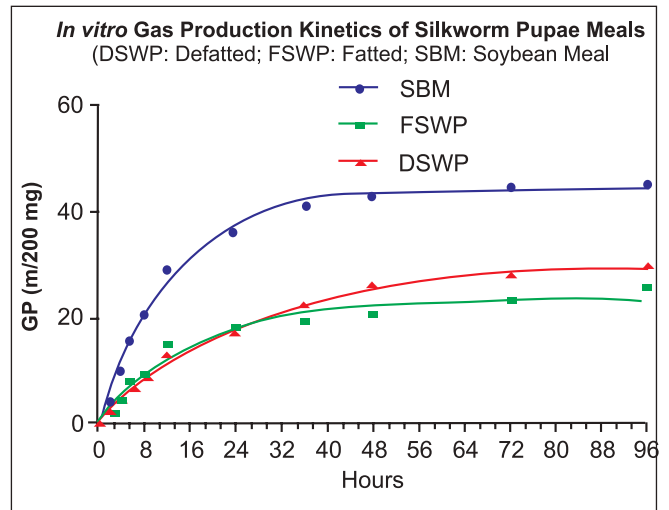
Solvent	BV (g/kg)	MV (g/kg)	Spent Pupae (g/kg)
<b>Soxhlet</b>			
Hexane	224.00 ± 4.58	224.6 ± 2.60	204.16 ± 2.56
Petroleum ether	219.60 ± 4.16	220.5 ± 1.22	203.00 ± 1.63
<b>Maceration</b>			
Hexane	223.10 ± 1.73	223.30 ± 0.93	209.83 ± 2.15
Petroleum ether	219.43 ± 1.18	223.40 ± 3.55	208.93 ± 4.20



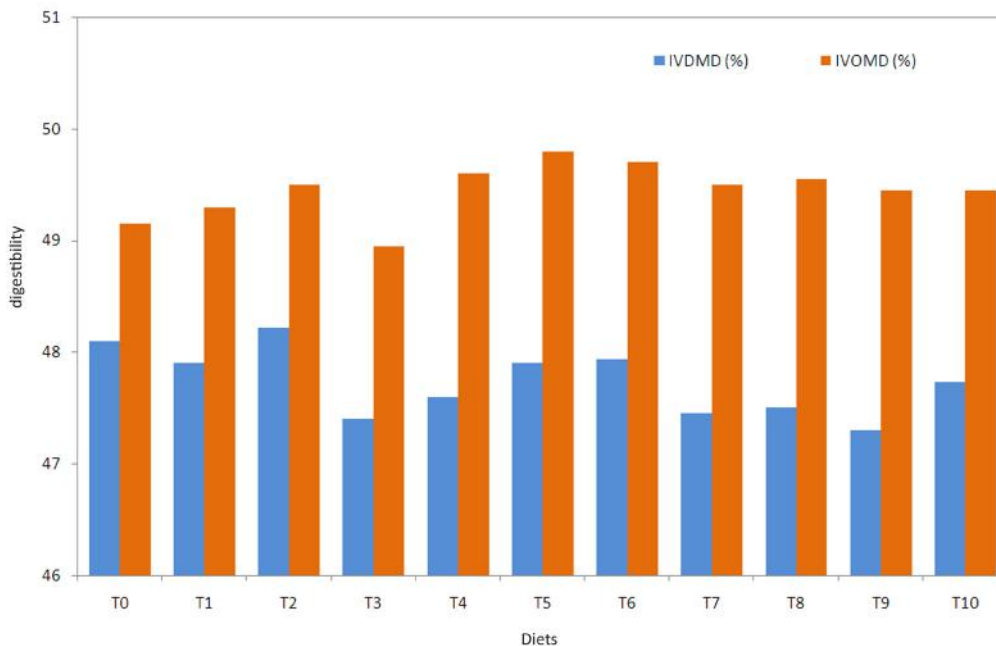
### Development of SWP Meal Enriching Cattle Feed

Dry silkworm pupae, silkworm pupal powder and pupal oil generated at CSRTI-Mysuru were obtained to study the effects of enrichment of cattle feed with silkworm pupal meal. *In vitro* studies on gas production kinetics of defatted silkworm pupal meal were conducted in comparison to fatted silkworm pupal meal and soybean meal (control).

Different cattle feed formulations (T0 - T10) were developed to study the effect of supplementation of SWP on digestibility and rumen fermentation of Finger Millet Straw (FMS) *in vitro* and chemical analysis. Results indicate that supplementation of silkworm pupae meal (upto 100% replacement) as protein supplement had no adverse effects on *in vitro* rumen fermentation and digestibility. *In vivo* studies are initiated to determine the actual level of inclusion palatability and rumen fermentation in cattle.



### Effect of Replacement of Soybean Meal with Silkworm Pupae Meal in Cattle Feed (FMS) (IVDMD: *in vitro* Dry Matter; IVOMD: *in vitro* Organic Matter Digestibility)



### AIP 3594: Feed Supplementation studies for Improving young age Silkworm rearing in Chawki Rearing Centres (Oct. 2016 - Sept. 2018)

E. Bhuvaneshwari, Y. Thirupathaiiah and M. Munirathnam Reddy

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

Various feed supplements were identified and are being evaluated for improving chawki larval feed response and growth through mulberry leaf and artificial diet. Maximum survival, feed response and larval growth were observed with ascorbic acid. Most effective supplements would be further evaluated by artificial diet for better chawki rearing.

## Continuous/Other Activities

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

Y. Thirupathaiah and M. Munirathnam Reddy

**Objective:** To maintain *Cordyceps* and other spp. cultures for original characters

Mother cultures of 13 isolates of eight *Cordyceps* spp. from different sources are being maintained and multiplied on potato dextrose agar (PDA) and sabouraud dextrose agar yeast (SDAY) media periodically at 15-25°C. All isolates were tested for viability *in vitro* (culture media)



and *in vivo* (silkworm pupae). For fruiting body formation of *Cordyceps*, inoculums were developed in potato dextrose broth and injected (0.1 ml) into live silkworm pupae (6-8 days-old) and incubated at 20°C for 20 days under controlled humidity and light/dark hours. *Cordyceps takaomontana* anamorph (*Isaria tenuipies* 91; IS 91) produced better fruiting bodies (2-5cm long; 0.5-1cm wide; club shaped; whitish cream colour) on silkworm pupae and *in vitro* culture media. *In vivo* fruiting body formation was better on live silkworm pupae.

## REARING TECHNOLOGY & INNOVATION

### Ongoing Research Projects

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

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

#### Objectives

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

Twenty two bivoltine parental breeds (CSR2, CSR17, CSR27, CSR50, CSR52, Gen1, 2C, D2, 2C, S8, SSBS3, SSBS5, CSR4, CSR6, CSR216, CSR26, CSR51, SK6, Bcon 1Dun 18, Dun 17, N6 and N7) were reared and based on rearing and reeling performance, 82 double hybrids were prepared utilizing the identified breeds in selective combinations. These double hybrids were evaluated by rearing at high temperature and high humidity (simulated conditions: CSRTI-Mysuru; Hotspots/Natural Conditions: Chebrolu-AP; Jayankondapattinam-TN; RSRS-Kodathi) and high temperature and low humidity (RSRS-Anantapur) regions during April-August. Based on overall performance, survival and cocoon characteristics 10 hybrids @ each location were short-listed. The best parental combinations of foundation crosses and short-listed hybrids would be further evaluated at each location.

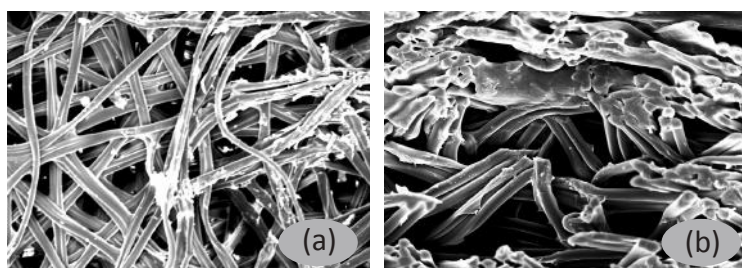
## Performance of Double Hybrids @ High Temperature &amp; High Humidity

RSRS-Kodathi											
Natural Rearing Conditions: Temp (39-41°C) & RH (61-86%)											
Hybrid	Pupa-tion (%)	Coc. Wt. (g)	Shell Wt. (g)	Shell Ratio (%)	Reel-ability (%)	AFL (m)	NBFL (m)	Denier	Raw Silk (%)	Raw Silk Rec. (%)	Neat-ness
DH13	55.8	1.269	0.278	21.91	81.24	700.59	569.17	2.59	16.84	78.19	97
DH21	55.2	1.262	0.265	21.00	86.63	731.57	633.77	2.14	17.85	89.96	98
DH24	55.5	1.286	0.270	21.00	84.73	606.49	513.89	2.87	17.47	87.33	98
DH32	55.5	1.300	0.280	21.54	83.00	666.45	553.15	2.79	16.34	85.09	97
DH48	54.8	1.362	0.275	20.19	77.59	612.54	475.29	2.67	16.79	83.97	97
DH52	55.3	1.288	0.265	20.57	83.14	802.76	667.39	2.46	15.97	76.97	95
DH53	55.8	1.278	0.260	50.34	86.82	780.92	678.01	2.42	13.53	79.32	96
DH54	56.1	1.281	0.263	20.53	74.32	653.82	485.91	2.62	15.51	82.74	97
DH04	55.2	1.225	0.253	20.65	88.22	745.53	657.71	2.58	17.31	83.79	96
DH06	55.6	1.227	0.251	20.46	79.93	600.64	480.12	2.60	12.65	65.85	94
Chebrolu (AP)											
Natural Rearing Conditions: Temp (39-41°C) & RH (61-86%)											
DH13	53.1	1.350	0.290	21.48	82.73	727.27	601.69	2.64	16.69	81.54	98
DH14	60.2	1.410	0.290	21.56	89.87	768.02	690.28	2.43	17.24	89.19	98
DH30	55.5	1.370	0.260	18.97	75.52	679.55	513.22	2.61	14.81	84.97	97
DH49	67.3	1.470	0.300	20.40	85.01	653.09	555.17	2.67	13.06	63.98	98
DH09	55.5	1.370	0.270	19.70	82.73	727.27	601.69	2.64	16.69	81.54	98
DH10	48.4	1.310	0.270	20.61	79.93	656.69	524.92	2.50	12.83	72.36	94
DH18	54.3	1.360	0.280	20.58	77.41	780.19	601.13	2.54	17.25	84.25	98
DH22	60.2	1.410	0.270	19.14	78.11	800.61	625.32	2.72	16.94	88.44	98
DH32	42.4	1.260	0.260	20.63	68.66	792.05	543.81	2.50	17.22	83.47	96
DH34	53.1	1.350	0.290	21.48	78.53	608.95	478.22	2.72	13.85	69.79	98
Jayankondapattinam (TN)											
Natural Rearing Conditions: Temp (28-36°C) & RH (62-80%)											
DH07	63.7	1.360	0.270	19.85	82.10	749.61	615.46	2.43	14.89	74.98	94
DH14	57.1	1.300	0.280	21.54	74.30	810.33	602.06	2.46	16.84	78.19	97
DH23	57.1	1.300	0.260	20.00	77.63	810.46	629.18	2.41	16.61	83.03	98
DH28	63.7	1.360	0.280	20.59	74.82	832.48	622.85	2.37	15.84	76.96	98
DH31	51.6	1.250	0.280	22.40	77.90	742.91	578.71	2.54	16.62	74.17	97
DH38	50.5	1.240	0.250	20.16	80.92	739.28	598.20	2.48	16.26	80.66	98
DH68	64.8	1.370	0.270	19.71	72.33	620.76	448.98	2.70	13.48	68.42	98
DH70	59.3	1.320	0.260	19.70	75.74	773.34	585.70	2.46	15.88	80.63	98
DH80	61.5	1.340	0.280	20.90	82.22	864.53	710.81	2.50	17.71	84.73	96
DH06	46.1	1.200	0.280	23.33	67.51	651.02	439.48	2.45	14.55	625.38	98

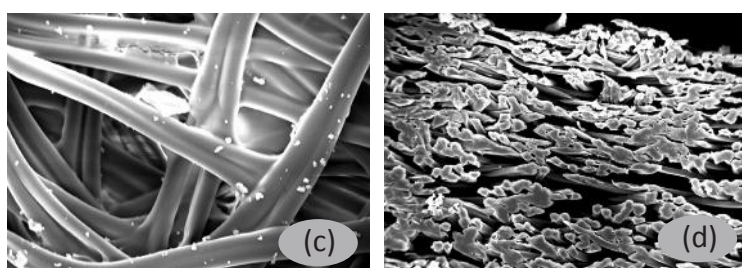
CSRTI-Mysuru											
Simulated Rearing Conditions: Temp (28-32°C) & RH (65-80%)											
Hybrid	Pupa-tion (%)	Coc. Wt. (g)	Shell Wt. (g)	Shell Ratio (%)	Reel-ability (%)	AFL (m)	NBFL (m)	Denier	Raw Silk (%)	Raw Silk Rec. (%)	Neat-ness
DH07	51.2	1.578	0.356	22.56	84.28	843.95	711.25	2.63	15.46	68.52	98
DH30	58.1	1.595	0.365	22.88	79.34	867.61	688.35	2.68	15.97	69.80	98
DH35	51.8	1.601	0.362	22.61	79.74	984.57	785.12	2.79	18.82	83.22	98
DH44	60.7	1.580	0.378	23.98	71.42	696.61	497.51	3.25	15.78	65.94	96
DH47	52.1	1.586	0.375	23.64	81.43	867.50	706.41	2.58	15.51	65.59	98
DH62	53.0	1.723	0.387	22.46	67.99	1035.15	703.84	2.93	19.30	85.95	94
DH66	54.8	1.579	0.372	23.56	81.07	911.16	738.66	2.63	16.70	70.90	96
DH72	55.4	1.579	0.369	23.37	85.97	982.46	844.59	2.76	19.03	81.41	98
DH03	52.1	1.674	0.366	21.86	83.77	904.02	757.32	2.82	16.84	77.02	98
DH12	60.7	1.473	0.345	23.42	81.58	940.50	767.29	2.76	19.39	82.79	98
Performance of Double Hybrids @ High Temperature & Low Humidity											

RSRS-Ananatapur										
Natural Rearing Conditions: Temp (39-41°C) & RH (61-86%)										
Hybrid	Pupa-tion (%)	Coc. Wt. (g)	Shell Wt. (g)	Shell Ratio (%)	Hybrid	Pupa-tion (%)	Coc. Wt. (g)	Shell Wt. (g)	Shell Ratio (%)	
DH28	98.30	1.316	0.307	23.33	DH59	88.30	1.165	0.265	22.78	
DH40	85.30	1.211	0.264	21.79	DH76	93.00	1.412	0.305	21.62	
DH45	87.70	1.481	0.312	21.11	DH79	97.70	1.404	0.305	21.76	
DH46	88.00	1.249	0.286	22.95	DH 28	98.30	1.316	0.307	23.33	
DH47	95.70	1.237	0.265	21.45	DH 40	85.30	1.211	0.264	21.79	

The cocoons of double hybrids reared at high temp. & high humidity and optimal conditions were subjected to scanning electron microscopic (SEM) studies on cocoon surface and cocoon cross section to record silk filament density and Sericin content.



Scanning electron microscopic images of (a) cocoon surface of silkworms reared at high temp & high humidity (x160) with dense sericin content & (b) cocoon cross section (x830) showing loosely packed silk filaments.



Scanning electron microscopic images of (c) cocoon surface of silkworms reared at optimal temp. & humidity (x1000) with normal sericin content & (d) cocoon cross section (x330) showing closely packed silk filaments.

## Other Activities

### Large Scale Multiplication of Parental Breeds

Rearing of three crops of bivoltine breeds (S8 & CSR16) for the egg production and large scale evaluation of hybrid was conducted. A quantity of 1.23 lakh seed cocoons were generated for hybrid dfls preparation

Season	Breed	Dfls	Coc. Wt. (g)	Shell Wt. (g)	Shell Ratio (%)	Pupation (%)
July	S8	50	1.53	0.34	21.98	91
	CSR16	50	1.51	0.32	21.19	90
Nov-Dec	CSR16	75	1.65	0.35	21.38	92
	S8	75	1.64	0.36	22.19	91
Jan-Feb	CSR16	75	1.71	0.36	21.12	92
	S8	75	1.67	0.35	21.64	91

## GRAINAGE SECTION

### Continuous/Other Activities

R. Bhagya

Selected bivoltine (2998) and multivoltine (461) cocoons from breeding laboratory were processed to conduct on-hand silkworm seed production training for the newly appointed Scientist-Bs. A total of 1344 bivoltine and crossbreed layings were prepared as sheet/loose eggs\* and the reproductive performance of pure lines was assessed.

Breed/Hybrid	Pupation Rate (%)	Dfls Produced (Nos)	Dfl/Egg Recovery (%/g)
S8 X CSR 16	90.00	461	37.94
CSR16 X S8	94.00	149	46.42
S8	90.00	492	38.32
CSR4	91.00	67	37.64
MV1 X S8	89.20	175	37.96
S8 X CSR 16*	90.00	275	90.00

## TECHNOLOGY VALIDATION & DEMONSTRATION CENTRE

### Continuous/Other Activities

#### Large Scale Evaluation and Multiplication of Silkworm breeds/Hybrids

P.C. Santha and V. Sivaprasad

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

Technology Validation and Demonstration Centre conducts large scale in-house evaluation of promising silkworm breeds/hybrids and validates for further field testing and adoption. This exercise besides ensuring evaluation in conditions resembling farmer's conditions, ensures large scale multiplication of parental stocks for commercial hybrid production facilitating field testing of hybrids. MV1 (multivoltine) and S8 (bivoltine) are two new silkworm breeds identified for the production of improved crossbreed, Cauvery Gold (MV1 x S8) with better productivity and superior quality silk.

Six crops of 800 Dfls (MV1, S8, FC1xFC2, & FC2xFC1) were reared and generated 429.0 kg (2.90 lakh) seed cocoons. These cocoons were utilized for commercial seed production (343kg) and to evaluate reeling performance.

Large Scale Evaluation and Multiplication of Silkworm breeds/Hybrids

Crop Season	Breed	Dfls (Nos)	Fec.	Actual Yield		Pupation Rate (%)	Coc. Wt. (g.)	Shell Wt. (g.)	SR (%)	Cocoons/ Kg (Nos)
				No	Wt. (kg)					
Mar. - Apr. 2016	MV1	100	440	35190	51	8521	1.602	0.301	18.80	690
Jun. - Jul. 2016	FC2 x FC1	100	503	42517	73	9143	2.070	0.461	22.25	583
Aug. - Sept. 2016	S8	50	454	17000	25	8213	1.682	0.401	23.84	680
	MV1	100	484	41400	60	9283	1.711	0.308	18.00	690
Sept. - Oct. 2016	FC1 x FC2	100	455	39000	60	9330	2.078	0.460	22.14	650
Dec. 2016 - Jan. 2017	S8	50	483	20880	30	9491	1.716	0.400	23.31	696
	MV1	100	426	33400	50	8790	1.710	0.312	18.25	668
Feb. - Mar. 2017	MV1	200	400	60480	80	8400	1.701	0.310	18.23	756

**PEST MANAGEMENT LABORATORY**

**Concluded Research Projects**

**ARE 3526: Investigation on Semio-chemicals of the silkworm uzi fly, *Exorista bombycis* (Collaboration with NBAIR-Bengaluru - Jan. 2015 - Dec. 2016)**

Vinod Kumar (upto Sep. 2016), J.B. Narendra Kumar, N. Morrison<sup>1</sup>, N. Bakthavatsalam<sup>2</sup> (PI) and Subhaharan<sup>2</sup>

<sup>1</sup>REC, Madivala, <sup>2</sup>NBAIR, Bengaluru

**Objectives**

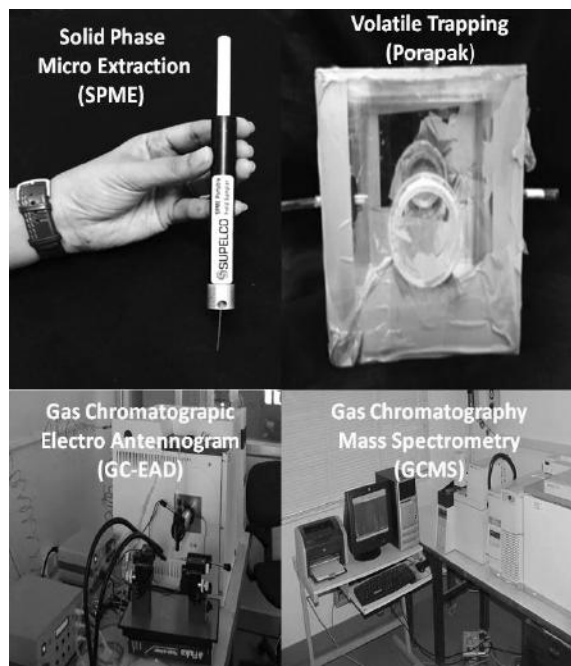
- To isolate and identify kairomones from mulberry leaf, silkworm larva, fecal matter and exuvium eliciting behavioural response in uzi fly
- To isolate and identify sex pheromones of *E. bombycis*
- To determine bio-efficacy of kairomones (mulberry) and sex pheromones (uzi fly)
- To formulate suitable semio-chemical based trap for uzi fly

**Uzi fly Extracts**

The uzi fly maggots were collected from the cocoon markets and allowed to pupate individually in test tubes. The adults on emergence were collected; sex separated and kept in cages. The abdomen of virgin female was kept in eppendorf tubes in hexane (1 ml). The tubes were shaken using vortex shaker for 20 min and the contents were filtered through Whatmann and membrane filters. The extracts were used for the electrophysiological and analytical studies.

**Pheromone Analysis**

The pheromones were collected by the clean air drawn over the virgin females for more than six hours in a porapak tube (porapak powder was kept in a glass tube covered on both sides with non-absorbent cotton and small copper mesh). The volatiles entrapped in the porapak were collected by repeatedly washing with hexane and the extracts were utilized for GCEAD and GCMS analysis and pheromone identification. The porapak extract of virgin female abdomen revealed 35 compounds and



were characterized. Among them tricosene (major), tricosane & pentacosane (minor) were short-listed for EAG and wind tunnel studies.

Solid Phase Micro Extraction (SPME) technique was followed for the collection of uzi fly pheromone. SPME was kept in an active mode with the extruded fiber to trap the volatiles in glass chamber with virgin females of *E. bombycis* for 24 hours and the SPME was directly injected into GC-MS and peaks were analyzed using Wiley software. The male uzi fly antenna was fixed in electro antennogram detector and exposed to the female abdomen extract. The antennal and GC traces were recorded and the coinciding peaks were identified. The volatiles from the uzi fly abdominal extracts were identified using gas chromatography coupled mass spectral detector (GCMS). Kovat retention index and mass spectra were used for the identification of volatiles. GCMS revealed the presence of chemicals viz., Azetidinecarboxaldehyde, Nonanal, Phenyl propanoic acid, Hexadecenal and Chlorohexadecenal. Trimethyl bicycle hept-2 was identified through the entrapment method.

Wind tunnel olfactometer studies with individual compounds revealed that nearly 70% adults responded to 9-tricosene and 75% flies attracted to a mixture of tricosene & tricosane (56:29). No attraction was elicited by uzi flies to the individual pheromone compounds along with rat gum trap and Mc phail traps. However, with water traps tricosene could attract 75% flies at a dosage of 5mg and 35% attraction was recorded to a mixture (Z-9-tricosene @5 mg + tricosane @2.5mg + pentacosane @1.2mg).

Pheromone	Conc.	Attracted Uziflies (Mean %)
Tricosene	275 µl	60.0
	137.5 µl	46.7
	68.75 µl	60.0
	5 mg	66.7
Tricosane	1.5 mg	50.0
	5 mg	65.0
Mixture (Tricosene+ Tricosane; 56:29)	56 µl +29 µl	75.0

Phermone	Conc.	Adults Trapped (Mean out of 20)
Z-9-tricosene	1 mg	3
Z-9-tricosene	3 mg	0
Z-9-tricosene	5 mg	0
Z-9-tricosene	10 mg	0
Hexane (Ctrl)	1 ml	0

Conc. (mg)	Water Traps (Nos)	Adults Trapped (Mean out of 20)
1	3	2
3	3	5
5	3	7
6	3	3
7	3	2
10	1	2

Ratio	Water Traps (Nos)	Adults Trapped (Mean out of 20)
5 mg + 2.5 mg + 1.2 mg	3	7
5 mg + 2.0 mg + 1.2 mg	3	3
5 mg + 2.5 mg + 0.6 mg	3	2
Z-9-Tricosene (Control @ 5mg)	1	2

### Kairomone Identification

Kairomone compounds from different instars of silkworm were also identified. Presence of 3-chloropropionic acid was revealed in the first as well as fifth instars. 1,2-Benzenedicarboxylic acid was present in I, II, III & IV instars. In addition to this, Isobutyl pentyl carbonate and Hexadecanoic acid were also revealed during III instar. However, these kairomones didn't attract uzi flies to the desired extent in the laboratory studies.

Instar	Retention Time	Compounds	Mol. Wt.
I	10.40	3-Chloropropionic acid	192
	13.50	1,2-Benzenedicarboxylic acid	222
II	13.50	1,2-Benzenedicarboxylic acid	222
III	10.13	Isobutyl pentyl carbonate	188
	13.50	1,2-Benzenedicarboxylic acid	222
	17.00	Hexadecanoic acid	270
IV	13.95	1,2-Benzenedicarboxylic acid	222
V	10.40	3-Chloropropionic acid	192

### Identification of Volatiles from Mulberry Leaf

GC-EAG and GCMS studies confirmed the presence of cis-3-hexanol in the mulberry leaves. Further, electro-physiological studies were also conducted for determining the attraction of uzi fly in comparison to the identified pheromone compounds. The mulberry leaf volatiles and kairomones did not attract uzi flies individually or in combination with the pheromone compounds.

Compound	Male (mV)	Female (mV)
Tricosene	-1.246	-0.819
Tricosene + Tricosane + Pentacosane	-1.918	-0.761
Cis-3-Hexanol	-5.418	-1.863
Tricosene + Tricosane + Pentacosane + Cis-3-Hexanol	-5.914	-1.512

### Inference

- 35 pheromone compounds were isolated from the abdominal extract of virgin female uzi fly and Tricosene (major), Tricosane & Pentacosane (minor) were short-listed as pheromone compounds. Tricosene was found effective in attracting uzi flies
- 5mg tricosene/dispenser was effective in trapping adult uzi flies in the laboratory experiments
- Water pan trap was better in trapping the adult uzi flies than sticky traps or Mc Phail traps
- Four kairomone compounds were identified from the silkworm larvae (3-chloropropionic acid, 1,2-Benzenedicarboxylic acid, Isobutyl pentyl carbonate and Hexadecanoic acid). A kairomone compound (Cis-3-Hexanol) was identified from the mulberry leaves and it is not effective in attracting uzi flies either alone or as mixture with pheromone compounds

### PRE 3527: Survey & Surveillance of major pests and their natural enemies in mulberry eco-system (Jan. 2015 - Dec. 2016)

J.B. Narendra Kumar (PI), N. Morrison<sup>1</sup>, H. Jairam<sup>2</sup>, S.N. Pallavi<sup>3</sup>, N.Sakthivel<sup>4</sup>, Mahiba Helen<sup>5</sup>, Kasi Reddy<sup>6</sup> (upto Aug. 2016) and Shanthan Babu<sup>6</sup>

<sup>1</sup>REC, Madivala (Kolar); <sup>2</sup>REC SU, Kanakapura; <sup>3</sup>RSRS, Chamarajanagar; <sup>4</sup>REC SU, Srivilliputtur; <sup>5</sup>RSRS, Salem;

<sup>6</sup>RSRS, Anantapur

### Objectives

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

Pest survey was conducted periodically in the mulberry gardens for two consecutive years in Karnataka (CSRTI-Mysuru; RSRS-Chamarajanagar; REC-Madivala; REC-Kanakapura), Tamil Nadu (RSRS-Salem; REC-Srivilliputtur) and Andhra Pradesh (RSRS-Anantapur). Highest mealybug incidence was recorded at RSRS-Salem command area (12.7%) followed by REC-Srivilliputtur (5.77%) & REC-Madivala (5.41%), RSRS- Anantapur (4.64%), CSRTI-Mysuru (3.2%), RSRS-Chamarajanagar (2.69%) and REC-Kanakapura (1.48%). Leaf roller incidence was highest in RSRS-Anantapur area (5.65%) followed by CSRTI-Mysuru (4.93%), REC- Madivala (3.8%), RSRS-Salem (3.71%), REC-Kanakapura (1.59%) and REC-Srivilliputtur (1.36%). Thrips incidence recorded was highest at RSRS-Salem (11.25/leaf) followed by REC-Srivilliputtur (7.04/leaf), REC- Kanakapura (5.61/leaf), REC-Madivala (3.3/leaf), RSRS-Anantapur (2.24/leaf) and CSRTI-Mysuru (1.6/leaf).

