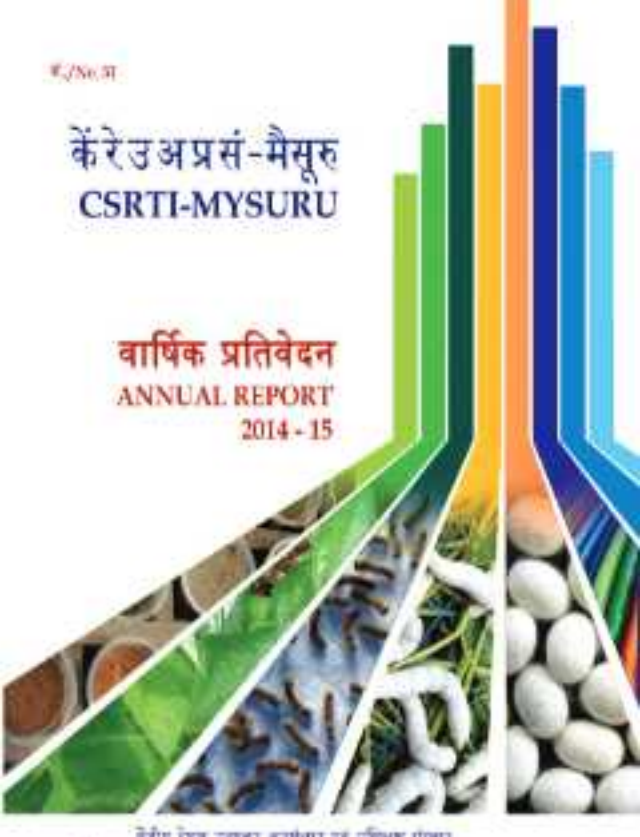
ಕೇ.ರೇ.ಉ.ಅ.ಪ್ರ.ಸಂ-ಮೈಸೂರು/No.31

केंरेउअप्रसं-मैसूरु
CSRTI-MYSURU

वार्षिक प्रतिवेदन
ANNUAL REPORT
2014 - 15



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(ISO 9001:2008 Certified)
Central Silk Board, Ministry of Textiles, Government of India, Mysuru - 570 008

CSRTI-Mysuru

ORGANISATIONAL SET-UP

सं.No. 31

वार्षिक प्रतिवेदन
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केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान

CENTRAL SERICULTURAL RESEARCH AND TRAINING INSTITUTE

[redacted]

संकलन
डॉ विनीत कुमार
श्री एच.एम. पुनीथकुमार
संतोषी एल. पिंटो
श्री जे. जगदीश कुमार

Compilation
Dr. Vineet Kumar
Shri H.M. Punitkumarappa
Smt. M. Pinto
Shri J. Jagdis Kumar

हिन्दी अनुवाद
संतोषी वी. जयश्री
संतोषी के. दर्शि

Hindi translation
Smt. V. Jayashree
Smt. K. Darshi

सहायता
श्री एम.के. मंजुनाथ
संतोषी वासन बिंब कुमारी वी.सी.

Assistance
Shri M.K. Manjunath
Smt. Vasan Bhi Kumari V.C.

मुख पृष्ठ डिज़ाइन
श्री वी. गणेशन
श्री जे. जगदीश कुमार

Cover Design
Shri V. Ganesan
Shri J. Jagdis Kumar

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मेसर्स गुड टच प्रिंटर्स, मैसूरु
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CONTENT

ENDOW

मेसर्स. मैसूर एक अग्रणीय संस्थान है और उसकी गतिविधियां विभिन्न स्थानों पर फैली हुई हैं। अतः यह आवश्यक था कि ऐसी एक प्रणाली विकसित की जाए जो उन सभी स्थानों पर फैली हुई गतिविधियों को एकीकृत कर सके। इसी आवश्यकता को ध्यान में रखते हुए यह विकास किया गया है। यह प्रणाली सभी कार्यालयों को एकीकृत करती है। इसमें सभी कार्यालयों के लिए एक केंद्रीय डेटाबेस है। यह प्रणाली वेब आधारित है। इसमें उपयोगकर्ता के लिए एक सरल इंटरफेस है। यह प्रणाली विभिन्न कार्यालयों के बीच संचार को सुगम बनाती है। यह प्रणाली विभिन्न कार्यालयों के बीच समन्वय को बढ़ावा देती है। यह प्रणाली विभिन्न कार्यालयों के बीच सूचना के आदान-प्रदान को सुगम बनाती है। यह प्रणाली विभिन्न कार्यालयों के बीच संसाधनों के साझाकरण को बढ़ावा देती है। यह प्रणाली विभिन्न कार्यालयों के बीच कार्यों के समन्वय को बढ़ावा देती है। यह प्रणाली विभिन्न कार्यालयों के बीच संचार को सुगम बनाती है। यह प्रणाली विभिन्न कार्यालयों के बीच सूचना के आदान-प्रदान को सुगम बनाती है। यह प्रणाली विभिन्न कार्यालयों के बीच संसाधनों के साझाकरण को बढ़ावा देती है। यह प्रणाली विभिन्न कार्यालयों के बीच कार्यों के समन्वय को बढ़ावा देती है।

इस बीच मुख्य ट्रिपल फेस एलायंस सहयोगी की संख्या 20 से अधिक हो गई। संस्थान, विज्ञान प्रौद्योगिकी और कृषि में व्यापक स्तर पर सहयोग करता है। 2 अप्रैल, मैसूर में मुख्य समारोह में 2 से 5 अप्रैल तक आयोजित किया गया। इसमें 2 अप्रैल को मुख्य समारोह में 3 अप्रैल को विभिन्न स्थानों पर समारोह आयोजित किए गए। 4 अप्रैल को विभिन्न स्थानों पर समारोह आयोजित किए गए। 5 अप्रैल को विभिन्न स्थानों पर समारोह आयोजित किए गए। इस समारोह में 20 से अधिक देशों के प्रतिनिधियों ने भाग लिया। इस समारोह में 100 से अधिक वैज्ञानिकों ने भाग लिया। इस समारोह में 50 से अधिक वैज्ञानिकों ने भाग लिया। इस समारोह में 30 से अधिक वैज्ञानिकों ने भाग लिया। इस समारोह में 20 से अधिक वैज्ञानिकों ने भाग लिया। इस समारोह में 10 से अधिक वैज्ञानिकों ने भाग लिया। इस समारोह में 5 से अधिक वैज्ञानिकों ने भाग लिया।

इस वर्ष संस्थान द्वारा दो नई परियोजनाएं शुरू की गई हैं। पहली परियोजना का उद्देश्य विभिन्न स्थानों पर फैली हुई गतिविधियों को एकीकृत करना है। दूसरी परियोजना का उद्देश्य विभिन्न स्थानों पर फैली हुई गतिविधियों को एकीकृत करना है। इन परियोजनाओं के लिए 2 करोड़ रुपये की राशि आवंटित की गई है। इन परियोजनाओं के लिए 1 करोड़ रुपये की राशि आवंटित की गई है। इन परियोजनाओं के लिए 50 लाख रुपये की राशि आवंटित की गई है। इन परियोजनाओं के लिए 25 लाख रुपये की राशि आवंटित की गई है। इन परियोजनाओं के लिए 10 लाख रुपये की राशि आवंटित की गई है। इन परियोजनाओं के लिए 5 लाख रुपये की राशि आवंटित की गई है।

डॉ. सी. विश्वनाथन, निदेशक

FOREWORD

CSRTI-Hosur is a thriving institution and its privilege is present here also. We challenges have led to both & may better, stakeholder revised to build on past accomplishments and expertise, but not rest on them. We are excited about the outcomes described in these pages. Major achievements from R&D includes identification of promising mulberry genotypes, which surpassed V1 variety in their yield-related characters; development of three productive and bivoltine hybrid silkworm breeds for evaluation and four thermo-tolerant silkworm breeds; development of 'Cauvery Silk', an improved crossbreed producing international grade silk; development of cocoon harvesters for cottage level mountages and boiling cum disinfection machine.

CSRTI-Hosur, a frontline institutional towards achieving the country's vision of silk production and coordinated cluster promotion programmes in South Zone in Andhra Pradesh, Karnataka, Kerala, Madhya Pradesh, Tamil Nadu, Telangana and Maharashtra. About 60% of total silkworm seed production, 2241 MT, which is an all-time record, was produced through 100 clusters by effective coordination efforts of CSB and DOD personnel. Institute Village Linkage Programme on 'Soil Model Village' was re-initiated at 11 locations for complete transfer of technology, which recorded 2.5% improvement in cocoon yield. Japan Overseas Cooperation Volunteers (JICA) have initiated work in Andhra Pradesh, Tamil Nadu and Karnataka for extending CBOs in farmer interacting bivoltine sericulture programmes. The latest developments in sericulture are delivered to the farmers by organizing extension communication programmes including farmers' conventions.

This year witnessed initiation of an EDP sponsored by NABG for the commercialization of cocoon harvesters. Eight technologies developed by the institute were commercialized through NABG to enhance avenues for effective supply and utilization. Six plant applications on scientific inventions were submitted to National Biodiversity Authority for clearance. The scientists of our institution contributed intellectually in publishing research results, popular articles and technology brochures in sericulture.

Conservation of traditional resources for sericulture sector is one of the critical mandates of our institution. The current year saw no different, and several stakeholders were trained in various aspects including 459 breeds/cycles under integrated Skill Development Scheme (ISDS), 797 under sponsored and need based programmes including 137 extension days in DRC activities. An ITEC-Indian Technical & Economic Cooperation training programme on Sericulture and Silk Industry sponsored by Ministry of External Affairs, Govt. of India was also initiated for 14 trainees from Bangladesh, Philippines, Uganda, Thailand and Egypt.

Further, a growing pipeline of mulberry varieties, silkworm hybrids and tech nological innovations are being perused for improving the productivity and sustainability of sericulture. Diverse R&D programmes were initiated in the current year with diverse, purposeful, innovative and action oriented partnerships for developing more productive and resilient technologies. I am hopeful that as we learn, our understanding will grow and we together with our associates and stakeholders as partners will become even more effective in making sericulture sustainable.

Dr. V. Sivaprasad, Director

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ABOUT CSRTI MYSURU

The Central Sericultural Research & Training Institute (CSRTI), Mysuru was established under the aegis of Central Silk Board, Ministry of Textiles, Govt. of India. The Institute started functioning at it's present address in the year 1961 after being given the Sericulture Research Institute of erstwhile Mysuru Government and later shifted to Hosur in the year 1963. With the inception of training component, the institute was renamed as "Central Sericulture Research & Training Institute (CSRTI), in years of the year 1965. The Institute has completed 40 years of dedicated service for the development of sericultural industry in the country. The Institute is accredited with ISO 9001:2008 certification (2012) 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 one of the premier institutions for sericulture research par excellence with all modern facilities and infrastructure including state-of-the-art 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 centre for higher learning and advanced training. CSRTI caters to the need of mid-tier sector of mulberry sericulture in Karnataka, Andhra Pradesh, Tamil Nadu, Telangana, Kerala, Maharashtra and Madhya Pradesh. To date CSRTI trained about 30,000 personnel including 638 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.

Vision
To become an international sericulture institute par-excellence in silkworm Genetic/race

Mission	Objectives
To achieve excellence in application oriented research in transform Indian Sericulture industry from the subsistence level of production to a vibrant competitive commercial production base	. Research to enhance production, productivity and quality of mulberry silk . Development of package of practices for mulberry and silkworm rearing . Commercialization of cocoons and technologies . Transfer of technology . Enhance production of import substitute silk through transfer of technology . Training . Strengthening institutional framework to support economic programmes . Maintenance of germplasm stock . Disease free seed production . Promotion of R&D and utilization and package of practices . Collaborative research with other R&D organizations in India and abroad

Organization Setup

CSRTI-Mysuru is the largest and most active scientific institution engaged in sericulture R & D in the country, supported by about 139 scientists of various disciplines including agricultural engineers, sociologists and biometrists. These personnel working in close coordination for the development of appropriate technologies and their transfer through the main institute and the several units spread in the states of Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Kerala, Maharashtra and Madhya Pradesh. R & D activities and technology development are carried out in four major divisions: Host Plant Production & Protection, Silkworm Production & Protection, Extension and Training. CSRTI-Mysuru also utilizes the services of several able technical and administrative staff in accelerating the mandated activities. The Director monitors the progress of R & D activities of the institute and several units with the support of Planning, Monitoring,

Coordination and Evaluation cell. CIRTI-Mysuru regularly publishes books, bulletins, leaflets and technical pamphlets. Over 30 books have been brought out so far in addition to large number of technical and research papers published in leading institutional and international journals. The institute has the distinction of publishing its own journal for its users, a mainstream journal of international repute and standard - documenting literature on sericulture sciences.

Extension Network

CSRTI-Mysuru has a three tier system of extension networks. Regional Sericultural Research Stations (RSRS), Research Extension Centres (REC) and Outreach Units (REC-OU) to facilitate validation and translation of laboratory findings effectively to the field. RSRSs are located in major sericultural zones of Southern States carrying out ongoing specific adaptive and applied research. Technology Kits are also constituted to suit the regional requirements besides arranging training to farmers and grassroot level extension staff. RECs and sub-units at are the major responsibility of technology transfer to the beneficiaries and also provide technological inputs and support services. CSRTI-Mysuru coordinates 106 clusters (Cluster Promotion Programme) and also run 'HLP centers for the promotion of cocoon sericulture in Southern States along with Maharashtra and Madhya Pradesh. Effective transfer of technologies is undertaken in close coordination with technical personnel of State Departments of Sericulture.

Training Centre

CSRTI-Mysuru is recognized as Regional centre for generation of trained human resources in tropical sericulture at international and national level. The institute is affiliated to University of Mysuru for conducting research including Ph.D. programmes. CSRTI-Mysuru also conducts training programmes sponsored by DBT, DST and Ministry of Textiles, Govt. of India to accelerate economic and technological empowerment of the rural poor, weaker sections and women sericulturists. Besides catering to the HRD needs of the state departments of sericulture in the country, CSRTI-Mysuru also conducts sericulture training programmes for international students/scientists through various organizations such as I-CCA and Ministry of External Affairs, Govt. of India (ITEC). The training has hi-tech well-equipped class rooms and the programmes are managed by qualified faculty. The attached hostel 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
- Modern Chawki Rearing Center (CRC) to promote the concept of CRC
- Engineering Division with excellent facilities to support designing, development and fabrication of machines / equipments
- Video Conference Studio @ CSRTI, Mysuru, a state-of-the-art facility for conducting live and effective interaction of the technology for effective interactions with farmers' units, DDSs and other organizations
- Computer centre provides Internet connectivity to all through LAN with printing and scanning support
- Maintenance Centre (MMU) at CSRTI-Mysuru, DBT Govt. vehicle to ease mobility and services
- Library Services : (1) 7253 books, 6362 bound volumes of sericulture journals, 90 journals, class notebooks: 250, Theses 20, technical reports and CD-ROM databases: AGRIS, BIOSIS, ENTOMOLOGY DATA BANK INDEX, BIMSWA

अनुसंधान प्रशिक्षण एवं विस्तार कार्यकलापों के मुख्यांश

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मानव संसाधन विकास

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- व्यावसायिक गतिविधियाँ: इकाइयां व्यावसायिक रूप से उपलब्ध के 10 अनुकूलित के लिए अनुसंधान उपकरण उपलब्ध हो सकेंगे। उपकरण डिजाइन, रेखा संयोजन, व्यवस्था उपकरण प्रयोगशाला विकास उपकरण भी किया जाएगा भी किया जाएगा। प्रौद्योगिकी अनुकूल उपकरण को उपलब्ध किया गया है।

वार्षिक रिपोर्ट उपकरण अनुसंधान रेशम की उपलब्धियों विश्लेषणात्मक है :

रेशम के लिए, अनंतपुर

- रेशम कपास रेशम उपकरण उपकरण
  मादा कुशली मार्केटिंग : 11,317 कुशली में रेशम कुशली का 50.69 तथा तथा में हैं। में व्यवसाय का व्यवसाय किया और रेशम 21,510 में हैं। में व्यवसाय का व्यवसाय उपकरण 24,650 में हैं। में व्यवसाय का व्यवसाय किया और 1950 के 100 में हैं। में व्यवसाय की प्रौद्योगिकी व्यवसाय की की की। और व्यवसाय की कुशली में व्यवसाय, कुशली की की।
- प्रौद्योगिकी व्यावसायिक मार्केटिंग
  1970 कुशली में उपकरण का 50 का 100 x 50 की एक आय 17 की 1,410 उपकरण में हैं। में व्यवसाय का मुनाफा किया गया था। उपकरण किया गया था। 1990 में में व्यवसाय की प्रौद्योगिकी उपकरण उपकरण उपकरण कुशली हैं। किया प्रौद्योगिकी व्यवसाय, प्रौद्योगिकी। किया मार्केटिंग का मुनाफा। किया का व्यवसाय का 2013-2014 में 1.0% का प्रतिशत किया गया। व्यवसायिक उपकरण किया था। और मुनाफा व्यवसाय उपकरण की किया गया है। व्यवसाय का उपकरण की किया गया।
- निवेशक व्यवसाय मार्केटिंग
  मार्केटिंग 1990 किया। की व्यवसाय 1970 किया। में किया उपकरण कुशली व्यवसायिक मार्केटिंग की गई। 1 किया किया व्यवसाय मार्केटिंग के व्यवसाय में कुशली 1700 कुशली मार्केटिंग हुए।
- प्रौद्योगिकी मार्केटिंग
  प्रौद्योगिकी उपकरण मार्केटिंग के व्यवसाय 1970 में में 1,200 कुशली तथा में 5 हुए। में के के व्यवसाय किया। मार्केटिंग की प्रौद्योगिकी किया गया।

रेशम के लिए, खनिजनगर

- व्यवसाय एवं विकास मार्केटिंग
  व्यवसाय मार्केटिंग में उपकरण व्यवसाय की व्यवसायिक का उपकरण कार्य हेतु व्यवसाय कुशली के लिए। मार्केटिंग उपकरण का उपकरण किया गया। कुशली व्यवसाय प्रौद्योगिकी के व्यवसाय कुशली में के किया कुशली में 2,200-2,500 मिलियन। उपकरणों व्यवसाय के उपकरण में 2,200-2,500 मिलियन। उपकरणों किया का व्यवसाय में 90,000। 21,000 का प्रौद्योगिकी उपकरण उपकरण में व्यवसाय में।
  मुख्य मिलेनियम प्रौद्योगिकी। प्रौद्योगिकी उपकरण उपकरण उपकरण में। में प्रौद्योगिकी। का व्यवसाय कुशली का। में 1 में। में व्यवसाय प्रौद्योगिकी 2,000 किया व्यवसाय की कुशली में व्यवसाय का कुशली 1 में 1,000 मिलियन का किया कुशली। व्यवसाय किया। व्यवसाय में व्यवसाय कुशली में 2,2,000 में की कुशली 1 में 1, 2,000 उपकरणों का की की कुशली।
- प्रौद्योगिकी व्यावसायिक मार्केटिंग
  जिले प्रौद्योगिक व्यवसाय, जिले व्यवसाय जिले कुशली जिले की व्यवसाय व्यवसाय कुशली कुशली उपकरण का 12.00% का 1.14% का प्रतिशत किया गया। कुशली प्रौद्योगिकी किया व्यवसायिक का व्यवसाय व्यवसाय का कुशली प्रौद्योगिकी उपकरण में 2,000 के 2,400 का की कुशली।
- प्रौद्योगिकी मार्केटिंग
  प्रौद्योगिकी उपकरण उपकरण मार्केटिंग के व्यवसाय 10 की में 1,100 कुशली तथा 2 कुशलियों। के उपकरण जिले व्यवसायिकों का प्रौद्योगिकी किया गया।

रेशम के लिए, कोलार

- रेशम कपास रेशम उपकरण उपकरण
  उपकरण का कुशली में कुशली उपकरण जिले 2,000 का 2,200 उपकरण में हैं। उपकरण का उपकरण किया। मार्केटिंग उपकरण 1,410 उपकरण 1,200 में हैं। में व्यवसाय का व्यवसाय किया। उपकरण उपकरण की 2013-14 में हैं। में व्यवसाय का उपकरण किया गया।

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HIGHLIGHTS OF RESEARCH, TRAINING AND EXTENSION ACTIVITIES

MULBERRY CROP IMPROVEMENT, PRODUCTION AND PROTECTION

- Four mulberry hybrids (Nos. 4, 12, 4 & 12) identified for their yield evaluation, which outyielded the ruling check variety by over 15%
- Ninety-five fungal isolates from roots of infected mulberries were characterized through DNA profiling and Pathogenicity tests and the most virulent strain identified to be being utilized for screening the mulberry accessions for resistance to root rot
- Trait corporate for 67 characters in 16 Jacalines were recruited for the development of SSR guidelines for mulberry
- 200 hybrid seedlings (hybrid progeny of 14 accesses) were short-listed through artificial inoculation under progeny row trials for developing mulberry varieties resistant to root rot and root knot
- Mulberry database with – a database for 23 mulberry diseases, which is a single window resource for effective disease management was developed
- All India Co-ordinated Experiment on Mulberry (AICEM) programme - yield data of four crops has been recorded for three test varieties-S54, C1635, Swarna 2 and two checks (Kanva 2, S1)
- Seed gardens for new mulberry varieties, S30 for cocoon testing (1 acre), and S54 for late age rearing (17 acres) were established to popularize the varieties and to take up plantation in about 300 acres in the field

SILKWORM CROP IMPROVEMENT, PRODUCTION AND PROTECTION

- Bivoltine single hybrids, CSR19 x CSR17 was evaluated with 6 FT test sites covering 2 NZ farmers of southern states and the average yield of 64.33 kg/100 dfls was recorded. The hybrid is proposed for further popularization in selected areas
- Three productive bivoltine hybrids viz., 58 x CSR19, CSR80 x CSR18 (single hybrids) and PCS x CSR17 (3 way cross) are developed.
- Two SmNPV tolerant bivoltine hybrids, 21 x 33 (single) and 21 x 18 A (Dfs07 stocks) were developed through marker assisted selection programme utilizing SmNPV protein
- Four thermotolerant silkworm races were developed utilizing 10 K markers (LPL2 GTB, L, PL1 121) associated with thermo-tolerance
- Four polyvoltine lines adapted to high temperature and SmNPV were short listed and are currently at F7 Generation
- L-4 pure line silkworm breed producing inter-varietal hybrid silk was improved for cocoon colour, shell ratio, silk yield, survival, disease resistance, larval period, productivity and reduction in diapause and moulting behaviour. The breed has strong basic with improved traits, viz., dark cocoon, yields upto 6 kg/ 100 dfls
- Bivoltry Gold (L-14 x SG), an improved crossbreed was developed through hybrid selection tools utilizing improved L-14 lines and exploiting the male component
- The expression of MAPK2 gene of mulberry cytosol was observed to be inhibited by Pathogen and could be utilized for therapeutic control of pebrine infection in silkworm
- CSRI DID – web page for the data collection and monitoring of silkworm diseases in seed and commercial crops was developed and the programme is being conducted in Southern States and Maharashtra
- Production and supply of biocontrol agents: *Nosema bombycis* (1.1 lakhs) and ectoparasitic beetles (1.46 lakhs)

- Tray rearing, Lime disinfection machine was developed to increase efficiency in tray cleaning and disinfection for the benefit of chawki rearing centers and farmers.
- DBT sponsored Biotechnology project was organized (2014-17) for developing molecular programmes for improvement of multivoltine and silkworm through biotechnological approaches

EXTENSION

- 2241 MT cocoons (the record till date) about 60% of total raw silk production in the country) was produced in 106 clusters in Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, Telangana, Maharashtra and Madhya Pradesh. A total of 2133 landholders were covered with an average yield of 68.3 kg/100 dfls. Multivoltine sericulture was practiced by 20174 farmers with 14505 farmers in clusters.
- Institute Village Linkage Programme (Devi Nidhi Village) was developed at 11 locations in Andhra Pradesh, Karnataka, Tamil Nadu, Telangana, Maharashtra and Madhya Pradesh. Two important technology assessments were made with the existing farmers under close supervision of extension officials from CSB and DOS. A total 2.33 lakh dfls of bivoltine hybrids were reared with farmers and 8.0% improvement in cocoon yield against the ruling check with an average yield of 62.2 kg/100 dfls was recorded.
- Sericulture farmers' orientation was organized at Malur (DBT Lab) (01 No.), in which new technologies and products were exhibited including seminar of mulberry variety, BV silkworm (double hybrid), Bi-11 x SK-6. Tray washing, cum disinfection machine, asked for mockup session and pamphlets on new technologies. 1660 farmers from northern Karnataka and adjoining states of Telangana and Maharashtra benefited from the workshop.
- A total of 53,000 dfls silkworm reared (52 batches) and supplied to 154 farmers covering 6th Plan Project through Hosur (CHC) and the average yields ranged 67.1-69.8 kg/100 dfls.
- 31 CSB technical bulletins were developed for new technologies in multivoltine cultivation, silkworm rearing and cross combination through IEC (Information Communication Programmes).
- An Artificial Intelligence integrated programme sponsored by NRDC (National Research Development Corporation) Govt. of India was validated for the production and supply of cocoon harvesters developed by the institute.

PATENTS AND COMMERCIALISATION

- Six patent applications (preparation of papaya powder), culturing of Corynebacterium, use of spent silkworm in worms, papaya for human food, preparation of papaya oil and preparation of silkworm powder) were submitted to National Biodiversity Authority for clearance.
- Eight technologies viz., Pesticen, Nervicure, Anticutin, Sericopoxine, PVC chawki stand, cocoon harvester, chawki leaf chopper, hand operated silkworm accessories were commercialised through NRDC with eight firms.
- MOUs entered with the manufacturers of Germicide, Sericide, Biotech Super for the commercialisation after thorough technical evaluation.
- Consultancy projects for validating the products/technology were initiated for CETI, SVASCOH and CERI PIT with manufacturers.

HUMAN RESOURCE DEVELOPMENT

- 400 beneficiaries trained in 26 batches on Cocoon Handicrafts, Mulberry Cultivation and Seed Multiplication, Quality Bivoltine Cocoon Production, Commercial Chawki Rearing and Mulberry & Silkworm Diseases and Pest management under integrated Skill Development Scheme (ISDS), Ministry of Textiles, Govt. of India.

- A total of 751 persons trained under silkworm and seed rearers' programmes including 51 entrepreneurs/CRC owners (3 months) and 76 entrepreneurs (one month) in CRC activities.
- Orientation training programmes in sericulture (one month) was organized for three Japan Overseas Cooperation volunteers (JOCV) working in Andhra Pradesh, Tamil Nadu and Karnataka
- Sericulture training programme on mulberry cultivation and silk reeling sponsored by ITEC (Indian Technical & Economic Cooperation Programme) - Activity, Orientation Attache, Govt. of Mauritius imparted with 14 trainees from Bangladesh, Philippines, Uganda, Thailand and Egypt

ACHIEVEMENTS OF REGIONAL RESEARCH STATIONS (RRS)

RRS, CHANNAPURA

- Bivoltine Raw Silk Production Programme
  DFP: 48.85 lakh/ha of bivoltine hybrids were reared with 72,117 farmers and the average yield recorded was 63.4 kg/100 DFLs. In P: 26,955 dfls of bivoltine hybrids were reared with 152 farmers and the average yield recorded was 66.6 kg/100 dfls and recorded an improvement of 5.1% against previous crop.
- Transfer of Technology Programmes
  1.47 lakh dfls of CSR 15 x CSR 17 were evaluated with 1035 farmers and obtained an average cocoon yield of 64.04 kg/100 dfls. Leaf feeding was limited to 4 instar from 5th-48th to supply the silkworm egg. V. farinosa (1:1) released in 61 hamlets (1 stage) - Plantation of new mulberry varieties (1977 x local) (344 farmers). Soil testing/ analysis was conducted for 337 samples and soil correction measures were recommended. TOT programmes were also conducted on M40, Pholiran, Kanva-2, PPU & composting (620 farmers)
- Extension Communications Programmes
  Sericulture Farmers Workshops were conducted at Hadasalahe (360 Farmers) and Aunargal (600 farmers); 240 EOPs were conducted benefitting 1700 farmers
- Training Programmes
  1330 farmers were trained in 62 batches under TUP and 128 persons under FDD

RRS, CHAMARAJANAGAR

- R&D Projects
  Silk-Log culture model for income augmentation was carried out to assess the feasibility of log production in mulberry plantation. First crop results indicate 200-300 Kg log/acre/year could be produced resulting in realizing an additional income of Rs.20000 – 70000
  Tree mulberry cultivation (Drip) irrigated with Affordable Micro-irrigation Technology (AMIT) resulted in an increase in mulberry leaf yield - 3360 kg/acre as compared to bush plantation (2160 kg/acre). The income augmentation was upto Rs.11,6800/acre/year as against Rs.20000 under rainfed condition with bush plantation
- Transfer of Technology Programmes
  Leaf retention was limited to 3 - 4% from 10-15% by supplying the silkworm egg, A. ricynus (all farmers); Reduction of bacterial wilt (Log Inoculation) from 20 % to 7 -10% was achieved through 3 cocoons/seed production and supply (TT conducted 34.5 acres)
- Training Programmes
  180 farmers were trained in 12 batches under TUP and 60 persons under FDD

RSRS, KODAIYAR

- Bivoltine Raw Silk Production Programmes
  DFR: 71.28 lakh dfls of bivoltine hybrids were reared in 36 rearers and the average yield recorded was 68.41 kg/100 dfls. NLF: 38600 dfls of bivoltine hybrids were reared and the average yield recorded was 61.23 kg/100 dfls and recorded an improvement of 12.79% against the standards.
- Transfer of Technology Programmes
  36750 dfls of CSR15 x CSR17 were evaluated with 145 farmers and obtained an average cocoon yield of 51.33 kg/100 dfls. New mulberry plantation was taken up in 10.33.0 acres with 6534 farmers. Soil testing facility was conducted for 27 samples and soil correction measures were recommended. TOT programmes were also conducted on Mulberry, Pest Management, Bivoltine Rearing, IPM & Composting benefiting 344 farmers.
- Extension Communication Programmes
  244 EDPs were conducted benefiting 5860 farmers.
- Training Programmes
  760 farmers were trained in 48 batches under TUF and 61 persons under ISDP.

RSRS, SALEM

- NSD Projects
  Various varieties of Vitex collected from farmers' gardens of Kanchipuram and Tiruvallur were deposited with NBAIR for identification.
- Bivoltine Raw Silk Production Programmes
  DFR: 66.30 lakh dfls of bivoltine hybrids were reared in 28 rearers in Tamil Nadu and Kerala and recorded highest cocoon yields (75.4 kg/100 dfls) in the country. NLF: 1,17,067 dfls of bivoltine hybrids were reared with 800 farmers and the average yield recorded was 71.1 kg/100 dfls and recorded an improvement of 12.9%.
- Transfer of Technology Programmes
  CSTRI released three superior silk moth hybrids CSR2 x CSR27, a single hybrid CSR4 x CSR12 and double hybrid CSHD1 over the control hybrids with respect to cocoon yield and improved silk quality. CSTRI's new productive bivoltine hybrid CSR4 x CSR12 and NPV isolate hybrid (MASNA x CSR2) recorded on average yield of 82 kg and 85.2 kg/100 dfls, respectively. Pebrine was controlled by using disease free layings and effective surveillance in 12,600 sqm. Mass multiplication and biology of Apanteles glomeratus was carried out. Total 28 field pockets (1 acre) were released. Mass multiplication of biocontrol agents Trichogrammatoidea bactrae and Apanteles glomeratus was carried out. Trichogrammatoidea bactrae (1.67 cc) and Diadegma (240 pockets) to manage leaf roller and Chrysoperla (6000 nos) for thrips were produced and supplied. Released V. Formica (222 pouches) for Uzifly management in rearing houses. Soil testing camp was conducted for 480 samples and soil correction measures were recommended. TOT programmes were also conducted on Mulberry, Pest Management, Bivoltine Rearing, IPM & Composting benefiting 344 farmers.
- Extension Communication Programmes
  Sericulture Farmers Workshops were conducted at Virudhunagar (700 farmers) and Bivoltine workshop at Salem (300 farmers). 246 EDPs were conducted benefiting 12800 farmers.
- Training Programmes
  1954 farmers were trained in 101 batches under TUF and 150 persons under ISDP.
- Nine PhD students are registered for higher studies in Botany and Sericulture under Periyar University, Salem.

राजभाषा कार्यान्वयन संबंधी गतिविधियाँ

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4. **राजभाषा कार्यान्वयन समिति की बैठकों का आयोजन** [illegible]

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5. **हिन्दी कार्यशालाओं का आयोजन** [illegible]

6. **हिन्दी टिप्पण-आलेखन प्रोत्साहन योजना का कार्यान्वयन** [illegible]

7. [illegible]

8. **हिन्दी पखवाड़ा** [illegible]

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10. **हिन्दी प्रतियोगिताओं का आयोजन** [illegible]

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11. संसद का हिंदी में कार्य: संसद में हिंदी में भाषण, संसदीय राजभाषा समिति, हिंदी सलाहकार समिति की बैठकों की संख्या, संसदीय समिति की बैठकों की संख्या, मंत्रालय के प्रश्नों के उत्तर हिंदी में, द्विभाषी रूप में तैयार किए गए प्रतिवेदनों की संख्या आदि से संबंधित जानकारी।

12. प्रशिक्षण: वर्ष 2014-15 के दौरान हिंदी में प्रशिक्षण प्राप्त करने वाले कर्मचारियों की संख्या।

13. निरीक्षण: कार्यालय में राजभाषा कार्यान्वयन की दृष्टि से किए गए निरीक्षणों की संख्या, उनमें की गई प्रमुख टिप्पणियां, उन पर की गई कार्रवाई आदि से संबंधित जानकारी।

ACTIVITIES REGARDING OFFICIAL LANGUAGE IMPLEMENTATION

During 2014-15 Official Language policy has been implemented well at Central Sericultural Research and Training Institute, Mysuru. Compliance of section 3.3(3) of the Official Languages Act has been ensured. The progress in implementation of Hindi was reviewed by conducting quarterly meetings of the Official Language Implementation Committee (OLIC).

Organization of Hindi workshops, Hindi diary, 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 Languages 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. Diarie sheets (all forms set), Diarie section, Despatch section and the concerned officer have been devised to ensure the same in bilingual.

3. Hindi Correspondence: During the year the prescribed targets for correspondence of Hindi were achieved by sending 91.4% 86.6% and 99.6% 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. Organization 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 2014-15, Official Language Implementation Committee meetings were organised on 19.6.2014, 30.9.2014, 16.12.2014 and 13.3.2015 and follow up action was taken on the decisions of the meeting.

For the sub-ordinate offices also Official Language Implementation Committee meetings were organised on 2nd 7.2014 and 18.03.2015 and reviewed regarding implementation of Official Language.

5. Organization of Hindi Workshops: Hindi workshop was organised in every quarter for the officials of the institute to provide information on how to use Hindi in the official work and various information about Official Language Policy. During the year 7 officers and 30 staff have been trained in Hindi workshops organised on 25.06.2014, 29.09.2014, 22.12.2014 and 16.03.2015 separately for technical, administrative officials and subordinate.

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, CSRTI has formulated noting-drafting incentive scheme was implemented in which cash awards are given for writing prescribed words in Hindi. During

the year cash awards were given to 4 officials on the noted/corry function of Official Language fortnight held on 30.09.2013. Apart from this, 10 officials of subordinate offices were also awarded prizes under this scheme.

7. **Use of Hindi in Identity Card:** During the year, some of the scientists have declared research papers and articles original in Hindi and also they were published in Navbharat Times, Half courts magazine in Hindi brought out by CSIRTS, Mysore.

8. **Publications in Hindi:** Annual report of the Institute was published partly in bilingual and the training calendar was published in bilingual. Navbharat Times Half yearly house journal of this Institute was published in Hindi.

9. **Notification of the subordinate offices under Rule of the Official Languages rules:** The offices in which 80% of the staff are having working knowledge in Hindi, are notified under (3)(4) of the official languages rules. In this direction, apart from this office, 5 subordinate offices have also been notified.

10. **Organisation of Hindi competitions:** Official Language fortnight was organised from 01.09.2014 to 15.09.2014 during which 10 different Hindi competitions viz., Correct writing, Dictation, Memory test, Group discussion, Elocution, Noting drafting, and administrative glossary, Technical glossary, Slogan, What does it mean book" and Antakshari 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 was carried out smoothly in computers. Unicode system is activated in all computers which facilitates to do work in Hindi, English and other Indian languages.

12. **Training:** 14 Officials have undergone training on "Basic Training programme to work in Hindi on computers" during Sept. 2014 to February 2015.

13. **Inspections:** Sub-ordinate offices are inspected for reviewing the progress made regarding implementation of Official Language Policy and rendering necessary suggestions & guidance accordingly. During the year under report 11 offices have been inspected.

MULBERRY BREEDING AND GENETICS LABORATORY

I. Consolidated Research Projects

PB(ST)73 : Development of superior mulberry varieties by exploitation of hybrid vigour based on molecular marker diversity and promising parents (Jan. 2006 to Mar. 2016)

Researcher : K. S. Ganesh Dass, Reena, M., Jo. K. Philip, Raja Urs, V. Girish Naik, R. Sasikumar, B. N. Sadananda, Indira V. Kapse and S. A. Dandin

Budget: Rs. 10.82 lakhs

Objectives: (i)to breeding promising hybrids for Final Yield Evaluation (FYE) through identification of divergent parental lines, hybridization, screening and evaluation of hybrid progeny in Progeny Row Trial (PRT) and Primary Yield Evaluation (PYE)

Observation of results: Fourteen elite and promising mulberry genotypes were selected as parents based on molecular diversity assessment by RAPD and ISSR analysis. Fifteen crosses were carried out among the identified parents to produce more than 30,000 hybrids based on genetic diversity. The hybrids were subjected to four-stage evaluation viz., seedling screening for vigour, progeny row trial, rooting evaluation and primary yield evaluation to identify hybrids superior to ruling varieties and growth parameters. Highest chlorophyll was observed among the 14 genotypes evolved and five genotypes are cultivated by the farmers of different agro-climatic zones and trained seedling populations for cultivation under specific conditions.

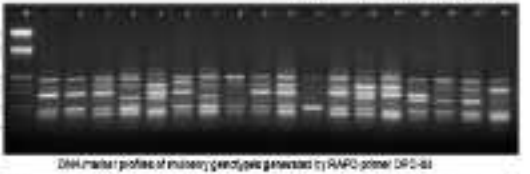
RAPD Primer	Sequence (5' – 3')	Total band number	Polymorphic band	Polymorphism (%)
OPA-01	[illegible]	11	11	84.75
OPA-04	[illegible]	13	09	81.25
OPA-07	[illegible]	10	10	83.33
OPA-09	[illegible]	13	04	66.75
OPA-10	[illegible]	10	08	80.00
OPA-13	[illegible]	11	08	84.00
OPA-14	[illegible]	13	09	75.00
OPA-15	[illegible]	13	09	85.75
OPA-16	[illegible]	13	12	92.75
OPA-17	[illegible]	10	08	80.00
OPA-18	[illegible]	11	10	90.00
OPC-01	[illegible]	10	11	73.33
OPC-04	[illegible]	10	10	83.33
OPC-05	[illegible]	13	12	90.00
OPC-06	[illegible]	10	11	83.33
OPC-07	[illegible]	10	10	90.00
OPC-08	[illegible]	12	10	83.33
OPC-10	[illegible]	10	10	100.00
OPC-11	[illegible]	14	11	85.71
OPC-13	[illegible]	13	01	77.00
OPC-14	[illegible]	11	08	72.75
OPC-19	[illegible]	10	11	84.00

ISSR Primer	Sequence (3' – 5')	Total band number	Polymorphic band	Polymorphism (%)
UBC-807	[illegible]	10	10	91.91
UBC-809	[illegible]	11	10	90.10
UBC-810	[illegible]	14	09	64.30
UBC-811	[illegible]	11	11	83.91
UBC-812	[illegible]	11	11	84.62
UBC-834	[illegible]	13	10	84.62
UBC-835	[illegible]	11	10	90.91
UBC-836	[illegible]	09	07	77.80

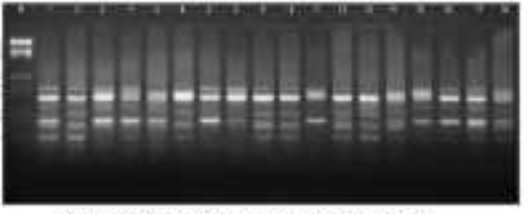
Genetic distance among elite and promising parental lines

Parents / Lines	2015	2234	ARS11	2111	RTB1013	RTB1015
032	0.218	0.179	0.271	0.214	0.233	0.151
034	0.256	0.214	0.263	0.234	0.291	0.248
SA-1466	0.209	0.173	0.253	0.181	0.215	0.151
7011	0.194	0.171	0.268	0.262	0.221	0.154
7012	0.208	0.179	0.268	0.183	0.232	0.171
01	0.133	0.103	0.264	0.172	0.223	0.211
030	0.158	0.103	0.273	0.183	0.241	0.199
02	0.158	0.233	0.268	0.211	0.223	0.171

Fifteen crosses were carried out among the parents selected based on genetic diversity analysis. More than 28,000 seeds were sown in seed beds to raise the hybrids progeny. After the initial screening for vigour in the seed beds, 3000 promising hybrids were transplanted in the field for progeny row trial (PRT). Out of the hybrids 2400 from the PRT plot were individually evaluated for length of the longest shoot (LLS), number of shoots per plant (NS) and weight of above ground biomass (AGB). Data on quantitative characters were also recorded for ten hills spread over rice years and analyzed. After stage evaluation process was applied to decided 44 promising hybrids.



