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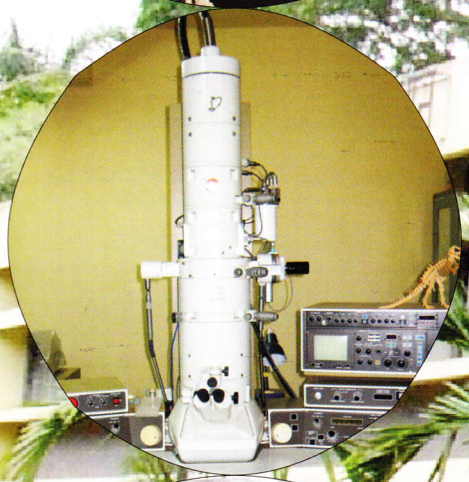
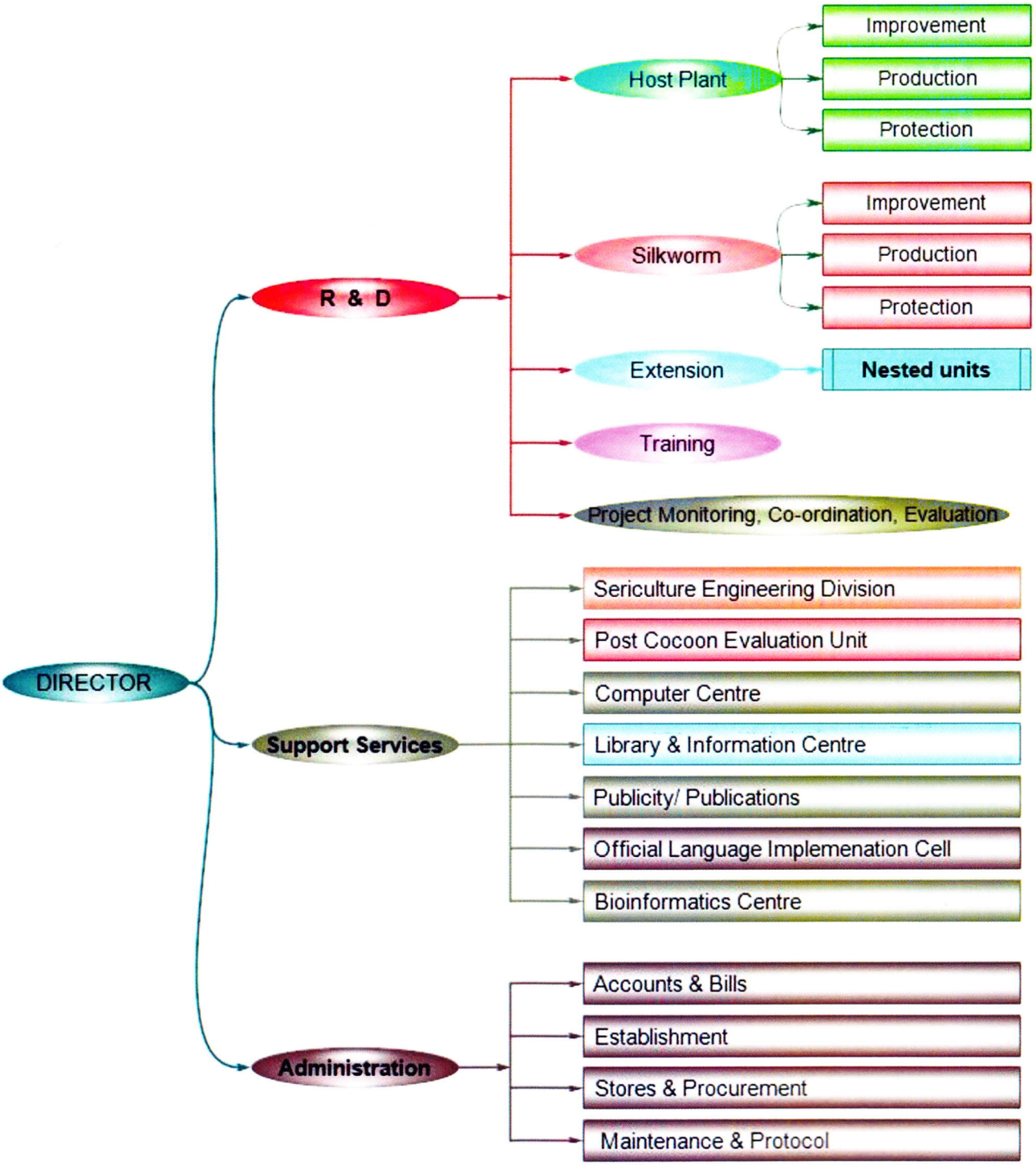