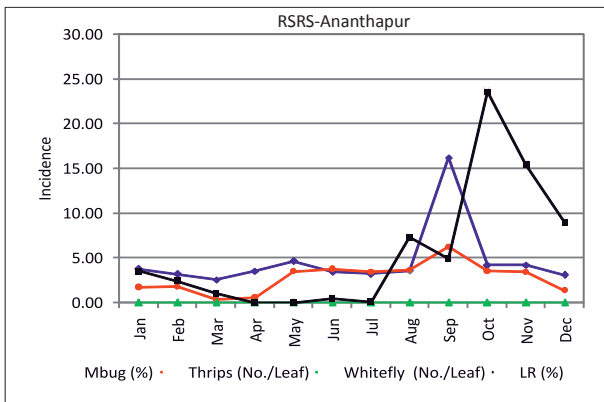
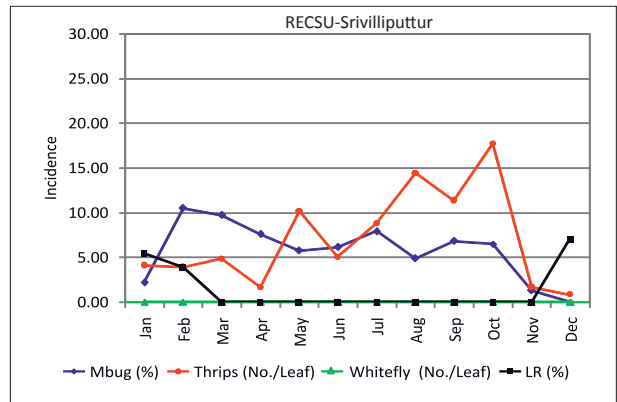
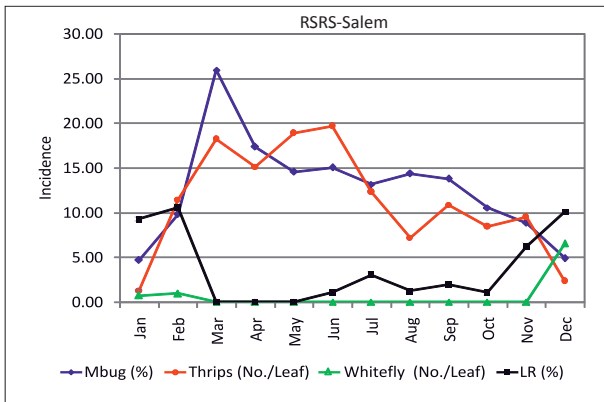
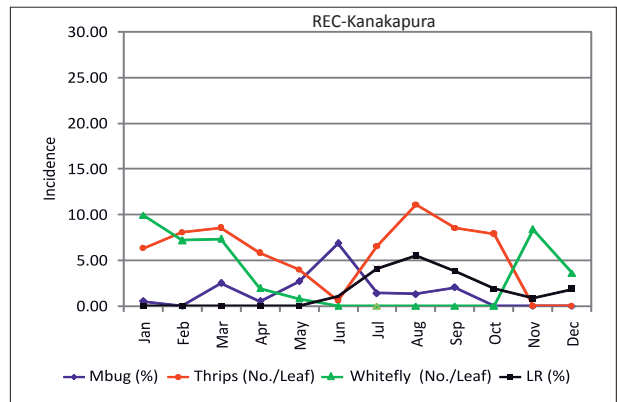
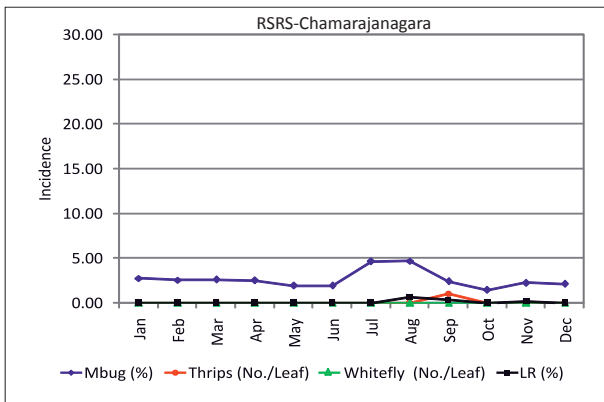
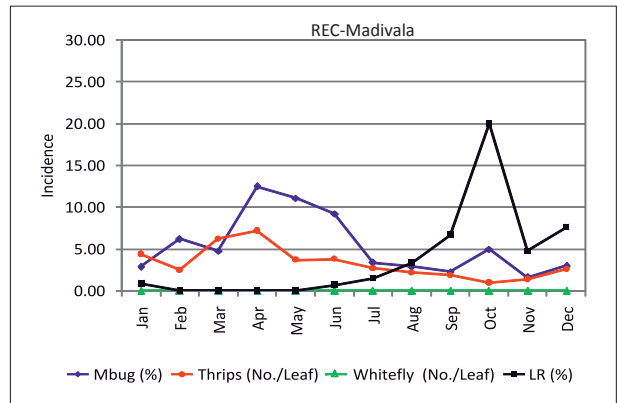
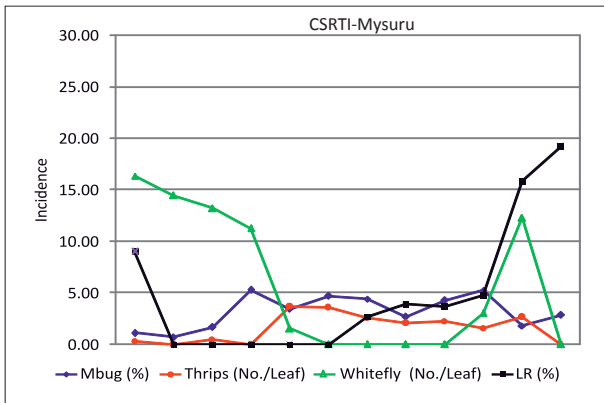
Centres	Pest incidence at Various Places (Avg. of 2 Years)			
	Mealybug (%)	Thrips (No./Leaf)	Whitefly (No./Leaf)	Leaf Roller (%)
CSRTI-Mysuru	3.2±1.62	1.6±1.41	6.01±6.78	4.93±6.54
REC-Madivala	5.41±3.63	3.3±1.88	0	3.8±5.78
REC-Kanakapura	1.48±1.96	5.61±3.7	3.26±3.86	1.59±1.92
RSRS-Chamaraja Nagar	2.69±0.99	0.08±0.29	0	0.2 ±0.41
RSRS-Salem	12.74±5.75	11.25±6.03	0.68±4.16	3.71±4.16
REC-Srivilliputtur	5.77±3.22	7.04±5.42	0	1.36±2.56
RSRS-Anantapur	4.64±3.69	2.77±1.67	0	5.65±7.32

*Nesolyx thymus**Scymnus coccivora**Acerophagus papayae**Chrysoperla zastrowi*

#### Important Natural Enemies Recorded in the Mulberry Gardens

Natural enemies	KA	TN	AP
<i>Cryptolaemus montrouzieri</i>	+	+	+
<i>Scymnus coccivora</i>	+	+	+
<i>Menochilus sexmaculatus</i>	+	+	+
<i>Illies sp.</i>	+	+	+
<i>Spalgis epius</i>	+	+	
<i>Acerophagus papayae</i>		+	
<i>Pseudleptomastix mexicana</i>		+	
<i>Phenerotoma noyesi</i>	+	+	

Incidence of Major Mulberry Pests



Pest Severity at Various Locations	
CSRTI -Mysuru	Whitefly > Leaf Roller > Mealybug > Thrips
RSRS-Chamarajanagar	Mealybug > Thrips > Leaf Roller
REC-Madivala	Mealybug > Leaf Roller > Thrips
REC-SU-Kanakapura	Thrips > Whitefly > Leaf Roller > Mealybug
RSRS-Salem	Mealybug > Thrips > Leaf Roller > Whitefly
REC-SU-Srivilliputtur	Thrips > Mealybug > Leaf Roller
RSRS-Ananthapur	Leaf Roller > Mealybug > Thrips

## Ongoing Projects

### PRE 3546: Identification, characterization, synthesis and field evaluation of sex pheromone of the mulberry leaf roller, *Diaphania pulverulentalis* (Lepidoptera: Pyralidae) [In collaboration with NBAIR-Bangaluru] (Jan. 2016 - Dec. 2017)

J. B. Narendra Kumar (PI), Vinod Kumar (upto Sep. 2016), N. Morrison<sup>1</sup>, N. Bakthavatsalam<sup>2</sup> (PI) and Subhaharan<sup>2</sup>  
<sup>1</sup>REC, Madivala, <sup>2</sup>NBAIR, Bengaluru

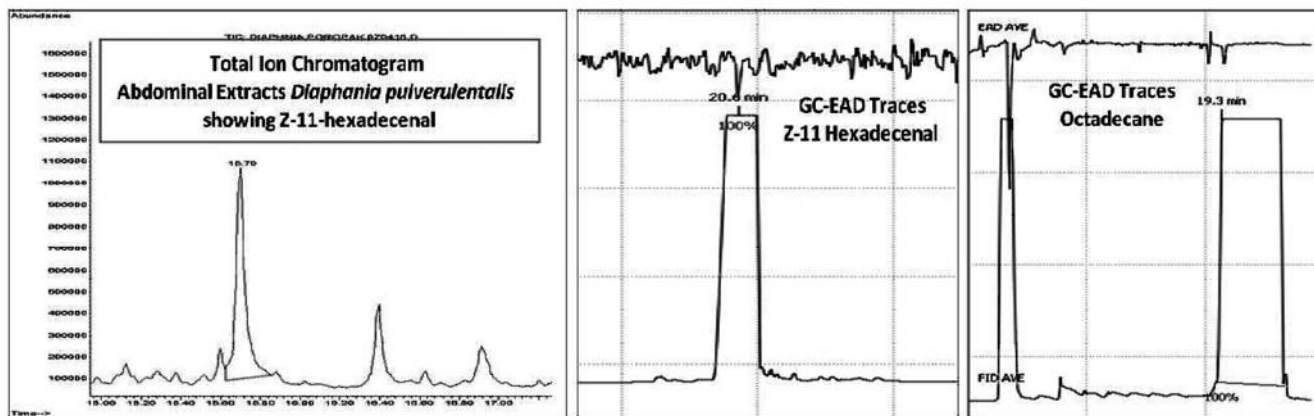
#### Objectives

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

#### Pheromone Analysis

Regular field trips were made to collect the larvae of *Diaphania pulverulentalis* and reared on the mulberry leaves in the laboratory and pupae were used for further studies. The adults upon emergence were collected, sex separated, and maintained in cages. The virgin female abdomen was cut and kept in eppendorf tube in 1ml hexane. The tubes were shaken using a vortex shaker for 20 min and the extracts were filtered through Whatmann and membrane filters. The extract was used for the electrophysiological and analytical studies.

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



The male moth's antenna was fixed in electro antennogram detector and exposed to the female abdomen extract. Antennal and GC traces were recorded and the coinciding peaks were identified. The volatiles from the abdominal extract were identified using the gas chromatography coupled mass spectral detector (GC-MS). Kovat retention index and mass spectra were used for the identification of volatiles. The volatiles from females were collected using entrapment method and the volatiles were identified using Wiley library. The main component was identified as Z-9-hexadecenal in GCMS and minor compound as Octadecane.

The electroantennogram studies indicated that Z-11-hexadecenal elicited good electro-physiological response. However, in addition to Octadecane, there are other minor compounds which probably may be z-11-tetradecenal or z-9-tetradecenal with pheromonal functionalities. Further identification and characterization of major and minor pheromone compounds is being conducted using FTIR & NMR spectroscopy and then wind tunnel studies will be carried out.

### Continuous/Other Activities

#### Maintenance of mother cultures for production of recommended bio-control agents and mass release

Vinod Kumar (up to September 2016), J.B. Narendra Kumar, K. Sathya Prasad (from July 2016), R. Meenal<sup>1</sup>, N. Morrison<sup>2</sup>, S. Mahiba Helen<sup>3</sup> and Shanthan Babu<sup>4</sup>

<sup>1</sup>RSRS Chamarajanagar, <sup>2</sup>REC Madivala, <sup>3</sup>RSRS, Salem, <sup>4</sup>RSRS Anantapur

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

Nucleus cultures of five ecto-pupal parasitoids of uzi fly (*Nesolynx thymus*, *Exoristobia philippinensis*, *Trichomalopsis uziae*, *Trichopria* sp. & *Dirhinus anthracia* and two predators of mealy bug (*Cryptolaemus montrouzieri* & *Scymnus coccivora*) besides host culture of housefly and pink mealy bug are maintained throughout the year. Besides main institute, the nested units are also involved in the production of bio-control agents and distributing to the stake-holders in the respective command areas. The release of bio-control agents in the field facilitated effective management of tukra and uzi fly incidence below ETL.

Production of Bio-Control Agents			
Centre	BCA	Quantity Produced	Sale to Stakeholders
CSRTI-Mysuru	NT	1956	772
	Beetles	408	195
REC-Madivala	NT	1006	487
RSRS-Salem	AP	1075	467
	CZ	1161	160
RSRS-Anantapur	NT	811	490
NT: <i>Nesolynx thymus</i> (No. of pouches) Beetles: <i>Cryptolaemus montrouzieri</i> & <i>Scymnus coccivora</i> (No. of boxes) AP: <i>Acerophagus papayae</i> (1 unit = 250 adults) CZ: <i>Chrysoperla zastrowi</i> (1 unit = 1000 eggs)			

#### Forewarning and forecasting of mulberry pests

J.B. Narendra Kumar (PI), RSRS-Chamarajanagar, REC-Madivala, REC SU-Kanakapura, RSRS-Salem, REC SU-Srivilliputtur & RSRS-Anantapur

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

Prevalence of Mulberry Pests - Selected Mulberry Gardens					
States	Seasons	Mealybug (%)	Thrips (No./Leaf)	Whitefly (No./Leaf)	Leaf Roller (%)
Karnataka	Summer	4.63±4.41	3.27±2.29	0.56±1.11	0.13±0.26
	Rainy	2.23±3.02	3.24±1.81		4.85±3.03
	Winter	1.40±1.46	1.09±1.02	2.09±2.85	1.28±2.16
Tamil Nadu	Summer	7.11±6.29	5.54±8.73	0.95±1.65	0.89±1.13
	Rainy	7.95±3.86	7.50±1.53	0.82±0.68	1.63±0.79
	Winter	5.89±4.90	5.52±4.81	2.77±4.32	1.17±0.35
Andhra Pradesh	Summer	3.20±0.96	2.83±2.49		0.49±0.99
	Rainy	3.47±0.36	2.18±1.91		2.37±2.74
	Winter	3.54±0.08	1.68±1.15		4.15±0.53

PEST CALENDAR								Incidence Levels		<5	6-10	>10	
Place	Pest	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mysuru	Mealybug												
	Thrips												
	Leaf roller												
Madivala	Mealybug												
	Thrips												
	Leaf roller												
Kanakapura	Mealybug												
	Thrips												
	Whitefly												
	Leaf roller												
Ch. Nagar	Mealybug												
	Leaf roller												
Salem	Mealybug												
	Thrips												
	Leaf roller												
Srivilliputtur	Mealybug												
	Thrips												
	Leaf roller												
Anantapur	Mealybug												
	Thrips												
	Leaf roller												

## SILKWORM PATHOLOGY SECTION

### Concluded Research Projects

#### ARP 3550: Validation trials of Automated Disinfection of rearing house (Jan. 2016 - Mar. 2017)

A. R. Narasimha Nayaka, G. Mallikarjuna, P. C. Santha, L. Maheswari, Ishwar and C. A. Mary Flora

**Objective:** To evaluate the effectiveness of Automated disinfection of rearing house in-house

The concept of automated disinfection model for disinfection of silkworm rearing houses was presented at "Innovative Sericulture Farmers workshop (Dec 16th 2011 at CSRTI-Mysuru) by a progressive farmer, Sri S. V. Rajashekarappa, Yalaganahalli village, Hassan Dist., Karnatka. The farmer's innovation was fine tuned by the scientists at CSRTI-Mysuru. The fine-tuned model is validated at different nested units of CSRTI-Mysuru (TVDC, CSRTI-Mysuru; RSRS-Salem, RSRS-Kodathi and REC-Bidarguppe).

Comparative Economics of Automated Disinfection Model				
Particulars	Manual		Automated	
	Qty.	Cost (Rs.)	Qty.	Cost (Rs.)
Manpower	6	2100	Nil	Nil
Time	9 hours	Nil	15 min	Nil
Fuel	6 litres Petrol	360/-	1 unit Electricity	3.60/-

Silkworm rearings were conducted in the identified units after conducting disinfection through automated disinfection system and regular disinfection through power sprayer was maintained as control. Crop performance

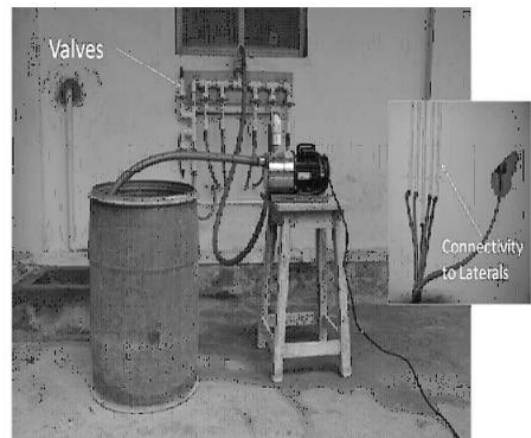
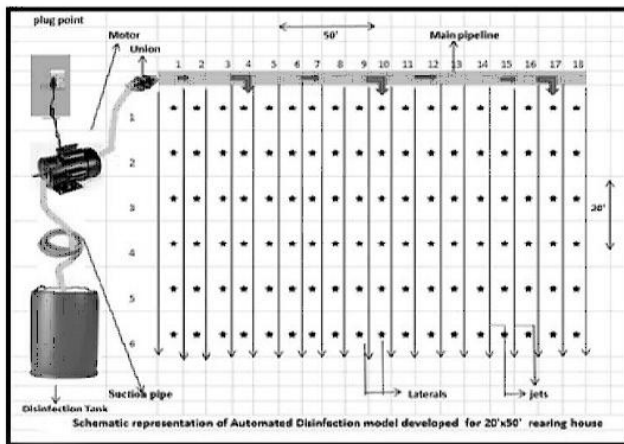
of all the batches in the units was on par with the control. Fine tuned model for automated disinfection of silkworm rearing shed which reduces the drudgery and avoids exposure of the farmers to disinfectants. Two models of different capacities were approved by CSRTI-Mysuru and the units cost was arrived at Rs.26500/- (20'x30' RH) and Rs.34500/- (20'x 50' RH). These models are also installed at Gowribidanur and Sidlaghatta TSC areas in Chikkabalapur district, Karnataka. The automated disinfection model is being promoted by DoS-Karnataka under the Bhoosamrudhi project of Agriculture Department and 46 units of automated disinfection model were established with the sericulturists.

Unit Cost of Automated Disinfection Model		
Materials	Rearing House Size	
	20' x 30'	20' x 50'
Micro-Sprinklers	600	800
CPVC Pipes (1' & 3/4')	4400	6100
Brass Tees, Collars, GI Nipples	2400	4000
CPVC Gate valve, Union, Suction pipe	1800	1800
Motor pump 1.00 Hp	10000	10000
Installation charges	4000	8000
Brass gun with HDPE pipe	1300	2300
Miscellaneous Items (elbow, clamps, nails, GI wire etc.)	1000	1500
Total (Rs.)	26,500	34,500

**Inference**

Automated disinfection model is recommended to the farmers and the farm-based units of CSB/DoS to reduce drudgery and avoid exposure to disinfectants. After successful in-house trials, the model was released in the farmers workshop held at Doddaballapur on 17.01.2017 and is well adopted by DoS-Karantaka.

**Automated Disinfection Model for Silkworm Rearing Houses**



## Ongoing Projects

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

M. Balavenkatasubbaiah (upto Dec. 2017), A. V. Mary Josepha and Raghavendra Rao (NSSO-Bengaluru)

#### Objectives

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

Silkworm disease monitoring is being conducted in every crop of selected BSFs (Karnataka, Tamil Nadu & Andhra Pradesh) and also 10 farmers' crops per month in selected clusters (Karnataka, Kerala, Andhra Pradesh, Telangana Tamil Nadu & Maharashtra). The data on disease incidence is uploaded in web site created for Silkworm Disease Monitoring.

Average Incidence of Silkworm Diseases in Basic Seed Farms					
State	BSFs	Disease incidence (%)			
		Grasserie	Flacherie	Muscardine	Pebrine
Karnataka	P4 BSF-Hassan	0.00	0.00	0.00	0.15
	P4 BSF-(DoS)Kunigal	0.00	0.00	0.00	0.00
	P3 BSF-Mysore	0.02	0.16	0.00	0.00
	P3 BSF-Kumbarahalli (DoS)	0.75	0.67	0.00	0.00
	P3 BSF DoS-Kudige	0.13	0.00	0.00	0.00
	P3 BSF DoS-Kagundi	0.00	0.00	0.00	0.00
	P2 BSF-Nagamangala	0.00	0.49	0.00	0.00
	P2 BSF-Gavimata K. R.Pet	0.00	0.53	0.25	0.00
	P2 BSF DoS-Sira	0.00	0.40	0.00	0.00
	P2 BSF DoS-Ambuga	2.62	0.29	0.00	0.00
	P2 BSF DoS-K.P. Doddi	0.00	0.00	0.00	0.00
Tamil Nadu	P2 BSF DoS-Rudrapatna	0.00	0.03	0.00	0.00
	P2 BSF-Yelagiri Hills	0.00	0.62	0.00	0.00
	P3 BSF DoS-Avalapalli	1.00	7.00	0.00	0.00
Andhra Pradesh	P3 BSF DoS-Berigai	0.00	1.00	0.00	0.00
	P2 BSF-Horsiley Hills	0.02	0.11	0.00	0.00
	P3 BSF DoS-Thadakalapalli	0.04	0.66	0.04	0.00
	P3 BSF DoS-Horsiley Hills	0.00	0.11	0.00	0.00

Average Incidence of Silkworm Diseases with Farmers in Southern States											
State	Hybrid	Dfls (Nos)	Yield/ 100 dfls (kg)	Disease Incidence (%) in V instar(Inspection Time)				Disease incidence (%) upto Crop Completion (Farmer's Assessment)			
				Grasserie	Flacherie	Muscardine	Pebrine	Grasserie	Flacherie	Muscardine	Pebrine
KA	BV	131201	66.88	2.52	2.32	0.26	0	2.06	1.65	0.16	0
TN	BV	229190	76.92	0.22	0.69	0.0005	0	0.36	0.89	0	0
	CB	150	75.33	0	3.00	0	0	0	3.00	0	0
	Tot	229340	76.12	0.11	1.845	0	0	0.18	1.945	0	0
AP	BV	164695	67.46	2.10	1.55	0.58	0	1.46	0.77	0.08	0
	CB	23885	58.28	2.71	1.30	0	0	3.56	1.74	0	0
		188580	62.87	2.405	1.425	0.29	0	2.51	1.255	0.04	0

State	Hybrid	Dfls (Nos)	Yield/ 100 dfls (kg)	Disease Incidence (%) in V instar (Inspection Time)				Disease incidence (%) upto Crop Completion (Farmer's Assessment)			
				Grasserie	Flacherie	Muscardine	Pebrine	Grasserie	Flacherie	Muscardine	Pebrine
KL	BV	11477	86.52	0.03	1.37	0	0	0.04	1.96	0	0
MAH	BV	25800	63.10	0.37	0.21	0.05	0	1.66	0.93	0.31	0

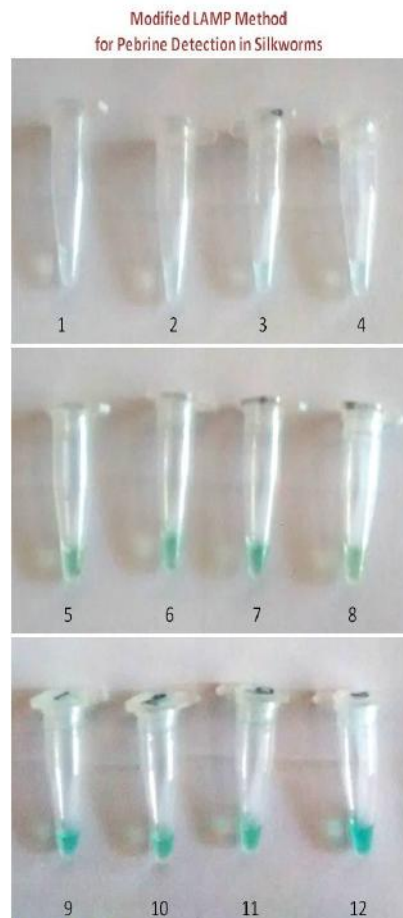
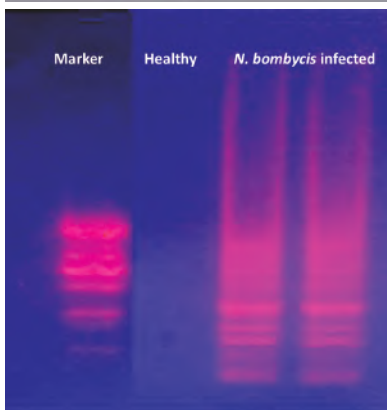
**ARP 3597: Standardization and Validation of LAMP (Loop mediated isothermal amplification reaction) technique for the detection of *Nosema bombycis* infection in silkworm (Oct. 2016 - Sep. 2017)**

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

**Objectives**

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

A simple, efficient, cost-effective and less time consuming diagnostic system based on direct PCR and LAMP primers was developed as Modified LAMP method for pebrine detection in silkworms. The pebrine infection in *N. bombycis* inoculated silkworms was detected ( $10^1$  to  $10^8$ ) on 7<sup>th</sup> day by modified LAMP method and HNB (Hydro Naphthol Blue) was used as indicator dye. The PCR colour reactions of Modified LAMP were also confirmed by agarose gel electrophoresis of PCR products. The pebrine in the samples was confirmed by microscopic examination (spores in  $10^8$  and  $10^7$  inoculated larvae and sporoblasts in  $10^6$ - $10^3$ ) tissue smears at 600x. Various indicator dyes (Eosin red, Methylene orange, Calcein, Syto-16, SyBr green, Phenol Red, Malachite Green, M-Cresol Purple and SYBR Green) were tested for developing contrasting colour observations instead of reaction mixture turning into light blue from dark purple blue in case of HNB. The utilization of loop primers enhanced the assay sensitivity and specificity in the Modified LAMP method.



Sample 1: Blank (-ve reaction: colour less)  
 Sample 2: Healthy larvae (-ve reaction: colour less)  
 Sample 3 – 12: *N. bombycis* inoculated silkworm larvae with  $10^1$  to  $10^8$  spores and showing positive reaction (greenish colour). The colour intensity increases with the concentration of inoculums.

The basic seed production samples (Breeding labs @ CSRTI-Mysuru and P4 BSF-Hassan) were utilized for validating Modified LAMP method. The results of regular microscopic test were similar to the observations by Modified LAMP method in egg shell, larval, pupal and moth samples. The egg shell testing at P3 BSF-Mysuru validated the microscopic examination of mother moth samples during egg production.

## Continuous/Other Activities

### Pebrine Monitoring in breeder's stocks and multiplication units

**Objective:** To monitor pebrine disease in breeder's stocks and seed multiplication units

Each crop of Breeder's stocks of silkworm genetic resources (Bivoltine & Polyvoltine) at CSRTI-Mysuru, CSGRC-Hosur, P4 BSF-Hassan, P3 BSF-Mysuru, SSBS-Coonoor, Seed multiplication units of CSB & DoSs (Karnataka: 13 BSFs, Tamil Nadu: 3 BSFs; Andhra Pradesh: 3 BSFs), P1 grainages (NSSO-SSPC-K. R. Nagar, NSSO-SSPC-Chikkamalavadi, DoS-K-SSPC-Chandapura, DoS-TN-SSPC-Denkanikota and other rearings of CSRTI-Mysuru are monitored regularly for pebrine incidence. The pebrine monitoring team involves scientific personnel from CSRTI-Mysuru and NSSO-Bengaluru, SSTL-Bengaluru, SBRL-Bengaluru. The pebrine monitoring activities and remedial measures undertaken are reviewed bi-annually. All the batches were monitored systematically following prescribed schedules and the infected lots were rejected summarily.

### Popularisation of SERIFIT, a New Disinfectant for Effective Sanitation in Sericulture

SERIFIT, a new disinfectant developed in collaboration with M/s Rayalaseema Hi-strength Hypo limited, Kurnool was commercialized in March 2016 following limited field trials in Karnataka, Tamil Nadu and Andhra Pradesh. SERIFIT was popularized during the year as ToT programme for the disinfection of rearing houses in 50 selected clusters and the data on crop performance was collected. The data reveals that SERIFIT as a general disinfectant is effective in the inactivation of silkworm pathogens and significant reduction in disease incidence was observed only in Andhra Pradesh. In the other states, SERIFIT (Treatment) performance was on par with the recommended disinfectant (Control: Asthra).