DNA marker profiles of mulberry genotypes generated by RAPD primer OPD-08



DNA marker profiles of mulberry genotypes generated by ISSR primer UBC-835

Lines: 1(032), 2 (034), 3(SA-1466), 4(ARS11), 5(Victoria Local), 6(ARS12), 7(RFS2), 8(S1635), 9(S214), 10(S13), 11(ARS11), 12(V1), 13(S1), 14(S36), 15(S146), 16(RFS1 30), 17(RFS172), 18(M2) and M. DNA EcoR1 + HindIII double digest molecular size marker in bp). The DNA marker data was utilized in estimation of genetic distance and diversity among genotypes for selection of parental combination in mulberry breeding for hybrid vigour.

In the next phase of selection, 24 hybrids short listed in PRT were subjected to rooting evaluation. The rooting percentage ranged from 49-94% in the test hybrids. Sixteen promising hybrids with 78-94% rooting were selected for primary yield evaluation. Cuttings of selected promising hybrids were tested in nursery beds and eight most vigorous seedlings were planted in RBD with 3 replications for colchicine treatment along with the check variety (V1). The PYE was conducted under assured irrigated conditions following recommended package of practices. Data on leaf yield and growth parameters for ten plants were recorded and analyzed. Four hybrids viz. 4, 6, 10 and 13 out-yielded V1 variety by 11.6% to 19.80%. The hybrids also showed significantly higher values for number of shoots/plant and weight of

the longest shoot. The best hybrids are ranked in their hybrids was on par with that of check variety, V1. The relative selection capacity was found to be marginally low in hybrid No. 4, 5 and 12, while it was on par with V1 in hybrid No. 13.

Inference: Crossing among distant maternary genotypes resulted in creation of beneficial variability as evidenced by selection above 2% population, which exceeded higher values than population mean plus standard deviation for quantitative parameters. Four hybrids that out yielded the check variety, V1 by 11.96- 19.60% in the primary yield evaluation trial, on lakes up to Peak Yield Evaluation followed by administration trials.

Information generated or technology developed or processes evolved and recommendations: Four hybrids that out yielded the check variety in the PYE may be taken up for PYE and subsequent trials.

Cross	Vigorous hybrids selected (> 1000 Kha)	Genetic distance
G2 x MR1	308	0.271
K2 x MR4-108	106	0.237
R4 x MR5-140	108	0.257
R4 x MR1	212	0.280
R4 x MR2-75	117	0.288
R22 x MR1	64	0.280
R22 x R12	28	0.280
K21 x MR5-108	118	0.237
K21 x AR 11	58	0.280
K1 x Y1	67	0.215
BAHIRA x MR1	119	0.280
R4 x R18	164	0.256
R36 x MR5-108	203	0.247
R65 x MR1	93	0.273
R22 x MR07-06	109	0.212

Population means and variability of quantitative traits at different stages of selection

Stage of selection	Hybrids tried	Length of longest shoot (cm)			Stem diameter (mm)			No. of stems per plant/ clump/ plot (g)		
		Range	SD	CV %	Range	SD	CV %	Mean	SD	CV %
I	2000	107.00	43.08	34.10	4.01	2.14	43.29	3017.66	347.80	78.48
II	240	150.00	20.02	17.08	6.00	2.07	33.60	3153.76	320.60	43.66
III	130	155.00	22.11	12.05	11.01	3.08	31.04	3410.66	405.67	33.60
IV	64	225.00	21.08	60.00	11.13	2.01	22.00	2840.66	430.00	17.60

Performance of best rated hybrids in PYE

Hybrid No.	Parentage	Genetic Distance	H/B (%)	L/B (cm)	R&S (cm)	aLC (%)	MRC (%)	Leaf yield (g/plant/yr)	% Variation
H 1	G2 x MR1	0.271	12.41	103.68	5.38	70.04	76.84	3845.66	13.08
H 2	G2 x MR1	0.271	14.80	110.33	5.10	77.58	80.80	3230.76	-6.28
H 3	K2 x MR5-108	0.237	16.54	104.78	5.37	75.24	77.11	3333.56	-3.19
H 4	G2 x MR07-06	0.267	16.84	111.13	6.66	77.97	68.36	3833.66	14.90
H 5	Bahira x MR1	0.280	12.86	101.87	6.81	70.07	71.27	3833.42	11.08
H 6	R4 x R18	0.256	14.47	110.15	5.40	75.91	79.58	3815.66	11.50
H 7	R4 x R18	0.256	11.01	104.68	6.06	72.18	72.76	3734.66	20.28
H 8	R4 x R18	0.256	11.02	101.18	5.20	70.72	76.84	3656.72	13.67
H 9	R36 x MR5-108	0.247	18.76	105.30	5.92	75.58	78.55	3617.74	14.08
H 10	R36 x MR5-108	0.247	20.08	102.37	6.15	70.47	73.33	3600.84	16.62
H 11	R36 x MR5-108	0.247	18.38	103.15	6.38	70.38	76.63	3558.62	80.00
H 12	R4 x MR5-108	0.237	18.11	94.47	6.13	73.04	68.84	3457.91	10.06
H 13	R4 x MR5-108	0.266	14.33	104.88	6.32	76.37	71.38	2984.91	13.22
H 14	R4 x MR5-75	0.280	16.08	108.00	5.77	70.08	76.80	3868.66	15.81
H 15	R21 x MR1	0.280	12.31	103.08	4.31	72.40	75.41	3758.00	10.08
H 16	R4 x R18	0.256	13.59	107.11	5.98	70.24	73.66	3344.86	40.00
		V1 (Check)	11.08	102.91	5.80	72.68	76.24	3400.34	
		SE m (±)	0.03	0.24	0.12	ns	2.65	207.56	
		CV%	7.79	5.17	3.29	9.88	9.43	10.68	

NB: Number of internodes/shoot; L/B: Length of the longest shoot; H/B: Internode distance; aLC: Number of shoots per leaf; MRC: Moisture retention capacity of leaves after 6 hours of harvest

II. On going Projects

PSI 0407 : Development of disease resistant and productive mulberry genotypes with special reference to root rot and root knot diseases suitable for wet zones of South India (Jan. 2012 to Dec. 2017)

D. Gandhi Doss, Rajashekar, K. and L. Haritha Nali

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

Hut 10 seedlings from crossing among eight females and four male germplasm accessions selected based on disease response to root rot and root knot pathogens in artificial inoculation studies were raised in seed beds. During the first stage of screening, seedlings were subjected to artificial inoculation studies with pathogens of root rot and root knot. More than 1600 seedlings, which survived selection pressure, were nurtured in the seed beds for hardening and evaluation in Progeny Row Trial (PRT).

Cross	Progeny screened (nos)	Progeny survived (nos)
Purple local x V1	324	110
Himachal local x C776	610	150
English local x V1	340	61
K2.2 x V1	40	8
S30 x V1	85	20
S30 x Mysore local	72	10
Rosa x V1	210	14
M. indica/alba x Mysore local	320	67
K2 (M.) x China white	80	27
M. multicaulis x C776	850	320
S2 x C776	30	10
S30 x Mysore local	350	28
S30 (M.) x Mysore local	30	8
Purple local x Mysore local	650	10
Purple local x C776	480	15
Purple local x Anand local	340	23

Conclusion

Out of 4845 hybrid seedlings raised from fourteen crosses, 356 seedlings, which survived after artificial inoculation of root rot and root knot pathogens in seed beds were shortlisted for progeny row trial.

Other programmes of sericulture & mulberry nature

Maintenance of mulberry germplasm, mother culture and clonal station plot

Rajashekar, K. and D. Gandhi Doss

A working germplasm unit of accessions was maintained for carrying out mycorrhization programmes. Sixteen elite varieties were maintained in the demonstration plot for the benefit of the students, scientists and other stakeholders. Brooder & seed plots of three varieties- (1) C4+ evolved for late age silkworm rearing, (2) C-2 evolved for young age silkworm rearing and (3) US-3 released for cultivation in commercial climate environments were planted and maintained for seed supply.

Development of cloudied haploids through in vitro technique for mulberry improvement (April 2014 to September 2016)

D. Gandhi Doss and Rajashekar, K.

Objectives: To develop cloudied haploids of mulberry through gynogenesis and colchicidization.

Gynogenic shoot induction was achieved in 2% of the female callus cultures. The gynogenic calli were sub-cultured for multiplication and rooting. Seventeen putative haploid gynogenic shoots were subjected to chloroplast and karyotyping. Four putative haploids have been planted in pots for acclimation. The shoot explants of putative haploids were simultaneously subjected to colchicine (0.1%) treatment in MS media for diploidization.

Conclusions: Viable for *in vitro* induction of flowering, zygoparenate and rooting of genotypic shoots have been standardized. The hybrid and duplicated nodal plants will be utilized in genetic studies.

All India Coordinated Experimental Trial for Mulberry (AICEM) - Phase-III (July 2011 to Dec. 2016)

Regional Coordinator: V. Dhanasekar, Director, CSRTI, Mysuru

G. Gopala Dass, Rajashekar, K. and Rekha, M. M. A. Shankaralingappa, and Sathyanarayana Raju, N. Venkatachalapathi', B. Srinath', S. Basavarajappa', S. Balakrishnan', M. Nirmal Kumar', Uma Maheswara Rao', Ashwini', K. Ramakrishna' 'RSRS Anantapur, 'RSC Rajahmundry, 'RSC Hindupur, 'RSC Hosahalli, 'RSC Kalimpur, 'NPSSRDU Hindupur, 'KSSRDI, Thalaghattapura, 'TNAU, Coimbatore

The experiment is laid out in RBD with 3 test varieties (C2038, S-1 & Somalina-2) along with one region as check (V1) and a National check (Victoria) with six replications. The progress of work in respect of different test centers is detailed below:

CSRTI, Mysuru: Data on leaf yield and growth parameters were recorded over eight crop seasons. Variety S-1 recorded significantly higher values for number of internode / shoot length and leaf, shoot ratio over the check varieties. The moisture content in S-1 was higher (75.82%) than in V1 (74.74%), whereas C2038 recorded significantly higher values for leaf: shoot ratio (3.47) and moisture retention capacity after 6 hours of excision (73.90%) and leaf yield over the check V1. None of the test varieties yielded significantly higher over V1 check.

Performance of mulberry varieties – AICEM-III Phase at CSRTI-Mysuru

Variety	DSP	TSL (cm)	NLPM	LS	MC(%)	WPC%	Leaf yield (kg/ha/ yr)
C2038	12.0	112.1.33	77.33	0.87	73.90	73.80	42875
S1	14.0	97.8.99	82.93	0.89	74.82	69.79	43640
Somalina 2	13.0	114.7.83	77.33	0.82	75.29	72.33	52651
Victoria	12.0	109.2.50	86.33	0.80	73.71	70.84	41200
V1	14.0	109.4.83	86.33	0.82	74.11	71.19	39400
CD at 5%	0.80	14.8.51	5.23	0.01	2.24	1.31	3200
CV%	8.87	14.75	10.01	0.81	2.16	3.87	10.24

DSP: Days to harvest after 2 worms, TSL: Total shoot length (cm), NLPM: No. of internode / shoot length, LS: Leaf : shoot ratio, MC: Leaf moisture content (%),WPC: Moisture retention capacity (%)

Performance of mulberry varieties – AICEM-III Phase at other test centers

Variety	DSP	TSL (cm)	NLPM	LS	MC(%)	WPC%	Leaf yield (kg/ha/ yr)
RSRS, Anantapur							
C2038	NA	110.21	11.64	0.91	72.77	62.34	33213
S1	NA	115.71	10.64	0.73	73.75	66.35	40830
Somalina 2	NA	101.32	10.33	0.73	71.71	61.32	40230
Victoria	NA	101.66	10.47	0.64	72.97	62.69	47150
V1	NA	113.89	10.64	0.71	73.66	63.13	44437
CD at 5%	-	10.03	0.30	0.09	NS	NS	1901
CV%		11.66	4.37	13.24	1.78	3.48	12.88
RSC, Hosahalli							
C2038	10.0	100.1.00	27.10	0.89	68.75	69.41	38100
S1	11.0	98.6.00	28.10	0.85	70.73	68.82	51400
Somalina 2	11.0	100.1.00	30.00	0.88	69.80	68.41	50800
Victoria	11.0	101.5.4	23.42	0.52	70.84	64.32	45134
V1	10.0	100.7.1	20.33	0.66	69.20	66.80	48100
CD at 5%		10.17	4.24	0.01	0.02	0.02	654
CV%		8.41	22.13	2.46	1.66	1.26	7.96

RCC Intercept							
CD(M)	0.23	1.41	0.53	0.23	0.16	0.23	1.41
GM	0.45	1.53	0.54	0.41	0.19	0.39	1.53
Replicate	0.23	1.41	0.53	0.23	0.16	0.23	1.41
Variety	0.45	1.53	0.54	0.41	0.19	0.39	1.53
SJ	0.23	1.41	0.53	0.23	0.16	0.23	1.41
CD at 5%	0.45	1.53	0.54	0.41	0.19	0.39	1.53
CV%	0.23	1.41	0.53	0.23	0.16	0.23	1.41
RCC Anthracnose							
CD(M)	0.23	1.41	0.53	0.23	0.16	0.23	1.41
GM	0.45	1.53	0.54	0.41	0.19	0.39	1.53
Replicate	0.23	1.41	0.53	0.23	0.16	0.23	1.41
Variety	0.45	1.53	0.54	0.41	0.19	0.39	1.53
SJ	0.23	1.41	0.53	0.23	0.16	0.23	1.41
CD at 5%	0.45	1.53	0.54	0.41	0.19	0.39	1.53
CV%	0.23	1.41	0.53	0.23	0.16	0.23	1.41
KSDRC Thalagavara							
CD(M)	0.23	1.41	0.53	0.23	0.16	0.23	1.41
GM	0.45	1.53	0.54	0.41	0.19	0.39	1.53
Replicate	0.23	1.41	0.53	0.23	0.16	0.23	1.41
Variety	0.45	1.53	0.54	0.41	0.19	0.39	1.53
SJ	0.23	1.41	0.53	0.23	0.16	0.23	1.41
CD at 5%	0.45	1.53	0.54	0.41	0.19	0.39	1.53
CV%	0.23	1.41	0.53	0.23	0.16	0.23	1.41
ATARI Hebbal							
C.D(M)	0.23	1.41	0.53	0.23	0.16	0.23	1.41
GM	0.45	1.53	0.54	0.41	0.19	0.39	1.53
Replicate	0.23	1.41	0.53	0.23	0.16	0.23	1.41
Variety	0.45	1.53	0.54	0.41	0.19	0.39	1.53
SJ	0.23	1.41	0.53	0.23	0.16	0.23	1.41
CD at 5%	0.45	1.53	0.54	0.41	0.19	0.39	1.53
CV%	0.23	1.41	0.53	0.23	0.16	0.23	1.41

MOLECULAR BIOLOGY LABORATORY-1

I. Ongoing Projects

PRS 5003 (DST): Isolating mulberry peridc identification of QTLs conferring resistance to root rot disease by Linkage Disequilibria mapping and Bulk segregation (Jun, 2018 to Sep, 2018)

V. Girish Naik (PI), V. Kavitha Naik, M. S. Ramangada (JRF), R. Triveni (JRF), H. S. Poornima (JRF)

Objectives:

- Resistance response of mulberry germplasm to major causal fungus of root rot disease
- Molecular characterization of germplasm accessions to identify the constants for resistance and susceptibility
- Development of mapping populations

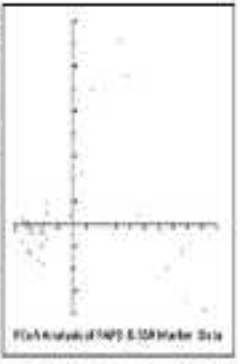
Two hundred and thirty one mulberry germplasm accessions were collected from CSGRC Hosur and planted in nursery for raising saplings and establishment of the Field of Diverse Germplasm (FDG) at the institute. Fungal isolates (99) associated with root rot disease were collected from mulberry gardens (Karnataka, Andhra Pradesh), Telangana and Tamil Nadu. Cultural and morphological characteristics of fungal isolates were studied. All phenotypic isolates (30) were profiled using 47 RAPD and 12 ISSR markers. The genetic diversity among the isolates was assessed

and bet distribution or correlation values is distilled to PCoA analysis. Deriving per gene allelic diversity coefficient matrices of RAPD as well as CDR markers resolved the fungal isolates into 3 clusters. Clustering procedure of combined data (RAPDs + SCARs) was very similar to the one obtained through the individual marker analysis. Mantel test indicated a high correlation (r=0.1.00) between the RAPD and SCAR markers suggesting consistency and suitability of both the marker systems in diversity analysis of fungus. The results show that the fungus is able to colonize different locations aided by movement of pathogen. Infected soils and plant materials through anthropogenic activities. SCARs with limited number markers (50 alleles) were able to provide similar result to that of RAPDs (250 markers). In the assessment phylogenetic diversity and interrelationships among the fungal isolates, by phylogenetic approach to be dynamic and omnipresent. Similarly, 56 isolates of Phytophthora and 10 isolates of Botryosphaeria theobromae were also DNA fingerprinted using 25 and 22 RAPD primers, respectively. Results indicate that Fusarium isolates are highly variable as compared to B. theobromae. All the 66 fungal isolates were mass multiplied and inoculated in vitro pot culture plants and pathogenicity check fungal isolate was assessed. Disease reaction among 20 mulberry germplasm accessions was evaluated using a virulent strain of M. phaseolina and results indicate that Mysore and Rosea are resistant.

A total of thirteen microsatellite primer pairs were custom synthesized for the characterization of diverse germplasm. PCR amplification was standardized for 13 primer pairs (FRI, Ranebennur collection) 56 accession nos. were profiled using 20 freely distributed SCAR markers. Profiling of the entire panel of germplasm using 14 new sets of SCAR primers was completed.

Disease reaction of mulberry genotypes to root rot caused by virulent isolate of M. phaseolina

Genotypes	Rating (%)	Rating (%)	Disease Reaction
S-1634	51.22	44.77	Moderately resistant
Mysore Local	27.10	30.85	Moderately resistant
V-1	41.38	24.11	Moderately resistant
K-2	50.86	33.84	Moderately resistant
S-34	50.32	45.46	Moderately resistant
S-4	50.86	32.28	Moderately resistant
S-36	32.76	44.32	Moderately resistant
RC-2	64.66	67.17	Susceptible
RC-1	68.75	66.22	Susceptible
Himachal Local	50.00	55.12	Moderately resistant
Rosea	44.99	33.84	Moderately resistant
Sujanpur-2	72.36	74.83	Highly Susceptible
S-1	32.76	53.00	Resistant
S-30	68.75	53.97	Susceptible
C-776	63.45	33.84	Moderately resistant
S-799	44.73	33.72	Moderately resistant
S-799	39.23	18.97	Resistant
Goshoba	76.72	51.99	Susceptible
Mulc	39.72	44.09	Moderately resistant
Kasmir	32.76	28.19	Moderately resistant



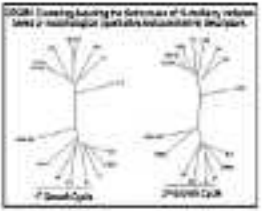
PhD SEDV (PPV & FFA) : Dose appraisal of Distinctiveness, Uniformity and Stability (DUS) descriptors for Mulberry (Morus spp.) and their Validation (Jagir, 2013 to Mar. 2016)

V. Girish Naik (P.I.), S. Gandhi Doss, Rajashekhar, K., T. Thippeswamy, P. Govindappa (CRP), B.S. Dhairya, V. Dhanapaal

Objectives:

- Develop and validate descriptors for mulberry
- Identify distinct varieties and specific morphological, biochemical molecular markers, and its stability
- To characterize the extent of variability
- Develop database for the descriptors of mulberry to be added to NDUS (Web Database for DUS)

Fifty-seven characters including morphological, reproductive and growth characters were recorded in the field and 15 cultivated varieties were selected for the assessment of extent of variations and validation. Plant (July-August, 2014), second (October - November, 2014) and third (March - April, 2015) round of growth cycle data on 15 identified cultivated mulberry varieties for all characters was completed. Identification of example reference variants for different states of expression is under progress. The data recorded for 2 growing cycles was analyzed using DARwin program and the results are shown in the figures. The analysis shows that all 15 varieties can be grouped mainly into 2 being those as male and female varieties (gynotypes) based on state of sex expression. AR-12 is distinct from other male varieties with shoot habit being straight (erect nature). Plant vigor shows that AR-12 and V-1 as weak and strong varieties, respectively. S-13 is distinct from other varieties having leaf shape with narrow blade state of expression. S-1 C33 has spindle shaped buds; other varieties invariably have acute triangle shaped buds. S-34 is distinct from the other varieties having truncate leaf base. RFCI-35 and MR2178 are distinct from each other having a phylodisy of 1.0, 1.0 and 1.0, 2.0, respectively.



Distinctiveness of Characteristics Expression

*	Expected characteristics for the International Harmonization of varietal descriptions and always to examined for DUS
**	Leaf, fruit, MR2, MR2S

	Total characteristics recorded	Non-expressed	Sub-total	Quantitative	Qualitative	Pseudo-qualitative
Plant	2	0	2	1	1	0
Stem	5	0	11	2	1	3
Leaf	11	11	23	7	1	4
Inflorescence	7	0	12	4	0	3
Fruit **	2	0	11	6	1	3
Total	27	11	57	19	10	13

Leaf nature is an important character with its variations, with four states of expression, namely Absence of heterophyllous, Moderate Level of heterophyllous with both lobed and unlobed leaves in the same plant, Extreme is distinct from other female varieties with pinnate leaf margin, while other varieties have serrate leaf margin. RC1 is distinguished from other varieties in fruit color (characteristic cumbish-white) expression. 42 is distinct from other varieties with truncate leaf base. S36 has green (RHS 137A) leaf color and distinct from other varieties with dark green (RHS 137A). RC2 can be distinguished from other varieties with young shoot color (superficial hue, RHS 186A), while others have young shoot with green color (RHS 143C). 02 and 04 are distinct from each other in bud shape, serrimucronate and lanceolate, respectively. The identified descriptors satisfy three technical requisites of distinctness, uniformity and stability. A variety is considered to be clearly distinguishable if the difference in characteristics is clear and consistent; therefore a mulberry variety is said to be uniform, subject to variations that may be expected for the particular features. Vegetative propagating nature of mulberry invariably ensures uniformity in characteristics. Stability can be tested by growing another generation from the seed to ensure that it exhibits the similar characteristics under different environs.

On-farm/on-Other activities

Mandatory list of supplying tea samples

- Yield and yield contributing traits: Women Local x V1 progeny (208 Nos)
- Water use efficiency (WUE) trait: Himachal Local x S13 progeny (202 Nos); S1 x V1 progeny (242 Nos); S4 x V1 S1 progeny (192 Nos)
- Root trait: Dasika Vittalu x UP progeny (62 Nos) and Punjab Local x Thailand progeny (25 Nos)
- Alkaline tolerance: Goenkatti x V1 progeny (103 Nos)
- Introgressed lines: MUB and local trait (25 Nos)

MULBERRY PATHOLOGY

1. Consolidated Research Project

PRP 3.1(ii): Development of database for mulberry diseases (Aug. 2010 to Jan. 2014)

Prabhakar Kumar, P. M. (PI), V. Mallikharjuna Naik, Banoshree Kumar, S (Comp Programmer)

Objectives:

- To develop database containing information on mulberry diseases in India
- To develop a web based disease diagnosing system
- To develop a web based forewarning system on possible outbreak of the diseases to alert extension functionaries

Methodology:

Secondary data from various sources such as research papers, published books, monographs, journals, annual reports of R&D institutes, project reports and thesis submitted on various aspects of mulberry diseases of various universities/institutions, variables were collected and entered for developing the database. The information was compiled and made detailed report of 32 diseases including brief introduction to the disease, symptoms, causal organism, systematic position, disease cycle, pre-disposing factors, variety reaction and control measures (cultural, biological and chemical) to the diseases. Essential characters important for the diseases were prepared based on available data. Diagnostic keys of various diseases were also prepared. The project files and collections, investigations and year of implementation of R&D projects were compiled. About 200 published papers on various aspects of mulberry diseases were collected and PDF files were created. Various technologies developed for control of mulberry diseases were compiled and presented. About 135 FAQs and answers were made and uploaded in the web page. Further, a disease forewarning model on the basis of outbreak of diseases and their correlation with weather parameters were included in the web page.

The database was constructed using MySQL as back end. Web page is created using HTML, Java script, PHP with a web based interactive interface with database using specific key based search and also have link to essential references to other related databases. Personal computer with Pentium-4 processor with minimum 4GB RAM and 500 GB hard disc (Windows 2000/ 2003 XP) is used for developing the web page.

Results and Discussion:

Mulberry disease information system has been developed which detailed information on 32 mulberry diseases. Diagnostic keys of 13 mulberry diseases with photographs of pathogens, pathogen propagules and infected plants were incorporated. R&D project records pertaining to mulberry diseases in various institutions of India were compiled. Research publications (PDF files) were uploaded in the database. Various technologies developed and recommendations suggested for the management of mulberry diseases were compiled and presented. FAQs (135) and answers pertaining to various aspects of mulberry diseases and their management were also presented. A menu driven to diseases about the possible outbreak of mulberry diseases and the management measures for timely management of the disease was provided.

The disease complexes pertaining to major foliar diseases viz. Bacterial leaf blight (Xanthomonas campestris), fungal leaf blight (Alternaria alternata), grey leaf spot (Pseudocercospora mori), leaf rust (Cerotelium fici), Cercospora leaf spot (Cercospora moricola), Target (Corynethecium mirabile), and powdery mildew (Phyllactinia corylea) incidence in various states were developed based on available literature along with disease severity (severe, moderate and less severe). Symptoms of diseases, control measures as well as safe period of chemicals used for the management of diseases is also provided in the calendar. These calendars would be useful for formulating of the diseases and undertaking proper management measures. A part of webpage was meant for diagnosis of the diseases by physical verification / comparison of the affected mulberry part and verification of symptoms and confirmation of the disease. Colour photographs of infected mulberry plant parts, pathogen and growing area were included in facilitating easy diagnosis of diseases. Further, 225 research papers published during the last 50 years on various aspects of mulberry diseases were provided for reference.

II. Ongoing Projects

PRP-1520: Development of a broad spectrum formulation for management of mulberry root rot disease (Jan. 2016 to Dec. 2016)

Pratheesh Kumar, P. M. (PI), Thippeswamy, T.

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

Root rot infected plants were collected from mulberry gardens of various parts of Karnataka and associated pathogens viz., Fusarium solani, F. oxysporum, Botryodiplodia theobromae and Rhizoctonia solani/Corticium sasakii were isolated. Experiments are being conducted with several fungicides, alternative fungicides and plant derivatives effective against above fungal pathogens.

PRP-1521: Popularization of 'Hemahari' – a bionematicide for management of root knot disease in mulberry (Mar. 2016 to Feb. 2017)

V. Nistitha Naik, RORDs: H. Jayaram, S. Raja Kumar and M. A. Dastagiri Saba

Objectives:

- To demonstrate the efficacy and cost benefit ratio of the Hemahari
- To demonstrate effective crop protection through Hemahari for management of root knot disease
- To popularise Hemahari among sericulturists

Root knot caused by nematode, Meloidogyne incognita is a serious economic disease and perennial nature of mulberry and widespread habit of nematode makes management of disease difficult. Hemahari was found effective against the root knot and large scale evaluation is being undertaken. The project was initiated in Karnataka, Andhra Pradesh and Tamil Nadu by procuring the raw materials for the production of Hemahari.

PRP 1522: Long term effect of mulberry cropping systems on soil biology and productivity (July 2015 to June 2018)

V. Nistitha Naik, Pratheesh Kumar, P.M., S. Iyer and Rekha, G.

RORDs : M. T. Himachandra, M. R. Shelbharani, M. R. Dayananda Murthy, P. Dasthakeer, M. P. Reddy, T. Megha, M. Venkatachalapathy, P. Venkateshwarlu, B. Vijaya Kumar and J. Ravi Kumar

Objectives:

- Study the role of soil microbiota and macro fauna towards sustainable mulberry production
- To study the beneficial antagonistic microbes associated with soil health in different cropping systems
- To investigate the factors responsible for the soil microorganisms to form into symbiotic units

Methodology:

120 soil samples were collected from identified mulberry gardens of Andhra Pradesh, Karnataka and Tamil Nadu

to study soil fungi, bacteria and actinomycetes prevalence in terms of frequency and relative density. The microbes were cultivated by dilution plate technique (Waksman, 1927) and identified based on morphological and cultural characters (Gilla and Gilla, 1963; Agrios, 2005). Soil samples were also analyzed for chemical properties of soil such as pH, electrical Conductivity (EC), Organic Carbon (OC), available Phosphorus (P), and Potassium (K) were analyzed by following standard procedure (Jackson, 1973). Available Zinc (Zn), Iron (Fe), Copper (Cu) and Manganese (Mn) were estimated by Atomic Absorption Spectrophotometer.

Microbial Population in 10^3 CFU g Dry Soil

Microbes	Andhra Pradesh	Avg	Karnataka	Avg	Tamil Nadu	Avg
Fungi	19.72 24.22	26.89	18.31 52.68	26.81	22.71a 44.00	26.81
Bacteria	27.00 46.27	53.6	28.75 44.68	29.83	27.51 49.61	34.01
Actinomycetes	12.67 33.45	15.62	11.09 20.07	16.27	12.04 21.05	16.83
Total	59.39 98.94	73.24	58.15 120.07	72.92	61.86 114.66	78.75

Microbial Population (10^3 CFU g Dry Soil)

	Staphylococcus	Escherichia	Total
Andhra Pradesh	25.27	15.09	12.34
Karnataka	26.74	14.78	9.82
Tamil Nadu	27.36	16.14	12.55
Total	80.39	145.42	33.11

The prevalent species of fungi belongs to genera of Penicillium, Aspergillus and Rhizopus and frequency (%) of occurrence in Andhra Pradesh was 90.23, 59.70, 50.00, Karnataka (100.00, 57.82, 62.5) and Tamil Nadu (100.00, 96.28, 66.25). Relative density was also higher in case of Penicillium in all the states and highest density was observed in Andhra Pradesh (21.3) followed by Karnataka (20.2%) and Tamil Nadu (16.6%). Aspergillus niger, Aspergillus was least prevalent fungi in all the states. Among the bacteria, Pseudomonas and Bacillus were found to be the soil samples and relative density was higher as compared to other bacteria. Actinomycetes were present with less density, in all the samples.

Soil sample analysis revealed varied characteristics of soil colour (light red - light black), texture (sandy loamy - sandy clay loam), pH (6.28 - 8.34), EC (0.09-0.65), OC (0.20-0.57), N (161.60-554.28 kg/ha), P (6.14-109.47 kg/ha), K (104.28-1194.63 kg/ha). Mean pH values were normal range in Andhra Pradesh and Tamil Nadu, whereas it is near to normal range in Karnataka (7.8). Average macro nutrients indicate that N is within the normal range (280.59-4.31 kg/ha), P and K is above normal range (25.23-41.66) and (363.24-446.65 kg/ha). Significant positive correlation was observed between microbial population with OC and N.

Occurrence of microbes in soil

Microbes	Frequency (%)			Relative Density (%)		
	AP	KA	TN	AP	KA	TN
Fungi						
Aspergillus niger	90.23	57.82	96.25	21.73	16.6	17.34
A. flavus	9.45	23.66	56.25	6.52	7.83	9.58
Rhizopus spp.	50.00	62.50	66.25	20.43	14.83	14.75
Penicillium spp.	90.23	100.00	100.00	21.30	20.23	16.56
Cladosporium spp.	41.67	46.66	7.50	10.62	8.63	6.66
Trichoderma spp.	37.41	61.66	56.75	4.23	8.67	5.28
Verticillium spp.	5.03	5.79	22.5	1.56	0.44	24.46
Fusarium spp.	25.27	27.50	41.25	3.47	3.65	5.06
Mucor spp.	3.87	16.66	22.50	0.30	1.15	1.28
Alternaria spp.	3.87	4.34	3.50	0.40	0.50	1.28
Bacteria						
B. flexneraie	30.12	23.66	30.00	1.62	1.83	2.01
Pseudomonas spp.	100.00	100.00	100.00	46.20	34.49	23.66
Bacillus spp.	100.00	100.00	100.00	48.06	60.27	43.80
Azospirillum	70.04	16.66	60.00	1.66	0.20	19.00
Azotobacter	30.12	33.66	56.25	2.46	4.00	4.57
Rhizobium spp.	7.87	0.55	0.00	0.13	0.20	0.00
Actinomycetes						
Streptomyces spp.	100.00	100.00	100.00	1.20	0.72	2.58
Nocardia spp.	100.00	100.00	100.00	1.20	2.31	1.29

Chemical Property	Andhra Pradesh	Ave	Karnataka	Ave	Tamil Nadu	Ave	Normal Range
pH	7.1-8.3	7.66	6.42-8.24	7.57	7.16-8.09	7.72	6.5-7.5
EC	0.1-0.55	0.31	0.05-0.58	0.25	0.14-0.51	0.29	<1.0
OC%	0.66-0.82	0.02	0.24-0.87	0.02	0.61-0.86	0.05	0.65-1.05
N (kg/ha)	352.32-537.15	460.66	151.36-434.39	411.57	280.13-388.61	316.76	250-500
P (kg/ha)	5.14-10.47	22.71	13.63-52.18	21.23	12.23-60.89	41.66	17-23
K (kg/ha)	161.45-612.17	383.31	235.83-1164.89	441.68	281.67-612.83	466.27	108-240

Correlation of microbial population with chemical properties of soil samples

		Fungi	Bacteria	Actino-mycetes	Total	EC	OC%	N (Kg/ha)	P (Kg/ha)	K (Kg/ha)
Andhra Pradesh	pH	0.013	0.174*	0.060	-0.067	0.033	-0.156	-0.030	-0.113*	0.087
	Fungi		0.230**	0.150**	0.744***	-0.001	0.214	0.005	-0.159**	0.090
	Bacteria			0.025	0.832***	-0.043	0.107	0.054	-0.151**	0.093
	Actinomycetes				0.811***	-0.018	-0.091	-0.031	-0.003	0.035
	Total					-0.005	0.092	0.036	0.178**	0.047
	EC						-0.031	-0.030	-0.143**	0.217**
	OC%							0.953***	0.234**	-0.161**
	N (kg/ha)								0.196**	-0.141**
	P (kg/ha)									0.160**
Karnataka	pH	0.213	0.150*	0.208	0.321*	0.269**	0.211	0.600	0.120	0.225**
	Fungi		0.470**	0.098	0.758***	0.117*	-0.040	-0.044	0.000	0.186**
	Bacteria			0.170**	0.834***	0.284**	-0.109	-0.030	-0.120	0.080**
	Actinomycetes				0.863**	0.082	0.013	0.076	-0.058	0.100
	Total					0.283**	0.060	-0.012	0.103	0.200**
	EC						0.034	0.014	0.170*	0.499**
	OC%							0.977***	-0.044	0.024
	N (kg/ha)								-0.060	0.048
	P (kg/ha)									0.387**
Tamil Nadu	pH	0.008	0.035	0.025	0.067	0.234**	0.043	-0.030	-0.012	0.084
	Fungi		0.230**	0.113	0.714***	0.168*	0.042	0.038	0.000	0.048
	Bacteria			0.142	0.758***	-0.011	0.042	0.022	0.005	-0.018
	Actinomycetes				0.813**	0.238**	-0.013**	0.230*	-0.060	-0.012
	Total					0.023	-0.021	-0.030	0.009	0.030
	EC						0.122	0.120	0.047	0.177*
	OC%							0.955***	0.059	-0.028
	N (kg/ha)								0.060	0.068
	P (kg/ha)									0.014

The results indicate that pH, OC are the most important factors for alteration in soil microbial population. 63% of mulberry gardens are with pH above critical limit (>7.5) and 44% with OC below critical limit (<0.4%). Farmers have to be advised about the importance of harnessing and appropriate application of chemical, organic and green manures to improve soil health status. Qualitative and quantitative microbial activities are key factors for improving productivity and sustainability of soil health.

On-Farm trial of Nemaherb- A plant based formulation for management of root knot disease of mulberry

Prathiban Kumar, P. M., V. Manthira Moorthi, A. S. Chowdary (RSRS, Anantharajupuram), D. Raja Kumar (RSRS, Salem) and M.R. Sudarmarajan (RSRS, Kodathi)

Objectives: To evaluate efficacy of Nemaherb+ a plant based formulation against root knot disease of mulberry

The OFT is conducted in states of Karnataka, Tamil Nadu and Andhra Pradesh and ten farmers each state with root knot nematode infection. Nemaherb has been discovered and applied @ 40 kg /ha after mixing with 400 kg FYM during intercultural operations or after pruning or after leaf harvest by making trenches (15 cm deep) near the root zone and

covered with soil. The garden is made to be irrigated immediately after application of Nimbicidal. Second and third application of Nimbicidal was conducted 70-80 days after first application and 140-150 days after second application. Plants without application of Nimbicidal served as control. The data on root knot was collected by counting number of knots on 50g of randomly selected 30 mulberry plants and subjected for arcsin √ test to assess for statistical significance.

District	Number of knots/ 50g root (No.)		Leaf yield (g/plant)		Disease incidence (%)	Yield increase (%)
	Treated	Control	Treated	Control		
DP	3.33	3.72	852.33	730.33	07.33	11.79
DC	0.33	0.667	8.767	7.267	0.337	0.433
TN	2.450	5.221	794.333	703.333	07.333	11.271
KA	1.450	2.72	39.33	41.33	14.33	5.434
KA	1.33	4.33	633.34	607.33	13.33	13.78
DC	0.431	1.333	23.33	20.331	1.473	2.933
Mean	1.33	4.52	331.66	644.50	36.33	14.22
Analysis	*			*		
t-value	17.33			21.33		

Plants treated with Nimbicidal recorded significant (P<0.01) decrease in number of knots and increase in leaf yield due to treatment with Nimbicidal against untreated control. The average number of knots ranged 0.33-4.33 in the treated plants against the untreated plants (3.77-13.72). Similarly, the average yield per plant varied between 660.37-422.4 kg in Nimbicidal treated plants against control (49.1-60.74 kg). Maximum disease control recorded was 94.28% with an increase in yield upto 21.13% due to treatment with Nimbicidal. The average disease control was 76.27% with an average increase upto 13.42%.

SOIL SCIENCE & CHEMISTRY

Soil fertility and other activities

Monitoring of soil fertility status of mulberry gardens in Karnataka, Tamil Nadu and Andhra Pradesh (April 2012 to March 2013)

Dileshwari Devi (PI), P. Sudhakar, J. Ravi Kumar and B. Vijay Reddy

Objective: To monitor the soil fertility status of mulberry gardens of Karnataka, Tamil Nadu and Andhra Pradesh and recommend fertilizers & manures for soil health

Diverse ranges of parameters of soil fertility (122 samples) from different areas in South India were analyzed. Fertilizer and manure recommendations for specific mulberry gardens vis-a-vis soil status were given for sustained soil fertility.

Soil fertility and analysis

Area	pH	Electrical Conductivity (mmhos/cm)	Organic Carbon (%)	Available Phosphorus (kg/ha)	Available Potassium (kg/ha)
Bangalore Rural (KAR)	6.01-8.83	0.08-0.69	0.06-0.57	3.6-89.1	80-760
Kolar (KAR)	5.82-8.48	0.08-0.55	0.20-1.15	5.0-81.0	104-672
Ramanagaram (KAR)	6.78-8.48	0.08-0.17	0.06-1.03	8.1-101.0	
Mandya (KAR)	7.13-7.75	0.43-0.46	0.20-0.33	11.4-62.8	48-336
Tumkur (KAR)	6.72-8.79	0.04-0.70	0.06-0.68	6.3-102.8	80-1040
Gujarat (MAT)	7.16-7.84	0.14-0.51	0.30-0.78	20.6-108.3	
Theni (TAMI)	7.34-8.61	0.08-0.92	0.11-0.61	46.3-88.6	
Pudukottai (TN)	5.49-8.86	0.01-0.90	0.15-1.19	6.44-22.3	176-1216
Dindigul (TN)	6.08-8.86	0.03-1.35	0.09-1.61	8.32-28.3	224-1216
Krishnagiri (TN)	6.51-8.96	0.04-0.91	0.06-1.19	6.41-38.9	224-1216
Tirupur (TN)	6.21-8.75	0.03-0.85	0.07-0.89	8.20-82.0	176-1216
Palakkad (KER)	4.99-7.96	0.08-0.48	0.13-0.73	8.56-87.7	168-1216
East Godavari (AP)	6.38-8.52	0.21-0.11	0.23-0.52	2.4-75.1	96-2304
West Godavari (AP)	6.06-8.13	0.03-0.66	0.33-0.53		
Chittoor (AP)	6.46-8.33	0.03-0.73	0.23-0.83	7.06-138.6	80-736
Ranga Reddy (AP)	7.06-8.86	0.06-0.66	0.18-0.53	8.6-130.6	112-280

Validation of new recommendation of fertilizer measures for V1 mulberry under irrigated conditions (Apr. 2014 to Mar. 2019)

S. Seni, T. Thippeswamy, M. T. Himantharaj, V. Lakshmana, P. Sadhasivam, J. Ravi Kumar, B. N. Murthy, Lydia Jose, D. M. Ajay and B. Ganesh (from 4.6.2014)

Objective: To monitor the changes occurring in major chemical properties of soil for the new fertilizer dose from the point of view of crop productivity and soil health

Leaf yields indicate that cotton plots (358:143:143 kg NPK + 20MT FYM/ha/yr) recorded the highest values of 10,464.33 and 9,231 as compared to 9,641.8,273, and 8,36 MT/ha/crop in treated plots (150:60:60 kg NPK + 20 MT FYM + 25 kg cotton/acre/yr + DMT LAMA) in Chikkaballapur, Ramanagappa and Basavaraj, respectively. The corresponding values in control were 9,13 and 8,278 MT/ha/crop.

Other Programmes of continuous routine nature:

Quality testing of bleached cocoons and inputs used in sericulture

Glanyan Sen

Quality analysis of cocoon shoulder spots and actual samples (Bi-hue) was conducted and about 4lk. Test cards were received as a testing fees for the benefit of stakeholders in sericulture industry

AGRONOMY

I. Consolidated Research Project

PRP Goal: Effect of acquisitive use of nitrification inhibitors for the efficient utilization of nitrogenous fertilizers for the sustainable mulberry production (Oct. 2018 to Sep. 2021)

Vasco Kumar Pastor (PI), Basappa, R. G. Kalyar and Gloyan Sen

Budget: 1.55 lakhs

Objectives:

- To increase the utilization of nitrogenous fertilizers by conjunctive use of nitrification inhibitors to optimum yield conditions
- Field action of hemicellulose rural application and leaching

Methodology: The experiments were conducted with the following treatments. FYM @ 25 MT/ha/year is applied as per recommendation.

T1: 360 N: 140 P: 100 K kg/ha (Recommended dose as control)

T2: 300 N coated with Neem Oil (5.5% v/v) 140 P: 100 K kg/ha

T3: 300 N coated with DCD (0.58% w/w) 140 P: 100 K kg/ha

T4: 220N coated with neem oil (5.5%v/w) 140 P: 100 K kg/ha

T5: 250 N coated with DCD (0.58% w/w) 140 P: 100 K kg/ha

Results: Nitrogen use efficiency over control per recommended dose of fertilizers increased in T3. All the treatments containing nitrification inhibitors increased the nitrogen uptake as well as organic carbon (%) content in soil. The growth parameters and mulberry leaf yield significantly increased over control in T3 (11.08 kg/ha) followed by T2 (10.89 kg/ha). Application of neem oil as a natural nitrification inhibitor along with urea was more cost effective

and microfilarial (Mf) indicating enhanced nitrogen use efficiency. Nitrification inhibitors inhibited the growth of nitrifying bacteria (1.85 to 1.82x10⁶ cfu/g), which is responsible for transformation of urea into nitrate form of nitrogen and nitrogen is retained for longer periods in the soil for plant utilization. Uptake of nitrogen by plants and available nitrogen in the soil significantly improved in treated pots as compared to recommended dose of nitrogen.

Effect of nitrification inhibitors on mulberry growth and yield
(Average of eight crops)

Treatments	Leaf yield (kg/ha)	Plant height (cm)	Length of longest shoot (cm)	No. of shoots/ plant	Leaf moisture content (%)
T1	9642	145	121	14.5	73.4
T2	10529	145	124	13.5	72.5
T3	11234	153	133	13.0	71.8
T4	9652	138	111	11.3	72.5
T5	9538	140	107	11.7	72.1
LSD (P=0.05)	148.37	14.00	5.11	NS	NS

Effect of nitrification inhibitors on soil characteristics and nutrient uptake

Treatments	Soil Analysis				Nutrient uptake (%)	
	pH	EC (mmhos/cm)	Available P (kg/a)	Available K (kg/a)	P	K
T1	7.0	0.23	30.00	276.25	0.32	2.07
T2	7.1	0.23	110.28	308.76	0.42	2.16
T3	7.0	0.24	120.23	324.25	0.54	2.32
T4	7.1	0.24	124.58	317.25	0.55	2.21
T5	7.0	0.23	125.68	317.79	0.56	2.15
LSD (P=0.05)	NS	NS	11.30	17.07	0.030	0.049

Outcome of the project: Application of urea along with nitrification inhibitors significantly improved the leaf yield and plant height over recommended dose of fertilizer revealing retention of nitrogen for longer periods.

Continuous/ Other activities

Effect of endophytic bacterial biocontrol agents on mulberry, Bacillus cereus (Isolate-1), Bacillus subtilis and Pseudomonas aeruginosa and its consortium on silkworm growth and cocoon characters by inoculating 3rd instar larvae

V. Ganeshkar and M. Manikandan Reddy

Objective: To determine the effect of oral feeding of BCAs on silkworm growth and development

Methodology: Bioassay was conducted on the effect of BCAs of mulberry (*Bacillus cereus*, *Bacillus subtilis* and *Pseudomonas aeruginosa*) and its consortium on silkworm growth and cocoon characters by inoculating 3rd instar larvae @ 10⁶ and 10⁸ cfu/ml to the 5th instar. After feeding silkworm larvae and the mature ones collected with normal leaves. Larval growth was analyzed at a frequency of 24h for five days. Amylase and cellulase activity was measured on 7th day of 5th instar larvae by following standard procedures.

Results: Larval growth increased (3.26 - 22.9% over control in different treatments and 8.4% increase in larval weight was observed in 10⁶ CFU treatment on 5th day). Amylase activity increased in all treatments and maximum activity (164.3 µmoles/min/ml) in *B. Cereus* treated (10⁸ CFU/ml) gut tissue and 226 µmoles/min/ml in *B. subtilis* treated (10⁶ CFU/ml) midgut juice. Protease activity also increased to 363.12% in cocoon shell in 10⁶ CFU treated *B. subtilis* midgut juice. Single cocoon weight, single shell weight and 28% was increased in all treated silkworm larvae and varies (2.78% - 14.28%) in different treatments. Results indicate that BCAs even at 10⁶ and 10⁸ CFU could be safely used for the control of soil borne diseases of mulberry.

Effect of BCAs (CFU) on aflatoxin growth (Jayashankar et al.)

Biocontrol	NK-2110 Lactobacillus (L)			LP			LF		
	OF	SC	AFLAT	AFFP	AFFL	AFLAT	AFFP	AFFL
B. megaterium	19.42 (2.44)	68.69 (3.86)	2.10	0.49	21.84	3.28	0.65	23.79
B. subtilis	19.65 (2.31)	66.88 (3.86)	2.26	0.49	21.81	3.27	0.65	23.71
P. aeruginosa	40.26 (3.28)	41.13 (6.33)	2.16	0.42	28.64	3.23	0.47	21.05
Combination	98.69 (1.98)	34.27 (6.21)	2.26	0.49	25.13	2.26	0.68	22.11
Control	44.48	44.48	2.03	0.42	28.48	2.26	0.41	20.83

Figures in parenthesis indicate log per cent decrease over control

Effect of BCAs (CFU) on enzyme and protease activity of aflatoxin

(NA: fungal juice; MT: mycelial tissue)

Biocontrol	Amylase (unit/ml/min)				Protease (unit/ml/min)			
	30°		37°		30°		37°	
	NJ	MT	NJ	MT	NJ	MT	NJ	MT
B. megaterium	0.028	0.030	0.031	0.027	0.205	0.670	0.23	0.30
B. subtilis	0.029	0.034	0.034	0.029	0.24	0.635	0.24	0.258
P. aeruginosa	0.044	0.015	0.035	0.018	0.32	0.628	0.134	0.208
Combination	0.045	0.031	0.034	0.018	0.17	0.635	0.15	0.208
Control	0.031	0.014	0.013	0.014	0.080	0.621	0.060	0.024

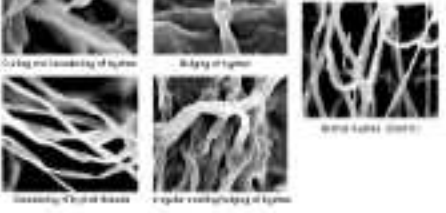
In vitro evaluation of *Bacillus subtilis* and *Pseudomonas aeruginosa* on the suppression of growth and hyphal morphology of *Rhizoctonia bataticola*

V. Jayashankar and Vinod Kumar

Objective: To determine the effect of *Bacillus subtilis* and *Pseudomonas aeruginosa* on mycelial growth and mycelial morphology of *Rhizoctonia bataticola*

Dual culture assay was used to assess the growth and hyphal morphology of *Rhizoctonia bataticola*. 3 mm bits of sclerotia of *R. bataticola* were placed on PDA and 48 h old *B. subtilis* and *P. aeruginosa* were streaked 2.0 cm away from the inoculum of fungal culture and incubated at 37°C in a BOD incubator. Growth of fungal colonies was observed at 24 h intervals and maximum growth was observed in control plates within 48 h, whereas in treated plates no growth was recorded. The morphology of mycelia from edges of treated and control plates were observed by SEM. Fungal mycelia were observed with irregular bulging, shrinking of mycelial tissues and curling of hyphal tips. The growth of *R. bataticola* may be curtailed by deformation of hyphal threads.

SEM studies on effect of BCAs (*B. subtilis* and *P. aeruginosa*) on hyphal morphology of *R. bataticola*



BIVOLTINE SILKWORM BREEDING LABORATORY

Consolidated Research Projects

All India Inter Institution project: Popularization of authorized silkworm hybrids among the farmers of South India (Ver. 2013-Coll. 2014)

CSRTI, Mysuru; KSSRDI, Thalaghattapura; APSSRDI, Hindupur; KSSDI, Bangalore; CSTRI, Mysuru

Budget utilized: Rs.13.36.709*

Objective: Popularization of the authorized silkworm hybrids for commercial exploitation and selection of suitable hybrids for different zones/locations

Four bivoltine hybrids viz., CSR16 x CSR17, CSR46 x CSR47, GEN3 x GEN2 and APS43 x APS12 and two multivoltine x bivoltine hybrids, MH1 x CSR2 and APS416 x APSR116 have been selected for popularization among the farmers of South India. The concerned R&D Institutes of the potential hybrids have supplied the P1 dfls (CSRTI-Mysuru: CSR16, CSR17, CSR46, CSR47, GEN3, GEN2; KSSRDI-Thalaghattapura: MH1; APSSRDI-Hindupur: APS43, APS12, APS416 & APSR116) to the selected seed reelers of NSSO for generation of seed cocoons. The seed cocoons were procured and hybrid dfls were procured as identified DFOs of NSSO. The properties Institutes have supplied the hybrids dfls (CSRTI-Hybrids: CSR16 x CSR17, CSR46 x CSR47 & GEN3 x GEN2; KSSRDI-Thalaghattapura: MH1 x CSR2; APSSRDI-Hindupur: APS43 x APS12 & APSR116 x APSR116) to the farmers through the RSKs/SoRECs. The cocoons were monitored by the identified local DOS Officer in Charge and CDE Sidlaghatta. The data on various rearing parameters were collected from the farmers through the RSKs/SoRECs. Total rearing for silk quality was carried out at CSTRI, Bangalore by purchasing the cocoons also from the farmers.

After monitoring the data of two trials, three bivoltine hybrids viz., CSR46 x CSR47, GEN3 x GEN2 & APS43 x APS12 were dropped for further testing due to poor performance over the control hybrid. The bivoltine hybrid, CSR16 x CSR17 and two multivoltine hybrids, MH1 x CSR2 & APS416 x APSR116 were continued for testing among the farmers.

CSR46 x CSR47: A total quantity of 93308 dfls of the hybrid was distributed to 209 farmers of Andhra Pradesh, Karnataka and Tamil Nadu. The average cocoon yield/100 dfls was 47.1 kg as against 52.30 kg in CSR2 x CSR4 (Control). The average price/kg of cocoon in CSR46 x CSR47 was Rs. 319/- as against Rs.320/- in control hybrid, CSR2 x CSR4. The hybrid was discontinued due to poor cocoon yield over control hybrid.

State	No. of dfls	No. of farmers	Yield/ 100 dfls	Price/kg (Rs.)
Andhra Pradesh	46000	100	48.00	317
Karnataka	31000	103	54.40	318
Tamil Nadu	16308	31	38.70	321
Total/Avg.	93308	234	47.14	319
CSR2 x CSR4 (C)	100000	275	52.30	320

GEN3 x GEN2: A total quantity of 102600 dfls of the hybrid, GEN3 x GEN2 was distributed to 226 farmers of Karnataka, Andhra Pradesh and Tamil Nadu. The average cocoon yield/ 100 dfls was 50.44 kg as against 52.00 kg in CSR2 x CSR4 (Control). The average price/kg of cocoon was Rs. 314/- as against Rs.320/- in control hybrid, CSR2 x CSR4. The hybrid was discontinued due to lower cocoon yield over control hybrid.

State	No. of dfls	No. of farmers	Yield/ 100 dfls	Price/kg (Rs.)
Andhra Pradesh	81600	200	50.80	313
Karnataka	16150	23	57.20	316
Tamil Nadu	4850	03	41.80	312
Total/Avg.	102600	226	50.44	314
CSR2 x CSR4 (C)	100000	275	52.00	320

APS43 x APS12: A total quantity of 64000 dfls of the hybrid APS43 x APS12 was distributed to 24 farmers of Karnataka and Tamil Nadu. The average cocoon yield/100 dfls was 42.74 kg as against 52.30 kg in CSR2 x CSR4 (Control). The average price/kg of cocoon was Rs. 317/- as against Rs.320/- in control hybrid, CSR2 x CSR4. The hybrid was discontinued for poor cocoon yield over control hybrid.

State	No. of dfls	No. of farmers	Yield/ 100 dfls	Price/kg (Rs.)
Karnataka	24000	3	39.80	314
Tamil Nadu	40000	21	45.10	318
Total/Avg.	64000	24	42.74	317
CSR2 x CSR4 (C)	100000	275	52.00	320

CSR08 x CSR17: A total of 5,17,350 dfls were distributed among 2132 farmers of Andhra Pradesh (338800 dfls), Karnataka (69000 dfls) and Tamil Nadu (90000 dfls). The average cocoon yield/100 dfls for all the three states was 54.30 kg as against 62.10 kg in CSR2 x CSR4 (Control). The average price/kg of cocoons (CSR16 x CSR17 was Rs. 332/- as against Rs.342/- in control hybrid, CSR2 x CSR4) and silk quality of 2A-4A grade. This hybrid is being commercialised through NSSO.

State	No. of dfls	No. of farmers	Yield/ 100 dfls	Price/kg (Rs.)
Andhra Pradesh	338800	1311	52.97	330
Karnataka	69000	493	55.84	339
Tamil Nadu	90000	317	57.29	328
Total/Avg.	517350	2132	54.36	332
CSR2 x CSR4 (C)	270000	1081	62.10	342

BM1 x CSR2: A total quantity of 1, 13,600 dfls of BM1 x CSR2 were distributed to the farmers of Karnataka. The average cocoon yield/ 100 dfls were 61.32 kg as against 61.8 kg in PM x CSR2 (Control). The average price/ kg of cocoon was Rs. 351/- as against Rs. 360/- in control hybrid, PM x CSR2. The hybrid recorded silk quality of 5A to 2A grade. DOG Karnataka expressed difficulties experienced in rearing performance.

Area	Yield/ 100 dfls	Cocoon Rs	Yield (Rs.)/ ac	Yield (%)
	kg	kg	kg	
A1	60.21	1.159	1.375	28.8
A2	62.54	1.159	1.378	28.8
T1	67.10	1.159	1.372	31.0
Total/Avg.	64.10	1.162	1.374	29.5

APDR16 x APDR116: A total quantity of 32,100 dfls of APDR16 x APDR 116 was distributed to the 113 farmers of Andhra Pradesh and Karnataka. The average cocoon yield/ 100 dfls were 53.60 kg as against 61.2 kg in PM x CSR2 (Control). The seedling institution expressed their inability to continue feeding of the hybrid.

Location	No. of dfls	No. of farmers	Yield/ 100 dfls kg	Price/ kg (Rs.)
Ramanagaram	8000	114	54.00	317
Kanakpura	4500	10	58.00	300
Kolar/Bagepalli	10000	17	58.50	300
Hosakote	3000	10	55.00	300
Hindupur/Lepakshi	1600	4	47.00	310
Total/Avg.	31100	155	51.50	317
PM x CSR2 (C)	40000	150	61.20	351

Local Area	No. of dfls	No. of farmers	Yield/ 100 dfls kg	Rate/ kg (Rs.)
Andhra P.				
Madanapalle	23,000	85	49.25	360
Chittoor (Dt.)	15,000	30	59.71	340
Total/Avg.	38,000	115	53.79	345
PM x CSR2 (C)	40,000	150	61.20	360

Conclusion

Systematic evaluation of authorized bivoltine hybrids suitable for different regions and seasons is an essential for enhancing the cocoon productivity at the sericulture level. Several bivoltine hybrids were developed by different sericulture research institutes to suit varying agro-climatic conditions prevalent in different zones. In this project, a total of 2,08,000 dfls of CSR16 x CSR17 were distributed to 1,332 farmers in Andhra Pradesh and the hybrid recorded an average cocoon yield of 62.57 kg/100 dfls. In Karnataka, a total quantity of 49,950 dfls were distributed to 393 farmers and the hybrid recorded an average cocoon yield of 65.84 kg/ 100 dfls in Tamil Nadu, a total quantity of 83,000 dfls were distributed to 317 farmers and the hybrid recorded an average cocoon yield of 67.79 kg/100 dfls. The average cocoon yield/ 100 dfls in 517350 dfls for all the three states was 54.30 kg as against 62.10 kg in CSR2 x CSR4. The average cocoon yield / 100 dfls at different locations in Andhra Pradesh indicated that, Vizianagaram recorded average cocoon yield of 70.15 kg/100 dfls ranked highest followed by Madakasira (66.00 kg). In Karnataka highest cocoon yield of 69.00 kg/100 dfls was recorded in Dharwad. Whereas in Tamil Nadu, highest cocoon yield of 70.46 kg/100 dfls was recorded in Udumalpet. The performance of BM1 x CSR2 indicated that, the total cocoon yield of 66.10 kg/100 dfls was recorded in Bangalore area and average cocoon yield/100 dfls for 113600 dfls was 61.32 kg as against 61.8 kg in PM x CSR2.

Interface

Popularization of CSR13 x CSR17 hybrid has motivated the farmers for rearing of new silkworm hybrids in place of existing hybrids resulting in better economic returns. This would motivate other farmers to take up new bivoltine hybrids silkworm rearing and consequently improve bivoltine cocoon production. The hybrid, CSR13 x CSR17 performs better than popular hybrid, CSR2 x CSR4 and NB7 x CSR2 better than PM x CSR2. Hence, these hybrids serve as alternate resources to the existing hybrids and can be exploited commercially.

Ongoing Projects

AIT 3440 : Development of robust bivoltine hybrids of silkworm, *Bombyx mori* L., tolerant to high temperature environment of the tropics through DNA marker assisted selection (January 2011 to December 2013)

G. Mallikarjuna Reddy, P.G. Koti, S. Rahmathulla, Ramprasad and N. Chandrakanth (DBT)

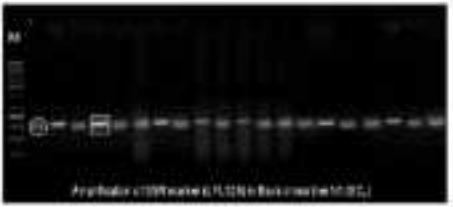
Objectives:

- Identification of DNA markers (SSR) linked to thermo tolerance in silkworm
- Development of thermo tolerant silkworm breeds / hybrids through DNA marker assisted selection

Bivoltine breeds, SH40 & APS110 were identified as donor parents based on SSR markers (LFL127, LFL225) identified for thermo tolerance and four breeds viz., CSR27 & CSR3 and bivoltine CSR6 & CSR20 were selected as recurrent parents. Breeding for thermo tolerance was initiated by crossing the selected parents and the resulting F1s and BC progeny were raised. These lines were selfed to get BC$_1$ to BC$_3$ generations. The selected crosses were tested for SSR markers in each generation by isolating DNA from 20-30 first instar moths from each line. The progeny with SSR marker i.e., heterozygous pattern was selected for next cycle. The progeny showing homozygous dominant pattern was selected in each generation (BC$_1$F to BC$_3$F). Simultaneously, these lines were also exposed to high temperature conditions to confirm the genotypic expression. Five thermo tolerant crosses (CH, NC, NS 6 NA) and four bivoltine lines (RE, NS, NT & NS) were developed. Hybridization evaluation of developed breeds with the other identified breeds is under progress.

Lines	Pupation Rate (%)		Yield (000 Cocoons/ 10g)		Single cocoon weight (g)		Single shell Weight (g)		Shell Ratio (%)	
	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15	2013-14	2014-15
NT	98.00	97.00	14.800	16.275	1.700	1.550	0.340	0.360	20.01	20.24
	±1.49	±1.29	±0.900	± 0.661	± 0.018	±0.009	±0.003	±0.013	±0.28	±0.280
NS	92.00	91.00	14.900	16.015	1.700	1.421	0.401	0.381	23.59	20.31
	±1.624	±1.155	±1.240	± 1.061	± 0.036	±0.062	±0.013	±0.020	±0.192	±0.066
NS	89.00	91.00	15.400	15.059	1.600	1.467	0.340	0.300	23.50	20.11
	±3.000	±1.000	±0.894	± 1.000	±0.632	±0.000	±0.021	±0.000	±0.000	±0.129
NA	97.00	96.00	16.200	17.021	1.700	1.613	0.430	0.500	23.62	20.29
	±0.700	±1.34	±0.000	±1.02	±0.632	±0.037	±0.014	±0.014	±0.216	±0.119
NR	92.00	91.00	14.900	15.059	1.600	1.414	0.370	0.320	23.52	20.22
	±1.00	±1.000	±0.894	±0.021	±0.063	±0.009	±0.007	±0.013	±1.200	±0.000
NS	92.00	90.00	14.900	11.741	1.670	1.429	0.380	0.280	22.84	20.03
	±1.20	±1.21	±0.000	±0.740	±0.094	±0.012	±0.020	±0.020	±0.000	±0.130
NT	97.00	96.00	16.800	17.600	1.800	1.800	0.370	0.270	22.85	15.01
	±0.700	±0.00	±0.894	±0.000	±0.000	±0.000	±0.000	±0.013	±0.200	±0.000
NR	92.00	90.00	14.800	11.700	1.600	1.563	0.350	0.300	22.55	19.04
	±1.000	±1.000	±1.000	±0.915	±0.000	±0.000	±0.000	±0.000	±0.300	±0.346

* Humidity at 25±1°C is 70-85% and at 30±1°C is 75-90%



AIS 0409: Development of a subunit vaccine against a baculovirus disease of Bombyx mori L. (silkworm) by oral delivery of polyhedrin nanoparticles containing viral envelope protein (Ajul, 2014 to Dec, 2016)

N. Gopi Reddy, M. Krishna Kumar Reddy and S. Manthira Moorthy

Objectives: Development of a subunit vaccine against a baculovirus disease of silkworm, *Bombyx mori* L.

Second round screen of recurrent backcross parental breeds: CSR2, CSR4, CSR4(B), CSR6, CSR10, CSR17, CSR20, CSR27, CSR30, CSR31, CSR32, CSR33, CSR, CSR & NSI were screened for BmNPV resistance @ 2.5×10⁶ PIB/larvae. The rearing was conducted till cocooning and survival rate was calculated on pupation size and twelve parental breeds: CSR2, CSR4, CSR6, CSR10, CSR17, CSR20, CSR27, CSR30, CSR31, CSR32, CSR33 & CSR were identified for initiation of breeding plans. Twelve breeding lines (cross over: CSR4CN, CSR17N, CSR27N, CSR30N, CSR31N, CSR33N, CSR6CN, CSR20N, CSR32N, CSR10N, CSR2N, CSR10A, CSR2SR4 & CSR2 F1) were created by crossing recurrent parental breeds with donor parents (nuc. MADNS, cumulus) and the breeding lines are at BC1 generation.

Per Os Infection of BmNPV to Silkworm Breeding Lines

Breeding Lines	Pupation Rate (%)	Cocoon weight (g)	Shell weight (g)	Shell Ratio (%)
CSR2N	98.8	1.635	0.363	22.4
CSR17N	97.8	1.423	0.341	23.8
CSR27N	92.8	1.478	0.337	22.8
CSR30N	98.8	1.535	0.351	22.8
CSR31N	93.8	1.501	0.332	22.1
CSR	98.8	1.613	0.347	22.8
CSR6	98.8	1.652	0.358	23.1
CSR4N	96.8	1.501	0.331	21.3
CSR6N	97.8	1.476	0.359	24.0
CSR10N	92.8	1.423	0.307	20.8
CSR20N	95.8	1.451	0.324	21.5
CSR32N	91.8	1.408	0.316	21.5

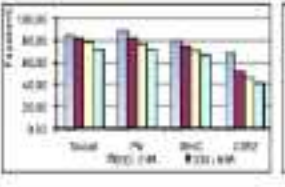
AIS0005 (XIT–10PR): Studies on thermo tolerance, heat shock protein synthesis during the heat shock and interesting in silkworm, *Bombyx mori* L.

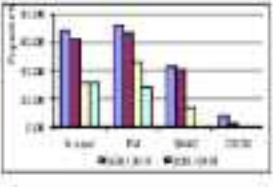
S. Manthira Moorthy (PI), Arindam (JRF upto 30.10.13) and R. Chandrakanth (JRF from 13.2.14)

Objectives:

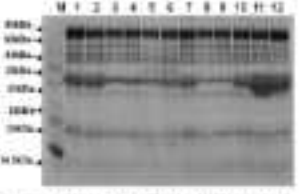
- Identification of critical thermal maximum in silkworm
- To analyze the profile of different forms of Hsps in silkworm under thermal stress

Two indigenous multivoltine breeds namely **i)** Pure Mysore and two crossbreeds (CSR2 & SK4C) were selected for the study in two sets of experiment to determine critical thermal maximum in silkworm. First day larvae of IV & V instar larvae were exposed to 30, 32, 34, 36 & 38 °C for 2, 4, 6, 8 & 12 hr every day. After a specific period of exposure, the larvae were reared at normal temperature (25±1 °C) and was continued till pupating in the case. Under the trial, IV-day V instar larvae were continuously exposed to 36, 38, 40 °C till pupating. Pupation rate varied greatly with temperatures with duration and slight reduction in pupation was observed in all the breeds if the larvae exposed to longer duration (4 & 12 hr). However, larvae exposed from IV instar onwards suffered more than V instar, since duration of treatment was longer. Pupation varied between 68.6-98%, 82.4-91.6, 79.6-88, 72.4-81% in the V instar larvae exposed to 40 °C for 2, 4, 6 & 12 h, respectively. Whereas, the same varied between 71.6 & 84, 67 & 81, 48.4 & 62, 42.6 & 60 in the V instar larvae exposed to 38 °C for 2, 4, 6 & 12 hr, respectively. No larvae survived in CSR2 on 5th day after 6 & 12 hr exposure. Pupation varied greatly in the larvae of SK4C and CSR2 exposed to 38 °C continuously and SK4C was able to survive till 42 hr. These results clearly demonstrate that silkworm can survive 4 hr even at 38 °C.

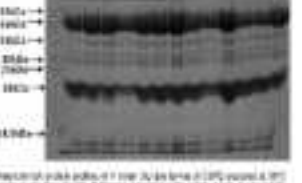




Haemolymph, midgut and fat body tissues of V. indica larvae exposed to 28, 24, 20 & 28°C for 3, 6, 9 & 12h were analysed by SDS-PAGE and data were recorded. The protein patterns of bivoltine (CSR2 & CSR4) exposed to 28°C for different duration revealed presence of ~11 polypeptides like haemolymph and ~13kDa showed been expressed in CSR2 after 3h of exposure (1st day) and higher expression at 9 & 12h of exposure. Similar observations were noticed in CSR4 also, but ~43kDa showed higher expression at 6 & 12h of exposure. Further no major changes in the expression of protein pattern was observed in midgut, but 20 & 70kDa fat body proteins showed higher expression if they lost the protein.

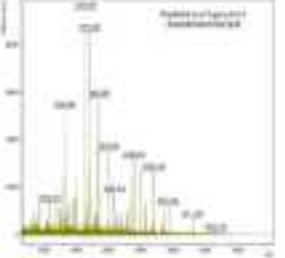


Haemolymph protein profiles of 5th instar silkworm larvae of CSR2 exposed at 28°C for different time intervals. M-Marker; 1-3 larvae (3h); 4-6 larvae (6h); 7-9 larvae (9h); 10-12 larvae (12h).



Based on 1D SDS-PAGE results, 9 polypeptides which were unique, highly/lowly expressed were identified for 2D gel electrophoresis. Remarkable variation in protein expression was observed between control and treated sets (28KD-48°C). Particularly ~80kDa protein expression varied between high to low descending on treatment, while 20kDa, 40kDa & 70kDa showed unique pattern.

Based on 2D analysis, two specific spots (high & unique expression) from day 1 (5h and day 5 (5h were subjected for MS/MS MALDI TOF to determine biological and molecular function of the expressed proteins. The database search program MASCOT Daemon (matrix science) against NCBInr/SWISS-PROT database with taxonomy specific to Drosophila (NoN %, 232512 sequences) was used to compare protein sequences. Biological and molecular functions were also determined by UniProt Knowledgebase (SWISSPROT & TrEMBL, http://www.expasy.org/sprot). The unique spot matched two genes with statistically significant protein score of 49 (P<0.05). The analysed protein covered 12-11



peptides with 28.5% peptide coverage each and high similarity with gene ID 108477982 of *D. ananassae* and ID 108477973 of *D. yakuba* with molecular weights 19.80 and 32.60 kDa, respectively. Band no. 2a and 2c were successfully predicted as Zinc ion binding proteins Alanine tRNA Ligase-similar to *D. ananassae* and *D. yakuba*, respectively. Another spot also had statistically significant protein score of 72 (P<0.05) matched with gene ID 24764324 of *Drosophila erecta* sp. The analyzed protein covered 4 peptides with 33.3% peptide coverage of *D. erecta* gene with molecular weight of 8.40 kDa. The protein spot no. 1 was predicted as immune protein Dorl3. Further work is under progress to ascertain biological function of hidden proteins.

Band No.	Spot type	Matched organism	Gene ID	Possible coverage	Protein score	Observed Mol. Wt. (kDa)
1	Unique	*Drosophila ananassae*	gi|24760332	3 (33.3%)	72	8.40
2a	Differential	*Drosophila erecta*	gi|24764324	11 (28.9%)	68	32.00
2b	Differential	*Drosophila yakuba*	gi|24477973	11 (28.9%)	68	32.00

SHIVOOR: Evaluation of three way cross hybrids for commercial exploitation (Jun., 2010) Vol. Dep. 2(1-4)

A. Nasreena Begum and N. Ayar (2014), M. Mallikarjun, S. Hamid Kumar Iquebal, A.K. Jain, S. Ramesh and Kiran Kumar

Objectives: To identify suitable three way cross hybrids silkworm hybrids for commercial exploitation.

Two bivoltine dumbbell favourable crossers viz., PC1 (PC3 and Sid-1) and PC4 (PC5 and PC6) and seven each of cyst (CGR02, CGR17, CGR27, CGR40, CGR46, CGR50 and CGR52) and dumbbell (CGR4, CGR5 CGR15, CGR35, CGR47, CGR51 and CGR53) bivoltine breeds were utilized and inverse eight three way cross hybrids were produced and evaluated. The important parameters governing silk quality and quantity such as fecundity, pupation, cocoon yield, cocoon weight, shell weight, shell percentage, reeability, filament length, denier and renditta were considered for evaluation. The reeability in three way cross hybrids ranged from 544 (PC1 x CGR50) to 585 (PC1 x CGR52), superior from 32.3 (PC5 x CGR27) to 97.7 % (PC3 x CGR50), cocoon weight from 1.972 (PC4 x CGR15) to 2.112g (PC3 x CGR52), shell weight from 0.423 (PC3 x CGR4) to 0.448 g (PC1 x CGR52), shell percentage from 22.2 (PC3 x CGR40) to 24.6 % (PC2 x CGR52), reeability from 68 (PC1 x CGR46) to 90 % (PC4 x CGR04) and raw silk percentage from 18.3 (PC4 x CGR15) to 19.1 % (PC3 x CGR17). Highest filament length of 1227 m was recorded in PC3 x CGR46, while lowest of 1025 m was recorded in PC2 x CGR15. The reeliness ranged from 82.0 to 94.0 points. Highest cocoon yield of 26.16 kg / 10,000 larvae was recorded in hybrid, PC3 x CGR52 while lowest of 17.23 kg was recorded in PC2 x CGR15.

The multiple trait evaluation index indicated that twelve three-way cross hybrids have scored index > 90. The maximum of 93.1 was obtained for the hybrid PC3 x CGR17 followed by PC1 x CGR2 and PC3 x CGR2 which ranked second (92.6) and third (92.2), respectively. The cocoon uniformity in terms of standard deviation (SDc) calculated based on the length and breadth ranged from 6.40 (PC3 x CGR17) to 13.91 (PC3 x CGR46). The hybrid, PC3 x CGR17 recorded least uniformity (6.40 CGR) followed by PC3 x CGR2 (6.45 CGs), PC3 x CGR2 (6.78 CGs), PC1 x CGR17 (6.86 SDc). The cocoon hybrid PC1 x PC3/ PC2 x PC1 has recorded cocoon uniformity of 7.78 to 7.84 SDs. The cocoon uniformity (SDc) less than 8, which is a target for selection of hybrid, was obtained in many three way cross hybrids.

PC3 x CGR17, PC1 x CGR2, PC3 x CGR2 &PC1 x CGR17 have been identified as best combinations on the basis of their silk evaluation index >90.6. High fecundity and more cocoon uniformity. Two short listed three way cross hybrids, PC1 x CGR2 & PC3 x CGR17 were evaluated along with control single and double hybrids at RSRTS and found superior over control single hybrid and on par with popular double hybrid.

A quantity of 20,500 dfls of PC1 x CGR2 was reared in AP, Karnataka and Tamil Nadu. The average cocoon yield/ 100 dfls was 65.20kg.

Performance of three way cross hybrids

Hybrids	Favourability	Days to 50% Plant (%)	Green fodder yield (kg)	Green fodder weight (g)	Stem weight (g)	Stem thickness (%)	Favourability (%)	Plant height (cm)	Plant width (%)	Plant area (sq. cm)	Leaf to stem ratio
FC1 x CSR6	-5.56	96.7	30.33	2.022	0.497	22.5	33	119.8	93.3	3.33	3.4
FC1 x CSR17	3.70	95.0	32.16	2.024	0.456	22.5	33	117.7	92.8	3.32	3.4
FC1 x CSR27	1.50	94.9	31.65	1.931	0.452	23.5	37	119.1	92.8	3.31	3.2
FC1 x CSR36	3.56	95.3	32.12	1.941	0.452	23.5	37	119.6	93.5	3.35	3.5
FC1 x CSR44	3.56	97.3	30.56	2.024	0.508	22.5	33	119.6	97.3	3.33	3.2
FC1 x CSR51	3.94	96.7	31.23	2.024	0.452	23.5	33	120.7	97.6	3.41	3.3
FC1 x CSR53	1.52	95.5	31.72	1.955	0.475	23.7	33	119.1	97.3	3.37	3.5
FC1 x CSR5	3.78	96.2	32.16	2.103	0.508	23.6	33	119.9	96.7	3.32	3.4
FC1 x CSR17	3.56	97.3	30.56	2.024	0.451	22.5	33	119.5	96.8	3.33	3.4
FC1 x CSR27	1.55	95.5	31.53	2.023	0.455	23.2	33	120.3	97.6	3.37	3.4
FC1 x CSR36	3.56	97.2	30.55	2.024	0.474	23.2	37	119.7	97.3	3.35	3.5
FC1 x CSR44	4.00	96.4	30.56	2.021	0.508	22.5	33	120.1	97.6	3.36	3.4
FC1 x CSR51	3.97	95.8	30.53	2.024	0.475	22.5	33	120.3	97.6	3.32	3.3
FC1 x CSR53	3.65	94.5	31.97	2.024	0.452	23.2	33	119.4	97.6	3.32	3.4
FC1 x CSR4	5.13	96.2	31.25	1.941	0.431	23.2	33	119.3	97.6	3.31	3.4
FC1 x CSR6	3.56	96.7	31.56	1.931	0.504	23.5	33	119.6	96.8	3.31	3.3
FC2 x CSR13	3.53	95.5	31.23	1.931	0.452	22.5	37	119.3	97.3	3.36	3.2
FC2 x CSR24	5.74	95.5	31.59	1.939	0.455	24.0	33	119.7	97.3	3.37	3.4
FC2 x CSR47	3.56	97.1	31.23	1.931	0.498	23.5	33	119.1	97.3	3.31	3.4
FC2 x CSR51	3.73	96.3	30.42	1.939	0.439	22.5	33	119.8	97.6	3.32	3.3
FC2 x CSR53	3.56	95.7	30.63	1.927	0.475	24.0	33	119.4	97.3	3.31	3.4
FC3 x CSR4	4.76	96.1	31.25	1.954	0.448	23.2	37	119.1	97.6	3.32	3.4
FC3 x CSR6	3.56	96.8	30.73	1.932	0.508	23.7	33	119.8	96.8	3.31	3.3
FC3 x CSR13	3.73	95.8	31.25	1.951	0.459	23.4	33	119.8	96.2	3.31	3.3
FC3 x CSR24	5.55	97.7	30.25	2.051	0.475	23.1	33	119.1	97.3	3.31	3.4
FC3 x CSR47	4.57	96.8	30.14	1.939	0.448	23.4	37	119.3	97.6	3.33	3.5
FC3 x CSR51	3.56	96.4	30.25	2.056	0.475	22.5	33	119.5	96.2	3.27	3.4
FC3 x CSR53	3.48	96.4	30.25	1.942	0.459	23.5	33	119.5	97.6	3.31	3.4
FC1 x FC2 (L)	3.73	96.2	31.25	2.024	0.475	23.5	37	119.6	93.5	3.32	3.4
FC2 x FC1 (L)	3.78	96.8	30.56	2.053	0.452	23.7	33	119.8	96.8	3.37	3.4
CD at 5%	na	2.1	1.52	0.93	0.028	1.00	na	0.0	1.2	na	na

Quantitative traits and cocoon yield traits in three way cross hybrids

Hybrids	DI	Cocoon Uniformity(DI)	Hybrids	DI	Cocoon Uniformity (DI)
FC1 x CSR2	50.8	6.93	FC2 x CSR4	48.3	7.09
FC1 x CSR17	50.5	6.94	FC2 x CSR6	48.6	7.07
FC1 x CSR27	49.5	7.14	FC2 x CSR13	50.6	6.98
FC1 x CSR36	51.3	6.91	FC2 x CSR24	50.6	7.07
FC1 x CSR44	50.8	7.16	FC2 x CSR47	48.5	6.85
FC1 x CSR51	50.1	7.46	FC2 x CSR51	48.4	6.85
FC1 x CSR52	50.7	6.94	FC2 x CSR53	50.6	12.61
FC3 x CSR2	50.2	6.76	FC4 x CSR4	96.1	12.46
FC3 x CSR17	50.1	6.46	FC4 x CSR6	48.3	6.76
FC3 x CSR27	49.8	19.76	FC4 x CSR13	50.2	6.94
FC3 x CSR36	50.4	6.18	FC4 x CSR24	50.9	7.37
FC3 x CSR44	97.4	13.81	FC4 x CSR47	48.3	12.31
FC3 x CSR51	50.5	7.04	FC4 x CSR51	50.3	7.37
FC3 x CSR53	49.8	12.31	FC4 x CSR53	44.1	13.23
FC1 x FC2 (L)	50.3	7.04	FC1 x FC2 (L)	50.3	7.04

Rearing performance of these way cross hybrids at RSRSs

Hybrids	Hatching (%)	Effective ginnel/10000 seed (g)	Cocoon weight (g)	Shell weight (g)	Shell Ratio (%)	Pupation (%)	Fresh weight (g)	Fresh cocoon (%)	Filament length (m)	Filament size (D)
FC1 x CSR2	93.3	15.16	1.641	0.330	21.3	91	972	91.0	2.72	3.4
FC2 x CSR17	94.3	17.03	1.772	0.390	21.5	93	957	89.5	2.75	3.4
Double Hybrid	91.9	17.26	1.683	0.366	21.5	90	908	91.1	2.73	3.5
CSR2 x CSR17	91.3	16.77	1.704	0.363	21.2	93	898	91.0	2.63	3.5
CD at 5%	(+2)	0.83	0.04	(NS)	(NS)	(NS)	32	(NS)	(NS)	(NS)

Host Performance of three way cross hybrids FC1 x CSR2

Location	Effective host	Number of Instars	Fresh Wt. (g/10 lvs)	Cocoon weight (g)	Shell weight (g)	Shell Ratio (%)	Raw dig effic
Andhra Pradesh	90.00	5	18.6	1.678	0.338	20.1	38.6
Karnataka	75.00	44	14.5	1.676	0.405	21.5	38.1
Tamil Nadu	82.00	45	14.7	1.647	0.385	21.0	38.1
Telangana	90.00	5	15.2	1.710	0.418	21.7	38.1

Discussion: Double cross hybrids are popularized for their various advantages such as easy rearing of FCs and higher egg yields. However, its polygenic expression is more stable than single hybrids in unfavourable environments because of genetic plasticity within the populations. However, utilization of bivoltine three way cross hybrids for commercial exploitation is very limited. The rearing and maintenance of four stocks lines for purity is a difficult task while producing double hybrids, the three- way cross hybrids involving one FC and an inbred line may be easier to maintain parental seeds. Results indicate that manifestation of heterosis in way vary depending on extent of genetic distance and allelic interaction and rare three-way cross hybrids have shown desirable manifestation of hybrid vigour for most of the economic traits. Multiperiod evaluation showed FC1xCSR17, FC1xCSR2, FC2 x CSR2 and FC2 x CSR17 as best combinations with an evaluation index >50.0, high heterosis and improved cocoon uniformity. FC1xCSR2 and FC2xCSR17 were selected and compared with control single and double hybrid at RSRSs and were found superior over CSR2xCSR4 and on par with the popular double hybrid and these three way cross hybrids can be exploited for heterotic breeding programmes.