#### Bivoltine Hybrid Crop Performance following Disinfection with SERIFIT

State	Dfls (Nos)	Coc. Yield/ 100dfls (Kg)	Coc. Wt. (g)	Shell Wt. (g)	Shell Ratio (%)	Avg. Disease Incidence (%)				
						Grasserie	Flacherie	Muscardine	Total	
AP	T	118779	71.18*	1.730	0.378	21.78*	1.039*	1.619*	0.434	3.12*
	C	98475	64.73	1.720	0.355	20.71	3.467	2.821	0.394	6.69
KA	T	116320	73.09*	1.820*	0.379*	20.68	0.905	0.307	0.01	1.22
	C	87855	65.66	1.708	0.349	20.49	2.689	1.109	0	3.89
MA	T	20200	66.67	1.677	0.360*	21.42	2.718	0.66	0.15	3.53
	C	17100	61.69	1.640	0.342	20.79	4.254	1.096	0.15	5.50
TN	T	92280	79.27	1.880	0.388	20.93	0.287	0.521	0.115	0.94
	C	12385	80.54	1.890	0.346	19.84	1.40	1.470	0.020	2.90

## POST COCOON EVALUATION UNIT

### Continuous Activities

#### Evaluation of newly developed silkworm hybrids for post cocoon parameters

Kariyappa and M.N. Chandra Sheakar

**Objective:** To evaluate the post cocoon parameters of pure and hybrid cocoons from laboratories

Cocoon lots of various breeds/hybrids from different laboratories from main institute and nested units were evaluated regularly for the post-cocoon parameters (535 Kg). The data is documented and analysed across the test centres; and the data is communicated to the silkworm breeders for implementation of suitable modifications/strategies in the breeding programmes for the improvement of post-cocoon traits and silk quality. The unit is also actively associated with the directional breeding programmes.

## SERICULTURAL ENGINEERING DIVISION

### Concluded Project

#### APR 3529: Design and development of silkworm rearing house models for hot and dry and hot and humid areas of peninsular India (Jan. 2015 - Dec. 2016)

Satish Verma, M.T. Himanthraj, Ch. Satyanarayan Raju, D. S. Somaprasadh and V. Sivaprasad

**Objective:** To design and develop silkworm rearing house models for non-traditional areas of sericulture which have hot & dry and hot & humid climates

#### Management of comfortable environmental conditions in the late age rearing house

A comprehensive analysis on the climatic conditions (minimum, maximum & average temperature and relative humidity) in non-traditional areas of sericulture in Karnataka, Andhra Pradesh and Telangana was undertaken based on metrological data for the past 10 years (Indian Metrological Department; IMD- Pune). The climatic conditions of non-traditional areas are very much different from the traditional areas of sericulture, which have moderate climate throughout the year. Enthalpy, the sensible heat of air and latent heat of water vapour was determined as the most important criteria for creating comfortable rearing environment for silkworms, instead of directly looking at the absolute figures of temperature and RH.

Climatic Zone	Winter Months			Summer Months		
	Min. Temp. (°C)	RH (%)	Enthalpy of Air (kJ/kg of air)	Min. Temp. (°C)	RH (%)	Enthalpy of Air (kJ/kg of air)
Hot & Dry regions of North Karnataka, AP & TS	12-15	40-60	30	> 45	20-40	90
Hot & Humid regions of Coastal AP	20-25	60-80	60	> 40	60-80	130

#### Combinations of Temperature & Relative Humidity for providing Comfortable Environment to Silkworms (Enthalpy ≈ 63 kJ/kg of moist air)

For the management of optimum environmental conditions inside a silkworm rearing house, enthalpy, the overall heat of the moist air comprising of sensible heat of air and latent heat of water vapour have been determined using Psychrometrics. The optimal environmental conditions for late-age silkworms is at 25°C temperature and 75%; the overall enthalpy of moist air at these conditions works out to 63.2 kJ/kg of air. Based on enthalpy calculations, the combinations of temperature and relative humidity to be provided for a comfortable environment inside a silkworm rearing house have been determined. Otherwise, the environmental conditions provided to silkworm rearing by maintaining optimal temperature/RH at each and every climatic conditions is not advisable. Balance between sensible heat of air and latent heat of water vapour is made for creating a comfortable environment for silkworms by maintaining Enthalpy at around 63 kJ/kg of moist air. For each degree increase in temperature > 25°C, the RH should be decreased by 5%. Similarly, for each decrease in temperature < 25°C, the RH should be increased by 5%.

Temp. (°C)	RH (%) to be maintained	Enthalpy of Air (kJ/kg of air)
20	100	57.41
21	100	60.88
22	95	62.31
23	85	61.32
24	80	62.34
25	75	63.19
26	70	63.85
27	65	64.30
28	60	64.53
29	55	64.50
30	50	64.19
31	45	63.59
32	40	63.66
33	35	63.85
34	30	64.06
35	25	62.23

#### Late-age Silkworm Rearing Houses

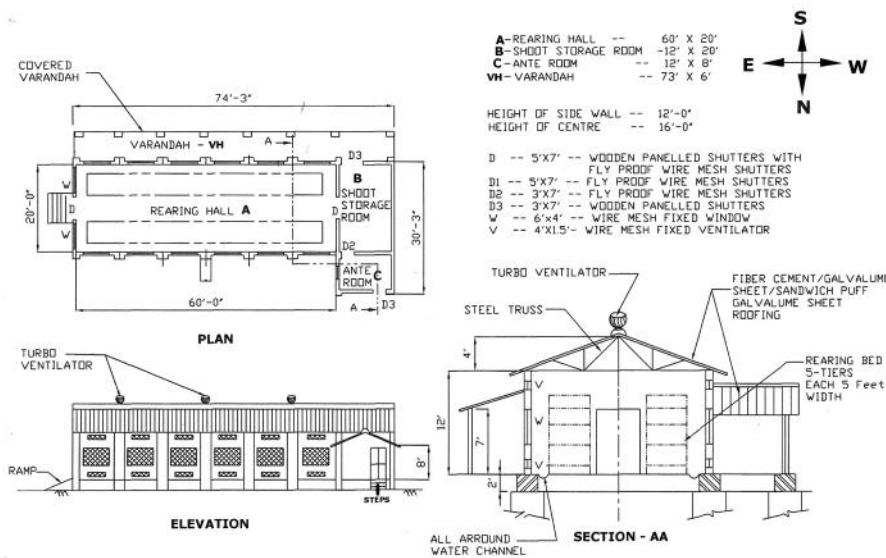
The late-age silkworm rearing houses in the project area were studied

with regard to design, construction materials etc. Most of the rearing houses have been constructed following the model designs given by CSRTI-Mysore in late nineties utilizing materials like earthen or cement bricks (solid & hollow), grass, shade nets etc. for making walls; asbestos or galvalume colour coated sheets or RCC for roofs; doors, windows and ventilators made out of local wood. Most of the farmers built rearing stands with 5 or more tiers to maximize the rearing capacity. Farmers also took care to construct rearing houses at elevated or well-ventilated places. Several farmers installed sprinklers on roof top to reduce solar radiation during summer months.

Most of the farmers practicing sericulture in hot and dry regions revealed that most of the time, the temperature is very much higher than 25°C and relative humidity lesser than recommended value of 65 -75% inside the rearing house. But the crop productivity in these rearing houses was not affected and cocoons produced were of good quality. They expressed the need for better management of environmental conditions inside the silkworm rearing house for further improvements in the cocoon productivity and quality.

### Development of Model Silkworm Rearing House

The model silkworm rearing houses for providing a healthy environment to late-age silkworms for different climatic conditions have been designed based on the hypotheses that it's the enthalpy that determines the comfortable climatic conditions rather than the absolute levels of temperature and relative humidity. The designs of elevations of model rearing houses for different climatic conditions have been developed.



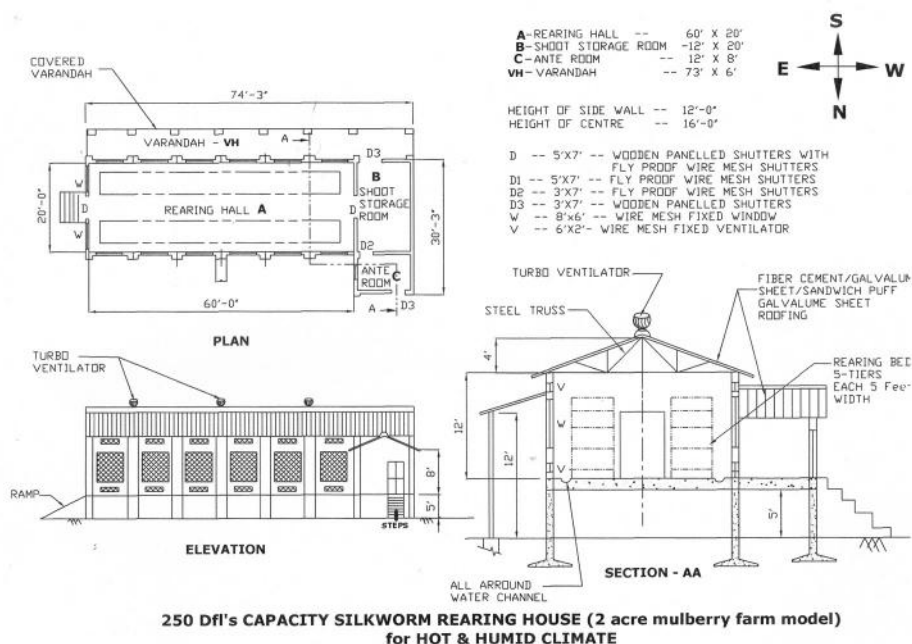
**250 Dfl's CAPACITY SILKWORM REARING HOUSE (2 acre mulberry farm model)  
for HOT & DRY CLIMATE**

### Guidelines for Construction of Silkworm Rearing Houses

The following guidelines should be followed while planning and constructing a silkworm rearing house for harvesting better quality cocoons with higher productivity.

The site for rearing house should be selected according to environmental conditions. In areas, where rainfall is abundant, a dry sunny, well-ventilated and well-drained highland should be selected. The location of rearing house at an elevated place will ensure cross ventilation, good drainage system for washing and disinfection works. Water should not stagnate around the building during rainy season.

- The rearing house site should have all-season approach road for transportation of mulberry shoots, rearing materials, workers, cocoons etc. by farm and transport vehicles.
- The orientation of rearing house has direct impact on heating, lighting and cooling costs. By maximising



southern exposure, for example one can take optimal advantage of the sun for daylight and passive solar heating. Minimising western exposures will result in lower cooling costs, where it's most difficult to provide shade from sun.

- The minimum wall to wall width of rearing hall should be 6m (20 feet to accommodate two rows of rearing stands each with a width of 1.5m).
- The silkworms should be reared with adequate space/bed area. For 50000 silkworms (100 dfls), the bed area should be at least 100 m<sup>2</sup> (1000 sqft) in hot and dry areas and a minimum of 120 m<sup>2</sup> (1200 sqft) in hot and humid regions.
- The best location for ventilators is at ground level and another at ceiling level.
- A 10-15 cm deep channel around inside the rearing hall is essential to prevent entry of ants into the rearing area and also to drain-out water at the time of washing/disinfection. During summer, the water in the channel increases the humidity and cools the air entering through the lower ventilators.
- The roof of rearing house should be either of asbestos or galvalume. This kind of roofing avoids entry of uzifly into the rearing house and also allows for the installation of turbo-ventilators, which are very efficient in evacuating heat and moisture from the building.
- An ante-room should be provided at the entrance of rearing hall for hand and feet washing by the workers to avoid secondary contamination to the silkworms.
- All the doors and windows should be fitted with corrosion-resistant and fly-proof mesh to prevent entry of uzifly into the rearing house.
- Water facility should be provided in the rearing house for cleaning/washing/disinfection and also for humidification purpose.
- The rearing house should have electrical power supply. Adequate lighting arrangements are essential for working during night. Electrical points should also be provided for using equipments such as heaters, humidifiers, coolers, power sprayer, deflossers etc.
- Plantation of trees and other plants help to cool the environment resulting in a simple and effective

means to reduce the heat in-and-around building. Deciduous trees shall be planted on north and west side of rearing house as these will provide shade by cutting very strong sun light during afternoons in summer months. In winter months, trees will shed the leaves, hence allows more sun light on building to make it warmer.

### Other Activities

#### NRDC New Delhi: Developing entrepreneurship for silk cocoon harvesting

##### V. Sivaprasad and Satish Verma

**Objective:** To demonstrate and popularize cocoon harvestors for silk cocoons with farmers and develop entrepreneurship

The Cocoon Harvester was demonstrated and on-hand training was imparted to over 150 farmers, officials, and workers related to silk cocoon production at CSRTI-Mysore and villages. A lot of enthusiasm was observed among farmers about the usefulness of the cocoon harvestors and came forward to procure the machines. Several farmers convinced about its utility for saving labour, reducing drudgery and carrying out cocoon harvesting with less-expenditure and time.

Ten farmers (2 each from AP & Tamilnadu and 6 from Karnataka) were identified as entrepreneurs and provided with the cocoon harvestors. These farmers were trained on operation and maintenance of the cocoon harvestors at CSRTI-Mysore. Real-time training on operation and maintenance of machine was also imparted to the farmers in the respective villages. The feedback on the utility of the machine reveals that the machine was very useful for saving time, labour, expenditure (atleast by 50%) and immense reduction in drudgery.



## SERICULTURAL EXTENSION, ECONOMICS & MANAGEMENT DIVISION

S. B. Nagaraja, B. Gangadhar, A. Mahima Santhi, G. S. Geetha, H.M. Munikrishnappa and D. Joycy Rani

### Concluded Research Projects

#### MOE 3523: Study on Drought Management Practices in Mulberry Sericulture (Jan. 2015 - Dec. 2016)

A. Mahima Santhi (PI), K. Vedavyasa, Noble Morrison, M N. Moorthy, Vidyunmala, A. G. K. Daniel and S. Rajaram

#### Objectives

- To analyse the different management practices adopted by farmers to overcome the drought in mulberry cultivation and silkworm rearing
- To study the adoption level of the scientific drought management techniques popularized by the research institutes and to rectify the gaps
- To study the preferences and expectations of farmers from research and extension scientists to overcome the crisis effectively

Study on drought management practices in mulberry Sericulture was conducted in Karnataka (Tumkur & Ithandahally), Andhra Pradesh (Penukonda & Hindupur) and Tamil Nadu (Oddanchatrum & Adaikalapattinam) bivoltine clusters based on purposive sampling design with a sample size of 300 farmers. Drought management technologies recommended by various R&D institutions were examined to compile a package for Integrated Drought Management (IDM) in mulberry sericulture. Data collection on socio-economic characteristics and drought management technologies were collected through specially designed and pre-tested interview schedule by personal interviews of the sericulture farmers.

Integrated Drought Management (IDM) Technology	
Category	Technology
Drought monitoring and forewarning	Predictions of meteorological department to plan crop schedules
Plantation in drought prone areas	Land leveling; Sub-soiling and chiseling of land; Planting drought resistant mulberry varieties such as S13, RC1, RC2 and MSG 2; Planting as tree mulberry cultivation
Irrigation techniques	Drip irrigation/Affordable Micro Irrigation Technology (AMIT)
Water conservation and soil moisture management	Mulching; Trenching and mulching; Wind breaks and shelterbelts; Weed management; Sub soiling or Hard pan breaking; Green manuring
Rain water harvesting	Impounding rainwater in the garden; Micro catchments; Runoff collection pits; Farm ponds; bore well recharging
Application of Nutrient Formulation	Spraying multi-nutrient formulation (Poshan) on mulberry leaves
Rearing of temperature tolerant silkworm hybrids	Single hybrid: CSR50 x CSR51 (Chamaraja) Double hybrid: (CSR50 x CSR2)x(CSR51 x CSR53) or FC3 x FC4 (Jayachamaraja); G11 x G19
Rearing schedule	Avoid during peak summer; Early brushing (brushing after 40 days of pruning)
Rearing shed maintenance	Providing false ceiling; Covering roof with grass/coconut leaves; Painting roof with cool guard/lime; Hanging water filled earthen pots; Providing drip line on rearing shed roof; Hanging wet curtains to windows and doors; Raising trees around rearing house; Using shade nets to prevent direct sunlight
Silkworm egg transportation	Transportation of silkworm eggs during cooler hours of the day; Use of egg transportation devices
Young age rearing	Proper incubation of Dfls and avoiding delay of brushing; Wrap-up method of chawki rearing; Use of blue polythene sheet to cover rearing bed; Increased frequency of feeding (from two to three); Use of air coolers/humidifiers/foggers; Sprinkling of clean water on floor and walls
Late age rearing	Increased frequency of feeding; Sprinkling of clean water on the floor and walls; Covering the rearing bed with old newspaper/paraffin paper immediately after feeding until leaf is consumed; Providing good aeration
Shoot harvesting and preservation	Harvest during cooler hours of the day; Feeding leaves harvested from irrigated garden for moult resuming; Preserve shoots in upright position; Sprinkling water on shoot & covering with wet cloth; Avoiding transportation of shoot to longer distances in hot & dry climate
Mounting and spinning care	Maintenance of temperature and humidity during the initial 92 hours; Providing continuous air flow during spinning to remove the excess moisture

Adoption Index and adoption gaps for all the selected technologies were calculated and adoption gaps were identified to bridge at the field level by conducting extension communication programmes. Farmers were motivated to adopt IDM technologies by individual visits, group discussions, demonstrations and awareness programmes. IDM were also compiled as a 'Handbook on Integrated Drought Management for Mulberry Sericulture' in English, Kannada, Telugu and Tamil languages and provided to the farmers and extension officers. Impact analysis was conducted in the clusters to study improvement in adoption and gap bridging for all the technologies were evaluated for significance. Disease free silkworm layings, cocoon productivity, yield output and cocoon rates were selected as measurable indicators to determine the efficiency of IDM technologies. Data collected from high adopters were compared with low adopters and analyzed through t-test.

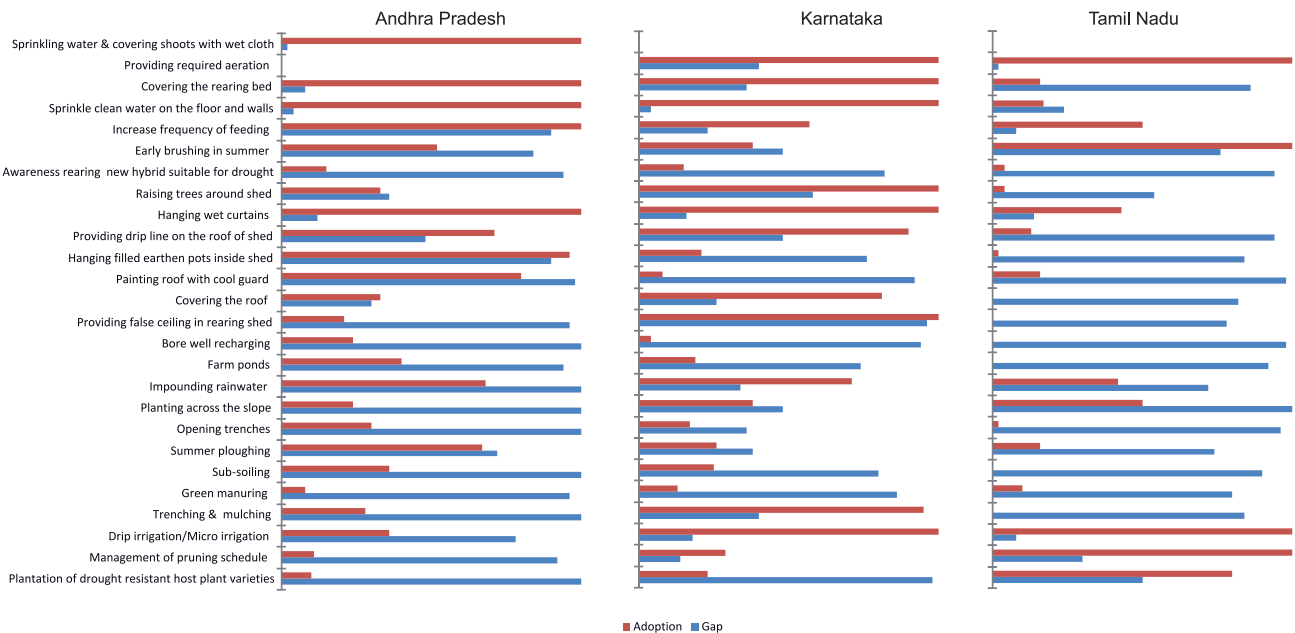
Ten well-known variables were selected to picture the socio-economic profile of farmers, which showed that the mean experience of sericulturists was 10 years, mean age of farmers was 46 years and 72% respondents were of middle age group (35-55 years). High proportion of respondents (52%) were educated upto high school level.

The mean land holding of respondents was 2.47 ha and mean mulberry land holding was <1ha. 84% respondents opined that water resources are low and insufficient for carrying out sericultural activities.

Extent of adoption of IDM technologies among the farmers of study area was computed after conducting ECPs and the adoption index showed that 46% were low, 37.33% medium and only 15.9% were high adopters of IDM technologies. Adoption index for the individual IDM technologies and adoption gaps were estimated with lesser adoption incase of utilizing drought resistant mulberry varieties, soil moisture conservation & rain water harvesting. Technology-wise extent of adoption at the time of benchmark study showed that only 1/3 rd of the technologies are less adopted. Important technologies in rearing shed such as false ceiling, roof covering, painting roof with cool guard, hanging water filled earthen pots, providing drip line on roof, raising trees around rearing shed were less adopted which lead to the production of inferior quality cocoons in drought seasons. Rearing drought tolerant silkworm hybrids and early brushing of eggs recorded low level of adoption, high level of adoption (74% farmers) in increased feed frequency during drought months, harvesting of mulberry leaves/shoots, transportation and preservation.

IDM Technology Adoption Index							
Category	Adoption Index	AP		Karnataka		TN	
Very Low	< 10	2	6.67	2	6.67	6	20.00
Low	11 - 30	8	26.67	6	20.00	7	23.33
Medium	31 - 60	4	13.33	3	10.00	3	10.00
High	60 - 90	5	16.67	4	13.33	3	10.00
Very High	> 90	11	36.67	15	50.00	11	36.67

### Project Implementation – IDM Technology for Mulberry Sericulture Technology Gaps & Improvement in Adoption



Impact analysis was conducted to find out bridging of adoption gaps in the three selected states. Amongst 30 identified IDM technologies (12 on mulberry and 18 on silkworm side), adoption gap has been bridged completely with regard to the silkworm rearing technology (providing required aeration, harvesting shoots during cooler hours of day, feeding chawki & moult resumption with shoots from irrigated garden, preserving shoots in upright position, sprinkling water & covering shoots with wet cloth and avoiding long transportation of shoots) affecting economic output. On the other hand, the remaining technologies on both silkworm and mulberry side were adopted lowly by the farmers. Implementation of the current project lead to the completely bridging of adoption gap on silkworm side

except for rearing of drought tolerant hybrids (<20%) in Andhra Pradesh, Tamil Nadu and Karnataka; while mulberry technology adoption has been initiated through repeated awareness programmes to the farmers. Statistically highly significant @ CD 0.05 level bridging of adoption gap was achieved on IDM technologies due to the project implementation. Certain technologies like run-off collection pit/pond and bore well recharging require financial assistance from the state governments; whereas the other technologies like drought resistant mulberry varieties, green manuring, sub-soiling etc., can be achieved through creation of awareness/understanding and motivation of the farmers. Continuous monitoring of adoption of technologies, forewarning through media needs to be carried out in the drought prone sericultural areas for the spread of IDM technologies as ToT for the benefit of sericulture farmers to combat future droughts and its ill effects.

Measurement of Efficiency of IDM Technologies								
Parameter	High Adopters			Low Adopters			Percent Increase	t- Value
	Mean	SD	CV (%)	Mean	SD	CV (%)		
Dfls Reared (ha/annum)	2337.7	305.2	32.6	1397.3	162.0	28.9	67.3	5.66**
Cocoons Produced (/ha/annum; kg)	1818.3	236.5	32.5	1011.5	120.1	29.6	79.8	5.01**
Avg. Cocoon Yield (kg/100 dfls)	78.1	4.9	6.3	72.3	4.2	5.8	8.0	4.60**
Avg. Cocoon Rate (Rs./Kg)	288.8	27.2	9.4	287.3	27.7	9.6	0.5	0.21

Positive correlation was observed between age and experience of farmer with the adoption index; brushing capacity and average cocoon yield with the extent of adoption, while the extent of land holding negatively correlated with the adoption level. Preferences and expectations of farmers from the research and extension scientists to overcome the issues related were enlisted, which includes development of drought resistant and high yielding mulberry varieties (75%), enhancement in the availability of saplings of newly released varieties (70%), development of low-cost inter cultivation implements suitable for mulberry plantations & inter-cultivation (80%), motivating CRCs to brush drought tolerant silkworm hybrids (71%) and financial assistance to dig/deepen open well or bore well and bore well recharging (80%).

**Inference/Recommendations:** Eighty four percent of farmers reported insufficient water to carryout the sericultural activities during the drought period and the benchmark study revealed that the extent of adoption of IDM technologies by the farmers to cope up with the situation was very low (8-40%). High adoption gap was observed with soil moisture management and rain water harvesting. ECPs conducted The extent of adoption of IDM technologies increased through the ECPs, which in turn helped farmers to improve productivity quantitatively and qualitatively. Farmers in drought prone areas should well be motivated to adopt IDM technologies to overcome the illeffects of drought. Further, there is necessity to to conduct studies on the combined effect of IDM technologies on soil moisture management, water-use efficiency, leaf production and cocoon productivity.

**MOE 3525: A Study on the impact of pest and disease management practices in sericulture among the farmers under Cluster Promotion Programme in South India (Jan. 2015 - Dec. 2016)**

B. Gangadhar, H. Jayaram, T. Mogili, Punithavathi and Ramaprakash

**Objectives**

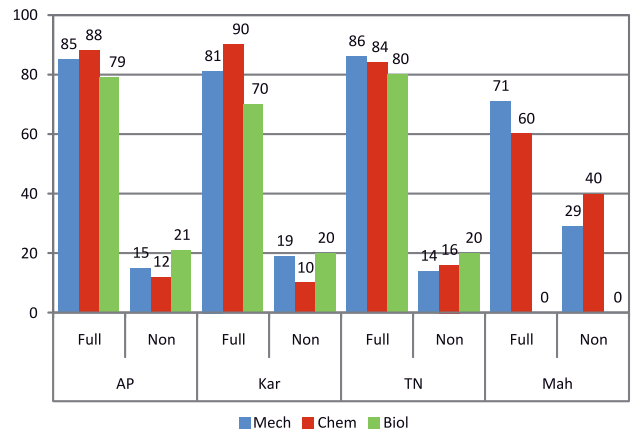
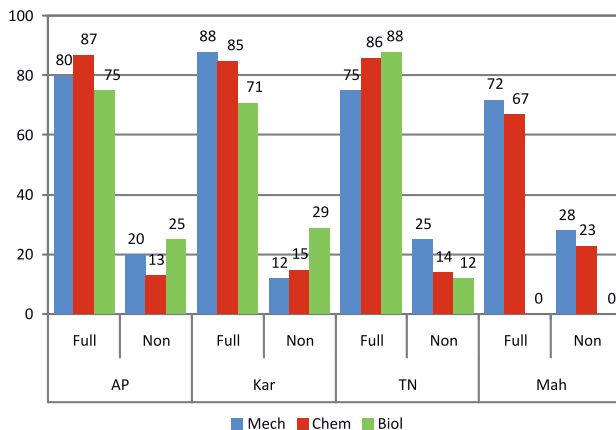
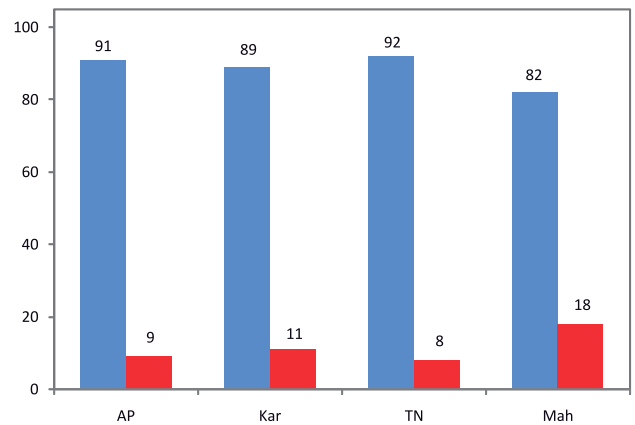
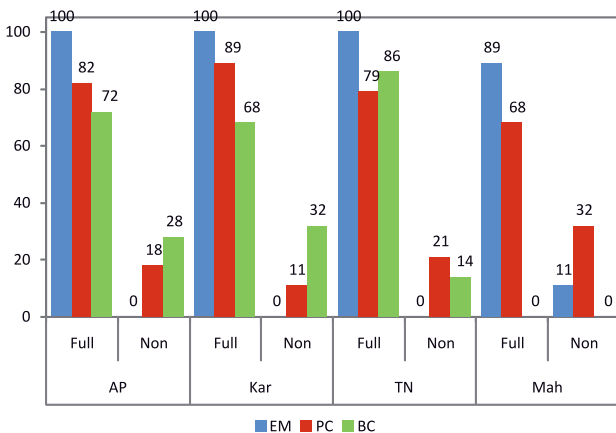
- To study the impact on the adoption level of management practices for pest and disease of mulberry and silkworm under CPP area
- To study the constraints in adoption of pest and disease management practices

Study on the impact of pest and disease management practices in sericulture among the farmers under Cluster Promotion Programme (CPP) in South India was conducted in 17 selected clusters in Andhra Pradesh, Karnataka,

Tamil Nadu and Maharashtra. A designed schedule was utilized for eliciting data from 850 randomly selected sericulturists from Kanakapura, Bevuru, Bidarakote, YN Hosakote & Yalaburga (KA), Keeranur, Palani, Udumlpet, Dharapuram & Poolavadi (TN), Madakasira, Kalyandurg, V. Kota, Giddalur & Pattikonda (AP) and Osmnabad & Satara (MAH). The incidence of pests and diseases of mulberry and silkworm and the adoption level of control measures (Integrated Pest Management; IPM and Integrated Diseases Management; IDM) were recorded and analyzed.