Inferences: FC1xCSR2 is superior over existing popular single hybrid (CSR2 x CSR4) and on par with the popular double hybrid (CSR4 x CSR2)x (CSR2 x CSR27).

Other Continuous Activities:

Maintenance of bivoltine silkworm breeds

N. Lokesh, C. M. Nikhil Kumar, S. Manohara Reddy and Y. Ravi Kumar

Objectives: To maintain bivoltine parental breeds conforming to the original breed characteristics

Productive bivoltine breeds (10), actual bivoltine breeds (11), silk deniers bivoltine breeds (2) and sex limited breeds (2) were maintained for evaluation of pre- and post cocoon parameters. The overall performance of the breeds was in conformity with the original breed characteristics and on par with the benchmark values.

Maintenance of bivoltine breeds

Characteristics	Productive (CSR2, CSR27, CSR4, CSR43, CSR44, CSR50, CSR51, CSR57)	Robust (CSR18, CSR19, CSR45, CSR47, CSR48, CSR51, CSR52, CSR53,)	Thin denier (CSR45,)Pm*	Silk denier (CSR2-SL, CSR4-SL, CSR43-SL, CSR27-SL, CSR50-SL)
Fecundity	>500	>500	>500	>400
Hatching rate (%)	>90	>90	>90	>90
Cocoon weight (g)	>1.75-1.85	>1.45-1.60	1.40-1.70	>1.45-1.90
Shell ratio (%)	>20.00	>20.00	>20.00	>20.00
Filament length (m)	>900	>800	>1200	>700
Raw silk (%)	>72.0	>70.0	>75.0	>70.0
Neamtosis (p) Control	<50	<60	<50	<60
			2.2-3.4	

P4 SMF - HASSAN

Bivoltine silkworm race maintenance and multiplication

R. V. Kapadia and K. B. Chandrashekar

Objective: Systematic silkworm race maintenance and supply to downstream multiplication centers.

Eleven bivoltine silkworm breeds were maintained following recommended silkworm race maintenance technology in 4 crops. Mean data of pupation rate, PMS / 100 dl layer cv, weight, single cocoon weight, single shell weight and cocoon shell percentage were recorded. The crops were meticulously monitored for pebrine incidence and the resultant dfls (~ 8,103 dfls @ 3 (+47% eggs recovery) were preserved as per requirement and utilized (2716 dfls to P3 & P5 centres) for further maintenance.

Performance of bivoltine breeds

Breed	Pupation rate (%)	Cocoon yield / 10000 larvae (kg)	Single Cocoon weight (g)	Single Shell weight (g)	Shell Ratio (%)
CSR2	97.14±0.8	16.19±0.3	1.67±0.03	0.40±0.01	24.14±0.3
CSR4	94.3±1.0	16.2±1.4	1.74±0.04	0.37±0.02	21.6±0.6
CSR5	94.2±0.8	16.1±1.1	1.68±0.05	0.40±0.01	23.8±0.8
CSR6	95.2±0.5	16.4±0.6	1.75±0.05	0.37±0.01	21.2±0.5
CSR27	97.4±0.5	17.0±0.5	1.66±0.03	0.44±0.01	26.1±0.4
CSR28	95.2±0.5	17.4±0.3	1.63±0.05	0.38±0.01	23.3±0.7
CSR31	97.0±0.2	16.9±1.8	1.68±0.05	0.42±0.01	24.8±0.8

SATELLITE SILKWORM BREEDING STATION-COONOOR

Maintenance of Bivoltine breeder's stock of genotypes

E. Rajakumari and K. Suroju

Objective: To maintain newly evolved bivoltine stock of bivoltine silkworm genotypes in its original characters

Thirty four bivoltine genotypes stocks were maintained in two crops. Mean data of fecundity, PPH by number, single cocoon weight, single shell weight and cocoon shell percentage were recorded. The crops were meticulously monitored for pebrine incidence and the results of this were utilized for further maintenance.

Development of bivoltine breeds with higher productivity under semi-temperate conditions of Nilgiris (Sept. 2015 to Mar. 2016)

E. Rajakumari, R. Suroju

Objective: To evolve new bivoltine breeds for higher productivity under semi-temperate conditions of Nilgiris

Maintenance of bivoltine germplasm stocks

Breed	Fec.	PPH (no.)	SC wt.(g)	SS wt.(g)	Shell Ratio (%)
CSR01	330	0600	1.740	0.370	20.69
CSR04	350	0600	1.800	0.370	20.57
CSR05	327	0550	1.800	0.390	20.53
CSR10	370	0647	1.420	0.320	22.65
CSR12	421	0485	1.640	0.350	20.58
SL04	444	0350	1.870	0.390	21.04
SL05	390	0327	1.710	0.370	21.67
L04	417	0500	1.800	0.390	21.04
SL09	401	0397	1.810	0.380	20.94
SL03	464	0473	1.570	0.320	21.38
SL06	417	0500	1.40	0.320	20.94
L1	330	0600	1.840	0.390	20.94
L5	394	0397	1.810	0.370	20.77
L9	405	0.400	1.710	0.440	20.94
CSR302	405	0550	1.800	0.390	20.78
CSR306	444	0473	1.400	0.340	20.79
L11	410	0613	1.910	0.390	20.94
L13	350	0600	1.840	0.390	21.48
L15	440	0350	1.420	0.320	20.52
L17	417	0613	1.800	0.390	22.14
Average	13	337	1.08	0.31	3.08
CV	8.30	6.13	9.68	6.61	5.63

Performance of CSR27 x Nistari genotypes stocks

Breed	Fec.	PPH (no.)	SC wt.(g)	SS wt.(g)	Shell Ratio (%)
CSR27	460	0550	1.870	0.370	20.90
CSR1	400	0600	1.910	0.390	20.94
CSR19	420	0450	1.710	0.350	21.07
CSR27	395	0.350	1.680*	0.360	21.75
CSR29	411	0600	1.870	0.390	20.76
CSR37	420	0691	1.710	0.350	20.91
CSR48	395	0510	1.80	0.390	20.81
CSR47	420	0550	1.810	0.340	21.27
CSR59	420	0.530	1.700	0.370	20.94
CSR31	400	0450	1.800	0.321	20.80
CSR52	400	0510	1.700	0.400	20.73
CSR53	370	0550	1.700	0.350	20.77
CSR	400	0551	1.700	0.370	20.77
Hybrid	394	0550	1.700	0.440	24.8
Average	70	370	1.08	0.32	3.01
CV	5.75	4.91	4.27	4.84	5.59

Mean bivoltine germplasm stocks are utilized in the breeding programmes developed by the CSRTI, Mysuru for developing productive bivoltine hybrids suitable for tropical sericulture countries

Eleven inbred lines (CSR14, SLD1, CSR17, CSR18, CSR47, CSR53, CSR202, CSR204, Ga10, D1, D15) and four commercial checks (SLD8, D16, D13, D17) were identified as useful performance from the germplasm stocks (CSR60-Common) as parental materials. Hybridization programmes were initiated and the lines were fixed at F7&F8 generations and scored (F5 F6, F7 & F8) during the period along with the hybrid evaluation trials. The quantitative traits targeted were achieved successfully (Pupation = 90 %, Cocoon wt = 1.7-1.8g; Shell wt. = 26 - 44 cg; Shell ratio % = 21 - 24). Correlating activity traits (30 hybrids) revealed that SCD05 x CSR4 was found as the best combining one for DFT.

Performance of the short-listed hybrids

Hybrids	Pen.	Pupation Rate (%)	6WSL Wt (kg)	HC wt. (g)	SS wt. (g)	Shell Ratio (%)
7 x 1	611	94.00	1.5760	1.941	0.448	22.99
1 x 7	532	93.00	1.5320	2.044	0.472	23.00
1 x 7	615	95.04	1.5110	2.033	0.483	22.75
7 x 1	613	94.03	1.5470	2.013	0.478	23.11
4 x 1	617	93.00	1.5380	2.033	0.477	22.93
1 x 1	620	93.00	1.5140	2.046	0.478	22.52
1 x 1	611	94.03	1.5160	2.017	0.476	23.00
5 x 4	612	93.00	1.5127	2.006	0.468	22.86
5 x 4	618	93.00	1.5120	2.047	0.478	22.39
CD (p = 0.05)	0.77	34.27	0.06	0.03	0.01	0.03
CV	0.001	0.000	0.000	0.000	0.001	0.000

Breeding for robustness is to utilize silkworm breeds under varied temperate as well as tro

S. Rajasekhrrt and K. Suvarag

Objectives: To evolve new bivoltine breeds for robustness under semi temperate conditions of Nilgiris

Ten bivoltine breeds viz.at, CSR17, CSR48, CSR58, CSR62 & 67, diamondss, D15, D20, CSR47, CSR21 & CSR42 were identified as breeding resource material and breeding program was initiated in Oct/ Nov 2012. The F5, F7, F6 & F8 generations were raised during the period and the fixation is under progress.

Performance of bivoltine and breeding lines for robustness

Breeds	Pen.	Pupation Rate (%)	6WSL Wt (kg)	HC wt.(g)	SS wt.(g)
RCH4 1	600	93.00	1.5000	1.980	0.448
RCH4 2	600	94.03	1.4900	1.960	0.448
RCH4 3	610	93.00	1.5000	1.980	0.448
RCH4 4	600	93.00	1.5000	1.980	0.448
RCH4 5	600	93.00	1.5000	1.980	0.448
RCH4 6	600	93.00	1.5000	1.980	0.448
RCH4 7	610	93.00	1.5000	1.980	0.448
RCH4 8	600	93.00	1.5000	1.980	0.448
RCH4 9	600	93.00	1.5000	1.980	0.448
RCH4 10	600	93.00	1.5000	1.980	0.448
CD (p=0.05)	0.00	0.00	0.00	0.00	0.00
CV	0.00	0.00	0.00	0.00	0.00

SILKWORM GENETICS LABORATORY

Ongoing Research Project

AID-0038: Evaluation of D11 x D19: A new bivoltine double hybrid for sub-optimal conditions (Lead: Shri B.Das, 2008)

K. K. Chandra (PI), G. M. Kishor Kumar, Y. G. Radha Lakshmi, B. A. Parthasarathy and M. Ramesh Babu

Objective: To evaluate the field performance of newly evolved bivoltine double hybrid, D11 x D19 for productivity and silk quality

P1 cells of D11 (20 nos) and D19 (2000 nos) were distributed to 2000 adopted seed farms through DOFDs (Palakkad, Madurai & Bangalore). Good cocoons generated (avg. yield: 65-72kg/ 100dfls; pupation rate: 92-94%) were processed for cocoon yield, productivity (2,43,500-2,61,150 cocoons/ha/yr) in rotary and plastic mountages and re-tested for quality parameters at CSTRI, last 24-44 grade in the rotary mountages and 24-44 plastic mountage, cuts recorded. 47,800 dfls were distributed to 251

Performance of Parental breeds and FCs

(D11 (SB1) x D19 (SB2)) x (D15 (SB3) x D20 (SB4))

Breed	Pupation rate (%)	Yield/ 10,000 larvae (kg)	Cocoon weight (g)	Shell weight (g)	Shell Ratio (%)
CSR61	93.00	64.44	1.442	0.342	23.73
3C	93.04	64.72	1.443	0.346	23.73
4D	93.00	64.18	1.500	0.356	23.73
4B	93.00	64.17	1.500	0.354	23.60
D11	93.00	65.12	1.472	0.342	23.16
D19	93.04	64.72	1.504	0.371	23.29

farmers of Karnataka, Andhra Pradesh, Tamil Nadu and Maharashtra received ₹Rs.1 (Rs)/ha in Tamil Nadu, followed by Maharashtra (Rs), Andhra Pradesh (Rs) and Karnataka (Rs/ha).

Weed performance of Brl-1 in Bhimasagar, March 2014

Plant	No. of farmers	Dry	Yield (kg/ha)	SCN (g)	SMW (g)	HI (%)
Karnataka	80	12806	40.10	1.620	0.063	21.60
AP	154	20759	42.08	1.720	0.062	23.08
Tamil Nadu	112	16886	41.04	1.27	0.064	21.621
Kerala	8	920	42.08	1.626	0.063	23.08
Maharashtra	84	9080	40.08	1.72	0.06	23.08
Total	360	57804	84.08	1.748	0.063	23.08

Quality characteristics of new site

Trait	Rainy season		Post-rainy season	
	Mean	Check	Mean	Check
Average size	21.84		21.45	
Pod Traits				
Days to 50% flowering (d)	1.24	36	1.32	35
Pod length (cm) (+/- cm)	6	66	7.6	6.6
Pod width (cm) (+/- cm)	1	66	1	6.6
Double pod (%)	80	66	80	6.6
Triple pod (%)	90	66	90	35
Pod shattering (%)	80	66	80	35
Seed Traits				
Maximum 100 seed (g)	1.8	1	2.45	1
Seed size variation (Minimum)	1	1	1	1
Shining seed (Yes/No)	2	2	2	2
Tannin (g/l)	3.8	1	3.7	1
Pungency (%)	1.9	1	1.9	1
Cotyledon (Yellow)	84	1	86	1
Overall Grade		56		3.6

Maintenance of silkworm breeds, larvae rearing, cocoon production, MPV technology and evaluation

K. K. Chandra

Chawki Rearing: Maintenance of silkworm races, conditioning for late instar larvae, cocoon

Breed	Race	Larval duration		Cocoon	Shell (g)	
		Days	(%) (kg)	(g)	(g)	(%)
KBR1	Race1	23.0	1.79	1.79	0.35	20.24
KBR2	Race2	23.0	1.68	1.68	0.35	20.83
3C	Race3	23.0	1.68	1.68	0.35	20.83
3P	Race4	23.0	1.68	1.68	0.35	20.83
KBR3	Race5	23.0	1.68	1.68	0.35	20.83
4C	Race6	23.0	1.68	1.68	0.35	20.83
4P	Race7	23.0	1.68	1.68	0.35	20.83
5H	Race8	23.0	1.68	1.68	0.35	20.83
5N	Race9	23.0	1.68	1.68	0.35	20.83
KBR4	Race10	23.0	1.68	1.68	0.35	20.83

Silkworm Rearing: Maintenance of silkworm races, conditioning for late instar larvae, cocoon

Eleven multivoltine breeds / 4 multi-6-7 particulars developed through sericulture mutant assisted selection. four MV/ foliage breeds and 20 related stocks were maintained and confirming to their breed characteristics under favourable Aug/ Sept and Nov-Dec.(12-14). Homozygosity for amylase genes was confirmed by amylase assay utilizing amylase marker. Egg, larvae and moth characteristics were maintained in the studied stocks.

Marker Genes (Linkage group)	Description	Marker Genes (Linkage group)	Description
w-3 (19)	White egg 3 yellowish white eggs	Y (17)	Bivoltine normal cocoon colour
Pb (2)	Red egg, serosa dark red	Re / (21)	Red blood
ps +/- (2)	Pink spotted white egg	l (19)	Larva, dark brown pigment on dorsum and lateral sides of larva
ely (19)	Elongated egg	m (3)	Moulting, larval body head & prothorax
Ge (1)	Green egg	sal+ (20)	Tubby, pupa elongated larva with small thoracic & larval abdominal
b (1.9)	Barred egg	Z (2)	Zebra diabrotica eggs
se (13)	Spindle shaped egg	Mr (10)	Normal larval, short thoracic & short abdominal
ok (12)	Chocolate, newly laid egg colour	o (1)	Elongated & pupa larval segment
p5 (2)	Striped, black dots segmental spots	ch (4)	Brown chocolate colour mutant larva
pM (2)	Minute dot larval markings	w (19)	Lethal eye in moths
Zz (3)	Zebra larval markings	wb (17)	Adult wing spot in moths
lem (3)	Lemon coloured larval skin	Pk (2)	Pale coloured cocoon
L (2)	Black mark spots on thorax side	Y (2)	Yellow blood

MULTIVOLTINE BREEDING LABORATORY

Concluded Research Projects

AAI 3003: Pre-authorization field trials of L14 x CSR2: A new polyvoltine x bivoltine hybrid of the silkworm *Bombyx mori* L. with superior fibre qualities (July 2011 to May 2013)

CSRTI, Mysore; NSDC, Bangalore; CSTRI, Bangalore

Objectives:

- To improve the L14 breed with respect to its demerits like variation in larval size, segregation in larval markings, variation in cocoon colour, shape and occurrence of thin useless filaments
- Large scale field evaluation of newly evolved hybrid L14 x CSR2 with respect to cocoon yield and quality

Silkworm breeding laboratories at CSRTI-Mysore undertook breed improvement programme besides multiplication of L14 stocks required for seed cocoon generation. The lines were subjected to the following breeding strategies in each rearing cycle:

- Rearing of a large number of silkworm seeds were brushed (minimum of 40)
- Bed wise observations on larval growth, larval markings, moultings and cocoon characters uniformity
- Best families among the lines with highest cocoon parameters
- Cocoon selection from the selected families
- Intermating / crossing among the selected lines
- Detection of non-filled matting eggs for farther multiplication
- Contaminant evaluation and productive qualities as checks

L14 seed cocoons were procured at CSRTI-Mysore and the F1 DFLs (L14 x CSR2) were produced at CSRTI-Mysore and NSDC Units (DOPOs).

Performance of L14 breed under improvement programme

Gen	Kg/dfl	Survival (%)	Cocoon weight (g)	Shell weight (g)	Shell Ratio (%)	Filament length (m)	Filament weight (g)
F1	42.5±0.60	94.50±0.50	1.95±0.04	0.39±0.01	19.90±0.58	1.16	1.89
F2	43.0±0.60	93.27±0.62	1.93±0.03	0.37±0.00	19.13±0.53	1.16	2.00
F3	39.8±0.60	93.00±0.75	1.48±0.05	0.28±0.00	17.16±0.67	0.75	0.91
F4	43±1.20	94.00±0.74	1.55±0.05	0.30±0.00	19.40±0.56	0.79	1.12
F5	41±0.60	93.00±0.81	1.48±0.04	0.29±0.00	20.13±0.42	0.78	2.47
Mean	41±0.68	93.75±1.21	1.68±0.08	0.33±0.02	18.95±0.96	0.91	2.00
C.V (%)	3.62	1.23	5.08	8.16	4.28		

Performance of L14 x CSR2 cocoons

Performance	Performance			
	2012-13	2013-14	2014-15	Overall
No. of Seed crops	31	32	8	67
No. of dfls	3000	3000	1000	7000
Fecundity	474	430	446	463
Total larval duration (DH)	22.00	23.00	23.00	22.67
5th age larval duration (DH)	5.12	05.18	05.18	05.16
Actual Cocoon yield (kg)	6745.00	6600.00	2738.00	16173.00
Actual Cocoon yield (kg)	1424	1111	684.10	1333.1
Cocoon yield/100 dfls (kg)	45.49	44.91	43.20	44.5
Survival (%)	88.19	89.87	89.00	88.88
Single cocoon weight (g)	1.285	1.402	1.308	1.402
Single shell weight (g)	0.297	0.374	0.378	0.356
Shell ratio (%)	18.15	18.37	18.11	18.19

Pl dfls were distributed to the field and performance was recorded. L14 x CSR2 cocoons procured from field were tested for seed cocoon quality parameters. The parental like variation in larval size, variation in cocoon colour and shape were eliminated completely during the improvement process. The occurrence of immature & stain deformation are within the acceptable limits and seasonal. The performance of thirty three seed crops of L14 (7000 Dfls) recorded an average cocoon yield of 47.30 kg/ 100 dfls. The performance of the L14 x CSR2 recorded an average egg recovery of 47,500 g per kg of cocoon as against the NSDD norms of 60g in the seed production process.

L14 x CSR2 47% productivity

	2012-13	2013-14		2014-15		Overall
	CSR2	CSR2	NSDD	CSR2	NSDD	
No. of crops	16	30	30	01	17	64
Cocoon/ kg- number	10380.25	11.3000	9371.00	9000	8341.009	9421.9040
Cocoon/ kg- weight (kg)	1731.48	341.15	760.0	7	598.73	3459.1.25
Pupation (%)	85.50	86.10	84.40	87.50	75.0	84.750
Recovery of cocoon	51.70	50.43	53.000	53.00	50.00	52.50
Egg yield kg/kg of cocoon)	50.00	50.43	48.10	47.50	49.00	47.500
No. of eggs/ g	1913	1757	1900	1700	1800	1750.0
Hibernation (%)	7.00	2.00	2.27	3	8.70	4.21
Total No. dfls produced	17000	35000	100000	1000	190000	643879

The overall performance of crop 5,76,423 dfls (2012 thereon) recorded an average cocoon yield of 2½ kg per 100 dfls and 60% had a cocoon price of Rs. 280 as against 62 kg and Rs. 247, respectively for the existing hybrid (FH x CSR2). Evaluation of seed cocoon parameters indicated the superiority of L14 x CSR2 over FH x CSR2 in terms of cocoon, filament length, renditality, raw silk, realisation and silk waste. Further, the field results of new silk reeled or multi-end reeling machines (4 samples) and automatic reeling machine (3 samples) recorded 4% raw and 14% raw quality silk, respectively.

Field performance of L14 x CSR2

State	Farmers	dfls	Yield/100 dfls (kg)
Karnataka	1200	1140000	61.20
Andhra Pradesh	420	210000	60.0
Tamil Nadu	500	12000	63.77
Maharashtra	110	25000	57.32
Madhya Pradesh	50	8750	58.86
Orissa	100	3000	43.47
Others	10	1000	57.00

Rearing performance on multivoltine rearing practices

Particulars	LH x CSR2	PM x CSR2	Improvement (%)
Shell weight	37.48	39.67	10.10
Average filament length (m)	980	763	22.20
Non-broken filament length (m)	932	713	27.30
Renditta (%)	89	84	5.95
Filament size (d)	2.78	2.86	
Renditta	5.32	7.35	15.70
Boilerless	91	89	3.09
Silk waste (%)	19.23	13.88	17.38

Interpretation/Recommendation: The field trial of LH x CSR2 confirms its superiority in terms of quality of silk (2A-2A grade). However, its cocoon yield varied from 31-66 kg/100 dfls indicating the instability in crop performance in the field. The inferior cocoon productivity was attributed to low survival and lower hybrid vigour.

Ongoing Research Projects

Acronym: Development of productive polyvoltine breeds of the silkworm *Bombyx mori* L. tolerant to high temperature and BmNPV (DoE, 2011 to Sep. 2016)

Investigators: Dejenanda (PI), V. Premalatha (Up to June 2014) and M. Balaram (Associate)

Objectives:

- To develop polyvoltine breeds tolerant to high temperature and BmNPV
- To identify productive crossbreed

Eight silkworm breeds/crossbreeds were reared for five generations under normal rearing conditions and further silkworm-baited for five times based on the average evaluation in the ERS of rearing/cocoon quality characters and multiplication evaluation of crossbreeds by using CSR2 as a tester. These four polyvoltine lines are currently under sterilization (F 6).

Performance of stress-tolerant lines/hybrids under normal rearing

Cross/ breeds	Survival (%)	ERS/ (g)	MSM (g)	Shell (%)	Filament length (m)	PC (%)	RR (%)	Weaving rate (F)	Suggestion
CS	80.52	1,313	0.232	17.64	773.88	000	12.74	83	SC/SV
HH1	86.83	1,280	0.241	18.43	714.34	001	12.62	84	SC/SV
HH4	88.86	1,314	0.251	18.94	712.88	000	12.77	81	SC/SV
HH5	82.86	1,282	0.235	18.19	693.88	000	13.13	83	SC/SV
LH x CSR2	85.24	1,780	0.329	20.22	901.22	001	15.85	83	SC/SV
HH1 x CSR2	82.76	1,741	0.319	21.01	841.14	000	15.42	84	SC/SV
HH4 x CSR2	86.88	1,819	0.338	21.33	861.44	000	15.15	83	SC/SV
HH5 x CSR2	83.88	1,748	0.325	21.20	851.88	000	15.15	81	SC/SV

AIS 001A: Improvement of Pure Mysore race for productivity and silk quality (Jan. 2015 to Jan. 2018)

Investigators: Dejenanda (PI), D.G. Kulkarni and Kadiyappa

Objectives: To develop Pure Mysore lines for improved hybrid vigor and fiber quality

The project is initiated with the collection of Pure Mysore stocks from KSSC and DCS, Karnataka and the lines are selected with the following characteristics for further development as per initiations.

Characters	KSSC	DCS, Kushalnagar	CSTRI, Mysore
Fecundity (no.)	430	400	408
Larval duration (days)	26	27	25
Cocoon weight (g)	1.939	1.814	1.895
Shell weight (g)	0.355	0.340	0.345
Shell %	18.31	18.79	18.20
Shape	Oval/ elliptical	Oval/ elliptical	Oval/ elliptical

AIS 3604: Development of improved crossbreeds of Kalahasti Sheep (Nellore L. collistes for quality mutton (Mar. 2016 to Mar. 2019)

Dayananda PR, C. Ist. Kishor Kumar, H. Basavarajappa, Sridhar and Y. C. Ramakrishna

Objective: To develop a cross breed for high productivity and improved pile quality

The project is initiated and eleven identified parental stocks including six greenish yellow, two dark yellow and three white coloured crossbreds from the breeding institutions were collected and the parental breeds are being maintained for further work.

Cost Evaluation of their Arable Sites

Development of new crossbreed Cauvery Gold (MAY x SS)

V. Divyaprasad (PI), Dayananda, D. S. Kishorni and M. Balaravindrakolobah

Objectives: Development of improved crossbreed for productivity and silk quality

Performance of (MAY x SS) Cauvery gold

Crossbreed	Pen	Survival (%)	GLW (g)	GBW (g)	Shed (%)	Pod weight (g)	FL (%)	Yield silk (%)	Grainage (g)
Cauvery Gold	300	94.44	1.780	0.235	87.7	80	650	14.00	80
(LN x CSW)	400	94.50	1.894	0.225	18.8	80	611	14.04	80
(NN x CSW)	479	94.00	1.900	0.230	18.4	80	650	13.90	80
Bivoltine hybrid*	0.37	78.41	0.24	18.24	0.08	0.20	0.24	8.41	
Bivoltine hybrid**	0.33	0.28	18.80	18.04	11.08	4.75	28.71	10.45	4.62

* Cross (LN x CSW) ** Cross (NN x CSW)

Breeding is done at the unstable crop performance of the crossbreed (LN x CSW2). In the field, cocoon/pupa productivity basics and assessment of the quality for quality silk for cocoon/yarn, a new polyvoltine line (MAY) was isolated utilizing improved lines of LN through directional selection and exposure to EMS/TV (2x10⁻³ PCD/ml @ 1 ml/100 larvae), (MAY) (10⁻⁴ dilution of stock solution @ 1 ml/100 larvae, and (MAY) (10⁻⁵ dilution of stock solution @ 1 ml/100 larvae). MAY is characterized by high survival and fertility, a new crossbreed "Cauvery Gold" (MAY x SS) has been identified through hybrid evaluation utilizing best productive exel bivoltines. The new improved crossbreed (CG) is characterized by higher productivity (>60 kg/100 dfls), superior than quality (2A-2A grade), light greenish yellow cocoon shell cocoons with compact shell and good grains, which can be reeled completely (no pupae layer resulting high raw silk recovery, a total of 600 MAY x SS) newly developed dfl is being proposed for commercialization during 2018-19 for the production of quality bivoltine crossbred silk in the country.

Maintenance of polyvoltine silkworm breeds

V. Premalatha (Up to June 2014), Dayananda, and Kishorkumar

Objectives: Maintain the polyvoltine breeds conforming to their original characters

TBO-five polyvoltine breeds were maintained conforming to their original breed characteristics for five generations and for utilization in the breeding programmes.

Performance of polyvoltine breeds

Breed	Pen	Pupation Rate (%)	Cocoon weight (g)	Shell weight (g)	Shell Ratio (%)	Pupation (g)	Reelability (%)	Raw silk (%)	Filament length (m)
PM/P	400±0.00	98.84±2.28	1.34±0.10	0.23±0.04	17.20±2.04	2.02±0.4	82.10±2.23	10.90±0.87	871±
PC/PE	400±0.00	97.92±1.15	1.30±0.20	0.24±0.05	18.47±2.50	1.96±0.2	81.77±1.53	11.30±1.17	884±
PE/PE	400±0.00	97.84±1.28	1.41±0.23	0.26±0.06	18.68±1.23	1.97±0.3	83.62±0.87	10.76±0.36	874±
MP1	400±1.78	98.87±3.28	1.38±0.22	0.23±0.05	17.34±1.10	1.97±0.3	84.00±0.00	10.20±1.15	862±
AE1/2	377±23	94.30±3.19	1.30±0.22	0.24±0.05	19.32±2.77	1.78±1.6	84.9±2.10.5	11.3±0.87	861±
AE1/2	401±1.78	93.73±1.17	1.41±0.24	0.26±0.06	18.26±0.65	1.99±0.3	81.16±0.23	11.12±1.12	862±
LN	400±0.7	98.88±0.17	1.61±0.26	0.28±0.06	18.08±1.66	1.82±1.0	84.0±1.0	10.98±1.25	864±
LN	400±0.8	98.81±1.24	1.38±0.10	0.23±0.05	18.08±1.66	1.97±1.7	83.80±1.66	11.20±1.00	863±

SILKWORM MOLECULAR BIOLOGY LABORATORY

I. Ongoing Project

AMS-SATP: Development of productive HPV tolerant bivoltine breeds/hybrids using BmNOX marker assisted selection (Apr. 2013 to Mar. 2018)

S. K. Avtaade (PI) and Virendra Kumar

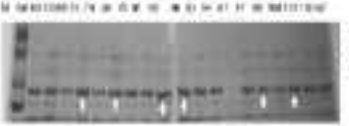
Budget: Rs. 2.50 lakhs

Objective

- To develop productive HPV tolerant bivoltine breeds using BmNOX as a marker
- To identify HPV tolerant single/double hybrid combination with economically evaluation and in-house testing

Though a number of productive bivoltine breeds of CSR series have been evolved, these are susceptible to diseases especially nuclear polyhedrosis caused by BmNPV resulting in our yields particularly into small and marginal farmers. Arduous efforts made for development of silkworm races tolerant to BmNPV resulted in the evolution of bivoltine breeds (CSR: 2A, 2B, 3N & 4N). A 25.5 kDa protein across BmNOX (NADPH oxidase) isolated in the gut fluid of Nistari strain of silkworm 'polyvoltine' has been identified and characterized, which has antiviral activity against BmNPV. The full-length gene encoding BmNOX has been sequenced (NCBI GenBank: Ser. no. 116004911; 2008). Nistari (N2.5.5N) (bivoltine) expressed significantly higher levels BmNOX. On this background, molecular marker assisted selection utilizing BmNOX protein marker was undertaken so to meet the present objectives.

To develop HPV tolerant bivoltine breeds, breeding programme was initiated employing BmNOX as marker utilizing donor parents with high BmNOX expression (Nistari, N2.5.5N) and the recurrent parents (CSR2, CSR4, CSR6, CSR26 & CSR27) of authorized hybrids (CSR2 x CSR4 & PCH x PM2). The donor parents were crossed with recurrent parents and the F1s were backcrossed with respective recurrent parents. The objective less of BC1 progeny was collected (3rd day) in Indian ink and screened individually by SDS-PAGE. The larvae with low BmNOX level were discarded and those with high BmNOX expression were selected and similar strategy was employed in each generation upto BC4. After BC4, the progeny were selfed/sibled to obtain homozygous lines with high BmNOX expression. Nine combinations each of single hybrids and double hybrids are prepared using the evolved BmNPV tolerant lines. The hybrids including F1s were validated for HPV tolerance in bore trials, which were inoculated per os by with 1X10⁵ PIB/ml of NPV at 1st instar and mortality upto 10 days post inoculation (DPI) was recorded. Based on BmNOX protein marker assisted selection, two lines each of CSR2, CSR4, CSR6, CSR26 and CSR27 with high BmNOX expression were evolved.



SDS-PAGE profiles of 3rd instar haemolymph of BC1 progeny showing the differential expression of BmNOX (NADPH oxidase) protein. Arrows indicate the low, intermediate and high expressers of the protein

SDS-PAGE profiles of BmNOX protein in larval haemolymph of BC4 progeny. Arrows indicate the low, intermediate and high expressers of the protein

Evaluation of parental lines and hybrids for tolerance to BmNPV isolates

Treatment (Larvae)	Mortality (%)	Weight (Mean ± SE)	Mortality (%)	Survival (Mean ± SE)	Mortality (%)
8	10.00±2.89	8 ± 28	11.67±3.68	(8 ± 1.27) + (31 ± 76)	10.67±3.68
31	22.33±3.33	8 ± 42	11.00±3.79	(8 ± 1.83) + (31 ± 87)	11.67±3.68
15	15.67±3.33	8 ± CSR4	12.67±1.15	(8 ± CSR4) + (31 ± CSR30)	14.67±1.53
42	23.00±3.00	31 ± 28	9.00±3.06	(31 ± 1.91) + (8 ± 76)	12.33±1.53
31	28.33±3.68	31 ± 42	10.00±3.00	(31 ± 1.10) + (8 ± 87)	8.33±3.76
32	20.67±3.33	31 ± CSR4	11.67±3.68	(31 ± CSR27) + (32 ± CSR30)	9.00±2.00
15	25.67±3.33	CSR2 ± 28	9.33±1.53	(CSR6 ± 1.91) + (CSR5 ± 76)	12.33±5.51
42	28.00±3.00	CSR2 ± 42	11.67±3.06	(CSR2 ± 1.10) + (CSR6 ± 87)	9.33±1.53
101	20.67±3.67	CSR2 ± CSR4 (C)	21.67± 1.53	157 ± 7.02 (C)	10.33±3.40
119	91.00±3.00	* Dead larvae: 8, 31, 15, & 119			
Mean	7.33±1.53	* Specified larvae: 28, 42, 42, 42, 15, & 91			
SEm	10.23±1.92	* LSD (comparing between V x S combinations) were considered			
CD	31.97±5.98	* Mean mortality (Mortality) were 0 larvae were control			
CD(5%)	32.97±11.55	* Mortality due to nuclear polyhedrosis were recorded 91 (91)			

Performance of BmNPV tolerant hybrids based on BmNCR marker assisted selection

	Hybrids	Pen.	Yield (100)		Cocoon	Shell	Shell	Fil	Denier	Filam	Raw s	Neck
			Kg/dfl		wt.	wt.	Ratio	Length	(d)	ent	(Mg	resist
			(%)	wt (Mg)	(g)	(g)	(%)	(m)			(%)	(c)
Single hybrids	8 x 28	450	28.00	13.00	1.827	0.330	21.19	807	2.80	0.72	97.24	88
	8 x 42	440	3480	13.34	1.834	0.340	21.27	820	2.85	0.82	94.12	84
	8 x CSR4	470	3680	13.68	1.901	0.318	21.19	764	3.08	0.78	94.28	88
	31 x 28	400	3620	13.58	1.882	0.340	21.60	819	3.08	0.81	96.61	88
	31 x 42	450	3720	13.73	1.879	0.341	21.64	808	2.80	0.82	94.28	84
	31 x CSR4	465	3535	13.37	1.856	0.335	21.41	760	2.89	0.79	94.28	84
	CSR2 x 28	410	3660	13.53	1.848	0.316	21.19	767	2.82	0.86	93.11	88
	CSR2 x 42	401	3670	13.53	1.839	0.337	20.64	803	2.88	0.80	94.17	84
	CSR2 x CSR4 (C)	400	3730	13.72	1.900	0.330	21.00	781	3.08	0.80	94.28	88
	Mean	450	3620	13.73	1.899	0.340	21.19	806	3.08	0.80	95.08	87
	SE	0.58	261	0.487	0.044	0.011	0.367	7.23	0.07	0.04	1.58	1.04
	CV (%)	2.58	3.92	4.878	2.707	3.425	0.761	8.86	2.21	3.29	1.62	1.11
Double hybrids	(8 x 101) x (31 x 15)	575	3997	14.08	1.930	0.340	21.27	809	2.73	0.7	97.97	88
	(8 x 119) x (31 x 91)	554	7700	15.55	1.770	0.370	21.09	843	2.91	0.11	97.28	90
	(8 x CSR27) x (31 x CSR30)	651	8660	15.92	1.903	0.380	22.01	921	2.88	0.83	96.78	88
	(31 x 101) x (42 x 15)	631	3860	13.89	1.827	0.330	21.03	816	2.78	0.78	96.78	84
	(31 x 119) x (42 x 91)	631	3867	13.91	1.850	0.330	21.24	809	2.88	0.80	96.89	88
	(31 x CSR27) x (32 x CSR30)	661	8167	15.92	1.906	0.389	22.03	949	2.72	0.11	96.84	90
	(CSR6 x 101) x (CSR6 x 15)	602	3847	13.91	1.837	0.330	21.19	818	2.87	0.80	96.07	86
	(CSR2 x 119) x (CSR6 x 87)	641	3453	14.04	1.702	0.370	21.03	852	2.88	0.86	97.24	88
	PC1 x PC2 (C)	575	3173	13.09	1.828	0.370	20.27	903	2.87	0.79	96.07	88
	Mean	670	4833	13.73	1.898	0.340	21.19	903	2.88	0.88	96.53	88
	SE	14.76	467	0.709	0.007	0.010	0.034	46.3	0.19	0.20	0.97	2.31
	CV (%)	3.58	5.41	5.368	4.549	4.370	3.467	8.93	3.46	3.97	1.13	5.74

Based on the overall performance for the pure and positive cocoon traits including BmNPV resistance, single hybrids (31 x 28) and two double hybrids ((31 x 15) x (CSR27 x 87) CSR27 x (CSR30)) have been short-listed for further evaluation under DOT during 2019-20 and RSRGs.

REARING TECHNOLOGY & INNOVATION

Completed Activities

Popularization of rotary mountages for quality cocoon production (Apr. 2013 - Mar. 2015)

Entire Responsible: JCA Experts and Pursuit Officer

Objective: To popularize rotary mountages for creating awareness among silkworm farmers for quality cocoon production

An extensive survey was conducted in Andhra Pradesh, Karnataka and Tamil Nadu along with 2 DA experts, Ms. Mridu Kawalgud to collect the feedback from farmers/industrials for their adoption of rotary mountage technology for quality cocoon production. To increase/ enable the technology, farmers were educated to follow dual cocoon collection method for collection of 50% of mature larvae to reduce stickages during the spinning and were also advised to mount 50% of mature worms on rotary mountages and the remaining on plastic collapsible mountages. JCA accepted rotary mountages, cyclonet and nets/sheets to 10 cookies in each Kodihalli district for the demonstration and quality cocoon production. About 700 farmers were benefited on use of rotary mountages and cyclonet collection method.

Multiplication of parental stocks of newly developed by hybrids and evaluation

Seven multivoltine and bivoltine breeders' cocoon crossings (700 dfls) were conducted and 500 dfls seed cocoons were supplied to the Grainage unit.

Rearing Performance

Cross Breeds	Breeds Pupation	Larval Wt (gms)	Cocoon Wt (gms)	Shell Wt (gms)	Shell %	Filament Length (mts)	Filament Denier
Mar-Apr.	1:14	10	1.519	0.251	0.225	17.80	3.1.22
May-Jun.	1:14	10	1.522	0.252	0.245	17.80	3.1.31
Jul-Aug.	1:14	10	1.515	0.212	0.250	17.80	3.0.98
	Breeding	30	1.519	0.238	0.240	17.80	
Sep.-Oct.	0:1	30	1.505	0.203	0.215	23.00	3.1.10
	0:6	30	1.514	0.211	0.204	23.00	3.1.10
	FC1	30	1.544	0.218	0.218	23.00	3.0.78
	FC2	30	1.514	0.203	0.202	23.00	3.1.13
	Breeding	120	1.519	0.217	0.207	23.00	
Nov.-Dec.	0:6	30	1.507	0.208	0.208	23.00	3.0.98
	0:6 FC1	30	1.518	0.209	0.209	23.00	3.1.00
	0:11	10	1.503	0.210	0.209	23.00	3.1.07
	0:16	10	1.503	0.213	0.204	23.00	3.1.10
	Breeding	70	1.510	0.208	0.208	23.00	
Jan.-Feb.	FC2	70	1.547	0.202	0.201	21.00	3.0.14
	FC4	70	1.551	0.203	0.200	21.00	3.0.25
	Breeding	150	1.550	1.70	0.20	21.00	
Mar-Apr.	FC3	90	1.515	0.205	0.205	21.00	3.1.30
	6:5x6	90	1.551	0.205	0.205	21.00	3.0.10
	6:5x6	90	1.554	0.210	0.205	21.00	3.0.30

GRAINAGE

Production of hybrid dfls for popularization of authorized and newly developed silkworm hybrids

K. Mallaya

A total quantity of 42.00 (multivoltine hybrid) dfls were produced utilizing 2,27,000 seed cocoons for DPT in South India under research projects AB-3468, AB-3469 & AB-3521 including 7200 dfls (FCs) and 700 dfls (FT). The grainage performance of different hybrid combinations was recorded. 1400 dfls of

Hybrids	Deposition Breeds	Brood Cocoon (No.)	Pupation Peak (%)	Eggs /g	DFLs Produced	Eggs Yield (g/kg)
CSR2 x CSR2	4	9500	85.15	1800	17100	10.53
CSR3 x CSR27	4	11300	86.50	1810	9845	11.51
FC1 x FC2	4	22800	91.50	1790	11360	21.10
SK1 x CSR18	3	12000	90.00	1700	9600	10.45
SK1 x SK2	4	24000	92.00	1770	9400	10.21
Total/Avg.	19	83100	90.23	1782	64305	81.83

Li x CSR2 were produced with a seeding percentage of 90.42, egg yield of 152.74 g/kg, seed cocoon's and average cocoon weight was 1737. These hybrids were distributed to the farmers under different programmes.

Alternate technique for silkworm egg preparation to improve of grainage operations (Pilot study)

G. B. Kalkarni (PI) and R. Sheque

Objectives: To test computed Pierces for moth emergence and nylon nets for egg laying

Outcomes: It helps to save time and avoids dependency on skilled workers for sexing and emergence. Plastic sheets can be easily cleaned and re-usable (20-30 times)

Particulars	Conventional Method	Current Method
Time required (Hrs.) (Male)	20	12
Pupae kept / tray (Nos.)	310	500
Total pupae kept (Nos.)	6200	6240
Time taken to keep the tray (2 persons in tray) (Hrs.)	20	5
Time to sex the pupae by 2 persons (Hrs.)	8	222
Time required for cocoon by 2 persons (+ manpower)	80	10

POST COCOON EVALUATION UNIT

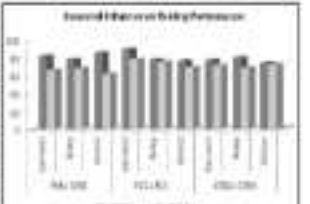
Continuous Other Activities

Post cocoon characters of seventy silkworm hybrids for practical acceptance parameters

Y. G. Rachalaiahmurthi (PI) and Kanjappa

Objective: To evaluate the post cocoon parameters of seventy silkworm hybrids in mulberry hybrids.

Cocoon lots (649) of various hybrids from different units of institute and its related units were evaluated regularly for the seeding performance. The data is commercial and analytical across four crop seasons. The data on reeling performance would help the breeders to suggest suitable breeding package of practices and to plan future breeding programmes to improve post cocoon traits and silk quality. The influence of seasons on the cocoon characters and raw silk recovery was analysed for popular crossbreed (PM x CSR2) and bivoltine double (FC2 x FC1) and single (CSR2 x CSR4) hybrids with pronounced effects in rainy season.



Region-wise comparison of seeding data of silkworm hybrids

Hybrid	Location	Crop	Shell weight (%)	10 Shell (gm)	Filament length (M)	Raw Silk (%)	Reeling Denier	Cocoon/kg (no)
PM x CSR2	Anantapur	1	20.41	0.33	450	2.53	11.15	87.54
	Bangalore	1	21.32	0.33	450	2.76	10.78	87.02
	Mysuru	2	19.28	0.31	500	2.76	11.20	89.02
	Average		20.34	0.32	467	2.68	11.04	87.86
CSR2 x CSR2	Anantapur	1	20.60	0.34	500	2.33	13.52	83.00
	Bangalore	1	20.13	0.34	524	2.57	14.27	87.25
	Mysuru	1	21.41	0.34	525	2.67	13.34	84.11
	Mysuru	2	20.12	0.31	500	2.66	13.23	79.00
	Average		20.56	0.33	512	2.56	13.59	83.34
CSR2 x CSR4	Anantapur	1	20.12	0.33	501	2.40	12.89	76.25
	Bangalore	1	20.04	0.34	512	2.64	13.98	71.13
	Mysuru	2	21.05	0.34	518	2.68	13.91	70.02
	Average		20.40	0.34	510	2.57	13.59	72.47
CSR2 x CSR4	Anantapur	1	21.20	0.32	517	2.47	14.01	88.00
	Bangalore	1	21.34	0.33	515	2.57	14.00	89.21
	Mysuru	2	20.10	0.31	513	2.53	14.42	71.00

Hybrid	Location	Lot	Replication (N)	APL (m)	MBPL (m)	Strain (m)	Raw Silk (%)	RSR (%)	Neatness (p)
FC1 x FC2	Salem	1	91.37	934	812	2.49	14.33	20.00	93
	Dodballa	1	71.44	938	649	2.58	14.70	21.67	93
	CF, Bangalore	1	82.17	732	617	2.58	16.71	21.66	93
FC2 x FC1	Yelwal (old)	1	70.28	938	664	2.72	15.33	20.00	94
	Salem	2	84.78	1179	909	2.54	16.64	19.32	94
FC1 x FC3	Yelwal (old)	1	82.23	934	796	2.60	16.16	19.87	93
	Kodlipet	1	73.23	944	680	2.59	14.21	19.85	93
	Salem	1	90.35	1148	953	2.72	13.45	19.52	94
CSR2 x CSR4	Salem	6	71.58	1.21	801	2.62	16.62	20.58	93
	Dodballa	1	70.28	934	656	2.63	14.63	19.43	93
	CF, Bangalore	1	81.57	938	753	2.61	17.61	20.36	94
	Yelwal (old)	1	70.37	938	661	2.59	14.70	19.00	93
C1 x C5	Dodballa	1	73.53	938	651	2.63	13.61	19.84	93
	Salem	1	70.24	1148	876	2.63	13.63	20.13	93
	Yelwal (old)	1	73.47	934	685	2.72	16.31	23.22	93

Field trial of reeling package to reel Li14 x CSR2 cocoons (Apr. 2014 to Mar. 2015)

Kariyappa. P.G and Y. C. Rathalakshmi

Objective: To demonstrate the reeling package for Li14 x CSR2 cocoons in the field

The robustness and silkreel properties of Li14xCSR2 cocoons are neither normal multivoltine cocoons and nor bivoltine cocoons, even though the cocoons of hybrid are being transacted at higher rate due to improved 'flow characteristics'. It is reported that these cocoons are not reeling up to the expectation in the process of reeling. This may be due to several factors, process methods including technical-managerial factors. Avoiding package exclusively for Li14xCSR2 cocoons was developed, which includes standardised reeling processes like method of stifling, cooking etc. to produce quality silk. As Silk Institute is focusing on popularising Li14x CSR2 in the field, validation of the scientific package through field trials was undertaken for fine tuning and commercialisation in the field at Doddaghatta (KOL) and Kolagal (KOL). The newly developed package was compared with the existing procedures. The reeling package modified for Li14xCSR2 revealed improvement in the reel raw silk recovery, which has direct impact on productivity.

Reeler	Place	RCCW (g)	RSW (g)	Reel Ratio (%)	Lot (Rs/kg)	Reelability (%)	Neatness	Raw Silk (%)	Size (d)	RSR (%)	Assess (%)
Manjula	KOL	1.450	0.135	18.79	61	88.20	7.38	13.63	2.38	20.03	15.44
S. R. Ahamad	KOL	1.697	0.130	20.01	64	87.99	7.80	14.11	13.83	20.05	14.32
Anjanappa	KOL	1.588	0.315	18.01	67	88.86	7.23	13.84	12.12	20.11	14.20
H. Mallu	KOL	1.588	0.130	18.35	42	88.33	7.13	14.04	0.27	24.23	13.13
Venkatesh	KOL	1.584	0.445	22.52	61	88.04	8.70	14.73	19.88	20.12	13.10
Abdul Zuhir	KOL	1.881	0.417	21.75	61	77.37	7.11	14.27	19.88	19.63	14.32

Technique for experimental lots for reeling performance

Y. C. Rathalakshmi and Kariyappa

Cocoons of newly evolved races (newly hybrids (17% nos) from different accessions of main institute and its related units were tested and cost division observations were analysed. The unit also processed 21 raw silk samples of different sources were tested on multilend machine and presented at DDTH, DDTR Bangalore. Further, a total of 420 Kg. of cocoons were stifled, conditioned, cooked and reeled and 44 kg of raw silk was produced. Thirty commercial cocoon lots from DFP cluster (Kolaradara and Tiptur) that were processed and reeling performance of the bivoltine hybrids was documented. The data revealed that re-ability ranged around 60-62%, average filament length (600-1000 m), denier (2.7-3.0 d), renditta (6.2-7.0), raw silk recovery (78-80%) and neatness of 84-95 points.

SILKWORM PHYSIOLOGY

Core Research Activities

Maintenance of bivoltine and multivoltine silkworm seed breeds for original breed characteristics (Apr 2015 to Mar 2018)

In sericulturam Reddy

Objectives: To maintain silkworm seeds conforming to the original breed characteristics

Two crossings of bivoltine semi-synthetic diet breeds were conducted for cocoon and post-cocoon characteristics. Pupal recovery ranged between 91.24 and 95.32, pupation rate 89.24 & 93.62) and the performance of breeds was in conformity with the original characteristics. Similarly, six crossings of multivoltine semi-synthetic diet breeds were conducted and the pupal recovery was between 90.62 and 94.36, pupation rate (86.82 & 90.74) and the pupal weight was in conformity with the original breed characteristics.

BV	CSR2xCSR26, CSR4xCSR27, CSR1xCSR50, CSR6xCSR2, CSR4xCSR50, CSR4xCSR2, CSR26xCSR4, CSR6xCSR50, CSR50xCSR4, CSR50xCSR2, CSR27xCSR4, CSR50xCSR6
MV	CPPA1xCPPA2, PM2xPM1, C.nichi(K)xCBJ1, CBJ1xCBJ2, CBJ2xCBJ1, KPG1xKPG2, KPG2xKPG1, KPG1xKPG3, KPG3xKPG1, SPA2xSPA1, SPA1xSPA2

Application of probiotics for improving economic characters of silkworm (Jun. 2012 to Mar. 2016)

In sericulturam Reddy

Objectives: To study the effect of probiotics for improvement of economic characters of Bombyx mori

Probiotics are live microbial food supplements, beneficially affecting host by enhancing cellular growth and development. The effect of *Streptomyces roseoviridis* a known probiotic for improvement of economic characters of *Bombyx mori* was undertaken. Standard culture of *S. roseoviridis* (NCIM 2082) from National Collection of Industrial Microorganisms, National Chemical Laboratory, Pune) was cultured in MSPP broth medium. The broth cultures (10 culture, 10 culture & 10 culture) were supplemented on leaves of V1 variety and fed to pre-ppr stadium and mulberry silkworm, Bombyx mori fed leaf after 48 hours of rearing under 200 larvae treatment in 3 replications. The control group was fed with MSPP broth treated leaves. Growth and developmental parameters of silkworm were recorded and analysed. The commercial characteristics of silkworm were significantly enhanced by probiotic supplement.

Effect of probiotic on economic characters of silkworm hybrids

Silkworm Hybrids	Probiotic Dose (cc/ml)	No. Larvae (n)	Pupation Rate (%)	Single Cocoon Wt (g)	Single Shell Wt (g)	Shell Ratio (%)
CSR2 x CSR4	Control	400	94	1.240	0.310	25.0
	10	400	96	1.356	0.340	25.4
	10	400	96	1.378	0.379	27.1
	10	400	94	1.328	0.362	27.1
PM x CBJ1	Control	400	92	1.200	0.210	16.00
	10	400	96	1.281	0.210	17.00
	10	400	92	1.259	0.230	18.34
	10	400	96	1.289	0.210	16.13

PEST MANAGEMENT LABORATORY

Co-Ordinated Research Projects

PRS-3527: Survey and surveillance of major pests and their natural enemies in mulberry ecosystem (Jan 2016-Dec 2016)

J. B. Narendra Kumar (PI), Vinod Kumar, M. Nanje Gowda, H. Jalaja, S. N. Patwari, N. Sathiyan, S. Manoja Hegde and B. Ravi Reddy

RSS, Hosakote, RSO Di, Kanakapura, RSRS, Channapatnagar, RSO Di, Chikkaballapur, RSRS, Salem, RSRS, Anantapur

Objectives:

- To monitor the incidence of insect pests and their natural enemies in mulberry eco-system
- To construct life tables and study bi-biotic interactions of key pests, if any and their natural enemies
- To establish cultures of new potential natural enemies for mulberry pests

Incidence of mealybug (3.87-4%), leaf roller (0.13-4%), thrips (0.26-2%) leaf and whitefly (0-1.87) leaf was recorded in sericultural areas of Karnataka (Mysore, Chamarajanagar, Kanakapura and Kolar), Tamil Nadu (Salem & Dharmapuri) and Andhra Pradesh (Anantapur). A new parasitoid of leaf roller, *Phanerotoma* sp. was found to parasitise the roller pest in Karnataka and Tamil Nadu to a extent of 42% and 30%, respectively. Besides, three species of coccinellids, one species of parasitoid on whitefly and one species of predatory thrips were collected at RSRS, Salem and the same were sent to NBAIR, Bangalore for identification.

APE-3008: Investigation on semio-chemicals of the silkworm pupal fly *Exorista bombycis* for *exotic* control with NBAIR, Bangalore (Jan 2009- Dec 2014)

Vinod Kumar (PI), J. B. Naik (Co-PI), Kumar, M. Hasib Mantoor*, N. Balthavaraja (PI) and Gokilavani

*RSO, Madurai, NBAIR, Bangalore

Objectives:

- To isolate and identify the kairomone from mulberry leaf, silkworm larvae, faecal matter and exuvium eliciting behavioural response in pupal fly
- To isolate and identify the sex pheromone of *E. bombycis*
- To determine the bio-efficacy of kairomones (mulberry) and sex pheromones (pupal fly)

Timely supply of cut pupae to NBAIR for achieving pupal fly emergence was ensured. Abdominal extract of *E. bombycis* was collected and is subjected to GC-MS at NBAIR and components identified were Nerolidol (sesquiterpene), Nerolone, Phenylacetamide, acid, Hexadecanoic acid and Oleic (fatty acid). In the olfactometer method, 3-methyl-1-butyl-3-methyl-2-butenoate and further work is under progress.

TOT Activities:

Demonstration of pupal fly management strategies in an adopted village of Srirangapatna Taluk (Jun. 2013 to May 2014)

Vinod Kumar and J. B. Naik (Co-PI)

Objective: Demonstration of pupal fly management

IPM package of exotic pupal parasitoid, *Nesolynx thymus* + placement of pupal trap + packing of silkworm litter in old cocoon crate was demonstrated covering the sericulturists (167) in Chikkatamarahalli village in Srirangapatna Taluk. A total of 1002 couples of *N. thymus* were released covering 16 batches in 251 crops. Untreated batches were considered as control. The results are presented in the following table.

Months	Crops (No.)	Silkworm (Kg)	Pupal Parasitism (percentage)	Trapped pupal flies (No.)	Cocoon Infestation (%)
July 2013	17	1000	322	4108	2.00
Aug.	27	4100	101	3040	1.00
Sept.	45	4500	103	3267	1.00
Oct.	44	1001.5	309	3864	1.00
Nov.	48	1000	144	3363	1.00
Dec.	39	1440	180	1424	1.00
Jan 2014	114	1500	254	1003	1.00
Feb.	56	11429	256	2457	0.63
March	43	1000	158	1023	0.75
April	43	1100	116	623	0.50
May	117	11500	295	1308	0.43
Total/Mean	753	34491	2038	25078	1.14

In the village, the pupal fly incidence was 2.00 per cent in July 2013 and it was reduced to 0.43 per cent in May 2014. The pupal fly incidence was reduced to 1.14 per cent in the village. The pupal fly incidence in the control batches was 18.7%. IPM package resulted in net addition of 48 kg in cocoon crop. Untreated batches were not able to bring 25.219 additional cocoon crop.

Contract activities other than Institutional Projects

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

Vinod Kumar (PI) and J. B. Ramesha Kumar

Objective: Maintenance of mother culture of bio-control agents and release in CSRTI campus

Nucleus cultures of five parasitoids namely *Nesolynx thymus*, *Exorista philippinensis*, *Trichomalopsis sp*(Ex), *Trichomalopsis apicifer*, *Trichomalopsis sp*(In) and *Dirhinus sp*. two predators of mealy bug i.e., *Cryptolaemus montrouzieri* and *Scymnus coccivora* and one egg parasitoid of lepidopteran pest i.e., *Trichogramma chilonis* besides host culture of mulberry pink mealy bug, *S. Crayon cephalonica* were maintained throughout the year. A total of 3,117 pouches of *Nesolynx thymus*, 1,48,250 *thymi* cocoons (605 bioets and 366 *Trichocards* were produced. 1,110 pouches (111 lakh adults) of *N. thymus*, 39,250 *Dirhinus sp*. (cells – 37 bioets and 30 *Trichocards* were released in CSRTI campus, which resulted in keeping pest incidence below 5%.

Release of multiple parasitoids to mealybug out fly population in cocoon markets, godowns & rearing units

Vinod Kumar (P.) and J. S. Ramesha Kumar

Objective: Reduce the population of out fly in cocoon markets, godowns and rearing units

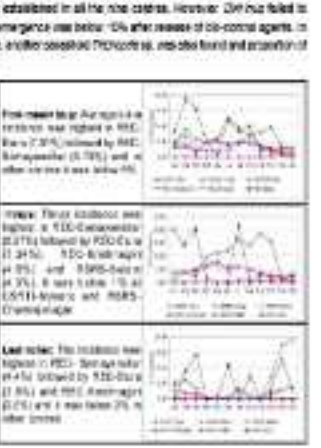
Release of *Nesolynx thymus gingeriae*) and *Dirhinus sinhalyi*) pupal parasitoids of out fly in cocoon markets (Ramanagaram, Channapatna & Kollegal), three rearing units (Ramanagaram) and godowns (DSRO-Ramanagaram, RSP, Ramanagaram & Smile- Channapatna) at fortnightly interval for a period of 6 months was carried out @ 10 pouches/*N. thymus*/centre and 1,000 adults of *Dirhinus*/centre. Old nail pupae were collected from localities to record establishment of natural enemies and *N. thymus* established in all the nine centres. However, *Dirhinus* failed to establish in any of the centres. Further, the out fly emergence was below 10% after release of bio-control agents in cocoon markets of Ramanagaram and Channapatna, another parasitoid *Trichocrios* was also found and proportion of *Trichocrios* was more as compared to *N. thymus*.

Pan-weaning and harvesting of mulberry pests

Vijay Joseph Mary A.V. (P.), J. B. Narshalu Kumar, M. Noble Monteiro, K. Sivakumaraswamy, A. Shankaramurthy Daniel, G. Gobbiraswamy, S. Haddaraju, U. Venkateswara Rao and Mr. A. Shankhar Babu

Objective: To make the control strategies for mulberry pests

Fortnightly surveys on prevalence of pests in mulberry gardens and silkworm rearings at CSRTI-Mysuru and related units (RSRS-Channapatna, REC-Hiriyur, RSRS-Hiriyabbur, REC-Kanakapura, RSRS-Galibore, REC- Krishnagiri & REC-Ramagiranahalli) was conducted and data was analyzed. Forty-five weekly farmeetings at Chief-Agronet advisories were collected through SMS Portal for Sericulture farmers (Vivid Sericulture Directorate in Andhra Pradesh, Nagpore and Vellore in Telangana).



SILKWORM PATHOLOGY

Concluded Projects

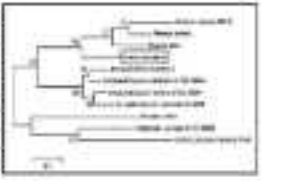
APR:0671: Therapeutic control of Microsporidiosis in the silkworm through characterization of Metalloprotease Janus-Peptidase enzyme genes (MMP3) in *Nosema bombycis* (Apr. 2012 to Mar. 2015)

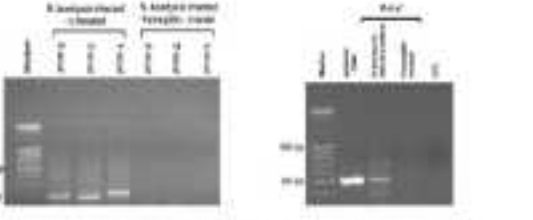
A. R. Narasimha Murthy (P.) and K. U. Poornima (SRF), Bengaluru

Objectives:

- Identification of mic responsible genes controlling MetAP2 enzyme using PCR techniques through specific primers for *Nosema* complex
- The cloning and characterization of MetAP2 gene of microsporidia
- Development of a process controlling mic responsible using certain chemical compounds in the silkworm

Nosema complex species were multiplied by the isolation to the susceptible silkworm breed and purified using standard protocols. Degenerative primers were designed for *N. bombycis* and the MetAP2 gene was amplified, cloned and sequenced. DNA isolated from purified microsporidian spores was used for PCR. Six chemicals including fumagillin targeting MetAP2 gene of *N. bombycis* were evaluated. The phylogenetic analysis of *N. bombycis* MetAP2 showed similarity with *A. cerenae* MetAP2. Anti-microsporidial activity was effective with fumagillin against MetAP2 gene expression and suppressed *N. bombycis* multiplication.





DPT 00/08: Identification of factors responsible for conversion crop loss due to diseases at field level and its impact on cocoon productivity (Jan. 2012 to Dec. 2014)

M. Basavaiahsubbaiah (PI), K. Dhanasekharane and A.R. Kamalmiha Nayaka, M. Maheswaran (RSRO-Bangalore), N. Shivakumar (RSRO-Bangalore), V.K. Baithur (RSC SU - Haldibari), S. Rajkumar (RSRS-Salem), T. Thirumeniselvanu (RSO- Dindi), N.G. Ashwanu (RSO SU- Trichy), S. Kasi Reddy (RSO-Madakasira), P. Venkata Ramana (RSO- Ulsoor) (w.e.f. May, 2013), S. Narasimha Murthy (RSO- Vijayapura) from June, 2013), M. Venkateswara Rao (RSO- Guntur) and T. M. Hegde (RSO- V, Kote from July, 2013 onwards)

Objectives:

- To determine the silkworm diseases incidence in the Southern Sericultural states viz., Karnataka, Tamil Nadu and Andhra Pradesh
- To estimate the extent of crop loss due to the silkworm diseases in the field
- To identify the factors responsible for crop loss and their impact on cocoon productivity

Fortnightly surveys on the silkworm disease prevalence in three southern states viz., Karnataka (Bangalore Rural, Kolar & Mandya), Tamil Nadu (Salem, Erode & Tirupattur), Telangana (Ranagareddy) and Andhra Pradesh

(Anantapur, West Godavari & Chittoor) were conducted from October 2012 to September 2014. The survey covered five farmers with V hybrid race (DFL-Pl day) silkworm rearings selected in each area. Total number of larvae fed in bed area and total number of larvae in the rearing bed were recorded. 10% of the bed area/cage were observed for the incidence of silkworm disease viz., Grasserie, Flacherie, Muscardine and Pebrine based on visual symptoms and microscopic examination and the disease incidence was recorded. After completion of crop, information on yield was collected from the farmers. Possible reasons for crop loss from farmers having less than 60 kg cocoon yield/100 dfls were documented and the data was analysed. The seasonal incidence of grasserie, flacherie and muscardine was documented. Only 18.02% crops yielded <60kg, while the rest yielded >60kg. The low cocoon yield (<60 kg / 100 dfls) was mainly attributed to poor quality of leaf (8.98%) followed by high temperature and high humidity (4.49%), poor rearing management (1.64%) and poor hygiene (1.64%).

Month	Disease Prevalence (%)			Yield/ 100 dfls (kg)
	Grasserie	Flacherie	Muscardine	
Oct.2012	0.75	2.41	0.00	67.07
Nov.2012	1.53	1.01	0.42	67.15
Dec.2012	1.34	1.53	0.47	66.51
Jan.2013	1.03	1.68	0.72	66.91
Feb.2013	1.98	1.51	0.33	65.90
Mar.2013	2.08	1.42	0.00	66.08
Aug.2013	0.74	1.39	0.00	66.03
May.2013	1.01	1.70	0.00	65.51
Jun.2013	0.93	1.11	0.00	67.10
Jul.2013	0.87	1.46	0.14	66.02
Aug.2013	1.10	1.50	0.63	67.12
Sep.2013	0.94	1.62	0.61	70.68
Oct.2013	0.98	1.66	0.63	69.08
Nov.2013	0.92	1.53	0.33	69.04
Dec.2013	0.72	1.06	0.46	69.05
Jan.2014	0.74	1.20	0.25	71.84
Feb.2014	0.98	1.09	0.16	72.25
Mar.2014	0.93	1.08	0.00	69.96
Aug.2014	0.73	1.16	0.64	69.08
May.2014	0.79	0.94	0.64	67.96
Jun.2014	0.88	1.29	0.61	69.30
Jul.2014	0.95	1.15	0.63	69.15
Aug.2014	0.98	1.47	0.66	69.41
Sep.2014	0.74	1.45	0.61	69.58
Average	1.08	1.50	0.36	67.90

AINP-SVM: Silkworm Disease Monitoring of Seed and Commercial Crop Rearings at South Indian States (Oct. 2013 to Mar. 2014)

M. Balaram Kotasthane (PI), A.V. Mary Josephine and M. Ramesh Babu (Voluntary)

Objectives:

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

Seasonal disease monitoring was initiated from January, 2013 onwards in selected basic Seed Farms from Karnataka, Tamil Nadu and Andhra Pradesh and also in selected Cluster areas of Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Kerala and Maharashtra. Crop-wise disease monitoring will be conducted in the cocoons reared during kharif & rabi in CRCs, whereas monthly / 6 times in a crop monitoring on the incidence of silkworm diseases will be conducted in the selected CRC clusters. A web based data entry sheet was uploaded for submission of crop inspection report by each team leader (CSB-CRC) along with remedial measures suggested and follow up action taken. The incidence of diseases from January, 2013 to March, 2014 in each CRC cluster of each IBP was recorded.

Seasonal prevalence of silkworm diseases

State	Season	Grasserie	Flacherie	Muscardine	Cocoon Yield (kg/100 dfls)
Karnataka	Summer	1.20	1.88	0.13	71.14
	Rainy	0.83	2.28	0.07	71.88
	Winter	1.02	2.02	0.13	71.27
Tamil Nadu	Summer	0.65	1.24	0.00	83.71
	Rainy	0.49	1.18	0.00	87.44
	Winter	0.34	0.98	0.00	71.27
AP	Summer	0.84	0.79	0.00	93.01
	Rainy	1.12	1.42	0.00	84.36
	Winter	1.16	1.13	0.00	80.23
Average	Summer	1.03	1.28	0.04	82.62
	Rainy	1.05	1.88	0.00	87.44
	Winter	1.09	1.08	0.07	80.38
	Average	1.06	1.18	0.13	87.46

Average disease incidence in DFT clusters in Dashi Zone

Name	Crop	Dfts (No.s)	Disease incidence (%)								Yield /100 dfts (kg)	Dev. Kg
			Incidence in values				Trends - Increase (+), stable (=), decrease (-) of crop					
			Dfts	Pbs	Mbs	Pbm	Dfts	Pbs	Mbs	Pbm		
Karnataka	BV	9000	0.10	4.78	0.00	0.00	0.89	2.60	0.00	0.00	91.14	0.57
Tamil Nadu	BV	440910	0.00	0.18	0.00	0.00	0.11	0.10	0.00	0.00	70.84	0.50
Andhra Prad	BV	19980	0.14	1.29	0.43	0.07	0.14	1.47	0.48	0.08	89.14	0.11
Telangana	BV	9000	0.00	0.00	0.00	0.00	1.45	1.00	0.00	0.00	86.56	0.00
Maharashtra	BV,CC	9000	0.00	0.22	0.00	0.00	1.80	0.72	0.00	0.00	82.01	0.41

Dont Issues/Other activities

Pebrine monitoring: Sporadic incidence of microsporidian was noticed in Pure Mysore seed area (Hunsur and Nagarahole) from Jan. 2014 to December. 2014. A joint committee comprising of CSRTI-Mysore, NSSO-Bangalore, KSSRDI- Bangalore and DoD-Karnataka constituted microscopic examination of different samples (silkworm eggs, larvae, pupae, moth, dust and thread mother samples from all the basinages, Basic Seed Farms, Cocoon markets and farmers crops and eliminated the microsporidian infected batches. The testing was conducted in two spells (July-August 2014 and September-2014). During the first spell, 3 samples (0.71%) revealed the infection out of 282 samples and in the second spell, 44 samples (1.22%) revealed infection out of 3,320 samples tested. Misc disinfection program was conducted in the entire Mysore Seed area and the incidence of microsporidian infection was brought under check. Pebrine free(Registered Seed Producers/Registered Chawki rearers)farms were established through Workshops/Training programs/Demo/Declarations on the control of pebrine disease. A Hand book on Pebrine Control and management in Kannada language for the benefit of the staff and farmers was prepared. The microsporidian infected crop from Mysore Seed Area was reared for four successive generations and found that the microsporidian is virulent and transmits transovarially. Pebrine monitoring was also conducted in other sericultural areas of Karnataka and necessaries of CSRTI-Mysore, PNDP mission and P3 DOF Mysore (NSSO and the incidence was kept under check.

Quality analysis Reports: Twenty six quality analysis certificates were issued for Ashwini, Ankush Seeds, Ramdoot, Vijetha, Kaveri Amruth, Vetcare Vijetha, Vetcare Vijetha Suprameem, Sanchari and Ramdoot Amruth, Vijetha Seeds.

Farmers meetings for dilseases diseases: A forewarning on Pachaora disease and its management was issued through CSRTI- Website. A total of 52 weekly Sen-Agromet advisories Bulletins (April, 2014 to March, 2015) were issued through DA Portal. 2612 messages were received from sericulturists on the management of silkworm diseases in six languages and issued under HSDAS.

MECHANICAL ENGINEERING DIVISION

The Mechanical Engineering Division is pioneer in design and development of various tools of trade, equipments and machines for mechanization for various sericulture activities in India. The machines/tools developed are in high demand and form major component in development programmes implementing agencies. The Division is actively involved in design and development of rearing houses for young and late-age silkworms. The major R&D activities, training, extension, publication etc. are as follows:

Design and Development of Equipments and machines for sericulture

Cocoon harvester for single/double pupa rearing/pupa: The cocoon harvester design was improved for higher efficiency, easy operation and maintenance. The machine was rigorously tested at institute and farmers level. The prototype was developed for commercial production and assigned to M/S D... New Delhi for patenting and commercialization. M/S Raj

Enterprises, Mysore and M/S OKS Systems, Coimbatore, were licensed through NRDC for commercial production of cocoon harvesters.

Design and Development of Mechanized Rearing Beds for Late-Age Rearing of Silkworms: Mechanized Rearing Bed design for late-age rearing of silkworms to reduce manpower requirement were improved. An auto-controller for forward and return of loading unit and sheet transportation mechanism was developed and tested.

Energy from mulberry shoots: A large quantity of mulberry shoots are discarded after silkworm cocooning and harvest. CSRTI Mysore has embarked research on effective utilisation of mulberry shoots by converting them into energy and combustible efficient bio-fuels like briquettes and charcoal.

Design and development of silkworm rearing houses for hot & dry and hot & humid climatic zones of peninsular India: Sericulture has gained ground and popularity in hotter regions of Karnataka, Andhra Pradesh and Tamil Nadu and hot and humid regions of Coastal Andhra Pradesh. The rearing house requirements of non-traditional areas are being studied to design and develop silkworm rearing house design for undertaking sericulture activities successfully.

Patenting	
Invention	Patent Details
A Machine for application of slaked lime and bed disinfectants powders over young-age silkworms (Chawki worm feeding machine)	No: 1713/DEL/2014 Date: 31/07/2015
Soil Heater	No: 1713/DEL/2015 Date: 31/07/2015
PVC stands for rearing young-age silkworm (Chawki Rearing stand)	No: 1945/CHE/2015 Date: 30/03/2015

Commercialization	
Machine/ Equipment	Firm
PVC stands for rearing young-age silkworm (Chawki Rearing Stand)	M/S Concept Components, Mysore
Cocoon harvester for cellular or plastic mountages	M/S Raj Enterprises, Mysore M/S OKS Systems, Coimbatore
Mahseer worm separator	M/S Das & Ramesh, Varanasi

Training: A total of 1,000 trainees were imparted practical aspects of mechanization in sericulture and silkworm rearing houses. Around 8000 farmers, students, vendors, etc. visited the division to acquire information.

Fabrication & Supply: Six units (Tray washing machines: 2 units @ Rs. 30,000/unit; Mulberry Cutting preparation machine: 2 units @ Rs. 10000/unit; Plastic mountage folding bed: 2 units @ Rs. 2.5lakh) of sericulture equipments and machines of Rs. 1.35 lakh value were fabricated and supplied to farmers and sericultural R&D institutions and organizations.

SERICULTURE EXTENSION, ECONOMICS AND MANAGEMENT

Ongoing Research projects

PICE 0135: A Study on the impact of post and disease management practices in sericulture among the farmers under cluster promotion programme in the South India (Jan. 2010 to Dec. 2016)

D. Gangadhar, H. Jayaram, T. Krupa, S. Parthasarathi and Ramprasad

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

A total of 17 CPP clusters were selected from Southern Zone and Uttaranchal and 40 sericulturists were selected from each cluster through multi-stage random sampling method. Interview schedule has been developed and pretested.

PICE 0135: Study on Drought Management practices in Mulberry Sericulture (Jan. 2015 to Dec. 2016)

Vasanta Bandal, M. Nadaf Mohiddin H., Vedavyasa, U. P. Reddy, B. Vidyunmala, A. Shankaramurthy Gowda and K. Vishwa

Objectives:

- To analyse different management practices adopted by farmers to overcome the crisis of drought in mulberry cultivation and silkworm rearing.
- To study the adoption behaviour characteristic drought management technologies popularised by the research institutes and to identify the gaps.
- To study the preferences and expectations of farmers from research and extension scientists to overcome the crisis effectively.

The project is being implemented in six clusters viz Tumkur & Bhandarahally (Karnataka), Hindupur & Penugonda (Andhra Pradesh), Dasanchatram & Addakuppattiram (Tamil Nadu). Interview schedule has been developed and pretested and data collection for the schemata survey is under progress.

Cluster Promotion Programme (CPP)

Cluster Promotion Programme is implemented and coordinated by CSRTI-Mysore in Southern Zone (Karnataka, Andhra Pradesh, Telangana, Tamil Nadu, Kerala and also in Maharashtra and Madhya Pradesh in 136 clusters in collaboration with Departments of Sericulture of respective states. The clusters in Southern zone are categorized into 93 mother clusters and 51 satellite clusters. The clusters are established with an objective to promote bivoltine silk production and also to produce more cocoons/ grainage than its the rest of the part. Clusters were legislated based on farmer's profile and cluster facility of the area. Each cluster is closely monitored by two Cluster Development Facilitators (CDFs) nominated by Central Silk Board and Department of Sericulture. All the backward and forward linkages are established in these clusters. The cluster development facilitators provide all the technical guidance to the farmers to improve productivity/ returns and also help farmers to maximize the mulberry cultivation area within the cluster. During the year South Zone clusters have

State	Cluster		Bivoltine Raw Silk Production (MT) As on 30 Nov'15			
	Mother	Satellite	Target	Achievement	% Achievement	% increase over 2014-15
Karnataka	27	19	820.00	887.37	108.23	84.38
Andhra Pradesh	11	2	411.00	464.84	113.10	28.09
Telangana		5	44.00	48.77	111.02	
Tamil Nadu	11	11	321.00	362.52	112.93	98.21
Kerala	2		2.00	13.98	699.00	211.11
Maharashtra	4	3	9.00	10.98	122.00	116.00
Madhya Pradesh		1	11.10	13.83	124.59	84.76
Grand Total	55	41	1618.10	1801.11	111.30	88.76

achieved all time high of 2241.15 MT lint-free raw silk production with an achievement of 115.3 % against the target and contributed 82% of cluster target and 80% overall target for lint-free silk production in the country.

An additional quantity of 430.34 MT lint-free silk production was achieved during the current year and this accounts for 57.13% increase in raw silk production over the previous year. Apparently of 1430.50 MT lint-free silk was produced against the target of 1400 MT with an achievement of 101.48% during 2012-14. Karnataka contributed highest quantity (~600 MT) to lint-free raw silk.

Silk Distribution: A total of 213.66 lakh cfls were distributed to the farmers in clusters. Tamil Nadu, Maharashtra, Telangana and Andhra Pradesh achieved more than 100% target in all clusters. The cfl uptake in the clusters increased by 71.25 lakh cfls over the previous year due to improvement in rearing & reeling and productivity and coordinated extension efforts by CSB & DoS.

Cluster	Annual Target (lakhs)	No. of crops	DFL Distribution (Nos.)	% Achievement	% increase over 2012-13
Karnataka	92.25	92750	23442777	98.87	93.29
Andhra Pradesh	47.25	77142	47448777	113.46	30.74
Telangana	4.35	1850	1857700	100.00	
Tamil Nadu	30.45	29000	14541111	113.06	45.03
Kerala	3.60	671	518779	93.93	86.08
Maharashtra	11.09	7500	11166000	150.84	33.38
Madhya Pradesh	2.40	1850	2224600	92.69	81.08
Total/Avg.	200.45	214621	213000671	106.08	51.03

Productivity improvement: The average cocoon productivity was 66.27 kg/100 dfls over 199.43 lakh dfls and 13348 MT Mulberry cocoons were produced in 106 clusters. Highest average cocoon yield (90kg) was achieved in Uttarahalli cluster, Tamil Nadu and Kolar cluster (Kerala) clusters. The overall cocoon productivity (kg/100 dfls) recorded revival trend that Tamil Nadu stands first (70.04) followed by Andhra Pradesh (66.68), Karnataka (66.24) and Telangana (65.08). cocoon productivity in Kerala was 72.58kg spinning 5.68 lakh/dfls. Overall cocoon productivity improved to 5% in clusters. The average cocoon yield/100 dfls in the clusters ranged from 53.00-70.04 kg/100dfls with a coefficient of variation (CV) of 11.22%. The performance of Tamil Nadu and Andhra Pradesh clusters was relatively homogenous with lower CVs.