**Incidence of Pests & Diseases:** The major pests of mulberry viz., mealy bugs, leaf roller, thrips, white fly, bihar hairy caterpillar; and important mulberry diseases viz., leaf spot, leaf rust, powdery mildew, root rot and root knot were recorded. Uzi fly was the major pest of silkworm, while grasserie, flacherie and muscardine were the important diseases affecting silkworm in all the clusters. IPM & IDM practices were followed by the farmers for the control of mulberry pests and diseases.

**Adoption of IDM & IPM Practices:** The adoption levels of IDM practices for the control of mulberry diseases were 85% mechanical, 88% chemical and 79% biological in Andhra Pradesh; while in Karnataka, the adoption levels were to the extent of 81% mechanical, 90% chemical and 70% biological measures. In Tamil Nadu, higher adoption levels (80%) recorded was in case of bio-control measures, while mechanical and chemical measures were around 85%. No bio-control measures were adopted by the farmers in Maharashtra, and 71% mechanical and 60% chemical measures were adopted.



The IPM measures for five important mulberry pests (pink mealy bug, papaya mealy bug, leaf roller, thrips & bihar hairy caterpillar) include cultural method of clipping and destruction of affected portion was adopted by 80% in AP, while chemical measures were to an extent of 87% and biological practices being 75% for the control of pink mealy bug. In Karnataka, the mechanical measures for the control of mulberry pests were to an extent of 88%, chemical measures at 85 % and biological measures to 71 %. The mechanical measures adopted were to an extent of 75%, while chemical and biological measures to an extent of 86-88% in Tamil Nadu. In Maharashtra, the mechanical measures were adopted to an extent of 73%, chemical measures by 67.0% and no bio-control measures were adopted.

82-92% of the farmers adopted IDM practices against silkworm diseases in AP, Karnataka, TN and Maharashtra. The physical methods for control of uzi were followed to an extent of 82% in Andhra Pradesh, 89% in Karnataka, 79% in Tamil Nadu and 68% in Maharashtra, respectively. The biological control measures for uzi fly management was to an extent of 86% (TN), 68% (AP), 68% (KA) and farmers did not adopt bio-control measures in Maharashtra.

**Impact of adoption of IDM & IPM Packages:** The impact of adoption of IDM package for mulberry diseases resulted in significant decrease in the incidence of leaf spot (*C. moricola*) from 1.2% to Nil; leaf rust (*C. fici*) from 2.97 to 1.55%; powdery mildew (*P. corylea*) from 10.37 to 2.9%; from 0.5 to 0% root rot (*F. solani*) and mulberry root knot was not recorded in Andhra Pradesh. In Karnataka, incidence of mulberry declined significantly from 6.13 to nil in case of leaf spot, 3.6 to 2.1% (leaf rust), 10.15 to 2% (powdery mildew), 11 to 5% (root knot caused by *M. incognita*) and 14.15 to 5.1% (root rot). Mulberry disease incidence significantly reduced from 3.4 to 1.2% in case of powdery mildew and 7.8 to 4.6% (root rot); while leaf spot, leaf rust and root knot were not recorded in Tamil Nadu. In Maharashtra, mulberry diseases significantly declined from 6.1 to 1.5% (leaf spot); 8 to 3% (leaf rust); 17 to 6.54% (powdery mildew); 3 to nil % (root knot) and 4 to 1.5% in case of root rot.

Impact of IDM Packages on Mulberry Disease Incidence

Mulberry Pathogens	Andhra Pradesh			Karnataka			Tamil Nadu			Maharashtra		
	B	A	%	B	A	%	B	A	%	B	A	%
<i>C. moricola</i>	0.50	0.00	100.00	6.13	0.00	100.00				6.10	1.50	75.40*
<i>C. fici</i>	1.20	0.00	100.00	3.60	2.10	41.66*				8.00	3.00	63.50*
<i>P. corylea</i>	2.97	1.55	47.81*	10.15	2.00	80.29*	3.40	1.20	64.70*	17.00	6.54	61.52*
<i>M. incognita</i>				11.00	5.00	64.82*	7.80	4.60	41.02*	4.00	1.50	62.50*
<i>F. solani</i>	10.37	2.90	72.03*	14.15	5.10	64.82*	7.80	4.60	41.02*	4.00	1.50	62.50*

B: Before & A: After; \* Significant @ 1%

The incidence of mulberry pests significantly reduced from 11.56 to 5.6% (tukra-*M. hirsutus*), 6.92 to 3.12% (leaf roller-*D. pulverulentalis*), 6.5 to nil % (thrips-*P. mori*), 5.12 to 1.4% in case of bihar hairy caterpillar (*S. obliqua*) and 12.5 to nil % (white fly-*A. dispersus*) in Andhra Pradesh. In Karnataka, the pest incidence declined from 12.13 to 3.13% in case of tukra), 8.13 to 5.13% (leaf roller), 13.25 to 5.13% (thrips), 3.8 to 1.5% (bihar hairy caterpillar) and 2 to 0.5% in case of white fly. In Tamil Nadu, the pest incidence decreased from 7.6 to 1.9% in case of tukra), 3.7 to 1.9% (papaya mealy bug-*P. marginatus*), 10.4 to 2.4% (leaf roller) and 14.3 to 5.8% (thrips). In Maharashtra, the pest incidence declined significantly from 15.15 to 5.23% in case of tukra, 3 to 2% (leaf roller), 17.16 to 11.1% (thrips) and 10.05 to 4.1% (white fly). No incidence of cutworms (*Spodoptera litura*) in AP, Karnataka, TN and Maharashtra. The complete adoption of bio-control measures against papaya mealy bug, effectively reduced the infestation in Tamil Nadu, while it was not recorded in AP, Karnataka and Maharashtra.

## Impact of IPM Packages on Mulberry Pest Incidence

Mulberry Pests	Andhra Pradesh			Karnataka			Tamil Nadu			Maharashtra		
	B	A	%	B	A	%	B	A	%	B	A	%
<i>M. hirsutus</i>	11.56	5.60	51.55*	12.13	3.13	25.55*	7.60	1.90	75.00*	15.15	5.23	65.47 *
<i>P. marginata</i>							3.70	1.90	48.64*			
<i>D. pulverulentalis</i>	6.92	3.12	54.91*	8.13	5.13	36.90*	10.40	2.40	76.92*	3.00	2.00	33.33 *
<i>P. mori</i>	6.50	0.00	100.00	13.25	5.13	61.28*	14.30	5.00	59.44*	17.16	11.10	35.31 *
<i>S. obliqua</i>	5.12	1.40	72.65*	3.80	1.50	60.52*						
<i>A. dispersus</i>	12.50	0.00	100.00	2.00	0.50	75.00*				10.05	4.10	69.20 *

B: Before & A: After; \* Significant @ 1%

Silkworm disease incidence following IDM packages significantly decreased from 3.6 to 2.3% in case of flacherie, 4.6 to 3.15% (grasserie) and 8.13 to 2.15% (muscardine) in Andhra Pradesh. In Karnataka, flacherie incidence declined from 8.13 to 3.13%, grasserie (7.15 to 4.1%) and muscardine (6.1 to 1.3%). In Tamil Nadu, the disease incidence decreased from 3.1 to 1.7% in case of flacherie, 1.7 to 0.4% (grasserie) and no muscardine incidence were recorded. In Maharashtra, silkworm disease incidence significantly decreased from 15.5 to 3.5% in case of flacherie, 17.99 to 4.15% (grasserie) and 7.1 to 2.3% in case of muscardine. Higher rate of adoption of technologies resulted significant decrease in diseases (<5%) and improved cocoon yields with the farmers. The uzi infestation declined after the adoption of IPM package from 13.12 to 2.05% in AP, 8.5 to 3.13% (KA), 7.4 to 1.9% (TN) and 10.15 to 3% in Maharashtra. The uzi fly infestation was maintained below 5% level.

## Impact of IDM Packages on Silkworm Diseases/Pest Incidence

Silkworm Diseases/Pests	Andhra Pradesh			Karnataka			Tamil Nadu			Maharashtra		
	B	A	%	B	A	%	B	A	%	B	A	%
Flacherie	3.60	2.30	36.11 *	8.13	3.13	61.50 *	3.16	1.70	46.20 *	15.50	3.50	77.41 *
Grasserie	4.60	3.15	31.52 *	7.15	4.10	42.65*	1.70	0.40	76.47 *	17.00	4.15	75.55 *
Muscardine	8.13	2.15	73.55 *	6.10	1.30	78.68				7.10	2.30	67.60 *
Uzifly	13.12	2.05	83.37*	8.50	3.13	63.17*	7.40	1.90	74.32 *	10.15	3.00	70.44*

B: Before & A: After; \* Significant @ 1%

## Overall Impact of of IDM/IPM Packages Adoption on Cocoon Productivity

The adoption of IDM/IPM packages against mulberry and silkworm diseases/pests resulted in substantial increase in cocoon productivity (acre/year) in terms of dfls intake, cocoon yield and income generation in all the four states.

Economic Parameters	AP		KA		TN		MAH	
	B	A	B	A	B	A	B	A
Dfls Uptake (Nos)	900	1100	800	950	750	900	400	550
Avg. Coc. Yield (kg /100 dfls)	62	69	62	67	65	74	51	63
Avg. Rate/kg. (Rs.)	278	324	247	309	265	318	210	290
Income (Rs. In lakhs)	1.55	2.46	1.23	1.97	1.29	2.12	0.43	0.99

## Ongoing Research Project

## MOE 3595: Development of business models for enterprises in pre-cocoon sector of Sericulture

(Oct. 2016 - Sept. 2018)

D. Joycy Rani and H. Jayaram

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

Chawki Rearing Centres (CRCs), mulberry nurseries, units of seed production, mobile disinfection, bio-control agent production and mounting halls are the enterprises selected for the study in AP, TN and Karnataka states. Separate schedules were prepared for data collection from each seri-enterprise and pre-testing was done. Various parameters like profile of enterprises, technical (input usage, recommendation and adoption of technology, innovations etc.), economical (establishment cost, input & output relationship, viability, efficiency), financial (availability, source, returns, repayment capacity, risk bearing ability, etc), marketing (product, place, price, promotion) and managerial aspects (planning, challenges faced, existing opportunities) were covered in the schedule. Other functioning units operating would also be considered to obtain the preferred sample size (10 units/enterprise). Data collection was initiated for the derivation of appropriate business models.

Enterprise	Identified Samples
Chawki Rearing	10 units each in KA, TN & AP (small: 4; medium: 3; large: 3)
Mulberry Nursery	3 units each in KA & TN
Seed Production	5 units each in KA, AP & TN
Mobile Disinfection	5 units each in KA & AP
Bio-Control Agents Production	KA (4) & TN (6)
Mounting Halls	5 units each in AP & KA

### Cluster Promotion Programme (CPP)

State	Clusters		
	Mother	Satellite	Total
KA	27	19	46
TN	11	17	28
AP	11	2	13
TEL		4	4
KER	2		2
MAH	4	5	9
MP		4	4
Total	55	51	106

Cluster Promotion Programme is being implemented by Central Silk Board in collaboration with the Department of Sericulture (DoS) of respective states in the Southern Zone viz., Karnataka, Andhra Pradesh, Telangana, Tamil Nadu, Kerala, Maharashtra and Madhya Pradesh states since April 2013 in 106 clusters (55 mother & 51 satellite). The main objective of establishing the clusters is to promote bivoltine raw silk production to a tune of 5000MT by the end of XII plan (2012-17). Clusters are organized based on farmers profile and potentiality. Each cluster is monitored directly by Cluster Development Facilitators (CDFs), one each nominated by Central Silk Board and State Department of Sericulture.

### Cluster Development Facilitators (CDFs)

ANDHRA PRADESH		
Clusters	CSB	DoS
Atmakur	Dr. P Venkataramana, Sci.-D, REC SU-Atmakur	Mr. D Anjaneyulu, SO, Atmakur
Bhimadole	Mr. TVS Srinivasarao, Sci.-D, REC-Eluru	Mr. M Subbarao, ASO, Eluru
Chebrole	Dr. K Ashok Kumar, Sci.-D, REC-Eluru	Mr. Koneti Apparao, SO, Chebrole
Chittoor	Dr. P Deepa, Sci.-D, SSPC-Chittoor	Mr. Vasantharayulu, SO, Chittoor
Giddalur	Dr. NB Chowdhary, Sci.-D, REC SU-Giddalur	Mr. G Sudharkarsharma, ADS, Markapuram
Hindupur	Dr. B Narasimha Murthy, Sci.-D, CPC-Hindupur	Mr. I Vijaya Rao, SO, Hindupur
Kalyanadurg	Dr. K.P. Kiran Kumar, Sci.-C, REC-Kalyanadurga	Mr. K Ramakrishna Reddy, ASO, Kalyanadurga
Madakasira	Dr. B Narasimha Murthy, Sci.-D, REC-Madakasira	Mr. H Hanumantharaya, ASO, Madakasira
Palamaner	Dr. GV Prasad, Sci.-D, CDC-Palamaner	Mr. S Noor Basha, ASO, Palamaner
Pattikonda	Dr. P Venkataramana, Sci.-D, REC SU-Atmakur	Mr. M. Suresh Kumar, SO, Adoni
Penukonda	Dr. Vidyumala, Sci.-D, REC SU-Penukonda	Mr. P. Sadasiva Reddy, ADS, Penukonda
V.Kota	S. Nazeer Ahmed Saheb, Sci.-C, REC-V. Kota	Mr. K Ramachandar Rao, SO, V. Kota
Vijayawada	Dr. RN Prasad, Sci.-D, SSC-Vijayawada	Mr. SVN Malleswar Rao, SO, Vijayawada

Clusters	CSB	DoS
<b>TAMIL NADU</b>		
Adaikalapattinam	Dr. A.Mahima Shanthi, Sci-D, REC-Srivilliputhur	Mr. S. Arunachalam, IS(I/c), Nanmagaram
Alangkayam	Dr. S.Balasaraswathi, Sci-D, RSRS Salem	Mr. S Vijayakumar, IS(I/c), Vaniyambadi
Alangudi	Mr. NG Selvaraj, Sci.-D, RECSU-Trichy	Mr. C. Karthikeyan, AI(S), TSC Pudakottai
Annur	Dr. A Mohamed Babu, Sci-D, RECSU-Avinashi	Mr. TD Karthik Ganesh, AI(S), TSC, Annur
Anthiyur	Mrs. Rajalakshmi, Sci-D, REC-Gobi	Mr. S. Veluswamy, AI(S), TSC Bhavani
Bagalur	Dr. Jagadishprabhu, Sci.-D, SSPC-Hosur	Mr. S Saktivel, AI(S), TSC Bagalur
Berigai	Mr. Y Humayun Sharief, Sci-C, RECSU-Berigai	Mr.C. Balakrishnan, AI(S), Berigai
Bhavani	Mrs. Rajalakshmi, Sci-D, REC-Gobi	Mr. S. Veluswamy, AI(S), TSC Bhavani
Dharapuram	Dr. P Samuthiravelu, Sci.-D, REC-Udumalpet	Mr. M. Muthaiah, AI(S), Dharapuram
Dharmapuri	Dr. V Chinnadurai, Sci.-C, SSPC-Dharmapuri	Mr. M. Chandran, AI(S), TSC Dharmapuri
Gobi South	Mrs. Rajalakshmi, Sci-D, REC-Gobi	Mr. M. Gopalan, IS, TSC Gobi
Gudimangalam	Mr. R Anbazhagan, Sci.-C, REC-Udumalpet	Mr. A M Sanavas, AI(S), Gudimangalam
Keeranur	Mrs. G Punithavathi, Sci.-D, REC-Udumalpet	Mr. C Thangavelu, AI(S), Dindigul
Kodiyalam	Dr. Jagadish Prabhu, Sci.-D, SSPC-Hosur	Mr. S Saktivel, AI(S), TSC Bagalur
Kottur	Mr.Raghupathy P A, TA, SSC-Udumalpet	Mr. P. Muthukumar, AI(S), Pollachi
Kumaralingam	Dr. CM Babu, Sci.-D, REC-Udumalpet	Mr. K Velayuthan, AI(S), Udumalpet
Madathukulam	Dr. CM Babu, Sci.-D, REC-Udumalpet	Mr. K Velayuthan, AI(S), Udumalpet
Manurpalayam	Mr. Issac Joseph, Sci-D, RECSU-Avinashi	Mr. K. Selvamani, AI(S), TSC, Manurpalayam
Oddanchatram	Mr. AGK Daniel, Sci.-D, REC-Samayanallur	Mr. Muthuraman, AI(S), TSC Dindigal
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Pitchandampalayam	Mrs. Rajalakshmi, Sci.-D, REC-Gobi	Mr. M. Gopalan, AI(S), TSC Gobi
Pollachi	Dr. K Chandrashekar, Sci.-D, REC-Udumalpet	Mr. P. Muthukumar, AI(S), Pollachi
Pongalur	Mr. Issac Joseph, Sci.-D, RECSU-Avinashi	Mr. D Dhanasami, AI(S), TSC,Pongalur
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Sannarpatti	Mr. T Sivasubramanian, Sci.-C, REC-S'nallur	Ms. A. Sivamani, AI(S), Dindigal
Srivilliputhur	Dr. S Rajaram, Sci.-D, REC-Srivilliputhur	Mr. R. Jagadeesan, AI(S), Srivilliputtur
Udumalpet	Dr. P Samuthiravelu, Sci.-D, REC-Udumalpet	Mr. K. Velayuthan, AI(S), Udumalpet
Uttangarai	Dr. S Masilamani, Sci.-D, REC-Krishnagiri	Mr.K Ramanujulu, I(S), Vepanapalli
<b>KARNATAKA</b>		
Andaralahalli	Smt KL Philomena, Sci.-D, RSRS-Kodathi	Mr. S Sundar Raj, ADS, Andarlahalli
Aurad	Mr. Ramesh Kumar S, Sci-C, REC-Bidar	Mr. Bhimesh Holge, SEO, Bidar
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Harohalli (KKP)	Mrs. Sarvamangala, Sci-D, SSPC-R'nagaram	Mr. Muthuraju, ADS, Kanakapura
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Siddlaghatta	Dr. P Muniswamy Reddy,Sci.-C, SSPC-Vijayapura	Mr. MC Chandrappa, ADS, Shidlaghatta
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Zaheerabad	Dr. B Srinath, Sci.-D, REC-Vikarabad	
<b>KERALA</b>		
Kozhicode	Dr. PM Pratheesh Kumar, Sci.-D, CSRTI-Mysuru	Mr. Salim Kumar, ASO-Wayanad
Palakkad	Smt K Sarala, Sci.-D, REC-Palakkad	Anil Kumar, ASO-Palakkad
<b>MAHARASHTRA</b>		
Akola	Mr. RV Kushwaha, Sci.-D, REC-Amaravathi	Mr. SS Shinda, DSO, Akola
Beed	Mr. Rahul Singh, Sci.-D, RECSU- Aurangabad	Mr.V M Bhange, SDO Gr.II, Beed
Buldhana	Mr. RV Kushwaha, Sci.-D, REC-Amaravathi	Mr.H S Chavan, DSO, Buldhana
Jalna	Mr. Rahul Singh, Sci.-D, RECSU- Aurangabad	Mr. Ramesh B Hande, SDO Gr.II, Jalna
Nanded	Mr. AJ Karande Sci.-D, REC-Parbhani	Mr. PJ Patil, SDO Gr.II, Nanded
Osmanabad	Mr. AP Bagde, Sci.-C, RECSU-Osmanabad	Mr. S. Y. Jojan, SDO Gr.I, Osmanabad
Sangli	Mr. Ramprakash, Sci.-D, REC-Baramathi	Mr. G Y Malani, SDO Sangli
Satara	Mr. Ramprakash, Sci.-D, REC-Baramathi	Mr. Vinit Pawar, SDO, Wai, Satara
Wardha	Mr. RV Kushwaha, Sci.-D, REC-Amaravathi	Mr. P S Padvi, DSO, Wardha
<b>MADHYA PRADESH</b>		
Betul	Dr. Pradip Shukla, Sci.-C, REC-Hoshangabad	Mr. Laxman Lillore, FO, Betul
Burhanpur		Mr. Harishankar Sony, FO, Burhanpur
Hoshangabad		Mr. Ravindra Singh, FO, Hoshangabad
Khandwa		Mr. Kastur Chandra Choudhary, FO, Khandwa

### Bivoltine Raw Silk Production

State	Bivoltine Raw Silk Production (MT) (2016-17)		
	Captive Area (CPP)	Non-Captive Area	Total
Karnataka	1235.19	248	1483.19
Andhra Pradesh	806.37	250	1056.37
Telangana	87.69	16	103.69
Tamil Nadu	888.27	737	1625.27
Kerala	14.10	2	16.10
Maharashtra	131.00	97	228
Madhya Pradesh	23.66	5	28.66
Grand Total	3186.28	1355	4541.28

The clusters under the CPP command area of CSRTI-Mysuru achieved a record bivoltine raw silk production amounting to 3186.28MT with 102.75% achievement against the target of 3100MT during the year. The increase in bivoltine raw silk production is about 414MT (14.93%) over the previous year. Further, a quantity of 1355MT bivoltine raw silk was also produced in the non-captive areas in the command states of CSRTI-Mysuru. The role of CSRTI-Mysuru in the bivoltine raw production in the country represents 93.57% in the CPP and 61.21% of total bivoltine raw silk production in the country.

Bivoltine Raw Silk Production Cluster Promotion Programme under CSRTI-Mysuru (2016-17)			
Cluster	Raw Silk Production (MT)		Achmnt. (%)
	Target	Achmnt.	
Karnataka	1241.48	1235.19	99.49
Andhra Pradesh	642.50	806.37	125.51
Telangana	76.00	87.69	115.38
Tamil Nadu	928.27	888.27	95.69
Kerala	23.08	14.10	61.10
Maharashtra	150.46	131.00	87.07
Madhya Pradesh	36.54	23.66	64.74
Total	3100.00	3186.27	102.84

Bivoltine Raw Silk Production Cluster Promotion Programme under CSRTI-Mysuru			
Year	Target (MT)	Production (MT)	Achmnt. (%)
2013 - 14	1400.00	1420.90	101.49
2014 - 15	1944.00	2241.15	115.30
2015 - 16	2491.50	2772.09	111.26
2016 - 17	3100.00	3186.27	102.84

### Performance of Clusters

The performance of clusters was documented monthly as per targets/achievements on all the assigned activities (distribution of dfls, chawki rearing, crop monitoring, data collection, conducting extension communication programmes and establishment of new mulberry plantations) and monitored on a regular basis in close coordination with DoS and CSB institutions.

#### Performance of Andhra Pradesh Clusters - Bivoltine Raw Silk Production (2016-17)

Cluster	Dfls Distribution			Yield/ 100 dfls (kg)	Raw Silk Production (MT)				New Mulberry Plantation (acres)*
	Target (lakhs)	Crops (Nos)	Ach. (Nos)		Target	Ach.	Ach. (%)	Increase over 2015-16 (%)	
Atmakur	1.80	544	180350	70.96	18.00	19.69	109.38	31.26	135 (72)
Bhimadole	2.20	840	215750	67.51	22.00	22.41	101.86	35.24	53 (50)
Chebrolu	3.60	812	363250	71.68	36.00	40.06	111.27	26.65	488 (110)
Chittoor	1.50	987	249000	73.34	15.00	28.10	187.30	84.96	
Giddalur	3.00	1048	343050	68.28	30.00	36.04	120.12	31.05	40 (20)
Hindupur	4.50	2706	688000	68.98	45.00	73.01	162.25	73.72	130 (117)
Kalyanadurg	3.60	2158	540625	70.46	36.00	58.60	162.79	78.73	302 (288)
Madakasira	7.25	3792	1005550	72.49	72.50	112.13	154.67	61.95	414 (228)
Palamaner	12.60	5097	1356650	67.80	126.00	141.51	112.31	34.52	54 (50)
Pattikonda	3.10	1040	362125	76.56	31.00	42.65	137.59	42.39	233 (112)
Penukonda	3.00	1496	361700	70.71	30.00	39.35	131.16	40.04	344 (344)
V.Kota	15.10	5460	1506200	72.36	151.00	167.68	111.05	26.45	741 (706)
Vijayawada	3.00	975	243850	67.93	30.00	25.49	84.95	-4.55	
Total/Avg.	64.25	26955	7416100	70.68	642.50	806.37	125.54	30.96	2934 (2097)

\* figures in parentheses indicate number of farmers

## Performance of Telangana Clusters - Bivoltine Raw Silk Production (2016-17)

Cluster	Dfls Distribution			Yield/ 100 dfls (kg)	Raw Silk Production (MT)				New Mulberry Plantation (acres)*
	Target (lakhs)	Crops (Nos)	Ach. (Nos)		Target	Ach.	Ach. (%)	Increase over 2015-16 (%)	
Bhongir	1.50	493	149400	71.22	15.00	16.37	109.13	14.15	
Metpalli	1.50	609	192550	64.41	15.00	19.08	127.21	55.26	148 (71)
Suryapeta	2.40	807	243600	76.34	24.00	28.61	119.21	27.76	
Zaheerabad	2.20	1065	221600	69.30	22.00	23.62	107.39	36.25	
Total/Avg.	7.60	2974	807150	70.62	76.00	87.69	115.38	32.13	148 (71)

## Performance of Karnataka Clusters - Bivoltine Raw Silk Production (2016-17)

Cluster	Dfls Distribution			Yield/ 100 dfls (kg)	Raw Silk Production (MT)				New Mulberry Plantation (acres)*
	Target (lakhs)	Crops (Nos)	Ach. (Nos)		Target	Ach.	Ach. (%)	Increase over 2015-16 (%)	
Andaralahalli	1.90	729	189950	66.58	19.00	19.46	102.41	34.72	153 (128)
Aurad	1.00	193	66500	71.56	10.00	7.32	73.21	11.02	19 (22)
B.R. Koppalu	4.30	1774	405670	67.04	43.00	41.84	97.30	15.26	113 (108)
Bannikuppe	1.50	1034	154525	75.07	15.00	17.85	118.98	47.96	79 (73)
Belagam	5.00	3177	460335	73.90	50.00	52.33	104.67	33.07	59 (55)
Bevuru	1.20	1125	125110	70.04	12.00	13.48	112.35	42.35	136 (137)
Bidarakote	1.00	1122	147175	68.20	10.00	15.44	154.41	73.99	58 (64)
Bijapur	1.50	698	113170	66.95	15.00	11.66	77.71	-6.38	270 (204)
Challakere	4.30	1985	350660	63.16	43.00	34.07	79.24	-1.79	111 (73)
Channarayapatna	1.30	764	109425	58.84	13.00	9.90	76.19	-1.52	75 (60)
D. Halasahally	1.30	827	116190	65.18	13.00	11.65	89.62	18.80	63 (65)
Davangere	2.40	1382	237777	67.61	24.00	24.73	103.06	12.50	76 (40)
Doddalahalli	1.40	1789	204675	69.33	14.00	21.83	155.94	68.41	103 (270)
Gajanur	1.50	386	166800	68.58	15.00	17.60	117.33	30.77	
Gouribidanur	3.30	1000	252875	64.30	33.00	25.01	75.80	-6.52	
Gulbarga	3.50	1152	220360	60.62	35.00	20.55	58.72	7.37	195 (320)
H.D. Kote	2.20	1480	222505	65.68	22.00	22.48	102.20	28.30	101 (45)
Hag'bmanahalli	3.60	1665	354325	63.67	36.00	34.71	96.40	4.53	294 (129)
Harohalli (B)	3.00	1358	213100	65.31	30.00	21.41	71.37	-5.36	118 (124)
Harohalli (KKP)	2.20	3230	302340	64.98	22.00	30.22	137.38	69.54	67 (183)
Haveri	3.10	1759	336205	70.25	31.00	36.34	117.22	30.11	90 (15)
Hiriyur	2.50	1532	214285	65.84	25.00	21.71	86.82	5.13	272 (190)
Humnabad	1.00	496	102850	69.21	10.00	10.95	109.51	58.83	34 (48)
Ithandahally	4.80	3633	674637	72.62	48.00	75.37	157.03	41.72	182 (112)
Jamkhandi	4.00	2167	325010	67.76	40.00	33.88	84.70	4.27	258 (220)
K.R. Nagar	1.00	796	94150	69.58	10.00	10.08	100.79	48.37	48 (46)
Kudligi	4.25	2906	526435	62.64	42.50	50.74	119.38	18.85	125 (89)