State	Cocoon Production (kg/100 dfls)			
	All Part	2012-13	2013-14	% Improvement
Karnataka	63.73	66.03	66.24	3.98
Andhra Pradesh	61.89	66.05	66.68	5.51
Telangana			65.08	
Tamil Nadu	67.10	70.40	70.04	5.28
Kerala		70.40	72.58	
Maharashtra	58.72	63.00	62.48	6.04
Madhya Pradesh		53.00	53.00	
Total/Avg.	64.40	66.61	66.27	3.00

Cluster Development Facilitators (CDFs)

Andhra Pradesh		
Clusters	CDF	DDO
Anantur	Dr. T. Venkateswara Rao, Scientist-D, RSCBU, Anantur	Mr. D. Nagaraju, SO-Anantur
Hindupur	Dr. M. Nirmalkumar Rao, Scientist-D, RSC,Pipli	Mr. K. Somasundara, SO-Hindupur
Chittoor-a	Mr. T.V.S. Ramanuja Rao, Scientist-D, RSC,Chittoor	Mr. T. Bhaskara Rao, SO-Chittoor
Chittoor	Dr. P. Durga, Scientist-E, SSPU-CF,RSC	Mr. Venkatrajulu, SO-Chittoor
Gokilam	Dr. V.B. Ghanthan, Scientist-E, RSCBU, Gokilam	Mr. S. Balkrishna Sharma, SDE, FSC/Gokilam
Hindupur	Dr. M.P. Reddy, Scientist-D, CSB-Hindupur	Mr. Krishna Reddy, SO-Hindupur
Kalyanadurga	Mr. B. Vijaya Kadia, Scientist-E, RSC,Kalyanadurga	Mr. K.Ramachandra Reddy, ASO,Kalyanadurga
Madakasira	Dr. S. Nagendra Kumar, Scientist-D, RSC,Madakasira	Mr. Y.Venkateshappa, ASO,Madakasira
Palamaner	Dr. S.K. Prasad, Scientist-D, CSB,Palamaner	Mr. B. Hari Babu, ASO,Palamaner
Pulivendla	Dr. T. Venkateswara Rao, Scientist-D, RSCBU,Anantur	Mr. Ramji Yadav, SO-Anantur
Rayalacheru	Dr. T.Jayaraju, Scientist-E, RSCBU, Rayalacheru	Mr. B. Hari Babu(Addl. charge), ASO,Palamaner
V.Kota	Dr. T. Mogili, Scientist-D, RSC-V.Kota	Mr. B. Ramachandra Rao, SO-V.Kota
Vayalpadu	Dr. K.B. Prasad, Scientist-E, RSC,Vayalpadu	Mr. P. Ramaiah, SO,Vayalpadu

Karnataka		
Chemist	CSIR	DSIR
Accountant	Mr. K. Thippeswamy, Scientist C, NCBS Mysuru	Dr. Anil Pais Naik, ADD, DSIR-Mumbai
Cook	Mr. Ishwar, Scientist C, HRDC Hubli	Dr. H.C. Nagendrappa, ADE, DSIR-Hubli
Driver	Mr. G.B. Nagaraja, Scientist C, CSMCRI Mysuru	Dr. Mukesh Kumar Singh, ADE, DSIR-G.B. Pantnagar
Electrician	Dr. A.N.S. Murthy, Scientist C, CSMCRI Mysuru	Dr. T. Ravi Babu, ADE, DSIR-Hanamkonda
Lab Asstt.	Dr. C.R. Singh, Scientist C, CRE-Gogavar	Dr. M.C. Lavan, ADE-Gogavar
Nurse	Dr. K. Gangadhar Reddy, Scientist D, CSMCRI Mysuru	Dr. J.A. Jegadeesh, ADE, DSIR-Chennai (Main)
Stenographer	Dr. Vinod S Bhat, Scientist D, FDDI Mumbai	Dr. M. Karthikeyaraman, ADE, DSIR-Mohanlal
Typist	Mr. Hanumant Bhimappa Hole, Tel. RMC Belagavi	Dr. N.V. Narayan, ADE, DSIR-Bijapur
Electrician	Mr. D.N. Venkateswara, Tel. RMC-Chitradurga	Dr. K.P. Apte, ADE, DSIR-Dehradun
Pharmacologist	Dr. M. Dhanalakshmi, Scientist E, RMRC Nelamangala	Dr. G. Sundaramoorthy, ADE, DSIR-Chennai (Main)
Lt. Laboratory Asstt.	Dr. S. Ravichandiran, Scientist C, CSMCRI Mysuru	Dr. M. Karthikeyaraman, ADE, DSIR-Mohanlal
Draughtsman	Mr. S. Umesha, Scientist C, RMRC-Chitradurga	Dr. Pradeep P. Bansal, ADE, DSIR-Visakhapatnam
Draftsman Gr. II	Dr. Dasaiah, Scientist D, CSMCRI Mysuru	Dr. S.N. Mahendra Kumar, ADE, DSIR-Visakhapatnam
Librarian	Dr. K.V. Hariprasad, Scientist D, FDDI-Mohanlal	Dr. M. Karthikeyaraman, ADE, DSIR-Mohanlal
Stenotypist	Mr. Umamaheshi Reddy, Scientist D, NIPER-Ahmedabad	Dr. Ashwani Kumar, ADE, DSIR-Gaziabad
Cook-cum-Bearer	Mr. Ishwar, Scientist C, HRDC Hubli	Dr. Avinash Babu P, ADE, DSIR-Solan (HP)
Field Asstt.	Dr. Nanda Gopal Mahajan, Scientist E, CSMCRI Mysuru	Dr. J. Sadhasivam, NDE, DSIR-Madhya Pradesh
Field Driver	Dr. B.K. Bandyopadhyay, Scientist D, CSMCRI Mysuru	Dr. S. Karthikeyaraman, ADE, DSIR-C.D.Arcot
Attendant-I	Dr. P. Radhakrishna Rao, Scientist C, NIBMG Kalyani	Dr. P.L. Dhananjaya, ADE, DSIR-Hyderabad
Attendant-II	Dr. T.V. Ramachandra, Prof. IISc, Bangalore	Dr. S.N. Mahendra Kumar, ADE, DSIR-Visakhapatnam
Driver	Mr. K.N. Nandi, STA (SC), NIOT Chennai	Dr. Brij, ADE, DSIR-Hisar
Peon	Mr. K.B. Bhajantri, Tel. RMC Belagavi	Dr. G. Nagendrappa, ADE, DSIR-Chitradurga
Attendant-I	Mr. Ishwar, Scientist C, HRDC Hubli	Dr. S.P. Nanda, ADE, DSIR-Guwahati
Attendant-cum-Typist	Dr. Harish Bhanagar, Scientist D, FDDI-Mohanlal	Dr. J.S. Sandhu, ADE, DSIR-Bangalore
Laboratory Asstt.	Mr. D.M. Ravi Kumar, Sr. TA(C), Lonavla-Khandala	Dr. D.S. Mahadik, ADE, DSIR-Lonavla-Khandala
Lt. Typist	Dr. D.S. Ramachandra, Scientist C, CSMCRI Mysuru	Dr. P.N. Borude, ADE, DSIR-A.P. Nagar
Gardener-cum-Peon	Dr. C. Jayaseel, Scientist E, NIO-RC Nagalapuram	Dr. S.N. Mahendra Kumar, ADE, DSIR-Visakhapatnam
Cook(Gr.)	Dr. Rajendra Hegde, Scientist E, NIPER-Kolkata	Dr. J. Sadhasivam, NDE, DSIR-Madhya Pradesh
Gardener-cum-Peon	Dr. Nanda Gopal Mahajan, Scientist E, HRDC Mumbai	Dr. M.S. Nathan, ADE, DSIR-Madurai
Draughtsman-cum-Typist	Mr. M. Hemmige, Tel. RMC-Belagavi	Dr. Ravindra Kumar, ADE, DSIR-Lucknow
Stenotypist-cum-Typist	Dr. M.R. Raghavendra, Sr. Sc. E, RRC-NIH Bangalore	Dr. Brij, ADE, DSIR-Hisar
Draughtsman	Dr. P.N. Navaneeth, Scientist E, CLRI-Chennai	Ms. R. Nirmala, NDE, DSIR-Bangalore, Kalyani
Driver-cum-Peon	Mr. H.M. Hiremagalur, TA, RRC-NIH, Bhanpur	Mr. S.M. Kapoor, ADE, DSIR-Bhatinda
Senior Clerk-cum-Typist	Dr. Thirumala Seetharam, Scientist E, NIPER-Kolkata	Dr. S.L. Kothapalli, ADE, DSIR, Pune
Driver-cum-Peon	Mr. Ravi Ishwarlal Shastri, TA, RRC-NIH, Guwahati	Mr. P.G. Vasudevapanicker, ADE, DSIR, Mumbai
Stenotypist	Mr. H.S. Bhanu, Scientist B, CLRI-Chennai	Dr. M.C. Chandrappa, ADE, DSIR-Bangalore
Peon	Mr. K. Ashwatha, Scientist D, CSMCRI Mysuru	Dr. S.N. Mahendra, ADE, DSIR-Pune
Sweeper	Mr. Chinnaswamy, TA, RRC-NIH, Chennai-Guindy	Dr. M.S. Patil, NDE, DSIR-Nagpur
T. Stenotypist	Dr. K. Kusuma Kumary, Scientist D, NIIST, CSIR-Thrissur	Dr. Jamangandla, ADE, DSIR, Hyderabad
Typist	Mr. H.M. Shanthappa, Scientist B, RRC-NIH, Chennai	Dr. Mangaiah, Sr. Manager, ADE, DSIR-Pune
Telephone Operator	Mr. J.P. Venkateshwarlu, Scientist C, CSMCRI Mysuru	Dr. M. Karthikeyaraman, ADE, DSIR-Mohanlal
Telegraphist	Dr. P.N. Arbade, Scientist D, NIIST, CSIR-Kerala	Ms. R. Nirmala Menon, ADE, DSIR-Delhi/Mehrauli
Teacher	Mr. K. Ashwatha, Scientist D, CSMCRI Mysuru	Dr. Y.K. Nanandrappa, ADE, DSIR-Kanpur
Field Attendant	Mr. S. Shanthappa, Scientist D, CSMCRI Mysuru	Dr. J. Manoj Kumar, ADE, DSIR, Ranchi
Technician	Mr. T.N. Suresh Kumar, Scientist C, RTC, Hyderabad	Dr. S.T. Nair, NDE, DSIR-Kolhapur
Fitter	Mr. Jayaram Reddy, SRA, BSMG-Chennai	Dr. M. Nagaraj, ADE, DSIR-Bangalore

Kerala		
Chemist	CSIR	DSIR
Accountant	Mr. P.V. Sivakumar, Scientist C, NIIST, Trivandrum	Dr. Satish Kumar, ADE, DSIR-Mohali
Assistant	Mr. M. Sivaraj, Scientist C, RRL-Trivandrum	

Maharashtra		
Chamber	CSR	CSD
Akola	Mr. M.V. Kothawade, Secretary C, PRO, Akola	Mr. S.P. Patil, DSO Akola
Beed	Mr. Rahul Singh, Secretary C, PRO, Beed	Mr. P.R. Dhongde, DSO Beed
Buldhana	Mr. M.V. Kothawade, Secretary C, PRO, Amravati	Mr. S.S. Dhage, DSO Buldhana
Jalna	Mr. Rahul Singh, Secretary C, PRO, Aurangabad	Mr. Ramesh R. Hande, DSO Jalna
Nanded	Mr. A.J. Kamble, Secretary C, PRO, Pandharpur	Mr. P.A. Patil, DSO Nanded
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Sangli	Dr. Chandrashekhar R. Nagda, Sec C, PRO, Belgaum	Mr. S.P. Sakate, DSO Sangli
Satara	Mr. Tanajirao K. Salunke, Secretary C, PRO, Satara	Mr. V.S. Pawar, DSO Satara
Wardha	Mr. M.V. Kothawade, Secretary C, PRO, Amravati	Mr. S.W. Pawnkar, DSO Wardha
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Tamil Nadu		
Chamber	CSR	CSD
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Alangulam	Mr. T.K.Dhanesh, Scientist E, PRO, Thiruvananthapuram	Mr. R. Rajaraman, AEO, Thiruvananthapuram
Alangudi	Mr. N.K. Sinha, Scientist D, PRO, Delhi	Mr. R. Parameshwaran, AEO, TSC, Pudukkottai
Arcot	Dr. A. Mohamed Nasiq, Scientist C, PRO, Bhopal	Mr. S.Senthil, AEO, Arcot
Arimpur	Mr. Thirumalaivasan, Scientist D, PRO, Goa	Mr. M. Thangaraj, AEO, TSC, Bhavani
Bargoor	Dr. Jagadishprabhu, Scientist D, SSPC, Hisar	Mr. S. Murugan, AEO, TSC, Erode
Bavigai	Mr. V. Hemavati Bharati, Scientist C, PRO, Jhansi	Mr. R. Arockiaswamy, AEO, Bavigai
Bhavani	Mr. Thirumalaivasan, Scientist D, PRO, Goa	Mr. M. Thangaraj, AEO, TSC, Bhavani
Chidambaram	Dr. P. Senthilkumar, Scientist D, PRO, Ludhiana	Mr. N. Ravindran, AEO, Chidambaram
Chinnasalem	Dr. V.Dhanalakshmi, Scientist C, SSPC, Bhubaneshwar	Mr. S. Lakshmanan, AEO, TSC, Dharmapuri
Dindigul	Dr. N. Dhanapalan, Scientist D, PME, Erode	Mr. S. Sukumaran, AEO, TSC, Salem
Gudhiyaragoor	Mr. R. Anbazhagan, Scientist C, PRO, Chennai	Mr. M. Murugesan, AEO, Gudhiyaragoor
Kalrayan	Mr. Pandiyarajan, Scientist D, PRO, Hyderabad	Mr. M. Natarajan, AEO, Dindigul
Kodiyalam	Dr. Jagadishprabhu, Scientist D, SSPC, Hisar	Mr. A. Murugesan, AEO, TSC, Erode
Kolar	Mr. K. Praveen, TA, PME, Chennai	Mr. J. Jayaprakashnarayanan, AEO, Kolar
Kumbakonam	Dr. D.M. Reddy, Scientist D, PRO, Ghaziabad	Mr. R.V. Murthy, AEO, Udumalpet
Madhiyanallur	Dr. C.M. Reddy, Scientist D, PRO, Ghaziabad	Mr. R.V. Murthy, AEO, Udumalpet
Mettupalayam	Mr. Jesan Joseph, Scientist C, PRO, Bangalore	Mr. Kanagasabhapathi, AEO, TSC, Ooty
Odiyamalai-kovai	Mr. K.M.M. Sharif, Scientist D, PME, Bangalore	Mr. J. Manoharan, AEO, TSC, Erode
Palani	Mr. G. Panchapakesan, Scientist D, PRO, Chennai	Mr. M. Natarajan, AEO, Kolar
Pitharchalan-pattaiyar	Dr. N. Dhanapalan, Scientist D, PME, Erode	Mr. S. Sukumaran, AEO, TSC, Salem
Pollachi	Dr. K. Chandrasekaran, Scientist D, PRO, Udaipur	Mr. A. Alagarsamy, AEO, Pollachi
Porgalur	Mr. Jesan Joseph, Scientist C, PRO, Bangalore	Mr. M. Natarajan, AEO, Udumalpet
Pudukkottai	Dr. P. Senthilkumar, Scientist D, PRO, Udaipur	Mr. Mariyappan, AEO, Pudukkottai
Sankarapuram	Mr. T.Gopalakrishnan, Scientist C, PRO, Sonipat, Hisar	Mr. Dhanapal Arumugam, AEO, Kanchipuram
Srivilliputhur	Dr. N. Ramesh, Scientist D, PME, Sri Ganganagar	Mr. S. Ayyakkaruppan, AEO, Srivilliputhur
Usilampatti	Dr. P. Senthilkumar, Scientist D, PRO, Ghaziabad	Mr. R.V. Murthy, AEO, Udumalpet
Vellalapatti	Dr. S. Mahendran, Scientist D, PRO, Ahmednagar	Mr. Paramasigamani Sundaram, AEO, Virudhunagar
Telangana		
Chamber	CSR	CSD
Bhongir	Dr. P. Saravanan, Scientist D, PRO, Udaipur	Mr. Venugopal, MO, Bhongir
Mahabubnagar	Dr. R.V. Singh Jat, Scientist C, PRO, Ghaziabad	Mr. Anandaswamy Yeri, AEO, Mahabubnagar
Sangareddy	Dr. P. Saravanan, Scientist D, PRO, Udaipur	Mr. P. Vishal Reddy, MO, Sangareddy
Zahirabad	Dr. R. Sivalingam, Scientist D, PRO, Ghaziabad	Mr. S. Sudhakar, DSO, Zahirabad

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Performance of Clusters : Tamil Nadu (2014-15)

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Performance of Clusters : [illegible] (2014-15)

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Cluster	Dry cocoon (kgs)			Yield (kg/ha)	Ratio w.r.t. previous year (%)	Raw Silk Production (MT)				Raw Silk Value (crore)	GDP (Percentage)
	Target (Lakhs)	Coop (Nos.)	Ach.			Target	Ach.	% Ach.	Improvement over 2023-24 (%)		
Varanasi	1.20	210	144700	60.27	-3.34	11.234	11.221	99.89	-0.48	350.1 (100)	5250 (1)
Chinnampudi	1.25	208	139100	66.76	8.04	12.77	11.68	107.76	10.49	364.1 (104)	5460 (1)
Jangal	1.10	211	93000	55.12	-4.02	9.87	9.71	98.62	-2.10	302.9 (86)	4545 (1)
Valasa	1.80	298	178000	59.82	6.01	17.45	17.18	98.46	4.76	535.7 (153)	8034 (1)
Lakka	1.60	2016	291000	60.63	5.21	15.65	15.64	99.94	10.87	487.4 (139)	7311 (1)
Bapu	1.75	240	203700	60.15	6.04	17.65	16.72	113.74	15.78	521.6 (149)	7824 (1)
Amba	0.75	261	46800	61.43	-3.89	5.43	5.64	96.76	10.21	172.5 (49)	2587 (1)
Vindhya	0.75	402	67000	60.83	6.08	5.65	5.01	103.87	16.01	156.1 (45)	2341 (1)
Sahkara	0.75	198	68000	60.02	5.45	5.43	5.32	98.49	13.20	165.7 (48)	2486 (1)
Total/Avg	11.80	2961	1555400	60.49	6.35	2.46.71	112.16	113.49	10.49	3512.4 (977)	47277 (10)
Performance of Clusters - Madhya Pradesh (2023-24)											
Bina	1.00	178	141000	59.97	2.51	9.55	7.98	102.9	11.7	199.1 (100)	
Barhanpur	0.65	148	79000	46.23	1.82	5.65	5.51	102.21	9.82	150.7 (76)	987 (1)
Khandwa	0.55	112	52000	46.81	2.11	3.51	3.49	99.81	10.23	100.2 (50)	656 (1)
Total/Avg	2.20	438	272000	51.00	2.15	17.61	16.98	101.71	10.58	450.0 (226)	2947 (3)
Performance of Clusters - Telangana (2023-24)											
Sangareddi	1.30	198	147700	56.77	5.17	12.07	11.4200	100.54	10.49	417.9 (113)	6811 (1)
Warangal	1.00	156	99800	53.80	4.80	9.30	11.2900	102.64	9.73	384.5 (104)	6268 (1)
Chinnamadadi	1.20	172	121700	55.02	5.24	12.07	11.7200	107.44	10.22	431.6 (116)	7036 (1)
Khammam	0.75	125	76000	51.20	3.46	5.85	5.9400	99.03	9.91	211.6 (57)	3450 (1)
Total/Avg	4.25	651	445200	54.20	4.67	39.29	40.3500	102.41	10.09	1445.6 (390)	23565 (4)

* Figures in parentheses indicate number of districts under new clusters

* Figures in parentheses indicate number of mandals considered

Cluster Performance - Karnataka: Karnataka clusters first with more than cocoon crop in the state has silk production (652.43 MT with 105.23% achievement, 68% increase) over the previous year) in the clusters in south zone. Twenty-two clusters achieved >100% in combination of crib with 68% improvement in silk uptake as compared to previous year. The overall cocoon productivity improved by 9% in the clusters.

Cluster Performance - Andhra Pradesh: Silkvillage raw silk production in the state improved by 39.89% and the improvement in cocoon productivity was highest (6.24) as compared to previous year. Seven clusters - Palamaner, Kalakaladurgam, Mantralayam, Madakasira, Vijayawada, Dharmavaram and Chittoor achieved > 100% target in crib uptake and the average cocoon yield ranged from 60.15 to 66.05 kg/ 100 DFLs with overall average rating 65.08kg in the clusters.

Cluster Performance - Telangana: Four satellite clusters in the state have improved average cocoon yield and crib uptake. The overall improvement in cluster performance is coupled with the consolidated state of Andhra Pradesh's Anantapur, Dharmavaram and Hindupur clusters achieved >100% target in cribs with an average cocoon yield of 65.08 kg/100 dfls.

Cluster Performance - Tamil Nadu: The state stands first in cocoon productivity per unit in the country with 74 kg/ 100 dfls with an improvement of 8.02% over the previous year over the 20.54 lakh dfls. The cultivated bivoltine production was 632.02MT against the target of 700.00MT, with an increase of 58% over the previous year. The overall activities in the clusters improved by 45% and recently, five clusters recorded >100% achievement in dfls distribution. The average cocoon yield ranged from 68.19kg (Dharmapuri) to 86.30 kg/ 100 dfls (Madathukulam).

Cluster Performance - Kerala: The overall improvement in the three raw silk production was around 78% with highest cocoon productivity covering 6.66 lakh dfls and weaver farmers with an achievement of 84% against the targets in terms of dfls distribution.

Cluster Performance – Maharashtra, Surat, Nanded, Jalna and Wardha clusters achieved >100% targets in silk distribution with 32% increase in overall silk cocoons in the state. The overall improvement in bivoltine seed production was 11.9% with 4.6% improvement in cocoon productivity.

Cluster Performance – Madhya Pradesh, Betul and Hoshangabad clusters achieved >100% targets in silk production and the overall improvement in bivoltine seed production was 82% with marginal improvement in cocoon productivity.

New Plantation: More emphasis was given to the sericulture expansion in clusters to increase the silk production by motivating farmers and resulting in an additional plantation of 2017.7 acres (~ 4535 farmers in 100 clusters) with improved mulberry varieties.

Extension communication Programmes (EEP): Different EEPs (116) including group discussions, awareness, enlightenment, exposure visits, exhibitions and capacity building programmes were conducted in the clusters and sensitized 8478 farmers on new improved technologies. These have helped to increase the technology adoption resulting in productivity improvement.

Cluster	New plantation		HQP	
	Farmers (No.)	Area (acres)	Grainage (No.)	Rearing Centers (No.)
Karnataka	8987	1838.8	418	11408
Andhra Pradesh	893	1311.8	70	1247
Telangana	410	330.08	74	1027
Tamil Nadu	1205	2271.8	246	1514
Kerala	01	05.5	02	002
Maharashtra	1911	1972.8	153	4727
Madhya Pradesh	212	1479.8	45	1429
Total	14000	10115.7	1008	21479

Clusters – Evaluation & Monitoring: The performance of clusters in the South Zone and five states of Maharashtra and Madhya Pradesh were effectively monitored by Director, CSRTI-Mysuru as South Zone coordinator and five nodal officers. The progress of bivoltine silk production in the clusters was reviewed every month by the nodal officers and zonal coordinator, while the quarterly progress is analyzed, video- and zoom-reviewed by the Member Secretary-CSB. The review meeting also focuses on issues in the clusters and appropriate solutions for improvement.

Institute Village Linkage programme (Seri Model Villages)

Objective: Transfer of Technology through Institute – Village Linkage programme (IVLP) for sustainable bivoltine cocoon production.

IVLP was initiated in eleven centres through CSRTI-Mysuru and Bivoltine units (RSRSs/RSCs/RECs) in Karnataka (1), Andhra Pradesh (2), Tamil Nadu (2), Maharashtra (2) and Madhya Pradesh (1) with 1068 farmers identified covering around 1000 acres of mulberry plantation.

Year	Centre	Scientist
Karnataka	Kollegala	K. R. Nagaraja, Sc-D, CSRTI-Mysuru
	K.R.Pet	V. Gurudhatha, Sc-D, CSRTI-Mysuru
	Hiriyur	V. Lakshmipathy, Sc-D, RSC, Bidarguppe
	Chamarajanagar	K. Ramakrishnaiah, Sc-D, RSRS-Chamarajanagar
Tamil Nadu	Sathyamangalam	Dhanavanthiraman, Sc-D, RSC-Sathyamangalam
	Thovalai	K. Sarala, Sc-C, RSC-Palladam
Andhra Pradesh	Rayalacheru	U. Jayasankar Nayanolu, Sc-D, RSC, Rayalacheru
	Madhugiri	T.V.S. Rao, Sc-D, RSC-Chintamani
Maharashtra	Ashti (Jalna)	Ramprakash, Sc-E, RSC-Aurangabad
	Barshi (Solapur)	
Madhya Pradesh	Hoshangabad	R.K. Ahirwar, Sc-D, RSC-Hoshangabad

Based on base-line survey of identified farmers was conducted before implementation to collect data on existing status of technology adoption and to identify technology needs. The following mulberry cultivation and silkworm rearing technologies were identified for implementation. To ensure 100% technology adoption, critical inputs were provided to the farmers free of cost through respective RSRSs/RSCs. Further, awareness programmes on various technologies

Cluster Promotion Programme (CPP) Activities (2014-15)

[illegible]

[illegible]

Green vs Saplings in Jalna Cluster

Exposure Visit of B.R.Kocadia Farmers

Harvesting Care in Jalna Cluster

Group Discussion in Nehal Cluster

Shelf in Cocoon Market of Pallavaram

Enlightenment Programme at Aurangabad

Activities @ Sericulture Farmer's Workshops (2014-15)

Release of 3G Multivoltine Hybrid at Malur

Scientist-Farmers interaction at Malur

Resham Krishi Mela at Virupapur

Krishi Mela inauguration by DDG Chairman at Warangal

Krishi Mela at Madakasira

Silkworm seed distribution at Hindupur

Farmers workshop at Chitradurga

Demonstration of Technologies at Jalna

Technologies Implemented under SCP	
Key Issues Addressed	Extension Strategy
• Soil tests for macronutrients and micronutrients	• Distribution and hygienic maintenance
• Soil fertility management	• Supply of chawki rearing worms
• Popularization of new mulberry varieties	• Use of videos in local dialects for dissemination of extension messages
• Management of mulberry pests	• Monitoring and advising rearers for maintenance of quality cocoons
• Application of Fertilizer-for soil quality & to control nutrient imbalances	• Offer of Loan by

was created through demonstrations and SCPs. Among 2.33 lakh dfls of bivoltine hybrids were reared with farmers and an average yield of 62.3 kg/100 dfls was recorded with 6.9% improvement in cocoon yield against the benchmarks. Through the programme was initiated in Sericulture and generally, considered rearing farmers were encouraged to rear bivoltine hybrids, a quantity of 34.4 MT of bivoltine silkworm silk was produced through IVLP.

Achievements of IVLP (2014-15)						
State	No. Beneficiaries (Nos)		Cocoon Yield (Kg/100 dfls)			Raw Silk Production (MT)
	Target	Achievement	Benchmark	Proj. Yield	% Improvement	
Karnataka	12000	10109	57.63	60.71	5.06	14.62
Tamil Nadu	11400	10452	53.00	57.25	14.58	11.80
Andhra Pradesh	11700	10452	52.40	56.58	8.00	9.97
Maharashtra	9000	8719	48.00	50.39	5.00	6.88
Madhya Pradesh	3400	3203	48.00	51.24	6.80	1.80
Total/Avg.	44500	39,935	47.43	52.38	8.93	34.44

Performance of IVLP Centres								
IVLP Centre	No. Beneficiaries (Nos)		Cocoon Yield (Kg/100 dfls)			Silk Raw Yield (MT)		
	Target	Achievement	Benchmark	Achievement	% Improvement over BM	Annual Target	Achievement
Hyderabad	3000.00	3032.00	48.00	50.00	4.08	4.50	5.00
Kolar, Chikkaballapur	6000.00	4231.00	48.00	48.00	0.00	9.00	7.00
Hindupur	3000.00	2320.00	50.00	56.00	10.00	4.50	3.73
Ramanagaram	1500.00	1650.00	48.00	50.00	20.00	2.25	2.33
Tiruchirapalli	4750.00	4249.00	47.00	52.00	7.04	6.00	7.00
Rayalaseema	2000.00	1750.00	50.00	60.00	10.00	2.21	1.70
Vijayapura	4000.00	3850.00	50.00	51.00	2.00	5.00	5.00
Ananthapur	3000.00	2800.00	48.00	52.00	4.00	3.00	3.10
Dharwad	3000.00	2200.00	48.00	51.00	10.00	4.00	3.10
Chittoor district	3400.00	1750.00	50.00	51.00	2.00	5.00	1.70
Total	34650.00	30032.00	47.43	52.38	8.93	37.77	34.44

Sericulture women and technology transfer – A Group Approach (Apr. 2010 to Oct. 2014)

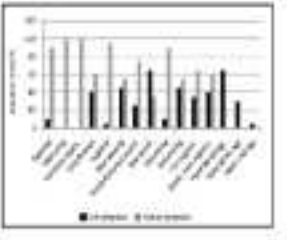
S. S. Seetha, P. Sudhakara Rao, K. L. Rajanna (RSRS, Kodathi)

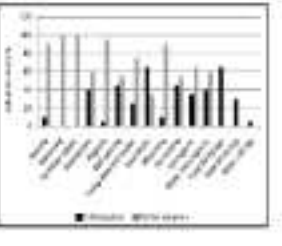
Objectives

- Skilled development for women on improved silkworm rearing and mulberry cultivation technologies
- Promote sericulture based self employment for rural sericulture women for income augmentation
- Create awareness on available resources inputs through government agencies/institutions for effective utilization and increased output
- Improve cocoon yields and income of sericulture farmers

Socio Economic & Personal Profiles		
Variable	Classification	%
Age	<20	24
	20-30	42
	30-40	18
	40-50	8
	>50	10
Marital Status	Married	87
	Single	13
Education	Illiterate	20
	Primary School	12
	Middle school	10
	High school	27
	PUC	11
	Graduation	3
Family Size	<3 members	39
	3 - 5 members	51
	>5 members	7
Caste	Scheduled	72
	BC	27
	OC/ Others	1
Agricultural Experience	< 5 yrs	58
	5-10 yrs	24
	10-20 yrs	1
	> 20 yrs	1
Mulberry Variety	Cultivated	100
Total Land Holding (acres)	Less than 1	80
	1-2	20
Land under Mulberry	<1	80
	1-2	20
Avg. Yield/ Ha/ day	0-100 kg	87
	100-200 kg	13

The study was taken up in Ramandra village located in Harohgalli Hobli of Hosakote taluk, Bangalore rural district. A survey was conducted to understand the village and participation profile of farmers, male and twenty women practicing sericulture were selected. Group discussions were held with the sericulturists to appraise the benefits of group and benchmark survey was conducted to understand the socio-economic status, knowledge and adoption levels of sericulture technologies. Based on benchmark survey, unknown and non-adopted technologies were identified to disseminate through suitable extension methods (EEPs). Feedback analysis was made to understand effectiveness of technology transferring by analyzing data using descriptive statistic method.





So sericulture is more accepted and practically taken up by small families with a family size of 3-5 members comprising complete nuclear sericulture is more suitable for joint families as it provides employment to more labor force for regular income. Majority of the sericulture practicing women are new to sericulture industry with <5 years experience. Feedback analysis indicate that technologies viz., disinfection, maintenance of hygiene, leaf spacing, maintenance of temperature and humidity, bed disinfection, moulting and harvesting with higher adoption levels.

Constraints/Other Activities

Transfer of Technology Programmes: CSRTI-Mysore and its regional units (RSRS/RSOs/REO-Guts) in Karnataka, Andhra Pradesh, Tamil Nadu, Maharashtra and Madhya Pradesh conducted several transfer of technology (ToT) programmes in sericultural activities, which resulted in benefiting the stakeholders with significant impact in crop productivity.

FLD Activity	Area (ha)		Farmers		Yield (q/ha)		Economics (₹/ha)		Impact
	Target	Achievement	Target	Achievement	Target	Achievement	Target	Achievement	
Rice (Hybrid rice variety PC1 PB2RGU 4018 (Mukthi))	5	5			0.0	0.0	0	0	Maximum mean yield by 10.4 q (PC1) & 3.7 q (PC2)
Rice varieties (No. of farmers)							0	0	Survival of seedlings - 90-100%
BMI (No. of farmers)	50	50	50	50	110	170	0	0	Improvement in test yield (7.17%) & income gain (26.93 - 50 %)
IPM - Mulberry (No. of farmers)	40	40	47	31	0.0	0.0			Reduction in disease incidence (0.0 to 1.0%), rotavating increases (0.70% in leaf yield)
IPM - Silkworm (No. of farmers)					0.0	0.0			Reduction in crop loss - 7.49 to 1.82%
Hand rice (No. of farmers)	10	10	100	100	0.0	0.0			50-70% survival rate in normal & affected gardens
Technician (No. of Farmers)			10	10					Increase in leaf yield by 21 - 25%
Composting (No. of farmers)	10	10	10	10	0.0	0.0			Reduction of 60-67 days in composting
Pruner (No. of farmers)	20	20	20	20	0.0	0.0			Improvement in leaf yield upto 10%
Organic Farming (No. of farmers)							0	0	Improvement in cocoon yield (13.04%) & cocoon yield (28.11%)
Production of new silkworm hybrids (nos.)		10,000		47,000		20,000			Avg. Yield/100 dfls (kg) CH1 x CH2 - 30.08 C-Nil x CSR2 - 30.21 S3 x CSR19 - 27.08 CSR19 x CSR27 - 30.51 NB4D2 X CSR4 - 30.54 PCG x PCA - 30.67 CSR2 x CSR27 - 30.14

Extension: Extension programmes: Extension Communication Programmes (ECP) were conducted in Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Maharashtra, Madhya Pradesh and Kerala. Farmers were sensitized to new sericulture technologies through ECPs. The major topics covered were, popularization of new multivoltine varieties, soil testing & its importance in mulberry cultivation, accumulation of bee nursery, pest practices by nursery, IPM, integrated disease management practices, disinfection & cylulene in silkworm rearing, popularization of neuroleucon hybrids, demonstration of rotary mountages, mounting & picking care etc.

ECP	Events (Nos)	Farmers Participated (Nos)
Exhibition	10	10000
Enlightenment Programmes	35	6400
Group Discussion	247	8250
Field Day	68	6440
Awareness Programme	110	8000
Film Show	33	1650
Technology Demonstration	89	7160
Study Tour	32	1440
Farmers Visit to Mela	10	2500
Total	630	56110

Model sericultural CPC:

G. S. Vindya, G. S. Nagaraja and S. Parameshwara

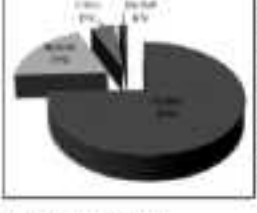
Thirty four batches of hands training batches were started with introduction of cocoon hybrids using e-bulletin for dissemination and its extension services. The chawki worms were distributed to 154 farmers covering 80 villages under CPP and FLP choices. Simultaneously training was imparted to chawki rearing technology to 302 farmers under

World wide Web based and ICDDR4IDT programmes. Special training programme for 100 persons was carried out under NBT based on the requirement of DoS, Karnataka and the programme was for 3 days in 30 days.

Month	Offs (number)	Contribution to Institute (Rs.)	Visitor Offs (Rs)	Fund Improvement (%)	Expenses (Rs.)	Rider
April	4000	14	28.0	0.3	3	NA
May	6230	15	57.4	1.5	14	NA
June	8000	12	68.0	4.0	23	NA & MRM
July	4400	18	39.6	0.1	1	NA & TR
Aug	4100	14	57.8	4.0	14	NA & MRM
Sept	7000	12	84.0	4.8	43	TR
Oct	10000	17	58.4	6.7	17	NA & NF
Nov	8000	22	36.0	0.8	10	NA
Dec	12000	28	58.4	0.2	18	NA & MRM
Jan	7000	18	75.0	12.0	22	NA & Rider
Feb	5000	18	27.7	22.5	25	NA & MRM
March	4600	18	78.0	18.0	19	NA & MRM
Total/Avg	85000	150	78.8	9.8	325	

Feedback Analysis on DRC Training Programmes (ISDD, Seed Act, TLR, NBT & Refresher Course)			
Parameter	Before	After	% improvement
Income from DRC/Crop (Rs.)	30000 - 50000	40000 - 70000	20 - 30
Farmer Yield (Q/Ha/Crop)	30 – 40	70 – 80	20 – 40

VISITORS' SERVICE: CSWRI-Mysuru is a visiting place especially for the students of biological sciences, farmers from agriculture background and foreign visitors. The visit of 5471 farmers, 1417 students and 356 officials including family members participants was co-ordinated covering different laboratories and interactional units/scientists.



State	Farmers	Students	Officers	SC/ST/ Staff	Total
Andhra Pradesh	51		3	17	71
Delhi	24		1		25
Karnataka	4000	186	277	55	4258
Kerala		125	16		221
Maharashtra	91	28	5	10	134
Pondicherry	50		1		51
Punjab			8		8
Orissa	23		3		26
Tamil Nadu	231	120	27	23	401
Uttar Pradesh		58	8		66
West Bengal	47		5		52
Total	5471	1417	356	113	7363

Sericulture Farmer's Workshop:

Bidar-Karnataka: CSWRI-Mysuru organized Sericultural Farmer's Workshop on 23rd Jan, 2015 at Bidar in coordination with DoS-Karnataka. Around 1500 farmers from northern districts of Karnataka sharing bordering districts of Telangana, Andhra Pradesh and Maharashtra, CSWRI-Mysuru & its regional units scientists & officials; DoS staff attended. The workshop was aimed to create awareness and empower farmers with new sericulture technologies developed for bivoltine sericulture and an exhibition of new technologies/products/machines/implements was displayed. Progressive

farmers (81) were felicitated by DoS+candidate for best performance. An interactive technical session was conducted for the benefit of participating farmers for immediate clarifications on technical issues raised by the farmers. The workshop also witnessed the release of technical literature, mulberry & silkworm booklet and equipments for the benefit of sericulturists.

Dharmapuri-Karnataka: RSO- Chitradurga in coordination with DoS organized district level Workshop-cum-Exhibition on Improvement of Hexavoltage (7th Feb, 2015) in which 378 sericulturists participated. During the technical session, scientists explained about soil testing, soil reclamation, package of practices for production, quality improving issues, disinfection, silkworm diseases & their management, new silkworm hybrids, silkworm rearing management and importance of DRC. Three best sericulturists from all the talukas were felicitated during the occasion. An exhibition was also organized for the benefit of visiting farmers.

Salem, Tamil Nadu: Sericulture Technology Workshop was organized by DoS in coordination with RSRO-Salem (14th June, 2014) at Salem and 291 sericulturists including women and 144 DOD officers / CGB scientists participated. The workshop witnessed the launching of an Integrated Value Response System (IVRS) for the benefit of silk farmers, traders and weavers for the current market price of cocoons and silk yarn. Sericulture exhibition and technical session were arranged for the benefit of the farmers.

Virudunagar- Tamil Nadu: A Reshem Krishi Mela was organized jointly by RSRO-Salem and DoS-Tamil Nadu (3rd July 2014) at Virudunagar and around 700 farmers attended the mela. A book on "Organic Farming in Mulberry" and technological bulletins "Disinfection & Hygiene in silkworm rearing, Silkworm diseases & their management, Silkworm pests & rearing and disinfectants, Silkworm rearing houses, Mechanization in Mulberry Cultivation, Guidelines for quality cocoon harvest & Mounting & Stifling, Care in Tamil were released. Sericulture exhibition and technical session were also organized for the benefit of visiting farmers.

Warangal- Telangana: RSRO-Anantapur and DoS-Telangana organized Sericulture Farmers' Workshop at Warangal (23rd March 2015) and around 080 farmers participated. The technical handbooks (3): Chawki Pampulu, Pampukanthi Pratyamnaya Acharalu Panchina Roothalu Mulberry Vangadamu, Chawki Pampula Mangatha Dinuleekarana Padakalu, Aakasigadalalo Vachhina Pettu Purugula Nirvahana & Pesticide Harmyakalam Jagratha Pedagalasu Impacts / Vachhanu" were released for the benefit of farming community on this occasion. The technology session was also organized to discuss farmers' issues and clear their doubts.

Madanapalle, Andhra Pradesh: RSRO-Anantapur and DOD-AP organized Sericulture Farmers' Workshop at Madanapalle (5th March, 2015) and around 700 farmers, 16 DOD & CGB officials/service providers participated. On this occasion, a booklet on "Pattu Purugula Dashkalatho Padigovalam" was released for the benefit of farming community. CGB Scientists and DOD Officials cleared the technical issues/doubts regarding various aspects raised by the farmers in technical session.

Technology Releases during Farmers' Workshop

- Reeling Unit (Automatic Basin) - Technology transferred to Bhadravathi Silk Factory for reeling of silk yarn from cocoons produced by sericulture farmers
- "Male Moths Guide" - Booklet on male moth detection technique and various uses of male moths
- Tray cleaning cum Distribution Machine - Equipment to enhance the rearing and health towards cocooning of chawki worms and distribution of rearing space
- CSR & CSR - New Productive Breeding Silkworm Hybrid suitable for non-optimal conditions for sustainability
- CC - New multivoltaine variety suitable for tropics silkworm rearing with higher productivity and quality traits
- Leaflet on Pests and Diseases, its Biological Control of Insect Pests in Sericulture, Disease Combination, Disease Resistance in Mulberry Germplasm, New Productive Bivoltine Silkworm Hybrids, Silkworm Variety for Chawki Silkworm Rearing, Bivoltaine & Mounting Card, Tray Washing cum Distribution Machine

24. Report on IEBR structure efficiency indices as on 31/3/14

Study of seed setting/seedlings of improved mulberry varieties and performance of DOR hybrids

Name of centre	Mulberry area (ac)	No. of mulberry	No. of silk reared	Average cocoon yield (kg/100 dfls)
RSRS, Anantapur	4.0	11000	111000	45.00
RSRS, D.G.Gowdanahalli	1.00	3000	30000	50.36
RSRS, D.G. Sathanur	2.20	10	10000	47.20
RSRS, D.G.Hadagur	0.1	1.14	1140.00	43.00
RSRS, Pakkanur	0.5	1800	20000	50.00
RSRS, Dasanapalli	0.5	1500	15000	50.00
RSRS, D.G. Bhoothinagudi	1.00	4.14	40000	50.00
RSRS, R.G. Laxmi	4.0	1500	20000	50.00
RSRS, Hunsenagudi	1.00	127	1200	50.00
RSRS, Avalagurki	3.00	1.04	44000	54.00

Extension Communication programmes conducted by CSRTI related units

Name of centre	OFC	FT	FD	FC	AP	RT	DE	ST
RSRS, Anantapur	12		10	04	14		08	
RSRS, D.G. Gowdanahalli	08			02	02		01	
RSRS, D.G. Sathanur	05			01		02	05	
RSRS, D.G. Hadagur	01			01			05	
RSRS, Pakkanur	01			02	01		06	03
RSRS, D.G. Bhoothinagudi	05			01			05	
RSRS, Dasanapalli	01	01		01	01	04		01
RSRS, R.G. Laxmi	04			01	01		01	01
RSRS, Hunsenagudi	05			02		01		
RSRS, Avalagurki	01			01	01	01	06	

CAPACITY BUILDING AND TRAINING

S. D. Sharma, V. N. Sudha (up to 30-09-2014), R. G. Kathale, A. S. Dukre (from 27-10-2014), G. Parameshwara (from 22-10-2014) and S. N. Potdar (up to 03-09-2014)

Several officials and trainers were trained under different programmes viz.CP: Management Development Programme; TUP: Technology Upgradation Programme; CDP: Integrated Skill Development Scheme; NAT: Need-Based Training; CC: Certificate Course; ITF: International Training Programme; under extension promotion and training under XII plan (CSB 2-09) including international trainings sponsored by ITEC, Ministry of External Affairs (MEA), Govt. of India. Four-fifths of training programmes were conducted at various RSRS and RSC units of CSRTI-Mysuru for the benefit of local officials and farmers.

Prog.	Course	Duration
MDP	Silkworm Hybrid Seed Production	4 days
	Quality Management	5 days
	Refresher Course	5 days
	Integrated Pest Management	5 days
	Late Age Rearing	10 days
TUP	Chawki rearing	8 days
	Late age silkworm rearing	12 days
	Mulberry Cultivation	5 days
	Integrated nutrient & disease management	5 days
	Silkworm Hybrid Seed Production	4 days

Integrated skill development scheme (ISDS)

S. D. Sharma, Dr. Sathyanarana Raju, Chikkanna, K. L. Rajanna, K. N. Shivakotiswamy, G. Parameshwara, A. G. Dukre and R. G. Kathale

Integrated Skill Development Scheme (ISDS) is the flagship scheme of Ministry of Textiles, implemented by RSO Institutes of Central Silk Board, Bangalore for providing skill training to unemployed youths and prospective entrepreneurs

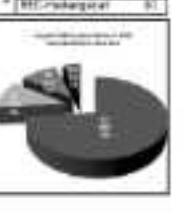
and is being implemented by CORTI Kannur since 2011. CMM training is provided on five topics viz., Commercial Oilseed Rearing, Quality Silkcliffe Cocoon Production, Cocoon Handicrafts, Mulberry Cultivation & Seed Multiplication, Mulberry and Silkworm Pests & Disease management for 15 days. During the year a total of 499 beneficiaries were trained under the scheme.

Programme	Location	Trainees	Batches						
			GEN	SCP	ST	PWD	EWS	Others	Total
MDP	CSRTI Kannur	C	75	8	3				87
TSP	CSRTI Kannur		110	53	16	10	47		260
	CSRTI & RSTCs	F	372	1308	1394		178	58	4310
BDP	CSRTI Kannur		358	108	33		108		660
EP		C						17	17
MDT		C	90	7	76		7	57	337
		F	137	9	91		66	13	240
EC		C						28	28
		Total	1024	1102	1203	10	406	210	5420

Programme	Training Duration (Batches)	Trainees (No.)	Total
Commercial Oilseeds Rearing	CSRTI Kannur (1)	15	81
	RSTC Salem (1)	21	
Quality Silkcliffe Cocoon Production	RSTC Salem (1)	44	110
	CSRTI Kannur (1)	22	
Mulberry Cultivation & Seed Multiplication	RSTC Hoshiarpur (1)	10	163
	RSTC Ch. Nagar (2)	44	
	RSTC Salem (1)	25	
	CSRTI Kannur (1)	13	
	RSTC Kodathy (1)	18	
Cocoon Handicrafts & Value Added Products	RSTC Kharagpur (1)	10	110
	RSTC Ch. Nagar (1)	15	
Mulberry and Silkworm Pest & Disease Management	CSRTI Kannur (1)	10	64
	RSTC Kodathy (1)	24	

Sl. No.	Programme	Mandays (Batches No.)		
		Target	Achv.	% Achvmt.
2012-13	Quality Silkcliffe Cocoon Production	2815 (5)	2280 (4)	81.00
	Mulberry Cultivation & Seed Multiplication	1820 (3)	2760 (5)	151.65
	Commercial Oilseeds Rearing	0 (0)	2880 (6)	28.57
	Cocoon Handicrafts & Value Products	900 (1)	1800 (2)	66.66
	Total	5540 (9)	10080 (17)	72.97
2013-14	Quality Silkcliffe Cocoon Production	2730 (5)	2280 (4)	76.27
	Mulberry Cultivation & Seed Multiplication	1820 (3)	2760 (5)	77.50
	Commercial Oilseeds Rearing	2340 (4)	1260 (2)	23.80
	Mulberry & Silkworm Pest & Disease Management	1170 (2)	1170 (2)	21.95
	Total	8060 (14)	7470 (13)	21.97

Centre	Total
RSTC, Salem	215
RSTC, Hoshiarpur	90
RSTC, Chikkaballapur	90
RSTC, Malda	90
RSTC, Ch. Nagar	90
RSTC, Kodathy	90
RSTC, Kharagpur	90
RSTC, Ranchi	90
RSTC, Ch. Nagar	90
RSTC, Hoshiarpur	12
RSTC, Salem	90
RSTC, Kodathy	90
RSTC, Malda	90
RSTC, Chikkaballapur	90
RSTC, Ranchi	90
RSTC, Ch. Nagar	90
RSTC, Kharagpur	90
RSTC, Kodathy	90
RSTC, Chikkaballapur	90
RSTC, Malda	90
RSTC, Ranchi	90
RSTC, Ch. Nagar	90
RSTC, Kharagpur	90
RSTC, Kodathy	90
RSTC, Chikkaballapur	90
RSTC, Malda	90
RSTC, Ranchi	90
RSTC, Ch. Nagar	90
RSTC, Kharagpur	90
RSTC, Kodathy	90
RSTC, Chikkaballapur	90
RSTC, Malda	90
RSTC, Ranchi	90
RSTC, Ch. Nagar	90
RSTC, Kharagpur	90
RSTC, Kodathy	90
RSTC, Chikkaballapur	90
RSTC, Malda	90
RSTC, Ranchi	90
RSTC, Ch. Nagar	90
RSTC, Kharagpur	90
RSTC, Kodathy	90
RSTC, Chikkaballapur	90
RSTC, Malda	90
RSTC, Ranchi	90
RSTC, Ch. Nagar	90
RSTC, Kharagpur	90
RSTC, Kodathy	90
RSTC, Chikkaballapur	90
RSTC, Malda	90
RSTC, Ranchi	90
RSTC, Ch. Nagar	90
RSTC, Kharagpur	90
RSTC, Kodathy	90
RSTC, Chikkaballapur	90
RSTC, Malda	90
RSTC, Ranchi	90
RSTC, Ch. Nagar	90
RSTC, Kharagpur	90



International Training Programmes: Three Japan Overseas Cooperation Volunteers (JOCV) viz., Ms. Yuki Yamanaka, Ms. Nozomi Aoki and Mr. Tadahiro Asai have been availed by the Institute for two years by JICA to support CSRTI in extension activities in cluster promotion programmes. JOCV is endowed on 'Orientation Training in Sericulture' for 30 days at CSRTI-Hqrs & and posted to Hesaraghatta, Ramanagaram and Hosur.

Special Training Programmes on BM and Sericulture Industry sponsored by International Technical & Economic Cooperation (ITEC) by Ministry of External Affairs, Govt. of India, New Delhi was initiated for 45 days. Fourteen trainees from Bangladesh, Uganda, Egypt, Philippines and Thailand are participating in the programme and it concludes on 12.04.2014.

Need Based Training Programmes: CSRTI-Mysore has conducted courses, for unemployed youth, personnel from NGOs, Universities & Colleges, Unemployed rural women, Farmers etc., in various technologies and NMT programmes are organized to meet the specific requirements.

	Programme	Duration (Days)	Batch					Trainees	Total
			KA	AP	TN	KER	MAT		
CSRTI-Mysuru	Orientation Programme (Graduates)		2	1	1	1	1	7	27
	Intensive Practical Training	30	20		1			30	50
	NGOs	5						14	14
	Farmers Training	7						13	13
	Extension Executives Training	10		2					2
	Silkworm Rearing & Technician Training	12			1				1
	Sociological Aspects	10	4						4
	Individual Visit	4			1				1
	Short Term Training	7		1				4	5
		Total	30	1	11	1	1	54	129
Farmers	Farmers Training	4	91			91			94
	Mulberry Cultivation	5	91				92		11
	FRS	60	28						8
	Practicing Programmes	5				78			78
	FRC (Each Kit)	60	91						91
		60	71	91					72
	IBT	30	90		11		91		9
	Farmers Training	10				91			91
	Bed Paper Dried	4	91						9
		Total	727	91	11	99	13		200

Intensive Bivoltine Training Programme: Bivoltine hybrid silkworm rearings were organized to support all the courses (FDI a FC2). 600 dfls/ 7 batches/ are on average cocoon yield of 74.7Kgs/100 dfls was recorded.

Performance of Bivoltine Hybrids (2013-14)							
Season	Dfls (Nos.)	Yield/ 10kg (Nos.)	SCA (g)	SHW (g)	Shell (%)	Yield/ 100 dfls (Kg)	Raising (Nos.)
April - May 2013	100	30.00	1.622	0.268	21.79	80.41	430.00
June - July 2013	100	30.00	1.61	0.269	22.07	82.16	330.13
July - Aug. 2013	75	30.00	1.747	0.329	21.12	67.07	345.00
Sept - Oct. 2013	100	30.10	1.691	0.368	21.92	69.00	370.00
Oct - Nov. 2013	80	30.00	1.602	0.441	22.08	78.88	330.13
Nov - Dec. 2013	100	30.00	1.677	0.368	20.82	81.00	370.00
Jan. - Feb. 2014	100	30.10	1.701	0.324	17.10	88.80	330.00
Total	855	30.02	1.653	0.378	20.72	74.76	337.00

RSRS-KODAIKANAL

RSC & Sub-Units
RSRS-Kodaikanal
RSC-Srirangapura
RSC-Chikkaballapura
RSC-Madikeri
RRCSU-Mysuru
RRCSU-Ankleshwar
RRCSU-Hanamkonda
RRCSU-Sonipat
RRCSU-Sujanpur
RRCSU-Ranchi
RRCSU-Hirehalli
RRCSU-Imphal
RRCSU-Pantnagar

Command Area	Staff	
Kodaikanal	Incharge Officer:	Dr. K. L. Rajanna
	Scientists :	14
	Technical Staff :	14
	Administrative Staff :	5

Unit	Farm Basic Units	
	Total Area (Acres)	Mulberry Acreage
RSRS-Kodaikanal	66.66	10.49
RSC-Srirangapura	7.28	2.07
RSC-Chikkaballapura	7.28	2.41
RSC-Madikeri	3.28	2.15
RRCSU-Hosapete	9.28	1.23
Total	66.66	18.34

Collaborative Research Projects:

RSRS-Kodaikanal is involved in collecting data on following collaborative projects with the main institute

- MOE 2022: Study on Drought Management practices in Mulberry Sericulture
- ARP 2018: Different Disease Monitoring of Seed and Commercial Crop Rearing of South Indian States
- AM 2018: Popularization of Authorized Silkworm Hybrids among the Farmers of South India
- CFT 2019: Identification of factors responsible for crop loss due to silkworm diseases at field level and its impact on cocoon productivity
- PRE 2020: Habitat studies - Spread of virus diversity on conservation and performance of natural enemies in mulberry ecosystem. The detailed report will be submitted by the Principal Investigator
- PRE 2021-2: Studies on pest status and eco-friendly management of thrips (Pseudodendrothrips mori) (Thysanoptera: Thripidae) on mulberry in Tamil Nadu and Karnataka
- PRE 2021: Survey and surveillance of major pests and their natural enemies in mulberry ecosystem
- Monitoring of soil fertility status of mulberry gardens in Karnataka, Andhra Pradesh & Tamil Nadu and creation of database
- Validation of new recommendation of fertilizers schedules for V1 mulberry under irrigated conditions
- Comparative study on the effect of split application of fertilizers in sucrose and liquid form on mulberry leaf yield, fertilizer saving, reduction in weed and pest incidence and rearing performance
- Studies on Disease forecasting and its screening for Mulberry yields, cocoons and silkworm seeds
- All India Co-ordinated Experiment for Mulberry (Phase III) at RSC-Madikeri
- Large scale pre-authorization field trial of 04 all RSRS-Kodaikanal Nm and farmers' fields
- Improvement of bivoltine traits (4), through multi-locational breeding approach
- Sericulture science and Technology, Hamirpur - Agro-up approach

Consultancies/Other Activities:

Extension/Communication Programmes:

Various kinds of EDPs were conducted by the RSRS and its related units for the transfer of technology developed by the main institute and are the names.

Centre	Tech. Demo	Farmer Disc.	Seminar Prog.	Field Day	Kisan Mela	Exhibition	Daily Talk
RSRS, Hunsur (L)	257 (14)	731 (28)	678 (12)	65 (5)			52 (5)
RSC, Bidirahalli (L)	49 (2)	121 (7)	90 (1)	20 (1)	30 (1)		60 (1)
RSC, Chintamani	70 (3)	187 (8)	40 (2)	314 (1)	287 (1)	200 (1)	20 (1)
RSC, Mandya	49 (3)	152 (8)	120 (1)	90 (5)	294 (1)	110 (1)	60 (3)
RSC, DLS, Kolar		883 (21)	177 (2)				
RSC, DLS, Kanakapura		58 (2)	50 (1)				
RSC, DLS, Ramanagara	15 (3)	121 (11)	60 (2)		30 (1)		47 (3)
RSC, DLS, Hosur	21 (1)	230 (8)	30 (1)		180 (1)		47 (3)
RSC, DLS, Hindley	20 (1)	197 (7)		154 (3)			50 (3)
RSC, DLS, Tamaka-Area	47 (2)	344 (12)	91 (2)	25 (1)			50 (3)
RSC, DLS, Bellary (L)		101 (6)					50 (3)
RSC, DLS, Gulbarga		230 (1)	130 (1)	114 (2)			

Values in bracket denote participation & figures in parentheses indicate number of events conducted

Transfer of Technology Programmes: The CPTs undertaken in the form of technology programmes are evaluated for their impact based on bench marking socio economic study and the effectiveness of the technologies is presented below:

Centre	PAU	PPU (Nos.)	PPA (Hectares)	Composting	Vermi-c	Nursery	Vermi-h
RSRS, Hunsur (L)	5	15					
RSC, Bidirahalli (L)	5	15					
RSC, Chintamani				5 (5)			
RSC, Mandya (L)		15	30 (1200)				
RSC, DLS, Ramanagara (L)				5 (5)		100	10
RSC, DLS, Ramanagara	5	5	15 (600)				
RSC, DLS, Kolar (L)	5		10 (200)		5	50	
Total	15	50	100 (2000)	10 (10)	5	150	10

Values represent No. number of beneficiaries

Values in parentheses indicate the number (PPA-Hectares) & areas covered, corresponding

Popularization of Shrubline Hybrids & Improved Cross breed: A total of 40750 slips of new Shrubline hybrids were distributed to the farmers and the average yield recorded was 70.63 kg/ 100 Slips. A total of 10200 slips of improved cross breed, CL14 x CSR2 was distributed to the farmers and the average yield recorded was 64.6 kg/ 100 slips.

Shrubline Hybrids			
Unit	Farmers	Slips	Yield/100 Slips(kg)
RSRS, Kodagu	4	1000	57.00
RSC, Bidirahalli	20	5475	69.00
CTRF, Chintamani	8	1000	68.00
RSC, Mandya	14	1000	68.10
RSC, Madikeri	4	500	
Total	50	11750	

KSB-1 X KSB-2			
Unit	Farmers	Slips	Yield/100 Slips(kg)
RSRS, Hunsur	2	1000	62.00
RSC, Bidirahalli	13	1000	61.00
RSC, Chintamani	1	1000	68.00
RSC, DLS, Ramanagara	10	1000	63.00
RSC, DLS, Kolar	1	1000	64.00
Total	27	10200	64.60

Production of Mealybug Control Agents: A total of 800 packets of Neochrysopa lacrimula were produced on mulberry pupa and distributed to sericulturists for the management of pests.

Establishment of ARWT: Affordable Micro Irrigation Technology (Drum Kit Technology) and Drip irrigation system was installed for four acres of mulberry gardens at RSRS, Kodagu to mitigate drought situation.

Cluster Promotion Programme (CPP): Shrubline sericulture technologies were disseminated in 22 clusters across Karnataka and 71,24,782 sfs were reared with an average yield of 66.67 kg/100 sfs, which is an achievement of 137.2 % of the target.

Institute Village Linkage Programme (IVLP): A total of 16,800 dfls of bivoltine hybrids were reared under RSC-Silkworm rearer and the average yield recorded was 81.23 kg/100 dfls, which is an improvement of 13.79% against benchmark.

Training Programmes @ RSRS-research & teachers units

Unit	2016-17 (till Dec)		2015-16	
	Training Events	No. of Farmers trained (Nos)	Training Events	No. of Farmers trained (Nos)
RSRS Kodathi			4	91
RSS, Chinnakoliyur			2	53
Total			6	144

RSRS-CHAMARAJANAGAR

RSC & Sub Units
RSS-1 Kollegal only

Command Area	Staff	
Karnataka	Incharge Officer	Dr. K. Sivakumaraju
	Scientific	5
	Technical Staff	11
	Administrative Staff	3

Unit	Total Area (Acres)	Mulberry Acreage
RSRS, Chamarajanagar		3,150
RSS-1, Kollegal only		

Ongoing Research Projects

PPP 2008: Development of tertiary culture model for income augmentation (Inter Institutional Project with IARI, Ranchi, Mar. 2013 to Dec. 2016)

V. Duraipandi, Project Coordinator, R. Ramesh, K. Sivakumaraju, Sibaram Das, Mahendra Gond

IMHS, Ranchi, RSRS Chamarajanagar

Objectives

- To work out the additional income generation out of lac post action and its economics in relation to mulberry leaf production
- To find out an appropriate role in improving the soil fertility and for sustenance of lac host activity
- To generate employment for rural people and improve their livelihood
- To study the pest & disease incidence, cross infectivity studies in mulberry, ber host plant vice versa

Plantings (Jan., / Kacha crop): the lac host plants were maintained between the multistry trees by following necessary cultural operations for better establishment. Lac insect, *Kerria lacca* (L.) inoculated on lac host plants for lac production. Post lac post action cycle was completed and the lac inoculated host were collected under sterile conditions (max. temp = 30°C) prevailing in the study area to be supportive for the lac production. Good lac samples from the brood culture, lac insect brood samples from the shoots were collected and sent to IARI for identification of predators. Only one lac insect predator, which is host-specific, was recorded. Around 200-250g of stick lac was recovered from each plant and a quantity of 200-250kg/ac.

acre was produced. An annual income of Rs 68000 to 72000 acre could be realized. Further validation trials of Eri-Lac culture are under progress at RSRS unit and with farmers.

Considering the importance of lac production with multivoltine as an alternative in augmenting farmers income, a farmer Sri Mahesh (Tamtada village, Thimmapura taluk) was identified for taking up the Eri-Lac cultivation. The farmer's land is characterized as red soil with low pH (4.7-5.8) and rich in organic matter. Two hundred plants of S. wightiana were planted in pits of 1 ft x 1 ft x 1 ft size at a spacing of 6 ft between the rows of mulberry. Among the total plant seedlings were replanted. Necessary care was taken for consolidation of lac host plant and > 90 % survival with good growth was recorded. Lac culture multiplied at RRS Ranchi was procured and inoculated to lac host plants and the first crop as production cycle is in progress. Soil samples were also collected to study the initial fertility status.

Economics of Eri-Lac Crop System					
	Lac Host Plant Cultivation		Mulberry Cultivation		
Input Costs (Rs.)	FYM (2MT)	2000	FYM (2MT)	4000	
	Fertilizers	1000	Fertilizers	1000	
	Labour	1500	Labour	2000	
	Wire	2000	Wire	Free	
	Fuel	1000	Fuel	11,000	
	Lac Inoculation	Nil	Cocoon Production	20000	
Returns (Rs.)	@ 300 grams x 600 plants	3 Crop	4 Crops/Year (440 DFL @ 45 kg/DFL) Rs.	Mulberry	
	Lac Sale @ Rs. 600/kg	60000	Cocoon Sale @ Rs. 350/kg	177400	
Profit		51000		116400	
Net Returns from Eri-Lac Crop System/Year = Rs. 1,67,400					

The first lac production cycle clearly indicates potentiality to exploit with multivoltine under coppicing for income augmentation in Cauvery region area. Secondly, being leguminous crop, lac host plant could facilitate reduction of synthetic nitrogen fertilizer application to get sustainable harvest by leaf production. Inter-cropping of Pigeon pea enriches insect biota in improving soil profile.

RSRS-Chamarajanagar is also involved in collecting data on the following collaborative projects:

- Post-pruning leaf biomass yielding of mulberry in pests
- CSTT in newly developed silkworm hybrids

Co-ordinated/Other Activities

Evaluation of RC1 and RC2 germplasm under farmer's condition

K. Srikantaswamy

New evolved mulberry varieties (RC1 & RC2) were evaluated with two farmers (Sri. K. Channappa, Kelaguru and Sri.M.K. Mahadeswaraiah, Mangala) in 0.75 acre each. Four cross-bed-hibernated dfls (CB4) @ 300 kg/acre in RC1 and 2300 kg/acre in RC2) against the check variety C-2 (2017 kg/acre) was reported with an improvement of 10.46% and 6.74% in RC1 and RC2, respectively. The average cocoon yield recorded was 60-70 kg/100 dfls over the bench mark yield (40 kg/100 dfls with Local x 2 variety). Overall shell crop leaf yield indicates that RC1 has shown higher yield (1850 kg/acre/crop) followed by RC2 (1648.89 kg/acre/crop) against 1517 (3 kg/acre/crop) in C-2.

Testing of three way cross bivoltine hybrids

R. Vencat and K. Srikantaswamy

Objective: To evaluate new three way cross bivoltine hybrids for its suitability

On-Station Trial (OST) was conducted with newly developed three-way cross bivoltine hybrids (FC1 x CSR2 & FC2 x CSR1) with FC1 & FC2 (double hybrid) and CSR2 x CSR4 (single hybrid) as controls. The three-way cross hybrid, FC1 X CSR2 & FC2 x CSR1 showed higher ERR by number and weight, cocoon weight, shell weight, shell ratio in comparison to control hybrids. Similarly, the new hybrids had shown considerably higher than the control hybrids.

Hybrid	Yield / 10,000 Larvae		Single Cocoon Wt (g)	Single Shell Wt (g)	Shell Ratio (%)
	No.	Wt (kg)			
FC1 x CSR2	8818	110.188	1.333	0.220	20.02
FC1 x FC2 (C)	8158	8.000	1.412	0.256	19.61
FC2 x CSR1	8443	11.666	1.451	0.291	21.10
CSR2 x CSR4 (C)	8868	9.611	1.081	0.192	21.68

Promotion and evaluation of mulberry tree plantation technology for sustainable sericulture development under rainfed conditions

K. Dhanavanthri

Objective: Ranking exotic tree mulberry germplasm cultures by mulberry tree plantation with ANM performance test

Mulberry tree plantation was undertaken with five farmers @ one acre each and stem kits were supplied to raise mulberry as successful tree for protective irrigation. The survival percentage ranged from 90 to 100% and significant improvement over the local practice in growth associated parameters was recorded one year after the establishment of mulberry tree plantation utilizing ANM.

Mulberry Germplasm	ANM	Local Practice	t value
No. of shoots/plant	17	7	31.298**
Total shoot length / plant (cm)	2.84	1.1	31.468**
Total leaves/plant	840	110	31.698**
Leaf area (cm²)	13.5	12.5	20.121**
Leaf area index	2.43	1.25	1.467**
Leaf weight (gm/plant)	7.85	0.21	11.598**
Leaf yield (kg/tree/year)	18.01	0.65	1.307**

Organic Farming in Mulberry

K. Dhanavanthri and S.K. Pathak

Objective: Transfer of organic farming technology to farmers

Organic farming for sustainable mulberry leaf production was assessed at four farmer's field (V-1 mulberry variety) (3) and 4 (V-1 seedling irrigated) one acre farmers. Critical inputs (Jag Amrutvardhini, Jag Pillai Biofertilizers, Phytovet) were supplied and Soil samples were collected to study the soil fertility status. Average leaf yield recorded ten crops 8700 kg/ha was in organic plots as against the benchmark of 8400 kg/ha (organic) with an improvement of 14.73%.

Farmer	Leaf Yield/Acre per Crop	Rearing Performance		
	Cocoon Weight	Pupation	Shell Ratio	Economic Value (Rs. /Acre /Year)
Krishna Rao (Mulberry)	5200	200		26,000
2 crops	4500	175	20%	52,14
	3800	240		58,00
Pullaiah Naidu (Mulberry)	5500	175		52,00
2 crops	4500	200	20%	60,00
Ramanaiah (Mulberry)	12000	90		18,00
Multivoltine	12040	90	20%	72,00
3 crops	9600	70		58,00
Pullaiah (Mulberry)	10500	100	20%	63,00
2 crops	10027	74	20%	77,00

Multiplication of parental stocks for seed production

R. Nirmal and K. Dhanavanthri

Bivoltine breeds, PC3, PC4, C(W16-5 C(W17) were reared at RSRS to raise seed cocoon generation to seed production. Two crops failed due to flacherie and grasserie and the third one (28 dfls each: PC3 & PC4) generated (7.40 and 65.00 kg) 139 dfls, respectively.

Transfer of Technology Programmes: The CPTs undertaken in ToT programmes were evaluated for their impact based on benchmarker agencies study.

Centre	HM	CTM Mulberry	CTM Silkworm
RSRS Chintamangala	5	25 (24.3)	75 (69.0)

Technology	Impact Analysis
HM	Reduction in leaf yield, increased CC content, 20% reduction in chawkiup to thasar, improvement in leaf yield (17%) & cocoon yield (20%)
CTM Mulberry	Reduction in cocoon infestation - 4.11% level (18%
CTM Silkworm	Reduction in cocoon infestation - 3.40% level (17.00%

Extension Communication Programmes (ECP)

Various kinds of ECPs were conducted for the transfer of technology developed by the main institute and are tabulated

Centre	Group Disc.	Resource Progs.	Field Days	Exhibitions	Study Tours
RSRS Chintamangala	05 (2)	1+0 (1)	05 (1)	1+01 (1)	2 (1)

Production of Biological Control Agents: Sixty seven lacs of *S. coccinae* were produced against the target of 60 lacs and 51 lacs were supplied to 25 farmers covering 84.58 acres of mulberry for the control of larva.

Cluster Promotion Programme (CPP): Bivoltine sericulture technologies were disseminated in 22 clusters across Karnataka and 77,28,762 dfls were brushed with an average yield of 66.47 kg/100 dfls, which is an achievement of 107.21% of the target.

Institute Village Linkage Programme (IVLP): A total of 30,600 dfls of bivoltine hybrids were reared under RSD-Biotechgarden and the average yield recorded was 61.23 kg/100 dfls, which is an improvement of 12.79% against conventional.

Training Programmes @RSRS - Chamrajanagar				
Unit	2015-2016		2016	
	Prog. (Nos.)	Beneficiaries (Nos.)	Prog. (Nos.)	Beneficiaries (Nos.)
RSRS, Chamrajanagar			1	50

RSRS-SALEM

- RSO & Sub dists
- Tamil Nadu
- Pennagaram
- Kadaiyur
- Uthangarai
- Dalmiapuram
- Sub Unit Mungar
- Sub Unit Krishnagiri
- Sub Unit Jayamangali
- Sub Unit T. Vadugapatti
- Sub Unit Ayothiyapattinam
- Yercaud
- Pethanaikenpalayam
- Sub Unit Kottapatti

Command Area	Staff	
	In-charge Officer	Dr. Chitra Ravi
Tamil Nadu Kerala	Scientists	24
	Technical Staff	24
	Administrative Staff	24

Unit	Total area (Acres)	Mulberry Acreage
RS RS Salem	45.0	5.0
RSO Ayothiyapattinam	3.77	0.5
RSO Dalmiapuram	2.00	0.5

Research Projects

PRE 3012: Studies on pest status and ecofriendly management of thrips (*Pseudodendrothrips mori*) (Thysanoptera: Thripidae) on mulberry in Tamil Nadu and Karnataka (in collaboration with NBAIR, Bangalore; April 2014 to December 2016

D. Mohan Rao (PI), Chandan R. Bakti*, N. Chitra Ravi**, M. Nicolt Morrison*, Chitra.ns

*NBAIR, Bangalore; **RSRS, Kothathottapalayam; ***RSO, Hosakote

Objectives:

- Survey on infestation of thrips on mulberry in selected sericulture areas of Tamil Nadu and Karnataka
- Laboratory evaluation of the efficacy of different bioinsecticides
- Laboratory and field evaluation of potential natural enemies
- Evaluation of the establishment and impact of natural enemies in the selected mulberry gardens

Surveys were conducted at fortnight intervals at farmers gardens, Thalaghattapura and Siddaraghatta areas in Karnataka; D. Pethanaikenpalayam, Kangeyam and Thannerpanthal puthur, Pethanaikenpalayam and Chekkanampalayam in Tamil Nadu. High incidence (5.11-40 thrips/leaf) was recorded in Salem and Erode area during December. Slight broad difference with Maximum temperature (33.6°C) correlated with thrips incidence in Siddaraghatta. A predatory mite (Polyphagotarsonemus sp.) and predatory thrips (*Scolothrips* sp. and *Aeolothrips* sp.) feeding on mulberry thrips was collected from Salem

and Goniochernbalayum. The specimens are being sent for identification to Zoological Survey of India, Kolkata by NSAR, Bangalore. Acrotaxis indica (Thaumastocoridae) and three species of anthocorid predators Orius maxidentex, Orius tantillomis Muraleedharan and Ahmandorius indus Dilawth are identified by NSAR, Bangalore.

Cost benefit ratio of their mass rearing

Mass rearing the spread of papaya mealybug and assessment of production of its parasitoid

S. Monica Hever and Chitra ma

Objectives

- Mass production and supply of papaya mealybug parasitoids, *Acerophagus papayae* and *Pseudleptomastix mexicana*
- Impact analysis of parasitoids in the management of papaya mealybug

Papaya mealybug parasitoids, *Acerophagus papayae* (1,48,000) and *Pseudleptomastix mexicana* (9,600) were supplied to 650 sericulture farmers through DOR / RSOs for the management of papaya mealybug in Krishnagiri, Erode, Karur, Salem, Namakkal, Thiruvannamalai, Villupuram, Thanjavur, Madurai, Trichy, Dharmapuri, Dindigul, Krishnagiri and Tirunelveli districts of Tamil Nadu and Palakkad district of Kerala. Above 90% reduction in the papaya mealybug population was achieved following the introduction of exotic parasitoids.

Collaborative Research Projects/Programmes

- MOE (R&D Study on Drought Management practices in Mulberry Sericulture
- ARP 35/3: Silkworm Disease Monitoring of Coconut Commercial Crop Rearing of South Indian States
- Monitoring of soil fertility status of mulberry gardens in Karnataka, Andhra Pradesh & Tamil Nadu and creation of database
- Validation of new recommendation of fertilizers level and for V-1 mulberry under irrigated conditions
- Comparative study on the effect of split application of fertilizers in solid and liquid form on mulberry leaf yield, fertilizer saving, leaf quality in silkworm and cocoon parameters
- Studies on Disease Forecasting and its screening for Mulberry seeds, diseases and Silkworm seeds
- All India Co-ordinated Experiment for Mulberry (Phase-III) at RSO, Hosagi
- Large scale on-farm validation Field trial of 0.4 at RSRO Gobichettipalayam and farmers' fields

Transfer of Technology

On-Station-Trials in C. A. Mary Flora and Chitra ma

Testing of single-cross Cross Breeds: Three trials of two improved Cross Breeds, CSR2 x CSR4 & NB18 x CSR4 (A/A undertaken (March-April 2014, August-September 2014 and October-November 2014)

Hybrid	Yield	Yield/100 Dfls (kg)	SCD (g)	SHP (g)	ERR (%)	Survivability (%)	ERR (%)	Fecundity	Shell Ratio (%)
CSR4 x CSR2	95*	83.08	1.554	0.345	21.13	87.56	872.56	7.07	19.83
NB18 x CSR4	112	98.48	1.918	0.436	21.13	84.93	872.56	7.05	19.10
CSR4 x CSR2 (C)	94.0	87.22	1.668	0.338	20.68	78.84	824.63	7.08	19.83
PM x CSR2 (C)	77.5	73.73	1.557	0.332	19.19	80.17	748.23	7.04	17.87

* Values represent an average of three trials

Testing of new bivoltine hybrids: Three trials of two new bivoltine hybrids, SC1 x SC2 (single hybrid developed at CSRTI, Mysore) and CH1 x CH2 (double hybrid developed at CSRTI, Mysore) are undertaken in different seasons (March-April 2014, August-September 2014 and October-November 2014). Another set of bivoltine hybrids (Double hybrids: DH1, DH2, DH3 and DH4; Single hybrids: SC1 x DH3) developed at CSRTI, Mysore were also tested (October-November 2014 and January-February 2015).

Hybrid	Season	Yield (t/ha) Exptl. Hyb.	50% flowering (g)	50% silking (g)	GLS (%)	Plant height (cm)	ASI (no)	Husk cover	Ear tip filling (%)
DMH-1 (Check)	Monsoon '17	37.51	1,333	1,339	20.00	179.00	1.60	1.14	15.00
	Late Kharif '18	28.10	1,337	1,347	20.00	177.67	2.00	1.00	17.00
	Late Kharif '18	71.01	1,333	1,333	19.70	180.00	2.33	1.03	13.00
	Mean								
CML312 x CML451 (Check)	Monsoon '17	31.09	1,333	1,339	21.00	178.00	1.60	1.01	16.00
	Late Kharif '18	40.00	1,333	1,333	22.00	177.67	2.00	1.01	14.67
	Late Kharif '18	71.02	1,333	1,333	21.00	178.00	2.00	1.01	13.00
	Mean								
DH1 x DH2	Monsoon '17	37.67	1,331	1,333	21.01	180.00	1.60	1.00	17.00
	Late Kharif '18	28.80	1,333	1,333	21.00	177.67	2.00	1.01	17.00
	Late Kharif '18	69.33	1,333	1,333	20.00	178.00	2.00	1.01	15.00
	Mean								
HQ1 x HQ1 (Check)	Monsoon '17	48.71	1,333	1,333	27.00	180.00	1.00	1.00	15.00
	Late Kharif '18	79.76	1,333	1,333	22.00	177.67	1.00	1.00	17.00
	Late Kharif '18	88.91	1,333	1,333	20.00	178.00	1.00	1.00	15.00
	Mean								

Hybrid	Yield (t/ha) Exptl. Hyb.	50% flowering (g)	50% silking (g)	GLS (%)	Plant height (cm)	ASI (no)	Husk cover	Ear tip filling (%)
DH1	40.76	1,338	1,417	21.00	180.00	1,334.00	1.00	17.00
DH2	19.00	1,338	1,412	21.01	180.00	1,338.33	1.01	16.77
DH3	33.77	1,340	1,413	21.00	181.00	1,336.67	1.00	16.00
DH4	15.02	1,344	1,423	21.00	181.00	1,336.67	1.00	15.00
HQ1 x HQ1 (Check)	1.47	1,334	1,413	21.01	180.00	1,334.00	1.01	15.00
DH1 x DH2	46.00	1,337	1,423	21.00	181.00	1,332.67	1.00	16.00
CML312 x CML451 (Check)	45.15	1,338	1,411	21.00	180.00	1,340.00	1.01	15.00

Values represent an average of two locations

DeTeam-Trifid: Novel developed Maize Hybrids Improved crosses with and double check and single hybrids were test verified with the formula by the RBRD and its related cells

Line	Hybrid Combination	Title (%)	Hardness (No)	Yield (t/ha) Average
HMMS-Specific	LM x CML451	4650	15	52.29
	MML x MI	5460	15	51.00
	CML328 x CML451	2000	15	51.00
	DH1 x DH2	600	1	45.00
HQ1-Specific range	MI x CML312	300	2	52.29
	DH1 x DH2	300	2	41.00
	LM x CML451	3450	11	40.00
	CML328 x CML312	1800	3	34.00
HQ1 Specific	HQ1 x HQ1	7500	37	47.00
	LM x CML451	600	4	37.00
HQ1 Specific range	MML x CML451	600	3	50.00
HQ1 Specific	CML328 x CML312	840	15	41.00
HQ1 Specific	DH1 x DH2	4650	31	40.00
HQ1 Specific	LM x CML451	600	3	40.00
HQ1 Specific	HQ1 x HQ1	3000	2	45.00
	CML328 x CML312	3000	15	44.00
	DH1 x DH2	1950	15	40.00

Extension Communication Programmes:

Various kinds of ICT Pieces constructed by the KSRDS and its nested units for the transfer of technology developed by the main institutes and are three-fold.