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Cluster	Dfls Distribution			Yield/ 100 dfls (kg)	Raw Silk Production (MT)				New Mulberry Plantation (acres)*
	Target (lakhs)	Crops (Nos)	Ach. (Nos)		Target	Ach.	Ach. (%)	Increase over 2015-16 (%)	
Kurudumalai	2.10	713	187245	67.47	21.00	19.44	92.55	36.54	70 (68)
Lingasgur	2.80	1381	217100	62.01	28.00	20.71	73.97	-15.19	42 (80)
Ranebennur	6.25	3159	654969	62.04	62.50	62.51	100.02	7.56	197 (126)
Raugodlu	1.00	543	100120	75.07	10.00	11.56	115.63	55.98	2 (2)
Shahapur	1.00	326	68300	61.58	10.00	6.47	64.71	-9.69	34 (26)
Shapur Kolar	3.60	1839	471500	70.82	36.00	51.37	142.71	49.81	952 (414)
Shirahatti	2.80	1409	222210	63.87	28.00	21.84	77.99	-10.16	49 (36)
Siddlaghatta	2.30	898	206025	65.34	23.00	20.71	90.05	9.80	54 (76)
Sira	4.30	2182	393420	68.98	43.00	41.75	97.10	24.82	78 (75)
Soraba	1.10	754	92800	71.68	11.00	10.23	93.04	13.16	72 (64)
T. Narasipura	2.20	1266	267720	67.75	22.00	27.91	126.84	47.65	69 (83)
Tekal	3.50	1764	329040	73.35	35.00	37.13	106.09	9.53	
Thoresettyhally	1.00	556	70235	63.46	10.00	6.86	68.57	-5.43	35 (64)
Tubagere	1.30	792	118855	73.55	13.00	13.45	103.46	44.46	85 (94)
Tumkur	4.30	2560	415760	74.54	43.00	47.68	110.87	40.80	81 (73)
Y.N. Hosakote	11.00	4374	891445	67.87	110.00	93.08	84.62	-4.78	100 (73)
Yelburga	1.80	887	144075	64.70	18.00	14.34	79.67	-12.91	153 (115)
Yeldur	1.30	703	146960	68.60	13.00	15.51	119.32	48.25	
Total/Avg.	123.20	68259	11882977	67.56	1241.48	1235.19	99.49	18.98	5363 (4546)

Performance of Tamil Nadu Clusters - Bivoltine Raw Silk Production (2016-17)

Cluster	Dfls Distribution			Yield/ 100 dfls (kg)	Raw Silk Production (MT)				New Mulberry Plantation (acres)*
	Target (lakhs)	Crops (Nos)	Ach. (Nos)		Target	Ach.	Ach. (%)	Increase over 2015-16 (%)	
Adaikalapattinam	2.20	1781	233600	76.81	25.38	27.60	108.74	27.48	96 (54)
Alangkayam	4.50	4495	585932	77.84	51.92	70.17	135.14	29.24	10 (7)
Alangudi	1.50	1019	167600	74.92	17.31	19.32	111.62	38.75	66.5 (49)
Annur	4.50	3045	401600	76.29	51.92	47.14	90.78	-10.59	102 (54)
Anthiyur	2.70	1174	157547	83.99	31.15	20.36	65.35	-29.17	28.5 (15)
Bagalur	1.20	507	122575	82.31	13.85	15.52	112.10	13.03	
Berigai	3.60	2724	541120	81.90	41.54	68.19	164.15	74.51	180.25 (130)
Bhavani	2.70	1170	145613	83.29	31.15	18.66	59.89	-33.07	38.5 (13)
Dharapuram	3.00	1704	226450	79.84	34.62	27.81	80.35	-20.36	10 (5)
Dharmapuri	1.70	2076	245217	73.90	19.62	27.88	142.14	91.36	262.5 (175)
Gobi South	2.75	1386	166617	78.34	31.73	20.08	63.29	-42.80	48.5 (25)
Gudimangalam	2.80	1058	229000	77.79	32.31	27.41	84.83	-6.90	
Keeranur	3.50	1432	269575	75.84	40.38	31.45	77.88	-7.24	13.5 (6)
Kodiyalam	1.50	616	163125	84.06	17.31	21.10	121.88	19.75	

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Cluster	Dfls Distribution			Yield/ 100 dfls (kg)	Raw Silk Production (MT)				New Mulberry Plantation (acres)*
	Target (lakhs)	Crops (Nos)	Ach. (Nos)		Target	Ach.	Ach. (%)	Increase over 2015-16 (%)	
Komaralingam	1.20	511	99000	78.70	13.85	11.99	86.57	-1.17	10 (6)
Madathukulam	2.70	1151	212925	79.58	31.15	26.07	83.68	-5.76	10 (7)
Manurpalayam	2.10	1179	198074	78.79	24.23	24.01	99.09	-10.50	71 (47)
Ottanchatram	3.60	1334	295783	75.87	41.54	34.52	83.11	-1.92	9.5 (5)
Palani	4.50	1482	346300	77.49	51.92	41.28	79.51	-8.04	15 (8)
Pitchandampalayam	3.40	1418	239324	78.32	39.23	28.84	73.50	-16.25	53 (27)
Pollachi	3.00	1506	275975	80.22	34.62	34.06	98.39	7.94	18.5 (9)
Pongalur	1.70	1015	144250	78.32	19.62	17.38	88.60	-12.42	26 (17)
Poolavadi	3.90	1401	323500	77.41	45.00	38.53	85.61	-4.32	
Sannarpatti	3.00	1472	272110	76.44	34.62	32.00	92.44	5.41	10 (6)
Srivilliputhur	3.10	1997	332200	77.63	35.77	39.67	110.92	20.68	97.5 (52)
Udumalpet	5.10	2228	404900	80.09	58.85	49.89	84.78	-3.13	
Uthangerai	3.60	3357	458973	76.94	41.54	54.33	130.80	46.98	201.5 (117)
Total/ Avg.	80.45	44726	7370435	78.37	928.27	888.27	95.69	3.85	1378.25 (834)

## Performance of Kerala Clusters - Bivoltine Raw Silk Production (2016-17)

Cluster	Dfls Distribution			Yield/ 100 dfls (kg)	Raw Silk Production (MT)				New Mulberry Plantation (acres)*
	Target (lakhs)	Crops (Nos)	Ach. (Nos)		Target	Ach.	Ach. (%)	Increase over 2015-16 (%)	
Kozhicode	0.75	116	10520	78.24	8.52	1.46	1.93	-82.51	14 (11)
Palkkad	1.25	825	101687	82.03	14.20	12.64	88.24	9.18	12 (12)
Total /Avg.	2.00	941	112207	81.68	23.08	14.10	61.10	2.24	26 (23)

## Performance of Maharashtra Clusters - Bivoltine Raw Silk Production (2016-17)

Cluster	Dfls Distribution			Yield/ 100 dfls (kg)	Raw Silk Production (MT)				New Mulberry Plantation (acres)*
	Target (lakhs)	Crops (Nos)	Ach. (Nos)		Target	Ach.	Ach. (%)	Increase over 2015-16 (%)	
Akola	0.80	240	35150	67.55	7.38	3.65	49.46	-5.05	88.5 (87)
Beed	3.30	1758	330400	64.57	30.46	32.82	107.74	14.98	100 (97)
Buldana	1.00	405	61300	61.64	9.23	5.81	62.97	9.57	206 (203)
Jalna	3.50	1666	311500	63.57	32.31	30.46	94.30	-6.22	105 (102)
Nanded	2.00	449	82450	59.51	18.46	7.55	40.89	-31.51	118 (110)
Osmanabad	1.50	730	134350	71.92	13.85	14.87	107.36	21.30	169.5 (163)
Sangli	1.20	640	109250	68.36	11.08	11.49	103.73	12.59	109 (98)
Satara	1.50	1134	157680	69.31	13.85	16.81	121.43	16.91	145.5 (139)
Wardha	1.50	392	78550	62.39	13.85	7.54	54.45	-28.75	49 (45)
Total/Avg.	16.30	7414	1300630	65.47	150.46	131.00	87.07	1.68	1090.5 (1044)

Performance of Madhya Pradesh Clusters - Bivoltine Raw Silk Production (2016-17)

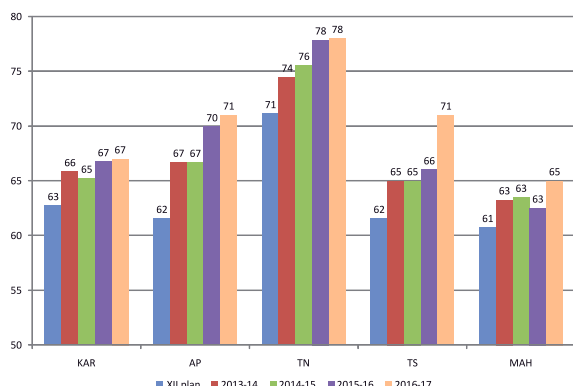
Cluster	Dfls Distribution			Yield/ 100 dfls (kg)	Raw Silk Production (MT)				New Mulberry Plantation (acres)*
	Target (lakhs)	Crops (Nos)	Ach. (Nos)		Target	Ach.	Ach. (%)	Increase over 2015-16 (%)	
Betul	1.75	550	155700	49.01	13.46	11.74	87.21	5.70	150 (150)
Burhanpur	1.00	273	45310	53.00	7.69	3.69	48.03	8.95	
Hoshangabad	1.00	367	65400	46.50	7.69	4.68	60.82	-30.69	
Khandwa	1.00	289	46600	49.97	7.69	3.58	46.57	89.04	
Total/Avg.	4.75	1479	313010	49.12	36.54	23.66	64.75	2.49	

Various ECPs (group discussion, awareness, enlightenment and training programmes; exposure visits; exhibitions) were conducted in the command area periodically and farmers were sensitized on the new technologies in mulberry sericulture. These programmes helped in motivating the farmers and adopt improved technology for improved productivity in bivoltine silk production.

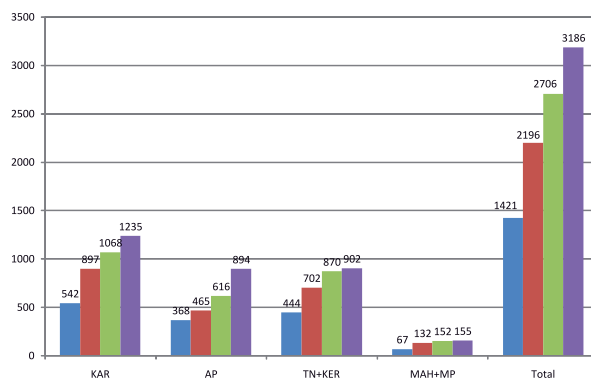
The clusters in the south zone are coordinated and monitored by the Director, CSRTI-Mysuru and five nodal officers (RSRSs) for effective implementation of CPP. The cluster/state-wise monthly progress is collected from the CDFs and analysed. A total of 292.03 lakh dfls were distributed to the farmers against the target of 298.55 lakh (97.80% achievement) and the brushing capacity of farmers increased by 13.35% due to continuous and effective monitoring of mulberry gardens. A total of 19726.94MT bivoltine cocoons were harvested from 277.43 lakhs dfls with an average cocoon yield of 71.33 kg/100 dfls.

Bivoltine Raw Silk Production - Cluster Promotion Programme under CSRTI-Mysuru (2016-17)

Cluster	Target (Lakhs)	Harvested Crops (Nos)	Dfls (Lakh Nos)	Achmnt (%)	Increase over 2015-16 (%)	Average Cocoon Yield/100 dfls (kg)				
						XI Plan	2013-14	2014-15	2015-16	2016-17
Karnataka	123.20	68259	118.83	96.45	14.26	62.73	65.83	65.23	66.74	67.49
Andhra Pradesh	64.25	26955	74.16	115.43	29.54	61.56	66.69	66.68	69.93	70.68
Telangana	7.60	2974	8.07	106.20	26.91			65.08	66.11	70.62
Tamil Nadu	80.45	44726	73.70	91.62	3.17	71.13	74.46	75.54	77.86	78.33
Kerala	2.00	941	1.12	56.10	-9.68	76.49	76.45	75.88	75.69	81.68
Maharashtra	16.30	7414	13.01	79.79	-5.82	60.73	63.26	63.49	62.51	65.47
Madhya Pradesh	4.75	1479	3.13	65.90	-3.69	56.30	52.93	53.93	47.66	49.12
Total/Avg.	298.55	152748	292.03	97.84	13.47	64.98	68.45	68.27	70.16	71.33



Improvement in average yield of Southern Zone Clusters (kg/100 dfls)



Impact of CPP on Production of BV Silk in Southern States

Further, more emphasis was given on horizontal expansion of mulberry acreage in the CPP area resulting in 8615 farmers plant improved mulberry varieties to an extent of 10939.73 acres for improving the bivoltine raw silk production in the country.

### Institute -Village Linkage Programme (Seri Model Village)

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

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

State	Cluster	Scientists
Karnataka	Kadakola	Mr. S. B. Nagaraja, Sci-D, CSRTI-Mysuru
	K.M. Doddi	Dr.D.Guruswamy, Sci-C, REC-Maddur
	Hosakote	Mr. Ishwar, Sci-C, REC-Bidarguppe
	Chamarajanagara	Dr. K. Srikantaswamy, Sci-D, RSRS-Chamarajanagara
Tamil Nadu	Sathyamangalam	Ms. Rajalakshmi E, Sci-D, REC-Gobi
	Thondamathur	Smt. K. Sarala, Sci-C, REC-Palakka
Andhra Pradesh	Rayachoty	Dr. A. Venugopal, Sci-D, REC-Rayachoty
	Vizanagaram	Mr.T.V.S. Rao, Sci-D, REC-Chebrole
Maharashtra	Ahmadnagar	Mr. Ramprakash, Sci-D, REC-Baramathi
	Baramathi	
Madhya Pradesh	Hoshangabad	Dr. Pradip Shukla, Sci-D, REC SU- Burhanpur

Technologies Implemented under IVLP	
Mulberry Cultivation	Silkworm Rearing
Soil tests for maintaining soil health	Disinfection and hygiene maintenance in silkworm rearing house
Soil fertility management	Supply of Chawki reared worms from CRCs
Popularization of new mulberry varieties	Application of Bed disinfectants for control of silkworm disease
Mulberry tree plantation with Affordable micro irrigation technique(AMIT) for rainfed conditions	Mounting and spinning care for production of quality cocoons
Application of Poshan – for leaf quality & to correct nutrient deficiencies	Control of Uzi fly through Integrated approach

Further, awareness programmes on various technologies was created through ECPs and demonstrations. A total 8.8 lakh dfls of bivoltine hybrids were reared by farmers with an average yield of 66.84kg/100 dfls and the improvement recorded in cocoon yield was 14.92% against the bench marks and 7.28% over 2015-16. Through IVLP programme, the crossbreed rearing farmers were encouraged to rear bivoltine hybrids. A quantity of 89.04MT bivoltine raw silk was produced accounting for 158.46% increase over 2015-16.

### Achievements of IVLP (2016 - 2017)

State	Dfls bushings (Nos)		Cocoon Yield/100 dfls (kg)			Raw Silk Production (MT)		
	Target	Achmnt	Bench mark	Avg. Yield (kg)	% Improve-ment	2014 -15	2016 -17	% Increase
KA	288000	312550	57.67	67.21	18.00	14.53	31.25	115.07
TN	235000	306659	63.00	78.64	9.86	11.02	35.85	225.31
AP	110000	103550	55.00	65.75	20.00	2.33	9.45	305.58
MAH	110000	127750	60.00	65.25	8.75	6.34	10.43	64.51
MP	80000	29500	50.00	48.09	- 1.91	1.25	2.06	64.80
Total	823000	880009	58.42	66.84	14.92	34.45	89.04	158.46

Performance of IVLP Centers

State	Dfls bushings (No.)		Cocoon Yield/100 dfls (kg)			Raw Silk Production (MT)	
	Target	Achmnt.	Bench mark	Avg. Yield (kg)	% improve-ment	Annual Target	Achievement
Kadakola	150000	190075	60.00	68.60	13.00	13.40	20.61
K.M. Doddi	70000	62575	58.00	65.00	13.00	6.50	5.08
Hosakote	60000	58900	55.00	65.35	16.00	5.00	5.47
Chamarajanagara	8000	1000	55.00	71.50	30.00	0.70	0.09
Sathyamangalam	125000	142904	59.00	78.00	13.50	11.50	16.48
Thondamathur	110000	163755	67.00	79.27	6.21	10.00	19.37
Rayachoty	55000	80200	55.00	69.00	17.00	4.00	7.44
Vizanagaram	55000	23350	50.00	62.49	23.00	4.00	2.01
Ahmadnagar	50000	60450	60.00	64.30	7.20	3.30	4.86
Baramathi	60000	67300	60.00	66.20	10.30	3.40	5.57
Hoshangabad	80000	29500	50.00	48.09	- 1.91	6.00	2.06
Total	823000	880009	58.42	66.84	14.92	67.80	89.04

**Continuous/Other Activities**

**Extension Communication Programmes (ECP):** Extension Communication Programmes (2350) were conducted in Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Kerala, Maharashtra and Madhya Pradesh through REC-SUs, RECs and RSRs in close coordination with the State Departments of Sericulture and CSRTI-Mysuru. Farmers were sensitised on new bivoltine sericulture technologies through ECPs and major topics covered were: popularisation of new mulberry varieties; soil testing & its importance in mulberry cultivation; popularisation of tree mulberry; INM practices for mulberry; IPM; integrated disease management practices; disinfection & hygiene in silkworm rearing; popularization of new silkworm hybrids; demonstration of rotary mountages; mounting & spinning care etc.

**m-Kisan:** Regular SMSs are sent to the farmers in vernacular languages across the nation periodically through m-Kisan portal (Ministry of Agriculture, Govt. of India). A total of 98 messages covering 50900 farmers in Karnataka, AP, Telangana, TN, Maharastra and MP were sent during the year as a part of ToT programme with excellent feedback.

**Sericulture Resource Centers:** Technical and financial support was extended to the identified progressive sericulture farmers in Karnataka (B.G.Kere, Molakalmuru Tq., Chitradurga & B.S.Doddi, Kanakapura) and Tamil Nadu (Maankadu, Pudukottai, Trichy & Kannamanaickanur, Udumalpet) for establishing four Sericulture Resource Centres (SRCs) for training of sericulturists regularly. The SRCs are well equipped with the infrastructure facilities and already initiated training programmes.

ECP	Events	Farmers Sensitized
Group Discussion	576	15258
Filed Day	46	4202
Awareness Programme	118	11782
Exhibition	06	5552
Workshop/Seminar	01	267
Farmer Day	240	11850
Resham Krishi Mela	06	5479
Exposure Visits	21	681
Video Recording	04	11
Special Awareness Prog.	1332	96060
Total	2350	151142

Topic
<ul style="list-style-type: none"> <li>Mulberry Cultivation</li> <li>Mulberry Diseases/Pest Management</li> <li>New Mulberry Varieties</li> <li>New Silkworm Hybrids</li> <li>Chawki Rearing</li> <li>Soil Fertility Management</li> <li>Silkworm Rearing management - Seasonal Advisory</li> <li>Silkworm Disease/Pest Control Measures</li> <li>Management of Rearing Climate</li> <li>Fertilizer Application</li> </ul>

**Infrastructure Assistance to Chawki Rearing Centres:** (CRCs): During 2016-17, extended infrastructure assistance on 80:20 sharing basis to establish five Chawki Rearing Centres(5000 dfls brushing capacity/ batch) to promote supply of bivoltine chawki worms to the farmers of CPP/IVLP clusters in Karnataka(4) and Andhra Pradesh(!). An amount of Rs. 6 lakhs worth CRC equipments viz., Plastic trays, PVC chawki rearing stands, 2 KVA online UPS, Humidifier cum heater, Leaf chopping machine, Incubation frames, Binocular microscope and disinfection cum tray washing machine were purchased and supplied to each unit

**Visitors' Service:** CSRTI-Mysuru as a premier sericulture research institute draws the attention of sericulture farmers across the country. Every year sericulture farmers, students from all over the country and foreign nationals visits the institute for awareness and update on the recent innovations in sericulture.



State	Farmers	Students	Others	Total
Karnataka	2024	966	144	3263
Kerala	14	188	15	217
Tamil Nadu	128	347	32	507
Maharashtra	21	28	9	52
Madhya Pradesh	16	2	2	20
Andhra Pradesh	32		19	51
Telangana	24		2	26
West Bengal	41		6	47
Jammu & Kashmir		8	1	9
Uttarakand	21		2	23
Total	2321	1539	232	4215

**Sericulture Farmers' Workshops:** Sericultural Farmers Workshops were conducted in Karnataka, Tamil Nadu, Telangana, Andhra Pradesh and Maharashtra in coordination with DoSs of Respective states for the benefit of all the stakeholders. Best achievers in the cluster promotion programme and selected farmers were honoured during the programmes.

**Karnataka:** CSRTI-Mysuru organized a Farmers Workshop with a theme "Produce Bivoltine to Achieve Self-Sufficiency" on 17th February, 2017 at Doddaballapur (Bangalore Rural District). Around 2400 farmers across Karnataka besides scientists and technical personnel from CSB and DoS including private entrepreneurs attended the programme. A sericulture exhibition was also organized wherein new technologies/ products/ machines/ equipments/ publications developed by the institute were exhibited. 100 progressive sericulture farmers in Karnataka were awarded for their extraordinary success in sericulture under different categories by the DoS-Govt. of Karnataka.

Technologies/Booklets Release
<ul style="list-style-type: none"> <li>● Cauvery Gold - New improved cross breed (MV1 x S8) A productive silkworm hybrid producing international grade silk suitable for all the regions and seasons with 22-23% cocoon shell, renditta (5.5-6) and cocoon yield (65-70 kgs/100 dfls)</li> <li>● Dr Soil - An Organic Liquid Fertilizer for Mulberry</li> <li>● Rot Fix – Formulation for Control of Mulberry root-rot</li> <li>● Automatic Disinfection System – Field release</li> <li>● Distribution of Soil Health Cards</li> <li>● CSRTI-Mysuru : Sericulture Technology Descriptor (South Zone)</li> <li>● Booklets on Biological Control of Insect Pests in Mulberry; Pamphlets in Sericulture Technology; Reshme Vahini - AIR Broadcasting; CD on Tree Plantation &amp; AMIT Technology</li> </ul>

**Maharashtra:** REC-Baramathi organized Resham Krishimela at Akuj village in coordination with DoS-Maharashtra on 01/09/2016. Sericulture farmers (>500) across Maharashtra participated in the programme and gained information through Sericulture exhibition on new technologies for achieving higher productivity and revenue generation.

**Tamil Nadu:** RSRS-Salem organized Resham Krishi Mela and Farmers Workshop in coordination with DoS-Tamil Nadu at Dindigul on 18-03-2017. Around 550 farmers/officials including entrepreneurs attended the programme. Two books (“Need based Technologies in Sericulture” and “Technological Descriptor”) were released on the occasion. Best sericulture farmers from the region were also honoured on the occasion.

**Andhra Pradesh:** RSRS-Anantapur organized Sericultural Farmers’ Workshop on “Bivoltine sericulture for sustainable income in Andhra Pradesh – Technologies for enhancing productivity” on 25th March 2017 at Penukonda in coordination with DoS-AP. 912 farmers from AP participated in the programme benefited from the deliberations and exhibition. The workshop also witnessed the release of a book “Dakhsina Bharatha desa malbari pattu parishrama – Sanketika avishkaranalu- vivaranathmaka varnana” for the benefit of sericulturists/officials.

**Telangana:** RSRS-Anantapur also organized a Sericultural Farmers’ Workshop on “Bivoltine sericulture for sustainable income in Telangana – Technologies for enhancing productivity” on 23rd February, 2017 at Suryapet in coordination with Department of Horticulture & Sericulture-Telangana. Around 765 farmers across Telangana besides scientists/officials attended the programme. A sericulture exhibition was also organized wherein new technologies/ products/machines/publications were exhibited for the benefit of farmers/officials. The workshop also witnessed the release of a book “Dakhsina Bharatha desa malbari pattu parishrama – Sanketika avishkaranalu- vivaranathmaka varnana” for the benefit of sericulturists/officials.

**Reshme Vahini - AIR Mysuru Broadcasting Programme:** CSRTI-Mysuru sponsored All India Radio (AIR)-Mysuru for broadcasting a special series on Sericulture entitled “Reshme Vahini” in Krishi Ranga Programme. 39 episodes (45 minutes duration; Wednesday at 6.50PM) from 8th March 2017 to 29th November 2017 would be broadcasted. The programme was inaugurated on March 8th 2017 at CSRTI-Mysuru in coordination with AIR-Mysuru and DoS-Karnataka.

**Japanese Overseas Cooperative Volunteer Programme (JOCV):** Japan Overseas Cooperation Volunteers programme (JICA) was initiated during January 2015 mainly to support CSB in seri-extension activities including organizing Self Help Groups (SHGs)/CBOs in clusters. Three JOCVs are currently operating in Hindupur & Madakasira (AP), Kanakapura and Bannikuppe (KA), Berigai and Bagalur (TN) Clusters. Few SHGs are already initiated and are involved in sericulture activities and members were enlightened through awareness programmes and field tours.

**Adarsha Resham Gram (ARG):** Under Adarsha Resham Gram (ARG) Yojane programme, CSRTI-Mysuru adopted Gopalapura Village (Mysuru Taluk) with an aim for the overall development of village including health camps and education on hygiene. The programme was formally inaugurated on 23.06.2016 and Gandhi Jayanti & Swaccha Bharath Abhiyan were conducted. Over 150 school children, teachers, elders, sericulturists, CSB/DoS/NGO officials participated in the programme. On the occasion, interactive sessions on personal hygiene and cleanliness were conducted besides distributing personal hygiene products and needy infrastructure support was provided to the school.



Reshme Krishimela- Karnataka



Krishimela- Andhra Pradesh



Krishimela - Telangana



Krishimela-Tamil Nadu





Krishimela- Maharashtra



Reshme Vahini- AIR Programme



JOCV Activities



Adarsha Resham Gram- CSRTI, Mysore



**RECs Activities:** The performance of RECs in Karnataka, Maharashtra and Madhya Pradesh and attached to CSRTI-Mysuru with regard to various activities is summarized as below:

Centr	Mulberry Acreage (Acres)	Farmers (Nos)	Dfls (Nos)	Avg. Yield/ 100 dfls (kg)	GD	FD	Farmers Day	AW	RKM	AW RKM
REC SU-Maddur	58.02	64	147175	68.20	18		4	2		7
REC-Amaravathi	343.50	335	128050	63.90	15		5	4		38
REC-Aurangabad	100.00	97	313400	64.53	5		3	1		25
REC-Parbhani	118.00	110	68250	58.96	15	1	2			9
REC SU-Osmanabad	169.50	163	106300	72.17	17	3				22
REC-Baramati	254.50	237	240730	73.26	11	1	6	1	2	4
REC SU-Jalna	105.00	102	232850	62.59	4		2	1		22
REC-Hoshangabad	150	150	221100	77.18	7	1	1			13
REC SU-Burhanpur			91910	45.95	8	2	3			08

### CAPACITY BUILDING AND TRAINING

K. Rajashekar (from 16-04-2016), R. S. Katiyar (upto 31-07-2016), A. S. Suma and C. Parameshwara

Training programmes were designed and conducted to serve the needs of practitioners and facilitators, at the Institute and its nested units. The target groups consisted of personnel of the State DoSs, students, researchers and practitioners including cocoon producers and chawki rearers. In addition, two volunteers (JOCV) from Japan sponsored by JICA were also trained in basic sericulture technology for one month. A total of 2811 persons were trained in different programmes including 675 at CSRTI-Mysuru and 2136 at RSRs and RECs. Further, need based training programmes tailor-made to suit the specific requirements of the target groups like State government personnel, sericulturists, unemployed youth, personnel from NGOs, Universities etc., were also conducted as per the demand from the stakeholders.



Training Programme	Course	Duration (days)
Technology Orientation Programme (TOP)	Chawki Rearing	10
	Production of Bio-Control Agents	5
	Refresher Course	5
	Integrated Pest & Disease Management	5
	Mulberry Cultivation & Organic Farming	5
	Soil Analysis	10
	Orientation Programme	5
Farmers' Skill Training (FST)	Chawki Rearing	10
	Late age Silkworm Rearing	10
	Awareness Programme	5
Need Based Training (NBT) (Officials)	Training in Sericulture	15
	Foundation Training - Sericulture	20
	Extension Management Approaches	4
Need Based Training (NBT) (Farmers)	Chawki Rearing	10
	Late age silkworm rearing	10
	Intensive Training in Bivoltine Sericulture	90
	Awareness Programme	5
	Commercial Chawki Rearing	90
	Intensive Bivoltine Training	35

### Training of Overseas Participants

Two Japan Overseas Cooperation Volunteers (Mr. Kazuya Arayama & Mr. Moto Ichikawa) sponsored by Japan International Cooperation Agency (JICA) were trained in mulberry sericulture, extension and economics over a period of 30 days at the Institute, before they embarked on Seri-SHG work at the selected sericulture clusters in South India.

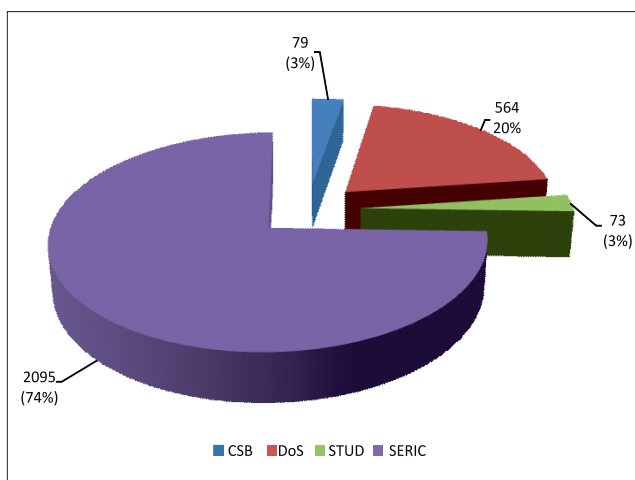
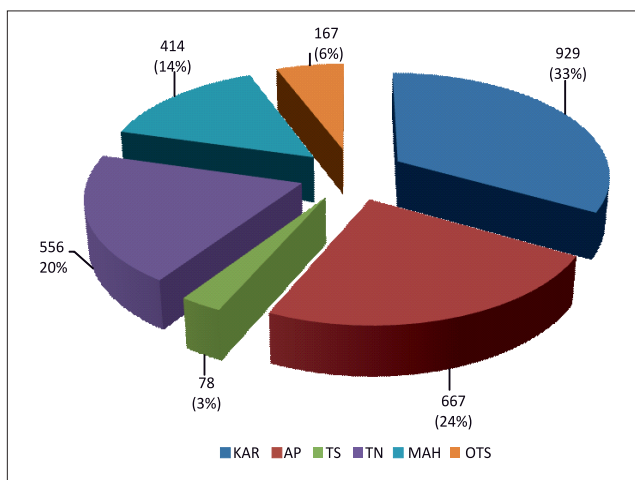
### Training in Commercial Chawki Rearing for Potential Entrepreneurs

The programme is designed to train potential entrepreneurs who wish to establish Commercial chawki centres. The 90 days programme includes classroom sessions on technologies involved in chawki silkworm rearing, mulberry cultivation, crop protection, mechanization and economics of chawki rearing. The participants are trained in chawki silkworm rearing over 9 crop cycles. Successful completion of training is mandatory for registration of enterprise and 44 entrepreneurs [KA: 34; TS: 4; AP: 1; TN: 4; Kerala: 1] were trained during the year.

Prog.	Unit	Group	KA	AP	TS	TN	MAH	OT	Total
TOP	CSRTI Mysuru	O	83	42		37	41	19	222
FST		F	23	60	72				155
TOP	RSRS & RECs	O	102	131		114			347
FST		F	580	423		378	326	75	1782
INTL	CSRTI	V						2	02
NBT		O	65	8	1	4	4	3	85
NBT		F	42	1	5	4	38	68	158
IBT		O	32	2		11	5		50
RMT		O	2			1			03
IBT	SSBS Coonoor	O				7			07
IBT									
Total			929	667	78	556	414	167	2811

F-Farmers; O-Officers; V: Volunteers; INTL-International; OT: Others

### TRAINEES - STATEWISE



Persons Trained at Nested Units of CSRTI-Mysuru				
Unit	IBT	FST	TOP	Total
RSRS-Kodathi & RECs in Karnataka		495	77	572
RSRS-Chamarajanagara Karnataka		85	25	110
RSRS-Anantapur & RECs in AP & Telangana		423	131	554
RSRS-Salem & RECs in Tamil Nadu & Kerala		378	114	492
SSBS-Coonoor Tamil Nadu	7			7
REC-Baramati Maharashtra		75		75
REC-Amaravathi Maharashtra		60		60
REC- Parbhani Maharashtra		101		101
REC-Aurangabad Maharashtra		60		60
REC- Jalna Maharashtra		30		30
REC-Hoshangabad Madhya Pradesh		75		75
<b>Total</b>	<b>7</b>	<b>1782</b>	<b>347</b>	<b>2136</b>

	Need Based Training Programmes (NBT)	Duration (days)	State					Total
			KA	AP	TN	MAH	OT	
Officials	Training in Sericulture	15		2				2
	Extension Management Approaches	4	14	6	4	3	2	29
	Orientation Training	6	1			1	2	4
	Foundation Training - Sericulture	20	50					50
	<b>Total</b>		65	8	4	4	4	85
	Sericulturists	Chawki Rearing	10				4	
Late age Silkworm Rearing		10	1			21		22
Intensive Training in Bivoltine Sericulture		90	4					04
Awareness Programme		5				13	66	79
Intensive Bivoltine Training		35	3				2	05
<b>Total</b>			8			38	68	114

**Project Works:** The Institute offered guidance and facilities to students for carrying out research work as a partial fulfillment of undergraduate and postgraduate courses (36) for a period of two to three months.

Subject	University	Students	
		UG	PG
Microbiology	University of Mysore-Mysuru		19
Biochemistry	University of Mysore-Mysuru		4
	JSS University-Mysuru		2
Biotechnology	JSS Science & Technology University-Mysuru		1
	Periyar Maniammai University-Thanjavur, TN	8	
	Dr. D.Y. Patil Vidyapeeth-Pune, MAH	2	
Total		10	26

**Silkworm Rearing:** The Institute conducted chawki and late age silkworm rearings as a part of the training programmes for skill development to the stakeholders. A total of 73500 dfls were chawki reared and distributed to 429 rearers. Late age silkworm rearings (BV-DH) were also conducted in six batches with an average cocoon yield of 72.50kg/100 dfls.

Season	Dfls (Nos.)	SCW (g)	SSW (g)	SR (%)	Yield/ 100 dfls (kg)
Mar-Apr 2016	50	1.250	0.256	20.75	53.00
Apr-May 2016	100	1.422	0.293	20.98	56.00
Sept-Oct 2016	100	1.700	0.350	20.69	72.20
Oct-Nov 2016	100	1.617	0.340	21.02	88.20
Dec-Jan 2017	100	1.770	0.360	20.33	90.50
Feb-Mar 2017	100	1.385	0.280	20.27	65.30
Total/Avg.	550	1.524	0.313	20.67	72.50

Chawki Rearing			
Month	Dfls Reared	Dfls Reared	Cocoon Yield/ 100 Dfls (kg)
Apr-2016	4900	28	69.90
May-2016	5300	32	77.30
Jun-2016	6800	47	72.20
Jul-2016	8000	47	62.30
Aug-2016	6200	33	76.20
Sep-2016	7000	38	68.40
Oct-2016	6300	35	74.30
Nov-2016	6750	37	74.20
Dec-2016	6600	35	74.90
Jan-2017	4350	26	76.00
Feb-2017	5100	32	75.80
Mar-2017	6200	39	72.00
Total/Avg.	73500	429	72.79

**Feedback & Assessment of Trainees through a Questionnaire**

Course	Training Utility Index	Training Efficiency Index	Training Facility Index	Course Coverage	Training Management Index	Variance over Benchmark (65%)
Integrated Pests & Disease Management	75.80	79.77	78.82	83.90	79.57	14.57
Orientation Course	76.92	80.56	74.25	80.00	77.93	12.93
Chawki Silkworm Rearing	90.11	87.29	83.31	92.11	88.20	23.20
Refresher Course	84.75	83.85	78.39	89.38	84.09	19.09
Foundation Training	76.96	81.97	77.49	84.00	80.10	15.10
Extension Management Approaches	70.72	71.02	79.47	79.66	75.22	10.22
Intensive Bivoltine Training	82.13	80.82	79.81	88.67	82.86	17.86
Silkworm Race Maintenance	80.00	78.97	57.14	80.00	74.03	9.03

## FARM MANAGEMENT SECTION

B.T. Sreenivasa

### Continuous Activities

- Maintained 20 acres mulberry garden including 2 acres chawki garden for production of quality mulberry leaf with recommended package of practices synchronous to rearing programmes
- Involved in general up-keeping and maintenance of farm machinery and institute campus
- Supplied 61920kg mulberry leaf and 156870kg mulberry shoot for the late age silkworm rearing (7450 dfls) under different projects/ experiments/ maintenance programmes in Silkworm Breeding & Genetics, Physiology, Pathology, RTI, TVDC and Training divisions
- Supplied 18420kg chawki leaf to Model Commercial Chawki Rearing Centre for quality chawki rearing (73500 Dfls) and supply of worms to the farmers
- Supplied mulberry seed cuttings (V1: 87.125MT, 92 Farmers, 348.5 acres; G2: 8.415MT, 20 Farmers, 33.66 acres; G4: 19.14MT, 40 Farmers, 76.42 acres) for establishing new plantations
- Generated revenue of Rs.4.68 lakhs through sale of mulberry seed cuttings, green grass and coconut auctioning etc.

### BIOINFORMATICS CENTER (Sub-DIC under BTISNET)

V. Sivaprasad (Coordinator), V. Grisih Naik (Co-Coordinator) and R. Sumathy

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

Ms. Ishwarya V and Ms. Prakruthi N Gowda (2016) "In silico analysis and characterization of silkworm gene related to silk production" for the award of the degree in B. Tech in Biotechnology, SJCE, Mysuru. Ms. C Harshitha and Ms. Rekha K (2016) "A study on growth regulating genes in mulberry and PCR amplification" for the award of the degree in B. Tech in Biotechnology, SJCE, Mysuru. One Traineeship was provided in Bioinformatics Center. 28 participants included students, research scholars and faculty of various universities/ institutes and organizations have participated in the workshop on Bioinformatics and its application in Biological Research conducted on 16-17 November 2016.

Database & Software ( <a href="http://btismysore.in">http://btismysore.in</a> )	
Database	Utility
SILKPROT	An Annotated Protein Database for Silkworm
SilkTF	Silkworm specific transcription factor databases
MuTF	Mulberry specific transcription factor databases
Mulberry Genome Database	Extensive molecular marker data on different mulberry genomes in the form of DNA fingerprints and molecular IDs, binary scores etc.
Soilinfo	Information on types of soils in South India including physio-chemical properties, micro-nutrient status etc.
SilkPPI	Protein-protein interaction in Silkworm, <i>Bombyx mori</i>
MuSatDB	Comprehensive database for mulberry microsatellite marker database
STRPLOT	A program for drawing elegant STRUCTURE bar plots in user friendly interface
Growth Index	Growth Index- Construction of growth indices in popular breeds/hybrids of silkworm <i>Bombyx mori</i> L. in relation to nutritional supplement

## REGIONAL SERICULTURAL RESEARCH STATIONS (RSRS)

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

### RSRS-KODATHI

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

Command Area	Staff	
	In-charge Officers	
	<ul style="list-style-type: none"> <li>• M. T. Himantharaj, Sci-D (upto 30.06.2016)</li> <li>• Jalaja S Kumar, Sci-D (from 01.07.2016)</li> </ul>	
Karnataka	Scientists	09
	Technical Staff	08
	Administrative Staff	03

Farm Based Units		
Unit	Area (Acres)	Mulberry Acreage
RSRS-Kodathi	66.90	10.50
REC-Bidaraguppe	7.00	2.07
REC-Chitradurga	7.00	2.41
REC-Madivala	8.00	3.15
REC SU-Koppal	8.00	1.50
<b>Total</b>	<b>96.90</b>	<b>19.63</b>

### Ongoing Research Project

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

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

#### Objectives

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

Based on the literature survey and discussions with the experts, the questionnaire for data collection for studying the impact of CPP on technology adoption, productivity improvement, socio-economic development of sericulturists and technological efficiency in North Karnataka was finalized. Data collection from 20 farmers each of big, medium and small scale was initiated.

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

Project Code	Title	Units
MOE 3525	A study on the impact of Pest and Disease Management practices in Sericulture among the farmers under Cluster Promotion Programme in South India	REC SU-Kanakapura
MOE 3523	Study on drought management practices in mulberry sericulture	REC-Madivala REC SU-Tumkur
PRE 3527	Survey and surveillance of major pests and their natural enemies in mulberry eco-system	REC-Madivala REC SU-Kanakapura
PRE 3535	Popularisation of Nemahari - A bio-nematicide for management of root knot in mulberry	REC SU-Kanakapura
ARP 3550	Validation trials of Automated disinfection of silkworm rearing house	RSRS-Kodathi
PPA 3549	Evaluation of modified spacing with special reference to planting geometry for sustainable mulberry leaf production	REC-Madivala
PRE 3546	Identification, characterization, synthesis and field evaluation of sex pheromone of the mulberry leaf roller, <i>Diaphania pulverulentalis</i>	REC-Madivala
PPA 3580	Soil health cards for sericulture farmers in states of Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Kerala, Maharashtra and Madhya Pradesh	RSRS-Kodathi
ARP 3519	Silkworm disease monitoring of seed and commercial crop rearing of South Indian states	CPP clusters - KA
MOE 3595	Development of business models for enterprises in pre-cocoon sector of sericulture	REC SU-Kanakapura
AIT 3556	To conduct multi-locational field trials of transgenic of BmNPV resistant silkworm strains to establish their efficacy and generate data for regulatory approval	RSRS-Kodathi REC-Bidaraguppe
AIB 3561	Identification of robust bivoltine silkworm hybrids suitable for different regions of high temperature and high humid conditions	RSRS-Kodathi

### Soil health cards for sericulture farmers in states of Karnataka (In collaboration with CSRTI-Mysuru)

(Apr. 2016 - Mar. 2019)

P. Sudhakar, P.K. Ambika and Jalaja S Kumar

A total of 1516 soil samples from CPP farmers in Karnataka were analysed for soil pH, EC, OC%, available N, P, Sulphur, Boron & K. The soil samples were also sent to CSRTI-Mysuru for micronutrient analysis and preparation of Soil Health Cards (SHC) for individual farmers.

Parameter	Samples (Nos)	Normal Range	Observed Range
pH	1516	6.50 - 7.50	5.49 - 8.86
EC (m.mhos/cm)	1516	< 1.00	0.03 - 1.86
OC (%)	1516	0.65 - 1.00	0.06 - 1.59
Nitrogen (N) kg/ ha	1516	250 - 500	25 - 602.1
Phosphorous (P) kg/ ha	1516	10 - 25	6.85 - 264.41
Potash (K) kg/ha	550	110 - 240	5.15 - 1075
Boron (B) ppm	1516	0.5 - 1.0	0.02 - 2.91
Sulphur (S) ppm	1516	10 - 15	6.85 - 213.1

### Cluster Promotion Programme (CPP)

Bivoltine sericulture technologies were disseminated in 36 clusters across Karnataka and a total of 98.65 lakh bivoltine hybrid dfls with 102.55% achievement against the target (96.20 lakh dfls) were brushed. The average cocoon yield recorded was 67.28 kg/100 dfls and 952.51 MT bivoltine raw silk was produced against the target of 919.53 MT

Zone	Parameters	Target	Ach.	Productivity Improvement (%)
South Karnataka (22 clusters)	Dfls (lakhs)	64.60	61.52 (95.23%)	5.76
	Yield /100 dfls (kg)	65	68.75	
North Karnataka (14 clusters)	Dfls (lakhs)	41.60	37.13 (89.25%)	2.04
	Yield /100 dfls (kg)	65	66.33	
Total/Avg.	Dfls (lakhs)	106.20	98.65 (92.80%)	4.30
	Yield /100 dfls (kg)	65	67.80	

## On-Station Trials

### Performance of Improved Crossbreeds

N. Jagadeesh, M. Venkatachalapathy and M. Maheswari

Three improved crossbreeds (MV1 x S8, HB6 x S8, L3 x S8) were reared along with popular crossbreed (PM x CSR2) thrice and data was analysed. MV1 x S8 performed better for survivability and shell ratio, filament length, reelability and raw silk.

Performance of Improved Crossbreeds (Mean of Trials)									
Hybrid	ERR/10000 Larvae		SCW (g)	SSW (g)	Shell Ratio (%)	FIL (m)	Reelability (%)	Raw Silk (%)	Renditta
	No.	Wt. (kg)							
MV1xS8	9605	16.23	1.75	0.36	20.55	746.32	90.02	14.12	7.08
HB6xS8	9069	15.32	1.79	0.36	20.25	757.33	83.34	13.87	7.21
L1xS8	9082	15.22	1.72	0.34	19.58	733.72	88.03	13.55	7.38
PMxCSR2	9614	16.42	1.77	0.34	19.25	631.78	86.04	13.75	7.27
F-test	**	**	NS	NS	**				
CD @ 5%	512	0.90			0.54				

## Continuous/Other Activities

**Popularization of New Silkworm Hybrids and Mulberry Varieties:** Newly developed silkworm hybrids (bivoltine: DH & SH; ICBs) were test verified with 38900 dfls with 192 farmers and the rearing performance was recorded as a part of popularization. Similarly, new mulberry varieties (V1, G2, G4 and Vishala) saplings/cuttings were supplied to the farmers.

Unit	Dfls (Nos)	Farmers (Nos)	Cocoon Yield (kg/100 dfls)		Unit	Mulberry Variety	Supply
			BV	ICB			
RSRS-Kodathi	11650	51	78.0	73.6	RSRS-Kodathi	G4	19670 saplings (27 farmers)
REC-Chitradurga	8300	36	67.0			G2	4080 saplings (DOS-AP-Kalyandurga & CSGRC-Hosur)
REC-Madivala	16150	88	84.3	74.8		Vishala	80000 cuttings (KSSRDI-Thalagattapura)
REC SU-Koppal	1500	08	49.0			V1	65100 (4 farmers)
REC SU-Ranebennur	400	04	56.3		REC-Chitradurga	G4	1.058 lakh cuttings (21 acres-21 farmers)
REC SU-Kanakapura	900	05		78.8	RECSU-K'pura	G4	One acre (1 farmer)
Total/Avg.	38900	192	67.0	75.4			

**Institute Village Linked Programme (IVLP):** 58900 bivoltine hybrid dfls were reared against the target of 60000 dfls and recorded an average yield of 65.350 Kg/100 dfls, which is an improvement of 12.13% cocoon yield over benchmark.

**Production of Biological Control Agents:** 72300ml of *Nesolynx thymus* were produced and supplied to stakeholders for the management of uzifly at REC-Madivala.

**Establishment of AMIT:** Affordable Micro Irrigation Technology (Drum Kit Technology) and drip Irrigation system was installed at RSRS-Kodathi and REC-Chitradurga to mitigate drought situation. Surface water tank installed at REC-Bidaraguppe was also maintained well.

**Farm Rearings:** 2170 dfls were reared to generate 788381 cocoons (1197kg) with an average yield of 55.16kg/100 dfls at RSRS-Kodathi and farm based nested units (REC-Madivala, Bidaraguppe and REC SU-Koppal). 13100 bivoltine hybrid dfls were also chawki-reared and distributed to 86 farmers through REC-Chitradurga and REC SU-Koppal.

**Farm Maintenance:** 20.48 acres mulberry garden was maintained by RSRS and its farm based nested units to produce 84.37MT mulberry leaves for farm rearing. Farm waste was recycled to produce 47.25MT compost and 41.05MT Vermicompost and utilized for manuring mulberry gardens.

**Capacity Building Training Programmes (CBT):** RSRS and its nested units conducted 33 Farmers Skill Training Programmes (FST; 3days) and trained 495 farmers on various sericulture technologies. 77 officials/students were also trained under 5 Technology Orientation Programme (TOP; 5 days) at RECs-Chitradurga, Madivala and Kanakapura. Further, four Exposure Visits were also conducted by RSRS- Kodathi (Shapur CPP) and REC-Madivala for the benefit of 200 farmers.

**Special Awareness Programmes:** Various special awareness programmes including digital transaction, UPI etc., in the CPP clusters (437 programmes) and sensitised 23811 farmers/stakeholders.

**Sericulture Resource Centers:** Established two Sericulture Resource Centres one each at B.G. Kere (Molakalmuru Tq., Chitradurga) and B.S. Doddi (Kanakapura) for training of sericulturists regularly.

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

Unit	Cluster	Extension Communication Programme (ECP)											
		Group Discussion		Field Day		Farmers Day		Aware. Prog.		Exposure Visit		Total	
		T	A	T	A	T	A	T	A	T	A	T	A
RSRS-Kodathi	Andaralahalli	5	5 (114)			3	1 (30)					8	6 (144)
	Y.N. Hosakote	5	8 (201)	1	1 (69)	3	2 (92)	1	1 (86)			10	12 (448)
	Harohalli (B)	5	5 (134)			3	4 (212)		1 (112)			8	10 (458)
	CR Patna	5	6 (118)		1 (110)	3	3 (107)					8	10 (335)
	Tubagere	5	5 (114)			3	5 (170)					8	10 (284)
	Shapur (K)	5	4 (108)			3	9 (524)	1	2 (258)		1 (50)	9	16 (940)
REC- Bidarguppae	Hosakote	5	5 (149)	1	1 (146)	3	3 (126)	1				10	9 (421)
REC- Chitradurga	Challakere	5	3 (67)	1	1(108)	3	2 (81)	1	2 (203)			10	8 (459)
	Hiriyur	5	5 (113)			3	4 (173)					8	9 (286)
	Davanagere	5	5 (204)			3	3 (124)					8	8 (328)
REC-Madivala	Ithandahalli	5	9 (264)	1	1 (147)	3	5 (304)	1	2 (224)	1	2 (100)	11	19 (1039)
	Kurudumalai	5	1 (26)		1 (98)	3	2 (113)				1 (50)	8	5(287)
REC SU- Kanakapura	Kanakapura	5	5 (144)	1		3	3 (217)	1	1 (59)			10	9 (420)
REC SU-Koppal	Yelburga	5	7 (390)	1		3	3 (159)	1	1 (135)			10	11 (684)
	Lingasgur	5	2 (50)			3	2 (101)					8	4 (151)

Unit	Cluster	Extension Communication Programme (ECP)											
		Group Discussion		Field Day		Farmers Day		Aware. Prog.		Exposure Visit		Total	
		T	A	T	A	T	A	T	A	T	A	T	A
REC SU-Tumkur	Tumkur	5	15 (445)	1	1 (91)	3	5 (200)	1				10	21 (736)
	Sira	5	3 (118)			3	7 (303)		1 (75)			8	11 (496)
REC SU-Ranebennur	Ranebennur	5	8 (296)	1	2 (176)	3	3 (120)	1	1 (45)			10	14 (637)
REC SU-Kudligi	Kudligi	5	5 (113)	1		3		1				10	5 (113)
	H.B. Halli	5	3 (73)			3						8	3 (73)
REC SU-Shahapur	Shapur	5	8 (114)	1		3		1				10	8 (114)
REC SU-Shirahatti	Shirahatti	5	5 (85)	1		3	4 (180)	1				10	9 (265)
REC SU-Bijapur	Bijapur	5	10 (220)	1	1 (65)	3	5 (291)	1	1 (55)			10	17 (631)
REC SU-Jamkhandi	Jamkhandi	5	6 (193)	1		3	3 (113)	1				10	9 (306)

**Visitors:** RSRS Kodathi is a regular visiting place of sericulture farmers/officials and 2664 sericultural farmers, students and officials visited the unit for enriching knowledge on new technologies of silkworm rearing and mulberry cultivation.

### RSRS-CHAMARAJANAGAR

REC & Sub-Unit	Command Area	Staff		Farm Based Units		
RECSU-Kinakanahally		In-charge Officer • K. Srikantaswamy)		Unit	Total Area (Acres)	Mulberry Acreage
	Karnataka	Scientists	04	RSRS-Chamarajanagar	14.02	6.153
		Technical Staff	08	SU-Kinakanahally	17.40	2.60
		Administrative Staff	02			

### Concluded Research Projects

**PPF 3500: Development of seri-lac culture model for income augmentation (Inter institutional project with IINRG-Ranchi; Mar. 2013 - Dec. 2016)**

V. Sivaprasad, R. Ramani<sup>1</sup>, K. Srikantaswamy<sup>2</sup>, Sibayen Sen and Mohanasundram<sup>1</sup>

<sup>1</sup>IINRG, Ranchi, <sup>2</sup>RSRS Chamaramanagar

### Objectives

- To work out the additional income generation out of lac production and its economics in relation to mulberry leaf production
- To find out the carbon sequestration rate in improving the soil fertility and for the sustenance of crop productivity
- To generate employment for the rural people and improve their livelihood
- To study the pest & disease incidence, cross infectivity studies in mulberry, lac host plant vice versa

Lac host plants were maintained in between the mulberry trees following necessary cultural operations for better establishment. Lac mother brood culture collected from IINRG-Ranchi was mass multiplied at RSRS and inoculated on lac host plants for lac production. Three lac production crop cycles were completed. Lac plantation at

farmer's field (Sri Mahesh, Tumbala village in T. Narasipura Tq.) with mulberry tree plantation (8' x 8' spacing) was



maintained and two lac production crop cycles were completed.

Lac was harvested from lac inoculated plants and quantified (100-150g lac/plant and 100-150kg lac/acre/crop) with an average lac production at about 150 kg/acre/year and resulted in an additional income of Rs. 46750/- to the farmer. The dual culture of silk and lac revealed higher returns of Rs. 1.57 lakh/acre/year over mulberry as a solo crop (Rs. 1.10 lakhs) and the cost benefit ratio was higher in Seri-Lac Culture Model (1:2.06) over mulberry as a solo crop (1: 1.74). Besides lac production, the lac host crop residue was used as surface mulch indicated significant improvement in soil fertility status namely soil organic carbon content, microbial biomass carbon, microbial nitrogen and dehydrogenase enzyme activity as compared to control. Development of Seri-Lac culture model paves way for long term benefits in socio economic development of sericulturists. No significant difference in leaf yield was recorded between seri lac and control plants which was evident from Land Equivalent Ratio being 1.75. Since LER is less than 2, it clearly indicates that Mulberry and Lac crops are complimentary in nature without affecting yields.

Seri-Lac Plantation			
Soil Characteristics			
Parameters	Mulberry with Lac	Mulberry with out Lac	t-value
pH	7.52	7.57	**
Organic Carbon Content (%)	0.82	0.74	**
Available N (kg/ha)	526	451	**
Soil Microbial Biomass C (Cmic X 10 <sup>-2</sup> gm <sup>-1</sup> soil)	2.07	1.90	**
Soil Microbial Biomass N (Nmic X 10 <sup>-3</sup> gm <sup>-1</sup> soil)	2.48	2.08	**
Dehydrogenase activity (mg TPR-1hr <sup>-1</sup> )	2.78	2.10	**
Available Soil Moisture (%)	16.6	10.20	**
Mulberry Growth & Leaf Yield (kg/crop/acre)			
Total number of shoots	21.6	21.3	NS
Total shoot length(cm)	3396	3387	NS
Total leaves/Plant	666	663	NS
Leaf area (cm <sup>2</sup> )	123663	122589	NS
Leaf Area Index (m <sup>2</sup> )	2.70	2.07	**
Leaf weight (g/plant)	4.03	4.1	NS
Leaf Quality & Mineral Composition			
Leaf moisture content (%)	71.35	70.43	NS
Nitrogen (%)	4.03	3.87	**
Phosphorus (%)	0.39	0.36	**
Potash (%)	1.3	1.17	**
LER	Mulberry 1	Lac 0.75	Total 1.75

Economic Viability of Seri -Lac Culture Model				
Parameters	Seri-Lac Culture		Solo Mulberry Crop	
	Mulberry	Lac	Mulberry	Lac
<b>A: Expenditure (Rs.)</b>				
FYM 4+2 MT	8000	4000	8000	4000
Ammonium Sulphate 20 kg		250	250	250
Single Super Phosphate 20 Kg	160		160	
MOP 20Kg	250		250	
Labor Charges	2000	1000	2000	1000
Protection measures		1500		1500
Miscellaneous Charges	2500	2500	2500	2500
Mother Brood Culture Cost		4000		4000
Rearing Cost	50000		50000	
Total	62910	13250	63160	13250
Leaf Produced (Kg/acre/year)	11160		11152	
No of Dfls Brushed	825		825	
<b>B: Returns (Rs.)</b>				
Cocoon Produced	577		560	
Amount Realized @ Rs.300/Kg /annum	173250		173250	
Lac Production (Stic lac)		150		200
Amount Realized @ Rs. 400/Kg/annum		60000		80000
Profit B - A	110340	46750	110090	53500
Net Profit	157090		110090	66750
CB Ratio	1:2.06		1:1.74	

**PPA 3551: Determination of Yield Potential of Newly developed Bivoltine Hybrids under Tree type Mulberry Plantation with Protective Irrigation (Jan. 2016 - Dec. 2016)**

S. N. Pallavi and R. Meenal

**Objective**

- To determine the productivity of newly developed silkworm hybrids under tree mulberry cultivation and protective irrigation

Mulberry plots (S13) were maintained for three treatments viz., Bush cultivation (3' x 3'spacing) with Protective irrigation (T1); Tree Mulberry Cultivation (8' x 8'spacing) with Protective irrigation (T2); Bush cultivation (3' x 3'spacing) without Protective irrigation (T0; Control). Four test hybrids (CSR16 x CSR17; CSR50 x CSR51; FC3 x FC4; G11 x G19 along with two popular hybrids (FC1 x FC2 & CSR2 x CSR4) were utilized for evaluation of test hybrids through feeding mulberry leaves from three treatments. Three trails were conducted at RSRS farm and two at farmer's field (Sri Mahesh, Tumbala village, T. Narasipura Tq.; tree mulberry plantation @ 8' x 8'spacing).