Events	Facts (Count)	Kisan Days	Awareness Prog.	Field Days	Delight Prog.	Exhibition	Study Tour
KSRDS Station	61 (9)	34 (4)	30 (1)	44 (1)	160 (1)	4000 (4)	28 (1)
RRC, Dalwanthapuram	44 (2)	200 (2)	40 (1)	40 (1)	324 (1)	140 (2)	40 (1)
RRC, Kovvuru	50 (2)	50 (2)	30 (2)	80 (1)	70 (1)	50 (1)	
RRC, Bapatla	45 (4)	100 (6)	60 (1)	100 (1)	480 (1)	1100 (4)	40 (1)
RRC, Darsi	30 (1)	150 (4)	150 (1)	80 (1)	180 (2)	200 (1)	20 (1)
RRC, Ambajipeta	15 (2)	200 (2)	20 (1)	200 (1)	180 (1)	500 (2)	
RRC, Pulivendula	20 (2)	70 (4)	30 (2)		160 (1)	100 (1)	
RRC, Nellimarla	40 (3)	70 (4)	50 (2)	20 (1)	90 (1)		
RRC, Ragolu	40 (2)	100 (6)	100 (1)	80 (1)	210 (2)	100 (2)	20 (1)
RRC, Lam	50 (2)	50 (4)	40 (2)	80 (1)	90 (1)	80 (1)	
RRC, Perumallapalli	20 (2)	50 (4)	20 (2)	80 (1)	80 (1)	1000 (2)	30 (1)

Impact of Technology Programmes: The DPTs and visitors to transfer of technology programmes were evaluated for their impact based on semi-structured questionnaire study and the effectiveness of the technologies is presented below:

Technology	Area (ha)	Yield Before (kg/ha)	Yield After (kg/ha)	Increase (%)	Production (tonnes)	Farmers Benefited	Investment (Rs. lakhs)
KSRDS Station		5000	6500	30	1500	300	50
RRC, Dalwanthapuram	400	4200	5460	30	504	120	18
RRC, Kovvuru	250	3800	4940	30	285	80	12
RRC, Bapatla	600	4500	5850	30	810	150	25
RRC, Darsi	350	4000	5200	30	420	100	15
RRC, Ambajipeta	500	4800	6240	30	720	140	22
RRC, Pulivendula	200	3500	4550	30	210	60	8
RRC, Nellimarla	300	4100	5330	30	369	90	14
RRC, Ragolu	450	4600	5980	30	621	130	20
RRC, Lam	380	4400	5720	30	475	110	17
RRC, Perumallapalli	220	3600	4680	30	242	70	10

Values represent the number of beneficiaries

Source: Questionnaire analysis data collected during DPTs and Farmers' Exposure Programmes, 2014-15

Technology	Impact Indicator
Bio-control	Reduction in use of chemical pesticides by 40%; 25% reduction in chemical fertilizer use
IPM & Mulberry	Reduction in soil solution and foliar application; 2 BCL over 30%
IPM & Silkworm	Reduction in use of pesticides – 10% and 7.4%
Composting	Popularization of organic manures
Pulses	10% higher leaf yield and improved fruit & leaf quality
Nanogas	10% reduction in the cost of effective plants
Vermiculture	40.28% decrease in vermicast & improvement in leaf yield by 10%

Farmers Interviewed and Interviewed:

Farmers Visiting (Before 14-08-2014)	Farmers Interviewed (By colleagues, 08-07-2014)	Total No. Trained in (Before 14-08-2014)
200 farmers visiting 118 new farmers since last	750 farmers attended Booked on Organic Mulberry Cultivation was released	167 farmers, 103 OBC/BSC officials, 3 Organizers, Advanced Technology for Silkworm Seed Crosses Production FAQ on Seed Act from Released

Popularization of Improved Mulberry Varieties & Bivoltine Hybrids: A total of 2575 acres were planted with improved mulberry varieties with 2067 farmers. A total of 24.27 lakh dfls of CSR hybrids and double hybrids were distributed to the farmers in non-coastal area and the average yield recorded was 73.5-6 kg/100 Dfls

Improved Mulberry Varieties		
Unit	Farmers	Acres
RSRS-Kolar	604	606
RSC-Anantapur	310	309
RSC-Sri Rangapatna	10	10.5
RSC-Udumalpet	338	281.00
RSS-Dalimi	141	347.50
RECSU, Berhampore	1158	274
RECSU-Srirampuram	44	28
RECSU-Vishveshwarapuram	49	48
RECSU, Jammu	269	269
RECSU, Thalla	49	76.5
RSC, Pampore	11	21
RECSU, Kokrajhar	12	14
Total	2467	2515.49

Bivoltine Hybrids			
Unit	Farmers	DFLs	Yield/ 100 dfls (kg)
RSRS-Kolar	253	18715	71.01
RSC-Sri Rangapatna	648	108000	74.52
RSC-Udumalpet	8	1200	73.20
RSC-Dalimi	1124.5	2248711	71.20
RECSU-Thalla	28	7400	67.20
RECSU-Kokrajhar	12	600	60.70
Total	22027	2434626	70.60

Cluster Promotion Programmes: Bivoltine sericulture technologies were disseminated in 26 clusters across Tamil Nadu and five clusters in Kerala. 42.26 lakh dfls of bivoltine hybrids were reared with an achievement of 116 % against the target of 43.26 lakh dfls and recorded highest cocoon yield (% kg/100 dfls) in the country. The raw silk production achieved was 852 MT against the target of 800 MT and contributed 17.56 % to the bivoltine raw silk production in the country.

Adhikarigram (AVLP): A total of 1.17 lakh dfls of bivoltine hybrids were reared with 200 farmers in two clusters i.Sathyamangalam & Thandekothur) and the average yield recorded was 71.1 kg/ 100 dfls, which is an improvement of 12.8% against the benchmark.

Training Programmes in RSRS-Kolar & Related Units				
Unit	2015-2016		2016	
	Prog. (No.)	Farmers/ trainees (No.)	Prog. (No.)	Beneficiaries (No.)
RSRS, Kolar	5	100	1	20
RSC-Gulbarga	1	41	1	15
RSC-Ramnagaram	3	60		
RSC-Srirampuram			1	21

RSRS-ANANTAPUR

Command Area	Staff	
	Sri Ranga Chittar	K. Subbaramaiah, Rtd.
Andhra Pradesh	Scientist	08
Telangana	Sericulture Staff	51
Karnataka	Administrative Staff	76

Farm Based Units		
Unit	Total Area (Acres)	Mulberry (acres)
RSRS-Anantapur	48.75	8.5
RSC-Hagaribommanahalli	5.06	1.0
RSC-Udumalpet	6.08	1.0
RSS-Dalimi	11.20	8.5

RSC & Sub Units
Andhra Pradesh State
V Thota
Madakasira
Bukka
Kalyanadurgam
Sub Unit-Hindupuram
Sub Unit-K.S.Palli
Sub Unit-Kothacheruvu
Sub Unit-Obulapuram
Sub Unit-Puttaparthi
Sub Unit-Settipalli
Sub Unit-Tadimarri
Sub Unit-Vidapanakallu
Telangana State
Sub Unit-Bayyaram
Sub Unit-Kothagudem

Research Projects

RP (A) 6(01): Evaluation of the Mulberry varieties under rainfed and agro climatic conditions.

M. A. Khan*Md Abdul Wasi, P.I and Dr. Satyanarayana Raju (Co-Investigator)

Objective

- To evaluate elite mulberry varieties under rainfed agro-climatic conditions and to assess the growth and yield potential of elite mulberry varieties under rainfed agro region of Andhra Pradesh.

Methodology

- Four test varieties viz., S2, RC1, RC2 and Tanvan Variety
- Evaluation of mulberry varieties under Randomized Block Design
- Raising of saplings of elite mulberry varieties in nursery beds
- 0.7 acre land preparation for experiment.
- V1 variety as National Check and Anantha variety as Local Check
- Replications: 3 (Three)
- No. of Plants per plot: 50 plants
- Spacing: 90 x 90 cm
- Inputs: FYM @ 25 tons/hectare in two split doses, NPK @ 350:140:140 kg/hectare in 3 split doses
- No. of crops/year: 5 crops
- Pruning method: Leaf harvest followed by bottom pruning after each crop
- Crop data recording for 3 years with a minimum of 12 crops on growth and yield parameters for the entire project period
- One cytological study on diploid hybrid meiosis during October-November in the III year of evaluation

Four leaf yield crops were collected during the period under report. Average data of five crops on growth and leaf yield attributing parameters on mulberry genotypes under Evaluation of Elite mulberry varieties under semi arid agro climatic conditions during April, 2014 to March, 2015 is given below.

Growth and leaf yield attributing parameters on mulberry genotypes under semi arid agro climatic conditions [Apl. 2014 to Mar. 2015] (Average of 4 crops)

Genotype	No. of branches/shoot	Total shoot length (cm)	No. of internodes length of shoot (cm)	Leaf moisture content (%)	MFC (%)	Leaf yield (g/plant/crop)	Leaf shoot ratio
MV1	8.21	324.25	19.87	71.20	13.80	5775.26	0.84
MV2	8.34	1064.31	20.25	71.83	11.36	7171.03	0.95
MV3	8.25	1025.12	20.50	73.08	10.73	7584.95	0.92
MV4	8.30	997.51	19.82	71.08	11.31	7362.73	0.92
MV5	8.01	1110.86	21.35	74.03	12.05	8080.69	0.87
MV6	8.01	951.08	19.85	69.47	13.35	7218.61	0.88
CD at 5%	0.49	14.78	1.52	0.87	0.25	57.50	0.044
CV	8.11	8.78	7.73	13.04	1.25	1.46	0.44

Growth and leaf yield attributing parameters on mulberry genotypes under semi-arid agro-climatic conditions [Project period: April-March, 2012] (Average of 7 crops)

Genotype	No. of branches/shoot	Total shoot length (cm)	No. of internodes length of shoot (cm)	Leaf moisture content (%)	MFC (%)	Leaf yield (g/plant/crop)	Leaf shoot ratio
MV1	8.24	969.18	19.81	71.48	14.25	6986.16	0.83
MV2	8.36	1078.86	20.46	71.58	14.71	8466.07	0.91
MV3	8.31	991.39	20.55	73.53	14.52	7985.53	0.89
MV4	8.33	912.67	20.00	71.14	14.20	8186.38	0.88
MV5	8.06	1002.71	20.84	73.73	13.92	8280.65	0.86
MV6	8.06	797.79	19.93	69.24	13.38	8097.48	0.93
CD at 5%	0.48	14.51	1.49	0.86	0.25	59.61	0.045
CV	8.21	7.97	7.31	13.21	1.72	1.32	0.54

All India coordinated experimental trial for mulberry varieties (AI CSR – Phase II (2011-2015)

M. A. Shanthan Babu (PI) and Dr. Satyanarayana Raju (Coordinator)

Objectives

- To evaluate identified mulberry varieties under varied agro-climatic conditions to assess the growth and leaf yield potential of the varieties for sericulture.

Methodology

Test varieties	: MV1, MI2, MV3, MV4
Check variety	: V1
No of replications	: 6
Experimental Design	: RBD
Spacing	: 90 x 90 cm

Four leaf yield crops were recorded during the year report. Average data of four crops on growth and leaf yield attributing parameters of different mulberry genotypes under AICSM during April, 2014 to March, 2015 is given below.

Growth and leaf yield attributing parameters on mulberry genotypes under semi-arid agro-climatic conditions [Apr. 2014 to Mar. 2015 (Average of 4 crops)]

Genotypes	No. of branches	Total shoot length (cm)	No. of internodes length of shoot (cm)	Leaf Moisture content (%)	MMC (%)	Leaf yield kg/plant/crop	Leaf shoot ratio
MV1	7.20	918.80	33.70	72.80	79.13	1355.00	0.29
MV2	8.40	868.92	19.80	72.64	85.15	1229.17	0.67
MV3	8.73	909.84	19.33	76.08	79.67	1048.00	0.67
MV4	7.00	917.74	19.40	72.33	78.40	957.00	0.33
MV5	8.80	868.13	19.84	71.74	80.00	923.00	0.58
CD at 5%	0.47	2.58	5.68	6.76	7.68	62.10	0.07
CV	6.83	1.68	1.98	5.68	10.85	9.81	3.28

Average data on growth and leaf yield attributing parameters on mulberry genotypes under AICSM- Phase I (Ruling Project period upto March,2014) (Average of 7 crops)

Genotypes	No. of branches	Total shoot length (cm)	No. of internodes length of shoot (cm)	Leaf Moisture content (%)	MMC (%)	Leaf yield kg/plant/crop	Leaf shoot ratio
MI1	7.21	760.38	21.73	72.33	82.33	1007.80	0.59
MI2	7.94	835.13	20.65	72.86	84.12	1057.83	0.56
MI3	8.87	748.40	20.43	71.96	81.33	1004.84	0.66
MI4	7.40	837.80	20.16	72.24	82.03	1021.85	0.61
MI5	7.60	845.00	20.02	72.61	83.01	1005.80	0.55
CD at 5%	0.47	2.03	0.61	7.21	7.15	67.18	0.06
CV	7.90	11.80	14.02	10.02	11.04	11.45	10.31

Research Projects in Sericulture

Project Coordinators: Dr. M. Magadum (PI), Dr. K. S. Jagadeesh Reddy (Co) and Dr. Satyanarayana Raju (Coordinator)

Co-Ordinated trials

Objectives: To test / verify the new sericulture practices developed by CSRTI, Mysuru under co-ordination trial programme suitable to conditions of Andhra Pradesh.

Due to severe water problem prevailing in the station, quality mulberry leaf could not produced. Hence, silkworm rearings were not conducted in Sericulture section of RARS, Anantapuramu, during the period.

Research Projects in Extension

PRE 0027: Survey and surveillance of major pests and their natural enemies in mulberry eco-system

M. Kasi Reddy and Dr. Satyanarayana Raju

The Project work was initiated in the month of January, 2012. One fortnightly survey is conducted and recorded the data. The data showed that cocoon infestation is 4.0 to 6.0%, leaf roller- 3.0 to 4.0%, Thrips- 4.0 to 10.0% and Mite- 1.0 to 1.5% and it is submitted the data to PME Section, CSRTI, Mysore.

Other Programmes:

Production of *N. rileyella* at RSRS, Anantapuramu for use in trial runs by interfacing on silkworm crops in the field

M. Raghupathi and Dr. Satyanarayana Raju (Coordination)

N. rileyella was produced using mouse by pupa and supplied to different areas as per their requirement. The pest also parasitized to pupae were sold to different areas and also used for a demo on Uzifly parasitoid combined with Uzi trap where 200 farmers were benefitted through this programme. The following are the details of supply of *N. rileyella*: 1118 pouches of *N. rileyella* (60 no. 2000 pupa) were supplied. Data was collected on the suppression of Uzi recorded that there was a significant decrease in the Uzi infestation (5.4% vs. 0.8%) through integrated control measures adopted.

Soil testing laboratory

M. Kasi Reddy and Dr. Satyanarayana Raju (Coordination)

200 Soil samples were collected from the farmers of CFP and RLP of Kadapa District, Ranga Reddy, East Godavari and Anantapur districts. The most of the soils of Andhra Pradesh were slightly alkaline in nature and poor in organic content. Farmers advised to go for ploughing of green manure crop two times in a year.

On-Farm-Trials: Newly developed 4 Bivoltine hybrids (Improved crossbreeds and Bivoltine double and single hybrids) were released and their performance was evaluated with the farmers by the RSRS and its nearest units.

Unit	Hybrid Combination	No (Nos)	Farmers (No.)	Yield (100 DFL) (Kg/Ac)
RSRS, V. Kota	NM4N x CSR19	100	2	75.80
	SS1 x CSR19	200	1	72.10
	CSR19 x CSR27	29750	52	71.00
	SY1 x SS1	1100	5	73.00
RSRS, Kurubalakota	PC3 x PC4	900	3.5	69.00
	CSR19 x CSR27	6000	27	64.00
	LH1 x CSR2	200	2	64.00
RSRS, Anantapuram	CSR19 x CSR27	3750	7	68.10
	PC3 x PC4	400	2	64.70
	LH1 x CSR2	1000	5	66.12
RSCSO, Chintamani	CSR19 x CSR27	22750	43	68.97
	LH1 x CSR2	200	1	66.00
RSC, Kolar	CSR19 x CSR27	17750	37	69.00
RSCSO, Hosakote	CSR19 x CSR27	14000	32	69.80
	LH1 x CSR2	400	2	66.00
RSCSO, Tirupur	LH1 x CSR2	1000	5	72.00
RSCSO, Salem	LH1 x CSR2	1400	6	61.67

Extension Communication Programmes

Various kinds of ECPs were conducted by the RSRS and its nearest units for the transfer of technology developed by the main institute and are the views.

Centre	FY Started	Group Size	Income Proj.	Field Exp.	Weight Proj.	Publication	Study Tour
REC, Ambikapur		15(1)			15(1)	2(2)	
REC, Bilaspur		60(2)	15(1)	60(2)	15(1)	60(2)	
REC, Durg-Bhilai-Jagdalpur		105(3)	60(2)	60(2)	15(1)	2(1)	
REC, Mahasamund	2(2)	45(2)	15(1)	2(1)		15(1)	
REC, Ranchi	2(2)	45(2)	60(2)	5(2)	15(1)	30(1)	5(1)
REC, Rourkela		45(2)	30(1)	2(1)		30(1)	5(1)
REC, V. Vihar	12(2)	105(3)	30(1)	60(2)	2(1)	15(1)	5(1)
REC Ltd, Angul	2(2)	60(2)	15(1)	15(1)		30(1)	
REC Ltd, Bilai	4 (2)	2(2)			15(2)	4 (2)	
REC Ltd, Hadagarh	5(2)	15(2)	60(2)	60(2)	2(2)	15(1)	
REC Ltd, Jharsuguda	2(2)	15(2)	30(2)	60(2)	2(2)	15(2)	5(2)
REC Ltd, Keonjhar	2(2)	15(2)	30(2)	60(2)	2(2)	15(2)	5(2)
REC Ltd, Malkangiri	2(2)	15(2)	30(2)	60(2)	2(2)	15(2)	5(2)
REC Ltd, Nayagarh	2(2)	15(2)	30(2)	60(2)	2(2)	15(2)	5(2)
REC Ltd, Rayagada	2(2)	15(2)	30(2)	60(2)	2(2)	15(2)	5(2)
REC Ltd, Sonepur	2(2)	15(2)	30(2)	60(2)	2(2)	15(2)	5(2)
Total	41(21)	2(1)	4(1)	5(1)	2(1)	2(1)	5(1)

Values expressed: Number (participants) Eg. 5(10) = 5 programmes with 10 participants; Number of service conducted

Transfer of Technology Programmes: The CPTs undertaken in transfer of technology programmes were evaluated for their impact based on bench marking realistic study and the effectiveness of the technologies is presented below:

Centre	ToT	IPR Obtained	Commercialized	Publication	Awareness	Demonstration
REC, Ambikapur		2(2)		2		
REC, Bilai	2		1 (2)	1		
REC, Bhilai-Durg-Jagdalpur	2	2(1)	1 (2)	1		
REC, Mahasamund	2	1 (2)	1 (2)	2		
REC, Rourkela	2		1 (2)	2		
RTC, Chandrakhol	1			1		
RTC, V. Vihar	4		1 (2)	1	1	
REC Ltd, Angul	2			1		
REC Ltd, Hadagarh	1			1		
REC Ltd, Jharsuguda	4		1 (2)	1	1	
REC Ltd, Keonjhar	2	2(2)		1	1	1
REC Ltd, Malkangiri	2	2(2)	1 (2)	1		
REC Ltd, Nayagarh	1			1		
REC Ltd, Rayagada	2		1 (2)	1		
REC Ltd, Sonepur	1		1 (2)	1		
Total		2(1)	1 (2)	2	1	1

Values expressed: No. number of items obtained
Values in parentheses indicate the amount (IPR Obtained = 2 means obtained 2 copyrights)

Terminology	Impact Analysis
PPA	Reduction in avg. p.f. increased 100 (units/h) 20% reduction in chemical consume
PPA Energy	Reduction in Iron Pipeline and hence emissions - 0.8% from 10%
PPA Delivery	Reduction in air pollution - 1.80% Fuel 0.08%
Co-processing	Replacement of virgin raw materials
Plastics	14% higher, but cost and maintenance is in best quality
Tyre Tyre	10% increase in the tyre life without any penalty
Biochar	5 - 7.20% decrease in the bricks & an improvement in load yield by ~ 15%

Activities Proposed(Remarks)

No.	Name of the activity (Guidelines for 2014-2015) (Percentage - 2013-2014)	Specific Programme (Percentage - 2014-2015)
1	FREE Sarees provided Formation of the Scheme entitled "Pattu Kunnavaram Kanchipuram Pattuchirai" published by APSRTC Commissioners for the survey of handlooms in the country	220 lakh rs were allocated

Popularisation of Improved Mulberry Varieties : A total of 2460.55 acres were coated with improved mulberry variety with 1384 farmers.

Disaster Prevention Programme: Sericulture agriculture technologies were disseminated in 13 clusters in Andhra Pradesh and 4 clusters in Telangana states. 48.59 lakh dfls of bivoltine hybrids were reared with an achievement of 111 % against the target of 43.00 lakh dfls and recorded the cocoon yields of 44.94kg/100dfls. The overall production achievement was 201.97 against the target of 180 MT and contributed 11.67 % to the bivoltine raw silk production in the country.

Adoption Hybrids (HYV): A total of 36 lakh dfls of bivoltine hybrids were reared with 191 farmers in two clusters (Rajahmundry and Vishakapatnam) and the average yield recorded was 53.44 kgs/100 dfls, which is an improvement of 6.3% against the benchmark.

Training Programmes under CSS-2009

A total of 1220 farmers were trained in 60 batches in CSS2009 programme during the year 2014-15 and also 136 workers and non farmers were trained in skills programme

Improved Mulberry Varieties

Unit	Farmers	Acres
RSRS Kalavi	818	1808
Andhra Pradesh		
RSC, Rava	70	80.00
RSC, Kotha vinagar	100	440.00
RSC, Mallikuntla	106	160.20
RSC, Rayadrug	83	80.00
RSC, V.Kota	128	160.00
RSC, BL, Kothakota	81	200.00
RSC, BL, Chittoor	100	400.00
RSC, BL, Kolhapur	44	120.00
RSC, BL, Hindupur	45	80.00
RSC, BL, Palamner	82	80.00
RSC, BL, Madakasira	40	80.00
Total	824	1864.00
Telangana State		
RSC, Vyalpad	100	210.00
RSC, BT, Mahaboob	75	80.00
RSC, BL, Suryapet	195	450.00
Total	370	960.00
Grand Total	1194	2824.00

Training Programmes at RSRS-Kalavi and 6 Related Units

Unit	CSS-2009		SSTP	
	Prog. (No.)	Beneficiaries (No.)	Prog. (No.)	Beneficiaries (No.)
Andhra Pradesh State				
RSRS, Anantapur	1	15	1	20
RSC, Rava	1	15		
RSC, Kothakottapalli	1	15		
RSC, Madakasira	1	15		
RSC, Rayadrug	1	15		
RSC, V.Kota	1	15		
RSC, BL, Chittoor	1	15		
RSC, BL, Kothakota	1	15		
RSC, BL, Chittoor	1	15		
RSC, BL, Kolhapur	1	15		
RSC, BL, Hindupur	1	15		
RSC, BL, Palamner	1	15		
RSC, BL, Penukonda	1	15		
Telangana State				
Rayal Peta	1	15		
Hyderabad	1	15		
Mid Pati	1	15		
Total	15	195	1	20

ADMINISTRATIVE REPORT

Central Sericultural Research & Training Institute, Mysuru, Karnataka and its regional units
Regional Sericultural Research Stations (RSRS)

Kodathi, Karnataka	Channapatnagara, Karnataka
Anantapur, Andhra Pradesh	Salem, Tamil Nadu

Research & Extension Centres (REC)

Basavapatna (Kar)	Udumalpet (TN)	Uthamapalayam (TN)
Chintamani (Kar)	Palakkad (Ker)	Amaravathi (MH)
Mallasandra (Kar)	Eluru (AP)	Barshetti (MH)
Doddichikkadenahalli (TN)	Kalyandurgam (AP)	Pandharpur (MH)
Srirangapatna (TN)	Madakasira (AP)	Washimpalkheda (MP)
Sathanur (TN)	Rayalacheru (AP)	
Srivilliputhur (TN)	V. Kota (AP)	

Sub-units of Research Extension Centre (REC-SU)

Attibele (Kar)	Dharapuram (Kar)	Chandrala (AP)
Bidar (Kar)	Dibbanahalli (Kar)	Gidnoor (AP)
Bijapur (Kar)	Gowribidanur (Kar)	Kanakavanda (AP)
Jamkhandi (Kar)	Tumkuru (Kar)	Mempally (TS)
Kanakapura (Kar)	Avinashi (TN)	Suryapet (TS)
Kirusamudram (Kar)	Bengal (TN)	Kumargaon (MH)
Kolgal (Kar)	Trichy (TN)	Jalna (MH)
Kudigi (Kar)	Vaniyambadi (TN)	Osmanabad (MH)
Malebu (Kar)	Kalpetta (Ker)	Kurnavur (MP)
Ramanagaram (Kar)		

Other Units

District Promotion Centre (DPC)	:	Hindupur
District Development Centre (DDC)	:	Pulamanakkavu, Y.N. Hosakote
Fil Basic Seed Farm	:	Hassan
Genetic Stock cum Breeding Station	:	Coonoor

R&D AND ADMINISTRATIVE PERSONNEL OF CSRTI AND MENTED UNITS

R & D Personnel

CSRTI-Mysuru

Sivaprasad V (Dr.), Director	Subramanian V (Dr.), Sc.-C	Muthuraja Hiti, Sc.-C
Ashwath BN (Dr.), Sc.-D	Kavitha (Dr.), Sc.-D	Muninarayan Reddy M (Dr.), Sc.-D
Balavenkatasubbaiah M (Dr.), Sc.-D	Kalyan PD (Dr.), Sc.-D	Nagendra DB, Sc.-D
Bhagya H (Dr.), Sc.-D	Mallik Kumar DM (Dr.), Sc.-D	Narasimha Reddy MT (Dr.), Sc.-D
Dakshina (Dr.), Sc.-D	Nataraj GB, Sc.-D	Nataraja Kumar JB, Sc.-D
Dandin Shekhar (Dr.), Sc.-D	Mallikarjuna Gowda A (Dr.), Sc.-C	Nirmitha Naik V (Dr.), Sc.-D
Ganesh Kumar S (Dr.), Sc.-C	Mallikarjuna Reddy N (Dr.), Sc.-D	Parameshwara C, Sc.-C
Gangadhar B (Dr.), Sc.-D	Manjunatha Murthy S (Dr.), Sc.-D	Prathiksh Kumar PM (Dr.), Sc.-D
Geetha SS (Dr.), Sc.-D	Mary Josephine AV (Dr.), Sc.-D	Purushotham S (Dr.), Sc.-C
Girish Naik V (Dr.), Sc.-D	Mukund V. Kiran, Sc.-D	Radhakrishna YVS (Dr.), Sc.-D

Rajasekhar K, Sc.-D
Rekha M, A.O. (Stat)
Ramakrishnappa P, Sc.-D
Sabitha MS, Sc.-D
Sachin PS-I (Dr.), Sc.-D
Satish Verma (Dr.), Sc.-E (Engineer)
Sharma SD-I (Dr.), Sc.-D
Sharmila RK-I (Dr.), Sc.-D
Shivaprakash BN-I (Dr.), Sc.-D
Srinivasa ST (Dr.), Sc.-D
Sudha AG, Sc.-D
Thippeswamy T-II (Dr.), Sc.-D
Vindhya GS-II (Dr.), Sc.-D
Vinod Kumar (Dr.), Sc.-D
Vinod Kumar Yadav, Sc.-B
Vinod Kumar, Sc.-D
Virendra Kumar (Dr.), Sc.-D

Nucleus Units

Karnataka

Amrutha PK (Dr.), Sc.-D
Harumanthaiyappa M, Sc.-C
Himantharaj MT (Dr.), Sc.-D
Ishwar, Sc.-C
Jayaramaiah, Sc.-D
Lakshmanan V (Dr.), Sc.-D
Malalingappa KC, Sc.-C
Maheswari U (Dr.), Sc.-D
Mohsin R (Dr.), Sc.-D
Nikhil Vaidian HI (Dr.), Sc.-D
Pallavi DN (Dr.), Sc.-D
Pitchimoni KL, Sc.-D
Raghunath MK (Dr.), Sc.-D
Rajanna KE (Dr.), Sc.-D
Ravisantra M Malligatti (Dr.), Sc.-D
Sandhi Kumar PN, Sc.-C
Shivashankara N, Sc.-C
Shilpna Swamy K (Dr.), Sc.-D
Sudhakar P (Dr.), Sc.-D
Sudhakara Rao P (Dr.), Sc.-C
Umesha A, Sc.-C
Vishnuvasa K, Sc.-D
Kalpana G-I (Dr.), Sc.-D
Chandrashekar Gi (Dr.), Sc.-D
Hatha I-II (Dr.), Sc.-D

Tamil Nadu

Anbazhagan R, Sc.-C
Babu DN (Dr.), Sc.-D
Annaamalai S (Dr.), Sc.-D
Chandrasekaran K (Dr.), Sc.-D
Chikkanna (Dr.), Sc.-D
Chithra Devi N (Dr.), Sc.-D
Sekarkumar Daniel A, Sc.-D
Sophiah CH, Sc.-C
Hubby Jayaraghan T, Sc.-C
Isaac Joseph, Sc.-C
Manivannan S (Dr.), Sc.-C
Mary Flora CA, Sc.-D
Mahalingam S (Dr.), Sc.-C
Mohamed Sabe A (Dr.), Sc.-D
Mohan S, Sc.-D
Punithavathi G, Sc.-D
Rajakumar S, Sc.-D
Ravikumar J (Dr.), Sc.-D
Sakthivel N, Sc.-D
Senthilnathan R (Dr.), Sc.-D
Selvaraj (Y2), Sc.-D
Shanmugamoorthi T, Sc.-D
Thirunavukkarasu T, Sc.-D
Vijayakumar R, Sc.-D
Senuraj R, Sc.-D
Rajalakshmi E, Sc.-D

Kerala

P.V. Baudoinny, Sc.-D
Sonia K, Sc.-D

Andhra Pradesh

Dr. Satyanarayana Raju, Sc.-D
Raja Reddy G (Dr.), Sc.-D
Nagil T (Dr.), Sc.-D
Narasimhakarthy G (Dr.), Sc.-D
Prasad Sv (Dr.), Sc.-D
Raghunadh (Dr.), Sc.-D
Reddy MP (Dr.), Sc.-D
Shekhar Babu MA, Sc.-C
Srikanta Rao T-II, Sc.-D
Venkateshwarlu M (Dr.), Sc.-D
Venkateswara P (Dr.), Sc.-D
Venkateswara Rao H (Dr.), Sc.-D
Venugopal A (Dr.), Sc.-D
Vijayanand D (Dr.), Sc.-D
Vijaya Nalla S, Sc.-C
Chowdary MB (Dr.), Sc.-D

Telangana

Srinivasulu Reddy P (Dr.), Sc.-C
Eshan H (Dr.), Sc.-D
Sandeep Rao BV, Sc.-C

Maharashtra

Kanande AJ, Sc.-D
Ram Prakash, Sc.-D
Kalsi Singh, Sc.-C
Kushwaha AS (Dr.), Sc.-C
Kagde AP, Sc.-C

Madhya Pradesh

Khare RK, Sc.-C
Pradeep Shukla, Sc.-C

ADMINISTRATIVE PERSONNEL

Anasuya R, CO (A&A)
Ganesan V, CO (C)
Girijasoma, AO (A&A)
Jayaramaiah (Dr.), CO (CS)
Jayamma V, AO (CL)
Manohara A, CO (F)
Nagen Rao Jadhav, EE
Nirmala, AO (A&A)
Pappu SG, AO (Fin)
Tasleem BY, LO
Yoganarasimha G, AO (A&A)

Staff position as on 31.03.2019

Category	Sanctioned	Filled	Vacant
Director	1	1	0
Scientific	61	35	26
Technical	104	103	01
Administrative	109	117	19
Supporting	80	72	8
Total	371	327	54

Budget (Rs. in lakhs)

Budget Head	Gross received	Grants Surrendered	Expenditure incurred during 2018-19
Non-Plan	3,450.00	4.17	3,445.83
Plan Gen (I)	775.00		775.00
Plan Gen (II)	178.81	2.18	176.63
Total	4,403.81	12.35	4,391.46

RESEARCH ADVISORY COMMITTEE

Chairman
Prof K. Narayana Gowda
Vice Chancellor
University of Agricultural Sciences
GKVK, Bangalore - 560065

Members
Dr. K.S. Anil Kumar
Principal Scientist
Soil Science Discipline
NBSS & LUP, P.B. No. 2407, Hebbal
Agriculture Farm, P. O. Bangalore - 560 024

Dr. K. Balakumar
Professor (Retd.), Dept. of Agronomy
Tamil Nadu Agricultural University
Coimbatore - 641003, Tamil Nadu

Dr. Kariyappa Hanabaratti
Project Coordinator, AICRPE
Indian Institute of Spices Research
Kozhikode (Calicut) -673 012, Kerala

Dr. G. Shivashankar
Principal Scientist & Head
Division of Plant Physiology & Biochemistry, IHR
Hessaraghatta Lake Post
Bangalore - 560 089

Prof. K.P. Chinnaswamy
Department of Sericulture
University of Agricultural Sciences
GKVK, Bangalore - 560065

Dr. H.K. Basavanneppa, Dr.S (Retd.)
Central Silk Board
Door No. 28/3, 8th Cross, II Stage
Srirampuram, Mysuru - 570 019

Dr. A.N. Shylesha
Pr. Scientist, Division of Insect Systematics
National Bureau of Agriculturally Important Insects
P. Bag, No.2491, H.A. Farm Post
Bellary Road, Bangalore - 560 024

Prof. M. Arvindachari
Former Dean (Ag. Engg.) & Professor and Head
Dept. of Farm Machinery and Power Engineering
College of Agricultural Engineering
University of Agricultural Sciences
P.O. No. 325, Raichur - 584 102

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

Commissioner of Sericulture
Govt. of Tamil Nadu, Post Box No.30
Poultry Compound, Anaimedu
Salem - 636 001, Tamil Nadu

Commissioner of Sericulture
Govt. of Andhra Pradesh & Govt. of Telangana
Road No. 13, Prasad Nagar, Adjacent to Water Tank
Jubilee Hills, Hyderabad - 5600 033, Andhra Pradesh

Director of Sericulture
Department of Sericulture
Govt. of Maharashtra, Nav Administrative Building
No.1, 4th wing, Opp Lane, Vidhan Bhavan
Nagpur - 440 001, Maharashtra

The Commissioner
Commissionerate of Rural Development
LMS Compound, Vikas Bhavan, P.O.
Thiruvananthapuram - 695 033, Kerala

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

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

The Director
Central Silk Technological Research Institute
Central Silk Board, CSB Complex
BTM Layout, Madiwala, Bangalore - 560 068

The Director
National Silkworm Seed Organization
Central Silk Board, CSB Complex
BTM Layout, Madiwala, Bangalore - 560 068

The Director
Central Sericultural Germplasm Resources Centre
Central Silk Board, P. B. No 44, Thally Road
Hosur - 635 109, Tamil Nadu

The Director
Central Silk Technological Research Laboratory
CSB Complex, Belgharia Road
Central Silk Board
Belgharia - 700 037

The Director
Karnataka State Sericulture Research & Development Institute (KSSRDI)
Thalaghattapura, Bangalore - 560 062

The Director
Andhra Pradesh State Sericulture Research & Development Institute
Kirlampudi, Rajahmundry - 533 210, Andhra Pradesh

Officer Incharge
Regional Sericultural Research Station
Central Silk Board, Ministry of Textiles
Govt. of India, P.B. No 48, Hindupur
Anantapur - 515 201, Andhra Pradesh

Officer Incharge
Regional Sericultural Research Station
Central Silk Board, Ministry of Textiles
Govt. of India, Dasnagara Post
Kodathi, Bangalore - 560 035

Officer Incharge
Regional Sericultural Research Station
Central Silk Board, Ministry of Textiles, Govt. of India
Near Railway Station, Hanyanguli Road
Channapatna - 562 101

Officer Incharge
Regional Sericultural Research Station
Central Silk Board, Ministry of Textiles
Govt. of India, Veerarakam Road
Kilkattai Post, Vellakkoil (via)
Salem - 636 003, Tamil Nadu

The Deputy Secretary (Tech.)
Regional Office of Central Silk Board
Ministry of Textiles, Govt. Of India
No. 18, Orbital Cybercity, Kamthan Post
Mumbai - 400 021, Maharashtra

The Deputy Secretary (Tech.)
Regional Office of Central Silk Board
Ministry of Textiles, Govt. of India
Anantasagar Nagar, Road No.12
Near New Vidhan Sabha, Jubilee Hills
Hyderabad - 500 096, Andhra Pradesh

The Deputy Secretary (Tech.)
Regional Office of Central Silk Board
Ministry of Textiles, Govt. of India
No 26/22, K.K. Salai, Karuvil
Kangar Nagar, Saligramam
Chennai - 600 093, Tamil Nadu

Shri. K. V. Srikanthaiah
S/o. K. V. Krishnaiah
Sericulture Farmer, Medihalli
Kallasandra Post, Tavarekere Taluk
Tumkur District

Shri. Syed Ziyauddin
Silk Reeler
S/o. Late Syed Rahamathulla, Mandi Road
Kurnool Municipality, Kurnool District

Sri. Ketan Ravindra
Silk Reeler
M/s. R.K.Silks, 2-9-P-228, Near Bhagilla College
Hyderabad Road, Jangaon - 506 167
Warangal District, Andhra Pradesh

Shri. Balvinderpal singh Reddy
S/o. Late P.Ramachandra Reddy
Bivottlee Farmer, Ramakonda village
Tirupati Mandal- 515 408
Kurnool Dist, Andhra Pradesh

Thiru. T. Jeevanantham
S/o. C.Thangavel
Agriculture Farmer
Ramalingapuram Colony Thottam, Ramalingapuram Post
Usilampatti Taluk - 625 536
Thanjavur Dist. Tamil Nadu

Thiru. C. M. Ramesh
Silk Weaving, Silk Reeler,
Dharmapuri, Dharmapuri Dist.
Tamil Nadu

Details of Reviews / Meetings held during the year

Sr.	Meeting	Date
1	Research Council (RC)	30th & 31st July 2018
		19th & 20th March 2019
2	Research Advisory Committee (RAC)	28th September 2018
3	Regional Research Advisory Committee (RRAC)	18th June 2018 at Chamarajanagara
		19th June 2018 at Coorg
		24th September 2018 at Bengaluru

METEOROLOGICAL DATA – CSWRI-RRS SURU

Month	Temperature (°C)			Humidity (%)			Rainfall (mm)
	Max.	Min.	Avg.	Max.	Min.	Avg.	
January	31.00	13.00	22.00	77.00	34.00	55.50	
February	32.00	14.40	23.20	86.00	34.00	60.00	1.20
March	36.40	16.00	26.20	84.00	38.00	61.00	27.60
April	35.40	19.80	29.60	84.00	49.00	66.50	6.10
May	35.50	19.00	27.50	90.00	35.00	65.00	207.50
June	34.00	19.00	26.50	90.00	41.00	74.50	94.00
July	31.00	18.00	24.50	90.00	66.00	78.00	100.10
August	31.00	18.00	24.50	90.00	60.00	80.00	71.60
September	31.70	17.00	24.50	90.00	68.00	79.00	208.60
October	31.00	18.50	24.50	90.00	66.00	77.00	82.20
November	30.20	13.40	23.50	90.00	44.00	69.70	12.00
December	30.00	11.00	23.00	90.00	36.00	69.70	32.00
Mean	32.50	15.72	25.25	90.17	46.67	67.36	
Extm. High	36.40	19.80		90.00	66.00		
Extm. Low	30.00	11.00		77.00	34.00		
					Total Rainfall		937.00
					No. of rainy days		53

PUBLICATIONS

International Journals

Krishnan, S. R. and Moorthy, S. M. (2004) Genetic Divergence, Heritable Variation, Correlation and Discrimination in Silkworm, *Bombyx mori* L. *Int. J. Biochemistry*, doi:10.1163/978-90-481-2085-0_15.

Chandrabalan, M., Jeyadas, P. and Moorthy, S. M. (2010) Analysis of genetic variability in some silkworm breeds of *Bombyx mori* L. through biochemical methods. *Int. J. Adv. Pharm. Biol. Chem.*, 3(2): 381-385.

Chowdary, B. S., Dr. Satyanarayana Raju Thippeswamy, T. and Sridhar, S. R. (2014) Variability in *Andrographis neurofloa* in natural habitat. *J. Medicinal Orchid Asia*, ISSN: 2286-8127, 3(1): 7-15.

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[illegible]	01	Regional Sericulture Research Station	01
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[illegible]	01	Silk to Silkworm Rearing Stalls	01
[illegible]	02		

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