Significant improvement in commercial characters of test hybrids was observed in hybrids fed with leaves from mulberry trees in wider spacing using AMIT (T2) followed by bush plantation in closer spacing with protective irrigation (T1). Significant differences (p<0.05) were recorded between the treatments and hybrids with respect to rearing characteristics (larval weight, yield/10000 larvae by No. and wt., single cocoon wt., single shell wt. and shell ratio and reeling parameters (reelability, average filament length, non broken filament length, denier, raw silk percentage, and raw silk recovery). No significant differences with respect to total larval duration, fifth instar larval duration and neatness were observed.



Tree Plantation with Protective Irrigation (T2)

Bush Plantation with Protective Irrigation (T1)

Bush Plantation without Protective Irrigation (T0)

Performance of Silkworm Hybrids under Different types of Mulberry Cultivation/Irrigation Practices											
Hybrids	Treatments	Yield/10000 L		Cocoon Wt. (g)	Shell Wt. (g)	Shell Wt. (g)	Reela-bility (%)	Avg. FIL (m)	Raw Silk (%)	Raw Silk Recovery (%)	Neat-ness (p)
		No.	wt. (kg)								
CSR16 x CSR17	T0	8028	10.49	1.328	0.274	20.65	77.97	647	11.8	61.94	97
	T1	9040	14.23	1.575	0.332	21.08	78.30	740	12.77	69.75	96
	T2	9627	16.32	1.695	0.362	21.36	78.84	827	13.63	74.79	97
CSR50 x CSR51	T0	8013	10.31	1.300	0.267	20.55	76.75	624	11.94	61.58	96
	T1	9027	14.09	1.564	0.324	20.72	77.55	728	12.76	67.31	95
	T2	9560	15.37	1.678	0.359	21.43	77.74	810	13.13	71.80	96
FC3 x FC4	T0	8079	11.03	1.325	0.278	21.00	80.00	658	12.8	66.83	96
	T1	9173	14.65	1.591	0.344	21.62	82.63	754	13.47	71.80	97
	T2	9693	16.89	1.742	0.381	21.87	84.04	875	13.93	78.28	97
G11 x G19	T0	8105	11.63	1.334	0.279	20.91	79.59	672	12.24	66.83	97
	T1	9187	14.71	1.602	0.338	21.10	80.50	763	12.96	73.09	98
	T2	9747	16.79	1.723	0.383	22.24	81.69	858	13.82	78.73	95
FC1 x FC2 (Control - I)	T0	8012	10.47	1.307	0.268	20.54	74.20	582	11.78	59.49	97
	T1	9005	12.99	1.526	0.321	21.06	76.97	640	12.44	65.57	97
	T2	9480	15.72	1.658	0.359	21.68	77.23	775	12.92	71.50	95

Hybrids	Treatments	Yield/10000 L		Cocoon Wt. (g)	Shell Wt. (g)	Shell Wt. (g)	Reela-bility (%)	Avg. FIL (m)	Raw Silk (%)	Raw Silk Recovery (%)	Neat-ness (p)
		No.	wt. (kg)								
CSR2 x CSR4 (Control - II)	T0	7893	9.45	1.247	0.248	19.88	73.59	565	11.69	55.13	97
	T1	8827	11.49	1.443	0.298	20.64	75.35	606	11.76	64.06	96
	T2	9280	14.51	1.579	0.333	21.02	75.49	662	11.94	69.75	97
CD @ 5%	Treatments	320	1.76	0.04	0.04	0.15	2.98	54	0.75	4.65	NS
	Hybrids	181	1.32	0.06	0.03	0.09	0.93	90.8	0.57	5.91	NS
	Treatments x Hybrids	386	1.67	0.1	0.03	0.47	2.45	72.42	0.66	5.28	NS

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

Project Code	Title	Units
PRE 3527	Survey and surveillance of major pests and their natural enemies in mulberry eco-system	RSRS-Chamarajanagar
ARP 3519	Silkworm disease monitoring of seed and commercial crop rearing of south Indian states	

### Continuous/Other Activities

**In situ green manuring through Gliricidia and wider planting:** Gliricidia green biomass was harvested and quantified (0.90-3.0kg/plant). 1181kg biomass was incorporated into the soil (0.1 ha) to build soil organic matter. Three mulberry varieties (RC1, RC2 & S13) were maintained through protective irrigation using AMIT in respective plots maintained in RBD. Soil sample analysis showed higher SOC (0.92%) green manured plot as against the control plot (0.76%).

**Forecasting and Forewarning of Mulberry Pests:** Survey for pest incidence was carried out at twenty five farmer's field covering five villages. No severe pest/disease incidence was noticed in majority of the mulberry fields. However, tukra incidence was recorded (0.40-0.90%) in ten farmers' fields. Average thrips incidence recorded in eight farmers' field was 0.66%.

**OST of New Silkworm Hybrids:** Improved crossbreeds (MV1 x S8, HB6 x S8, L3 x S8) were reared along with popular crossbreed (PM x CSR2) thrice and data was analysed. MV1 x S8 performed better for survivability, shell ratio, filament length, reelability and raw silk.

Hybrid	ERR/10,000 Larvae		SCW (g)	SSW (g)	Shell Ratio (%)	Fil. Length (m)	Reela-bility (%)	Raw Silk (%)	Ren-ditta
	No.	Wt. (kg)							
MV1 x S8	8807	14.460	1.430	0.284	19.62	711.47	85.42	13.83	7.30
HB6 x S8	8070	12.420	1.500	0.288	19.10	689.47	87.56	12.86	7.78
L1 x S8	8385	13.700	1.480	0.283	18.96	647.14	85.29	13.00	7.71
PM x CSR2	8538	14.240	1.390	0.255	18.41	577.59	84.62	11.71	8.85
CD @ 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS

**Popularization of New Mulberry Varieties:** New mulberry varieties especially RC1, RC2, MSG2, G7 & G17 saplings/cuttings were raised and supplied to the farmers in rainfall deficit areas.

Unit	Mulberry Variety	Supply
RSRS- Chamarajanagar	G4	2000 saplings
	S13	7100 saplings
	RC1	375 saplings
	RC2	665 saplings
	MSG2	1240 cuttings
	G7	380 saplings
	G17	760 saplings
	V1	300 saplings
	AGB8	24000 cuttings

**Cluster Promotion Programme (CPP):** Bivoltine sericulture technologies were disseminated in one cluster under RSRS Chamarajanagar. 2.20 lakh bivoltine hybrid dfls were reared with an average yield of 68.12 kg/100 dfls. 35.76 acres of new plantations were also established with 88 farmers and conducted 9 ECPs for the benefit of 453 farmers.

**Institute Village Linked Programme (IVLP):** Twenty two acres of tree mulberry plantation were established in 22 farmers' field with wider spacing. Survival/sprouting rate is more than 90%. The farmers were provided with drum kit (AMIT) at 80:20 ratio under the programme. A quantity of 920 dfls were reared with nine farmers with an average yield of 77.90 kg per 100 dfls.

**Farm Rearings:** 412 dfls were reared to generate 207.8kg cocoons with an average yield of 52kg/100 dfls. 18492 dfls were chawki reared and supplied to 197 farmers with an average yield of 59.33 kg/100 dfls obtained.

**Farm Maintenance:** RSRS and its farm based nested unit produced 7482kg mulberry leaves for farm rearing/chawki rearing. Farm waste was recycled to produce 8MT Vermicompost and utilized for manuring mulberry gardens.

**Capacity Building Training Programmes (CBT):** RSRS and its nested unit conducted 6 Farmers Skill Training Programmes (FST; 3days) and trained 100 farmers on various sericulture technologies. 25 officials/students were also trained under Technology Orientation Programme (TOP; 5 days).

**Special Awareness Programmes:** Various special awareness programmes including digital transaction, UPI etc., in the villages (31 programmes) and sensitised 6759 farmers/stakeholders.

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

Unit	Cluster	Extension Communication Programme (ECP)											
		Group Discussion		Exhibition		Farmers Day		Aware. Prog.		Exposure Visit		Total	
		T	A	T	A	T	A	T	A	T	A	T	A
RSRS-Chamarajanagar	T. Narsipura	10	11 (455)	2	2 (7238)	1	1 (111)	4	4 (342)	1	1 (11)	18	19 (8157)
REC SU-Kinakahalli		1	1 (27)					1	1 (55)			1	1 (27)
Total		120	12 (481)	2	2 (7238)	1	1 (111)	4	4 (342)	1	1 (11)	19	20 (8184)

**Visitors:** RSRS Chamrajanagar is a regular visiting place of sericulture farmers/officials and several sericultural farmers, students and officials visited the unit for enriching knowledge especially on tree cultivation, AMIT and serilac culture and also on new technologies of silkworm rearing and mulberry cultivation.

**RSRS - SALEM**

Command Area	Scientists / Staff		RSRS-Salem
	In-charge Officer:	• Dr. S. Rajakumar	
Tamil Nadu Kerala	Scientists:	25	
	Technical Staff:	23	
	Administrative Staff:	20	
Farm Based Units			
Unit	Total Area (Acres)	Mulberry Acreage	
RSRS-Salem	20.0	3.4	
REC-Krishnagiri	2.77	2.5	
REC-Samayanallur	2.62	0.6	
			<b>RECs</b>
			REC- Gobichettipalayam
			REC- Krishnagiri
			REC- Samayanallur
			REC-Srivilliputhur
			REC-Udumalpet
			REC-Palakkad
			<b>Sub-Units</b>
			REC SU-Avinashi
			REC SU-Berigai
			REC SU-Tiruchirapalli
			CDC-Agali

**Ongoing Research Projects**

**PPA 3580: Soil Health Cards for Sericulture farmers in states of Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Kerala, Maharashtra and Madhya Pradesh (Apr. 2016 - Mar. 2019)**

N. Dhahira Beevi and S. Rajakumar

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

3000 soil samples from CPP Tamil Nadu (28 clusters), Kerala (2 clusters) and other sericulture farmers were analyzed for pH, EC, OC%, available P, K and S. The soil samples were also sent to CSRTI-Mysuru for secondary and micro-nutrient analysis and preparation of Soil Health Cards (SHC) for individual farmers.

Parameter	Normal Range	Samples (%)
pH	6.50 - 7.50	16.68
EC (m.mhos/cm)	< 1.00	98.14
OC (%)	0.65 - 1.00	30.18
Phosphorous (P) kg/ ha	10 - 25	26.94
Potash (K) kg/ha	110 - 240	96.58
Sulphur (S) ppm	10 - 15	29.60

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

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

**Objectives**

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

Based on the literature survey and discussions with the experts, the questionnaire for data collection for studying the impact of CPP on technology adoption, productivity improvement, socio-economic development of sericulturists and technological efficiency in Tamil Nadu was finalized. Data collection from 20 farmers each of big, medium and small scale was initiated.

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

J. Ravikumar (PI), S. Rajakumar, M. Noble Morrison, M.A. Shanthan Babu and R. Meenal

**Objectives**

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

Data on weather parameters, natural enemies and soil biota (Macro fauna, meso flora and micro flora) at fixed plot before and after imposing treatments were collected at RSRS-Salem. Pre-count data on soil biota was collected after laying out RBD at REC-Madivala and RSRS-Chamrajnagar.

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

Project Code	Title	Units
MOE 3525	A study on the impact of Pest and Disease Management practices in Sericulture among the farmers under Cluster Promotion Programme in South India	RSRS-Salem REC-Samayanaallur
MOE 3523	Study on drought management practices in mulberry sericulture	REC-Samayanaallur
PRE 3527	Survey and surveillance of major pests and their natural enemies in mulberry eco-system	RSRS-Salem
PRE 3535	Popularisation of Nemahari - A bio-nematicide for management of root knot in mulberry	RSRS-Salem REC SU-Trichi REC-Samayanaallur REC-Gobi
ARP 3550	Validation trials of Automated disinfection of silkworm rearing house	RSRS-Salem
PPA 3580	Soil health cards for sericulture farmers in states of Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Kerala, Maharashtra and Madhya Pradesh	RSRS-Salem
ARP 3519	Silkworm disease monitoring of seed and commercial crop rearing of South Indian states	CPP clusters – TN & Kerala
AIT 3556	To conduct multi-locational field trials of transgenic of BmNPV resistant silkworm strains to establish their efficacy and generate data for regulatory approval	RSRS-Salem
AIB 3561	Identification of robust bivoltine silkworm hybrids suitable for different regions of high temperature and high humid conditions	RSRS-Salem

**Cluster Promotion Programme (CPP):** Bivoltine Sericulture technologies were disseminated in 30 clusters across Tamil Nadu and Kerala and a total of 73.68 lakh bivoltine hybrid dfls were brushed. The average cocoon yield recorded was 78.37kg/100 dfls and 79.10kg/100 dfls respectively.

**Institute Village Linked Programme (IVLP):** 3.067 lakh bivoltine hybrid dfls were reared with 200 farmers in two clusters (Sathyamangalam & Thondamuthur) and recorded an average yield of 77.48 Kg/100 dfls, with an improvement of 17.55% cocoon yield over benchmark.

**On-Station Trials**

**Performance of Improved Crossbreeds:** Five improved crossbreeds (MV1xS8, L3xS8, HB4xS8, HB6xS8, L1xS8) were reared along with popular crossbreed (PM x CSR2) four times and data was analysed.

Performance of Improved Crossbreeds (Mean of Trials)									
Hybrid	ERR/10,000 Larvae		SCW (g)	SSW (g)	Shell Ratio (%)	FIL (m)	Reela-bility (%)	Raw Silk (%)	Renditta
	No.	Wt. (kg)							
MV1xS8	8382	12.56	1.57	0.325	20.64	845	86.56	15.53	6.45
L3xS8	8950	14.00	1.69	0.358	21.13	869	85.32	14.96	6.69
HB4xS8	9438	15.28	1.66	0.330	19.89	920	90.46	15.30	6.54
HB6xS8	8611	12.31	1.52	0.328	21.55	812	87.62	15.43	6.49
L1xS8	7065	10.12	1.51	0.314	21.19	781	83.91	14.88	6.72
PMxCSR2	8391	13.09	1.59	0.300	18.74	689	83.91	12.85	7.79

**Performance of New Bivoltine Hybrids:** One trial of three single (SHP1, SHP2, SHR1) and six bivoltine double hybrids (DHP1, DHP2, DHP3, DHP5, DHR3, DHR4) was conducted during Nov. - Dec. 2016. One trial of three thermo-tolerant bivoltine hybrids (TT21 x TT56, TT23 x TT56 and TT23 x TT67) was also conducted during June - July 2016.

Performance of New Bivoltine Single and Double Hybrids											
Hybrid	Fec.	ERR (No.)	ERR Wt. (kg)	SCW (g)	SSW (g)	SR (%)	Reela-bility	AFL (m)	NBFL (m)	Renditta (kg)	RS (%)
SHP1	587	9019	13.840	1.682	0.389	23.13	89.45	982.75	879.12	5.91	16.91
SHP2	536	9459	14.425	1.628	0.389	23.89	95.23	915.12	871.45	6.09	16.42
SHR1	680	7081	10.651	1.644	0.348	21.18	90.59	821.14	743.89	6.65	15.05
DHP1	576	7655	12.913	1.755	0.403	22.96	88.88	939.54	835.07	5.97	16.74
DHP2	581	8939	14.596	1.565	0.359	22.93	94.75	931.74	882.82	5.90	16.95
DHP3	597	8445	13.598	1.632	0.387	23.71	94.45	1119.24	1057.10	4.95	20.22
DHP5	631	7328	12.874	1.789	0.409	22.86	91.89	998.25	917.25	6.20	16.14
DHR3	709	7817	12.962	1.730	0.381	22.02	94.56	940.65	889.52	6.36	15.73
DHR4	691	8477	13.496	1.766	0.394	22.31	87.39	975.09	852.09	6.30	15.88

Performance of Thermo-Tolerant Bivoltine Double Hybrids											
Hybrid	Fec.	ERR (No.)	ERR Wt. (kg)	SCW (g)	SSW (g)	SR (%)	Reela-bility	AFL (m)	NBFL (m)	Renditta (kg)	RS (%)
TT21 X TT56	719	8422	12.052	1.445	0.308	21.31	82.26	881.3	724.99	6.07	16.48
TT23 X TT56	460	7095	10.551	1.506	0.339	22.51	88.90	935.7	831.83	5.86	17.08
TT23 X TT67	726	7381	9.895	1.342	0.289	21.31	84.20	790.3	665.37	6.39	15.64

**Continuous/Other Activities**

**Popularization of New Silkworm Hybrids and Mulberry Varieties :** Newly developed silkworm hybrids (Bivoltine: DH & SH; ICBs) were test verified with 62800 dfls with 263 farmers and the rearing performance was

recorded as a part of popularization. Similarly, new mulberry varieties (G2, G4 and RC1) saplings/cuttings were supplied to the farmers.

Centre	Hybrid	Dfls (Nos)	Farmers (Nos)	Yield/100 Dfls (kg)	Unit	Mulberry Variety	Supply
RSRS-Salem	G11 x G19	10400	46	70.90	RSRS-Salem	G4	10.25 acres (17 farmers)
	FC3 x FC4	4850	17	72.90		G2	10.5 acres (10 CRCs)
	S8 x CSR16	7000	35	72.00		RC1	0.5 acres (1 farmer)
	SSBS5 x SSBS6	20950	84	73.00		RC2	1.0 acre (2 farmers)
	MV1 x S8	600	02	49.00	REC-Gobi	G4	6.25 acres (10 farmers)
REC SU-Berigai	MV1 x S8	650	4	67.50	REC-Gobi	G2	1.56 acres (3 farmers)
	G11 x G19	3250	15	73.81	REC-Trichy	G4	2 acres (4 farmers)
	S8 x CSR16	1550	8	68.00	REC-Udumalpet	G4	11.5 acres (10 farmers)
	SSBS5 x SSBS6	2400	9	74.00		G2	4.5 acres (2 farmers)
REC-Samayannallur	G11 x G19	6600	22	53.4	REC-Udumalpet	RC1	1 acre (1 farmer)
	S8 x CSR16	500	3	65.2		REC-Samayannallur	G4
REC SU-Trichy	SSBS5 x SSBS6	1000	07	74.300	REC-Samayannallur	RC1	2.50 acres (2 farmers)
	G11 x G19	3050	21	69.787	REC-Krishnagiri	G2	3 acres (3 farmers)
Total/Average (combination wise)	MV1 x S8	1250	6	58.25	REC-Krishnagiri	G4	2.63 acres (3 farmers)
	G11 x G19	21300	105	67.50	REC-SRVputhur	RC1	3.50 acres (2 farmers)
	SSBS5 x SSBS6	24350	90	70.56			
	S8 x CSR16	9050	46	68.4			
	FC3 x FC4	4850	17	72.90			
	Total/Avg.	62800	263	68.23			

**Production of Biological Control Agents:** Biological control agents such as 2.68 lakh *Acerophagus papayae* (1071 units; 1049 farmers); 1.76 lakh *Chrysoperla zastrowi* sillemi (174 farmers;) and 33 units of *Scymnus*, *Cryptolemus montrauzieri* beetles (10 farmers) were distributed through DoS/CSB units in the mulberry gardens infested with papaya mealybug traits and pink mealybug. The biocontrol agents reduced infestation of papaya mealy bugs, thrips and tukra mealy bug by 99%; 95% and 72.3%, respectively.

**Establishment of AMIT:** Affordable Micro Irrigation Technology (Drum Kit Technology) and drip Irrigation system was installed at REC-Samayannallur to mitigate drought situation.

**Capacity Building Training Programmes (CBT):** RSRS and its nested units conducted 23 Farmers Skill Training Programmes (FST; 3days) and trained 378 farmers on various sericulture technologies. 114 officials/students were also trained under 13 Technology Orientation Programme (TOP; 5 days) at RSRS-Salem and its RECs.

**Special Awareness Programmes:** Various special awareness programmes including digital transaction, UPI etc., in the CPP clusters (206 programmes) and sensitised 22182 farmers/stakeholders.

**Sericulture Resource Centers:** Established two Sericulture Resource Centres one each at Thadiyamanai, Mangadu (CPP Alangudi, REC SU-Trichy) and Kannamanaikanur (CPP Udumalpet, REC-Udumalpet) for training of sericulturists regularly.

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

Centre	Tech. Demo.	Group Discussion	Awareness Prog.	Field Day	Farmers Day	Exhibition	Study Tour
RSRS-Salem		147 (6)	340 (3)	103 (1)	795 (18)		
REC-Krishnagiri		110 (5)	175 (2)	90 (1)			
REC-Samayanallur	45 (7)	212 (10)	463 (5)	88 (1)	274 (7)	127 (1)	
REC-Udumalpet		853 (45)	1175 (12)	166 (2)	670 (18)	539 (2)	
REC-Gobi	272 (17)	586 (30)	747 (8)	87 (1)	327 (10)		
REC-Srivilliputhur	55 (2)	289 (13)	442 (4)	175 (3)	191 (5)		
REC SU-Berigai		88 (5)	358 (4)	85 (1)	81 (2)		40 (1)
REC SU-Vaniyambadi		125 (5)	392 (4)	126 (1)	81 (2)		
REC SU-Avinashi		273 (15)	360 (4)	65 (1)	239 (6)		
REC SU-Trichy		140 (6)	199 (3)	85 (1)	111 (3)		
REC-Palakkad		317 (15)	424 (6)		381 (7)		
CDC-Agali		1 (20)					

**Ph.D. Students:** At present 9 students are pursuing Ph.D., under Periyar University-Salem and one student pursuing Ph.D. under Manonmaniam Sundaranar University-Tirunelveli. During the year one student has completed external viva-voce for Ph.D.

**M.Sc. Students:** Two students of Sri Sakthi Kailash Arts and Science College for Women-Salem completed M.Sc. (Microbiology) dissertation work.

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

### RSRS-ANANTAPUR

Command Area	Scientists / Staff	
	In-charge Officer:	
		<ul style="list-style-type: none"> <li>• Ch. Satyanarayana Raju (up to 28.02.2017)</li> <li>• Dr. M.A. Shanthan Babu (w.e.f. 01.03.2017)</li> </ul>
Andhra Pradesh	Scientists:	16
Telangana	Technical Staff:	29
	Administrative Staff:	17

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

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

### Ongoing Research Projects

#### PPA 3580: Soil Health Cards for Sericulture farmers in states of Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Kerala, Maharashtra and Madhya Pradesh (Apr. 2016 - Mar. 2019)

B. Vijaya Naidu and Ch. Satyanarayana Raju

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

1528 soil samples collected from farmers were analysed for pH, EC and OC. The soil samples were also sent to CSRTI-Mysuru for micro-nutrient analysis and preparation of Soil Health Cards (SHC) for individual farmers.

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

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

#### Objectives

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

Based on the literature survey and discussions with the experts, the questionnaire for data collection for studying the impact of CPP on technology adoption, productivity improvement, socio-economic development of sericulturists and technological efficiency in Andhra Pradesh and Telangana was finalized. Data collection from 20 farmers each of big, medium and small scale was initiated.

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

Project Code	Title	Units
MOE 3525	A study on the impact of Pest and Disease Management practices in Sericulture among the farmers under Cluster Promotion Programme in South India	REC -Kalyandurga REC-Madakasira REC-V. Kota
MOE 3523	Study on drought management practices in mulberry sericulture	REC SU-Penukonda
PRE 3527	Survey and surveillance of major pests and their natural enemies in mulberry eco-system	RSRS-Ananthapur
PRE 3535	Popularisation of Nemahari - A bio-nematicide for management of root knot in mulberry	RSRS-Ananthapur
ARP 3550	Validation trials of Automated disinfection of silkworm rearing house	RSRS-Anantapur
PPA 3580	Soil health cards for Sericulture farmers in states of Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Kerala, Maharashtra and Madhya Pradesh	RSRS-Anantapur
ARP 3519	Silkworm disease monitoring of seed and commercial crop rearing of south Indian states	CPP clusters - AP & Telangana
AIT 3556	To conduct multi-locational field trials of transgenic of BmNPV resistant silkworm strains to establish their efficacy and generate data for regulatory approval	RSRS-Anantapur
AIB 3561	Identification of robust bivoltine silkworm hybrids suitable for different regions of high temperature and high humid conditions	RSRS-Anantapur

**Cluster Promotion Programme (CPP):** Bivoltine sericulture technologies were disseminated in 13 clusters across Andhra Pradesh and 4 clusters in Telangana and a total of 82.23 lakh bivoltine hybrid dfls were reared with an achievement of 114.45% against the target of 71.85 lakh dfls and recorded an average cocoon yield of 70.95 kg/ 100 dfls. The raw silk production achievement was 894.49 MT against the target of 718.50 MT.

**Institute Village Linked Programme (IVLP):** 103550 bivoltine hybrid dfls were reared with 200 farmers in two clusters (Rayachoti & Vizianagaram) and recorded an average yield of 63.17 Kg/100 dfls, which is an improvement of 20.32% cocoon yield over benchmark.

### On-Station Trials

**Performance of Improved Crossbreeds:** Three improved crossbreeds (MV1 x S8, HB6 x S8, L3 x S8) were reared along with popular crossbreed (PM x CSR2) thrice and data was analysed.

Performance of Improved Crossbreeds (Mean of Trials)									
Hybrid	ERR/10,000 Larvae		SCW (g)	SSW (g)	Shell Ratio (%)	FIL (m)	Reela-bility (%)	Raw Silk (%)	Renditta
	No.	Wt. (kg)							
MV1xS8	7038	10.45	1.39	0.289	21.76	729	84.93	14.72	6.79
HB6xS8	6393	8.52	1.33	0.269	20.28	741	86.74	14.58	6.86
L1xS8	8718	13.01	1.36	0.275	20.25	759	82.98	14.65	6.83
PMxCSR2	9316	14.55	1.56	0.298	19.07	693	83.87	11.86	8.43
F-test	**	**	NS	NS	**				
CD @ 5%	512	0.90			0.54				

One trial of SHP1 (SH) and six bivoltine double hybrids (DHP1, DHP2, DHP3, DHP5, DHR3, DHR4) was conducted during Nov. - Dec. - 2016.

Performance of New Bivoltine Single and Double Hybrids						
Hybrid	Fec.	ERR (No.)	ERR Wt. (kg)	SCW (g)	SSW (g)	SR (%)
SHP1	480	9574	15.19	1.750	0.932	22.40
DHP1	502	2105	3.13	1.731	0.359	20.73
DHP2	507	7741	11.71	1.877	0.357	19.01
DHP3	515	7283	12.13	1.479	0.329	22.24
DHP5	516	8620	12.52	1.570	0.341	21.71
DHR3	491	9548	16.98	1.446	0.330	22.82
DHR4	511	9737	14.86	1.631	0.366	22.40

One rearing trial of new NPV tolerant bivoltine hybrids (21•27 x 62•26) and (62•87 x 21•118) and S8 x CSR16 was conducted during Dec 2016 – Feb. 2017.

Hybrid	Fec.	ERR (No.)	ERR Wt. (kg)	SCW (g)	SSW (g)	SR (%)
(21•27) x (62•26)	400	9536	16.61	1.595	0.336	21.13
(62•87) x (21•118)	370	8125	12.16	1.668	0.350	20.83
S8 x CSR16	452	8134	12.27	1.975	0.432	21.87

### Continuous/Other Activities

**Popularization of new Silkworm hybrids and mulberry varieties :** Newly developed silkworm hybrids (bivoltine: DH & SH; ICBs) were test verified with farmers and the rearing performance was recorded as a part of popularization. Similarly, new mulberry varieties (V1, G2 and G4) plantation by the farmers was coordinated along with DoS-AP & Telangana (3139.5 acres by 2224 farmers).

Unit	Hybrid	Dfls (Nos)	Yield/ 100 dfls (kg)
REC-Madakasira	S8 x CSR16	2000	72.50
	FC3 x FC4	2000	74.50
	MV1 x S8	2400	65.00
REC SU-Atmakur	S8 x CSR16	8300	66.00
REC SU-Markapur	G11 x G19	2200	63.30
	MV1 x S8	500	64.00
REC SU-Penukonda	S8 x CSR16	100	62.90
REC SU-Chebrolu	S8 x CSR16	3000	69.70
	FC 3 x FC 4	7800	60.60
REC-Rayachoti	S8 x CSR16	1000	64.60
REC SU-Palamaner	G11 x G19	4200	68.40
REC SU-Metpalli	G11 x G19	3000	45.16

**Production of Biological Control Agents:** 811 pouches of *Nesolynx thymus* (2000 pupa/unit) was produced using house fly pupa and supplied to 215 farmers which resulted in significant reduction in the uzi infestation (to 3% level from 16%).

**Capacity Building Training Programmes (CBT):** RSRS and its nested units conducted 35 Farmers Skill Training Programmes (FST; 3days) and trained 423 farmers on various sericulture technologies. 131 officials/students were also trained under 10 Technology Orientation Programme (TOP; 5 & 8 days) at RSRS-Anantapur and its RECs.

**Special Awareness Programmes:** Various special awareness programmes including digital transaction, UPI etc., in the CPP clusters (178 programmes) and sensitised 16046 farmers/stakeholders.

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

**Radio/TV Programmes:** Scientists working at RSRS-Anantapur and its nested units were involved in promoting sericulture technologies through programmes conducted by All India Radio (21) and Television (16) in Andhra Pradesh.

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

Extension Communication Programmes

Centre	Group Discussion	Field Day	Farmers' Day / Enlightenment Prog. / Technology Demo.	Awareness Programmes	Study Tour
RSRS-Anantapur			1 (70)		1 (15)
REC-Madakasira	6 (285)	1 (106)	5 (345)	2 (212)	2 (75)
REC-Kalyanadurg	6 (167)	1 (165)	2 (145)	2 (336)	2 (40)
REC SU-Penukonda	5 (144)	1 (102)	2 (118)	2 (247)	1 (13)
REC SU-Hindupur	5 (187)	1 (105)	4 (245)	2 (175)	2 (17)
REC -V. Kota	6 (205)	1 (130)	2 (119)	1 (160)	
REC SU- Palamaner	5 (139)	1 (39)	2 (155)	2 (172)	
REC-Rayachoty	5 (109)	1 (32)	2 (65)	1 (119)	1 (55)
REC SU-Atmakur	10 (236)	1 (125)	4 (142)	1 (120)	
REC SU- Markapur	7 (235)	1 (127)	4 (215)	1 (120)	2 (24)
REC-Eluru	5 (135)	1 (81)	2 (90)	1 (110)	
REC SU-Chebrolu	7 (228)	1 (150)	2 (50)	1 (160)	
REC-Vikarabad	5 (133)	1 (45)	2 (83)	1 (110)	
REC SU-Suryapet	4 (99)	1 (104)	4 (174)	1 (135)	
REC SU-Metpalli	5 (130)	1 (151)	2 (121)	1 (89)	
REC SU-Bidar	10 (261)				
Total	91 (2693)	14 (1462)	40 (2137)	19 (2265)	11 (239)

ADMINISTRATIVE REPORT

Main Institute

Central Sericultural Research & Training Institute, Mysuru

Regional Sericultural Research Stations (RSRS)

State/Units	RSRS	REC's	REC-SU's	CDP/CDC's
Karnataka	Kodathi	3	13	
	Chamarajanagara		1	
Andhra Pradesh	Ananthapur	5	3	2
Tamil Nadu	Salem	4	5	1
Telangana	Shadnagar	1	2	
Kerala		1		
Maharashtra		3	3	
Madhya Pradesh		1	1	
Total		18	28	3
P4 Basic Seed Farm, Hassan [KA]				
Satellite Silkworm Breeding Station, Coonoor [TN]				

**R&D and Administrative Personnel of CSRTI and Nested Units****R & D Personnel****CSRTI Mysore****Director**

Sivaprasad V

**Scientist-E**

Satish Verma (Engineer)

**Scientist-D**

Anuradha H Jingade  
Balavenkata Subbaiah M  
(upto 31.12.2016)  
Bhagya R  
Chandra Shekar KB  
Chandra Shekar MN  
Dasappa  
Gandhi Doss S  
Gangadhar B  
Girish Naik Vorkady  
Gunasekhar V  
(upto 13.10.2016)  
Kariyappa  
Kishor Kumar CM  
Katiyar RS  
(upto 31.07.2016)  
Mahima Santhi A  
Mal Reddy N  
(upto 31.03.2017)  
Manthira Moorthy S  
Mary Shery (Josepha) AV  
Mogili T (from Jun-2016)  
Munirathnam Reddy M  
(upto 28.02.2017)  
Nagaraja SB  
Narasimha Nayaka AR  
Narendra Kumar JB  
Parameshwara C  
Pratheesh Kumar PM  
Purushotham S  
Rajashekar K  
Sabita MG  
Santha PC

Satyaprasad K  
Somaprakash DS  
Srinivasa BT  
Suma AS  
Vineet Kumar  
Vinod Kumar  
(Upto 30.09.2016)

**Scientist-C**

Geetha GS  
Madhusudhan KN  
Munikrishnappa HM  
Satish B Kulkarni  
Sibayan Sen  
Soudaminy PV  
Vinod Kumar Yadav

**Scientist-B**

Arunakumar GS  
Bhuvaneshwari E  
Gayathri T  
Joycy Rani D  
Kusuma L  
Mallikarjuna G  
Satish L  
Sobhana V  
Tanmoy Sarkar  
Vaijayanthi PV  
Yeruva Thirupathaiiah  
Yashwanth BS  
(upto June 2016)

**Nested Units****Karnataka****Scientist-D**

Ambika PK  
Dayananda  
Himantharaj MT  
(upto 30.06.2016)  
Iswar  
Jalaja S Kumar

(from 01.07.2016)

Jayaram H  
Jagadeesh N  
Lakshmanan V  
Maheswari M  
Meenal R  
Mukund V Kirsur  
Nishitha Naik V  
Noble Morrison M  
Pallavi SN  
Philomena KL  
Raghunath MK  
Raveendra M Mattigatti  
Srikantaswamy K  
(upto 31.03.2017)  
Sudhakar P  
Vedavyasa K  
Venkatachalapathy M

**Scientist-C**

Guruswamy D  
Hanumantharayappa SK  
Mahalingappa KC  
Rameshkumar S  
(from Jun 2016)  
Sanath Kumar YN  
Srinivasulu Y  
(from Jun 2016)  
Sudhakara Rao P  
(upto Jul 2016)  
Umesha A  
(upto May 2016)

**Tamil Nadu****Scientist-D**

Babu CM  
Balasaraswathi S  
Chandrasekaran K  
Dhahira Beevi N  
Gnanakumar Daniel A  
Issac Joseph  
Mary Flora CA

Masilamani S  
Mohamed Babu A  
Mohan B  
Punithavathi G  
Rajakumar S  
Rajalakshmi E  
Rajaram S  
Ravikumar J  
Sakthivel N  
Samuthiravelu P  
Selvaraju NG  
Vijayakumar R

**Scientist-C**

Anbazhagan R  
Humayun Sherief Y  
Mahiba Helen S  
Sivasubramonian T

**Kerala**

**Scientist-D**

Sarala K  
Mohandas TP

**Andhra Pradesh**

**Scientist-D**

Ashok Kumar K  
Ch. Satyanarayana Raju  
(upto 28.02.2017)  
Chowdary NB

Kasi Reddy B  
(upto 31.08.2016)  
Narasimha Murthy B  
Prasad GV  
Reddy MP  
(upto 30.06.2016)  
Shanthan Babu MA  
Srinivasa Rao TVS  
Venkataramana P  
Vidyunmala S  
Venugopal A  
Vijaya Naidu B

**Scientist-C**

Kiran Kumar KP  
Nazeer Ahmed Saheb S  
(from Jun. 2016)

**Telangana**

**Scientist-D**

Praveen Kumar  
Reddy PS  
Sanjeeva Rao BV  
Srinath B

**Maharashtra**

**Scientist-D**

Bagde AP  
(from Jan. 2017)  
Karande AJ

Kushwaha RV  
Rahul Singh  
(from Jan. 2017)  
Ram Prakash

**Madhya Pradesh**

**Scientist-D**

Khare RK  
(upto 31.08.2016)  
Pradeep Shukla

**Technical Personnel**

Ganesan V - DD (Comp)  
Rekha M - AD (Stat.)  
Sumathy R - Info. Officer  
(DBT-Sub DIC)

**Administrative Personnel**

Mohan Jadhav R - EE  
(upto 31.10.2016)  
Balappa Yallappa Talawar - LIO  
Bheem Sen Pappu - AD (Pub)  
Girijamma - AD (A&A)  
Jayashree V - AD (OL)  
(upto Feb 2017)  
Mohan - AD (A&A)  
Rama Rao HK - AD (A&A)  
Vishwanath BS - AD (A&A)  
Yoganarasimha S - AD (A&A)  
(upto 31.08.2016)

**Budget (Rs. In lakhs) for 2016-17**

Particulars	Grant Released	Expenditure
Non-Plan	4,706.67	4,699.70
Plan-Gen-31	549.46	549.46
Plan-Cap-35	186.85	186.85
Total	5,442.98	5,436.01

## RESEARCH ADVISORY COMMITTEE

### Chairman

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Prof. M. Ananthachar

Former Dean (Ag. Engg.) & Professor and Head, Dept.  
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**Member Convener**

Dr. V Sivaprasad  
Director  
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**Meteorological Data 2016: CSRTI-Mysuru**

Month	Temperature [°C]			Relative Humidity [%]			Rainfall (mm)
	Max.	Min.	Avg.	Max.	Min.	Avg.	
January	31.80	22.00	26.90	84.00	58.00	71.00	0.40
February	35.30	21.70	28.50	90.00	49.00	69.50	0.00
March	37.10	22.90	30.00	83.00	41.00	62.00	3.00
April	39.90	24.40	32.15	81.00	39.00	60.00	19.00
May	38.10	24.20	31.15	98.00	79.00	88.50	109.40
June	32.30	22.50	27.40	95.00	90.00	92.50	93.80
July	31.50	23.00	27.25	96.00	82.00	89.00	141.50
August	31.80	20.60	26.20	90.00	81.00	85.50	38.10
September	32.10	20.60	26.35	84.00	75.00	79.50	9.10
October	32.90	21.30	27.10	88.00	73.00	80.50	11.20
November	32.80	21.60	27.20	79.00	65.00	72.00	0.00
December	31.90	19.40	25.65	96.00	84.00	90.00	32.00
Mean	33.96	22.02	27.99	88.67	68.00	78.33	
Extm. High	39.90	24.40		98.00	90.00		141.50
Extm. Low	31.50	19.40		79.00	39.00		0.00
Total Rainfall							457.50
No. of Rainy Days							53

## PUBLICATIONS

### International Journals

- Anbu Radhika, S.; Sakthivel, N. and Sahayaraj, K. (2017) Acceptance of tertiary and non-food plants by eri silkworm, *Samia cynthia ricini* Boisduval (Lepidoptera: Saturniidae). *Munis Entomol. & Zool.*, 12 (1): 127-132.
- Balavenkatasubbaiah, M.; A.V. Mary Josepha, P.; Vineet Kumar; Satheesh, B. and Sivaprasad, V. (2017) Morphology and pathogenicity of a new microsporidian isolated from silkworm, *Bombyx mori* L. crops of Pure Mysuru seed area of Karnataka, India. *Sericologia*, 57(1):32-38.
- Balavenkatasubbaiah, M.; A. V. Mary Josepha, P.; Narasimha Nayaka, A. R. and Sivaprasad, V. (2016) Serifit – A disinfectant for effective sanitation in Indian sericulture. *Sericologia*, 56(4):253-261.
- Balavenkatasubbaiah, M.; Sharma, S. D.; Chandrasekharan, K.; Narasimha Nayaka, A. R. and Sivaprasad, V. (2015) Silkworm Disease Management Technology for higher Cocoon Productivity and Crop stability- A Success Story. *Int. J. Res. Zool.*, 5(1): 1- 4.
- Chowdary, N.B.; Ch. Satyanarayana Raju, Govindaiah and Sivaprasad, V. (2015) Discriminant function analysis of factors associated for the outbreak of root rot disease in Mulberry (*Morus* Spp.). *Sericologia*, 5(3): 165-172.
- Daphine, R. and Daniel, A. G. K. (2016) Attitude towards Individualization is behind the success in learning science through computer technology. *Int. J. Multidisciplinary Res.Rev.* 1(3): 28-30.
- Dayananda; Sivaprasad, V.; Kulkarni, S. B.; Parameswara, C. and Kariyappa (2016) Identification of improved crossbreeds of silkworm, *Bombyx mori* L. suitable for Southern India. *Int. J. Plant, Animal & Envir. Sci.*, 6(1): 109-113.
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- Geetha, G. S. (2016) Asset possession status and work participation levels of farm women - A case study of Sericulture. *Global J. Seric. & Cotton Prod.*, 1(1):1-4.
- Geetha, G. S. and Sudhakar Rao, P. (2016) Group approach and technology adoption - A case study in sericulture. *Global J. Interdisciplinary Social Sci.*, 5 (3):52-56.
- Geetha, G. S.; Rekha, M.; Punithavathy, G.; Ambika, P.K. and Raghupathi, M. (2015) Assessment of current status of women farmers in sericulture using empowerment indicators. *Sericologia*, 55 (2):122-128.
- Mahimasanthi, A.; Daniel, A.G.K. and Sivaprasad, V. (2016) Extent of adoption of drought management technologies in mulberry sericulture in southern dry zone of Tamil Nadu. *Int. J. Trop. Agric.*, 34(1): 95-102.
- Narendra Kumar, J.B.; Vinod Kumar and Sivaprasad, V. (2017) Holistic approach for effective management of silkworm uzi fly, *Exorista bombycis* (Louis) (Diptera: Tachinidae). *Sericologia*, 57(1): 53-57.
- Rajaram, S.; Nirmal Kumar, S. and Sivaprasad, V. (2016) Weather based computation and management of irrigation water for mulberry crop in Gangetic alluvial soil under West Bengal conditions. *Int. J. Trop. Agric.*, 34: 69-74.
- Rukmangada, M.S.; Sabitha, M.G.; Sivaprasad, V. and Naik, V.G. (2016) Genetic variation in photosynthetic parameters and SPAD chlorophyll content among a diverse set of mulberry (*Morus* spp.) germplasm. *Sericologia*, 56(3):139-148.

- Satish, L.; Kusuma, L.; Moorthy, M.S.; Sivaprasad, V. (2017) Interactome analysis of protein kinases, germination related and horizontally transferred genes of *Nosema bombycis* using String. *Int. J. Adv. Res.*, 5(2), 497-506.
- Sivaprasad, V. and Vineet Kumar (2015) Scanning electron microscopic studies on the head appendages and its sensory structures of an immature stage of *Spilarctia obliqua* (Wlk.) (Lepidoptera : Arctiidae) - A pest of mulberry (*Morus sp.*). *Redia*, 98:161-165.
- Sreenivasa, B. T.; Divya, S. H.; Narendra Kumar, J. B. and Sivaprasad, V. (2016) Laboratory evaluation of chemicals against giant African snail, *Achatina fulica* Bowdich and bio-assay studies on the silkworm, *Bombyx mori* (Linn.). *Biolife*, 4(2): 289-294.
- Yadav, V.K.; Pratheesh Kumar, P.M. and Sivaprasad, V. (2016) Nitrification inhibitors mediated enhanced nitrogen use efficiency in mulberry (*Morus spp.*). *Int. J. Plant, Ani. & Envir. Sci.*, (6):103-109.

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- Balavenkatasubbaiah, M.; Rajkumar, S.; Thirunavakarasu, T.; Selvaraj, M.P.; Chandrasekharan, K.; Mary Josepha, A. V.; Narasimha Nayaka, A. R. and Sivaprasad, V. (2015) Impact of silkworm diseases on cocoon productivity in the selected areas of Tamil Nadu, India *Indian J. Seric.*, 54(1-2):51-59.
- Balavenkatasubbaiah, M.; Sivashankar, N.; Maheswari, M.; Mathur, V.B.; Chandrasekharan, K.; Narasimha Nayaka, A. R. and Sivaprasad, V. (2014) Prevalence of silkworm diseases and their impact on cocoon productivity in the selected areas of Karnataka, India. *Indian J. Seric.*, 53(2):51-59.
- Dhahirabeevi, N.; Helen, M.S.; Thirunavukkarasu, T. and Chikkanna (2014) Field evaluation of *Chrysoperla zastrowi sillemi* (Esben-Peterson) (Neuroptera: Chrysopidae) and neem cake for the management of thrips *Pseudodentothrips mori* (Thripidae: Thysanoptera) on mulberry in Tamil Nadu. *Indian J. Seric.*, 53(2): 36-39.
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- Joycy, R. D. and Bhakthavatsalam, K. V. S. (2017) An overview of finance in Sericulture, *Agro-bios Newsletter*, XV (8): 119-120.
- Joycy, R. D. and Bhakthavatsalam, K. V. S. (2017) Farmer Producer Organization (FPO) for the benefit of farmers, *Agro-bios Newsletter*, XV (9): 129-131.
- Joycy, R. D.; Suresh S. Patil.; Veerabadrappa Bellundagi, K. V. S. and Bhakthavatsalam, N. (2016) Impact of minimum support price on farmers economy in North-East Karnataka. *Green Farming*, 7(1): 197-202.
- Mallikarjuna, G.; Neetha, N. K.; Manjunatha, B.; Sivaprasad, V. and Syam Kumar (2016) A mini review of functional proteins in silkworm *Bombyx mori* L., haemolymph. *Indian J. Sci. & Tech.*, 9(38): 1-8.
- Mamrutha, H. M.; Nataraja, K. N.; Rama, N.; Kosma, D.K.; Mogili, T.; Jhansi Lakshmi, K.; Udayakumar, M. and Jenks, M.A. (2017) Leaf surface wax composition of genetically diverse mulberry (*Morus sp.*) genotypes and its close association with expression of genes involved in wax metabolism. *Curr. Sci.*, 112 (4): 759-766.
- Mandal, K. and Moorthy, S.M. (2015) Analysis of phenotypic stability for yield and yield components in bivoltine silkworm hybrids. *Indian J. Seric.*, 54(1&2): 36-45.
- Nishitha Naik, V. and Sowmya, P. (2014) A new record of Gummosis disease in mulberry (*Morus spp.*) caused by

*Macrophomina phaseolina*. *Indian J. Seric.*, 53 (2): 34-35.

Nishitha Naik, V.; Sharma, D. D.; Thippeswamy, T. and Sivaprasad, V. (2015) Integrated approach for management of root disease complex in mulberry (*Morus* spp.) *Indian J. Nematol.*, 45 (2): 207-212.

Pratheesh Kumar, P.M. and Swetha, M. S. (2016) Exploration of glucosinolate hydrolysis activity in Brassica plants for suppression of root rot disease of mulberry. *J. Mycol. & Plant Path.*, 46(3): 242-249.

Radhalakshmi, Y. C., Kariyappa and Sivaprasad, V. (2014) Studies on interrelation among cocoon and reeling characteristics *Indian J. Seric.*, 53(2): 65-70.

Sharma, D. D.; Pratheesh Kumar, P. M.; Chowdary, N. B.; Rajkumar, S.; Nishitha Naik, V., Tippeswamy, T. and Sivaprasad, V. (2014) Nemahari - An effective plant based formulation for control of root knot disease of mulberry. *Indian J. Seric.*, 53(2): 28-33.

Sivaprasad, V.; Mal Reddy, N. and Moorthy, S. M. (2015) Development of highly productive silkworm hybrid, S8xCSR16 of *Bombyx mori* L., for higher cocoon yield and crop stability. *Indian J. Seric.*, 54(1&2): 29-35.

Yadav, V. K., Pratheesh Kumar, P. M. and Sivaprasad, V. (2016) Effect of nitrification inhibitors on physio-chemical, growth and yield attributes of mulberry. *Envir. Conser. J.*, 17(3): 1-9.

#### Popular articles

Mogili, T.; Prasad, G. V.; Satyanarayana Raju, Ch. and Sivaprasad, V. (2016) Thakkuva neetitho saguku anuvaina mulberry chetla pempakam. *Annadata*, 48(9): 68-70. (Telugu).

Narendra Kumar, J.B. (2016) Management of thrips in mulberry (in Kannada). *Krishimitra*, 13(4): 32-33.

Narendra Kumar, J. B. (2016) May-June beetles attacking mulberry and control measures. (in Kannada) *Reshme Krishi*, Sept.-Oct., p: 17-18.

Rajakumar, S. and Sakthivel, N. (2016) Income through crafting of cocoon, Women Today, *The Hindu* (Tamil), 14th August 2016.

Sakthivel, N. (2016) Management of weeds by cover cropping in new mulberry garden, *Pattu Malar*, October, 2016, Department of Sericulture, Government of Tamil Nadu. p:11-13.

Sakthivel, N. (2016) Mulberry pest management guidelines through "WhatsApps", *The Hindu* (Tamil), 27th July 2016.

Sakthivel, N. (2016) Secondary contamination in silkworm rearing and management. *Pattu Malar*, December, 2016, Department of Sericulture, Government of Tamil Nadu. p:16-18.

Sakthivel, N. (2017) Additional income from mulberry garden through intercrop, Nilamum Valamum (Land & Prosperity), *The Hindu* (Tamil), 11th February 2017.

Satish Verma and Bindroo, B. B. (2016) Young age silkworm dusting machine - *Indian Silk*, 7(55 old) (8):20-21.

Sreenivasa, B.T.; Narendra Kumar, J.B. and Divya, S.H. (2016) Infestation of giant African snail in mulberry and its management. (in Kannada) *Reshme Krishi*, Sept-Oct., 2016, p:3-4.

Yadav, V.K; Dasappa, D. and Sivaprasad, V. (2016) Mulching and their importance in mulberry cultivation. *Resham Kiran*, p: 6-7.

### Technical Reports

- Kushwaha, R. V. (2016) Awareness programme at Jalgaon on 13.06.2015. *Indian Silk*, 6(54 old) (3-5):38.
- Kushwaha, R. V. (2016) Awareness programme at Yavli Sahid on 03.07.2015. *Indian Silk*, 6(54 old) (3-5):38.
- Kushwaha, R. V. (2016) Awareness programme at Talkhed Amravati on 05.08.2015. *Indian Silk*, 6(54 old) (3-5):39.
- Kushwaha, R. V. (2016) Farmers Skill Training at Alegaon Akola on 28-29.09.2016. *Indian Silk*, 7(55 old) (8):40.
- Kushwaha, R. V. (2016) Farmers Skill Training at Jamthi Buldana on 20-22.09.2016. *Indian Silk*, 7(55 old) (8):40.
- Kushwaha, R. V. (2016) Farmers Training at Shirla, Akola on 22-23-07.2015. *Indian Silk*, 6 (54 old) (3-5):42.
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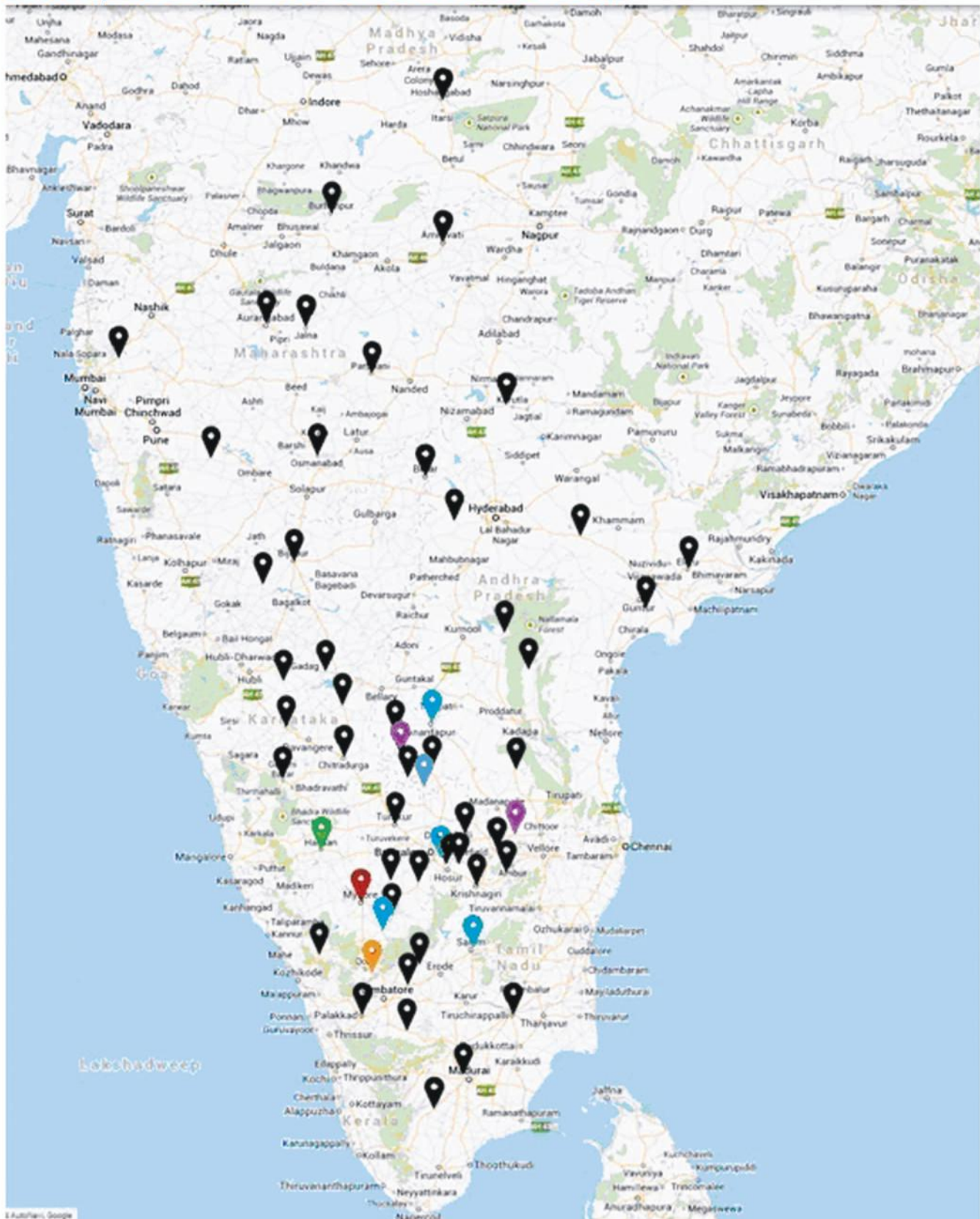
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## Highlights of Research Framework Document (RFD)

#	Success Indicator	Unit	Target	Acheivement
1	Total on- going Projects	No.	30	42
2	Projects Concluded	No.	14	14
3	New Projects taken up	No.	10	13
4	Research Projects (ongoing) at RSRS's	No.	5	6
5	No of Technologies / innovations developed /likely to be developed out of concluded projects	No	6	9
6	New Technologies for field testing	No	4	8
7	Equipment/ machines newly developed for sericulture mechanization	No.	2	1
8	Machines / equipment absorbed in the field	No.	2	2
9	Technologies commercialized	No.	2	4
10	Technologies applied for patenting (patents filed)	No.	2	1
11	No. of Farmers database created for m-Kisan Portal	Number	50000	50900
12	No. of Messages up-loaded in M-Kisan Portal	No	96	96
13	Up-loading of data in " Seri-5k" Portal	%	95	95
14	No. of Research Projects uploaded for E-Monitoring	Nos	34	42
15	Digitization of Soil Health Records	No.	10000	10007
16	Preparation of Technology descriptor adoption document	Date	5/15/2016	20.12.2016
17	Number of Seri-model Village identified	Number	11	11
18	No. of farmers adopted	No	1100	1100
19	Expected raw silk output	MT	80	82.98
20	No. of Dfls proposed for large scale trial	Nos.	2 L	0.1829
21	Number of Blocks/Districts adopted	Number	106	106
22	No. of farmers covered	No.	26000	26000
23	Raw silk Output	MT	3100	2886.41
24	Popularization of improved mulberry varities	acres	800	9357.24
25	No. of villages covered under "Swachha Resham Gram"	No	2	1
26	Adoption of villages	%	100	100
27	Number of farmers coverd under 100% adoption of technology	Number	11000	11000
28	No. of programmes conducted	No	1000	2473
29	No. of farmers covered	No	35000	142069
30	Post programme follow up	%	80	80%
31	Participation in Radio Programme	No	16	54
32	Participation in TV Programme	No	16	41
33	No. of Seri Tourism corridor developed		2	
34	Beneficiaries trained under structured programmes, need based programme etc.	No	1640	2811
35	Revenue generation through commercialization of Technology	Rs.In lakh	4	13.96
36	Revenue generation through other methods	Rs.in lakh	90	165.8
37	Effective utilization of cultivable land for assigned mandates	Acres	45	45
38	Extent of utilization of facilities for the core purpose of assigned mandates	%	95	95
39	Utilization of scientific manpower for research activities	%	95	95
40	Projects taken up for collaborative research	No.	5	5

# CSRTI, MYSORE - EXTENSION NETWORK



Basic Seed Farm	01	Regional Sericulture Research Station	05
Cluster Dev. Centre	03	SU of Research Extn. Centres	28
Cluster Promotion Centre	01	Satellite Silkworm Breeding Station	01
Research Extn. Centre	18		



Inauguration of International Workshop on 'Potential of Sericulture and Silk Industry for Employment and Income Generation in AARDO Member Countries' 11<sup>th</sup> to 16<sup>th</sup> April 2016 at Mysuru



Inauguration of Swatch Bharat Abhiyan Programme at Adarsh Reshem Gram, Gopalapura village on 23-06-2016



Resham Krishimela at Doddaballapura on 17-02-2017

केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान  
(आई एस ओ 9001 : 2015 प्रमाणित)

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