वार्षिक प्रतिवेदन
ANNUAL REPORT
2012-13

केंद्रीय रेशम उत्पादन अनुसंधान एवं प्रशिक्षण संस्थान
(आई एस ओ 9001 : 2008 प्रमाणित)
केंद्रीय रेशम बोर्ड, वस्त्र मंत्रालय, भारत सरकार,
मैसूर - 570 008

CENTRAL SERICULTURAL RESEARCH & TRAINING INSTITUTE
(ISO 9001 : 2008 Certified)
Central Silk Board- Min. of Textiles - Govt. of India,
MYSORE - 570 008

कें रे अ प्र सं, मैसूर – संगठन चार्ट
CSRTI, MYSORE - ORGANIZATION CHART



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CENTRAL SERICULTURAL RESEARCH AND TRAINING INSTITUTE
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Central Silk Board, Ministry of Textiles, Govt. of India, Mysore-570 008

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FOREWORD

I am delighted to place before you the annual report of Central Sericultural Research and Training Institute, Mysore for the year 2012-13. Established in April 1961 under the aegis of Central Silk Board, the Institute has been rendering yeomen service to the sericulturists through its R&D activities. Over the years, it has gained the status of a R&D Institute *par excellence*, and has been serving as a springboard for scientific/technological/ extension and training activities in India, more so in the southern peninsula.

During the year, the Institute has adopted the Results Framework Documentation (RFD) and achieved the set targets. The Institute and its nested units initiated **67** research projects/programmes of which **three** were funded by DBT/DST. Out of these, **4 projects** and **10 programmes** were concluded.

Scientists under host plant division have come out with notable accomplishments by identifying the promising genotype No.2 for soil moisture conditions besides short-listing six mulberry accessions which are resistant to root rot. A panel of diverse mulberry germplasm comprising of 300 accessions have been assembled through DNA profiling for sustainable conservation and enhanced utllisation towards crop improvement. A package involving application of organic inputs and crop residue management has been developed which significantly improved soil with respect to physical, chemical and biological characters. The soil testing laboratories of the Institute as well as regional stations have analysed a total of 3314 soil samples of farmers from southern states and suitable recommendations have been given. Controlling the root rot up to 90% has been achieved by formulating a consortium of endophytic bio- control agents (BCAs). It is gratifying to note that for management of root knot pathogen, *Nemahari,* an eco friendly formulation has been developed.

Under Silkworm division, development of improved cross breeds (ICB) is one of the major tasks being pursued and during the year, two more ICBs, *viz*., NDV6 x CSR51 and L14 x CSR50, superior over the existing cross breed PM x CSR2 have been short-listed for further trials. Special emphasis has been made for popularisation of the ICB, L14 x CSR2 with the potential to produce 2A-3A grade silk and over three lakh DFLs have been distributed and the results are encouraging. Further, a modified reeling technology package developed for effective reeling of L14 x CSR2 cocoons. Two hybrid combinations, 2C x 4S and G11 x G19 developed for sub-optimal conditions were found to be superior in terms of higher survival under on station trials. Molecular biology approaches for silkworm improvement has resulted in identification of two DNA markers associated with thermo-tolerance. For developing new strategies for controlling pebrine disease, microsporidian genes controlling MetAP2 enzyme have been identified which are being characterised. Databases pertaining to soil information, mulberry genome, important genes of mulberry, silk proteins, silkworm transcription factors were maintained and updated.

Use of eco-friendly measures for control of pests and diseases has been the major thrust of the Institute and biological control methods for the control of *Tukra,* Papaya mealy bug and *Uzi* infestation were popularized through mass production and supply of over 59,000 parasitoids. The efficacy of individual mother moth examination in five successive generations in eliminating the newly reported microsporidian was successfully demonstrated.

A beginning has been made in the frontier areas like Nanotechnology through the use of Silver and MgO nano particles, which were found to be effective in suppressing flacherie disease in silkworm. With regard to development of value added products, studies were initiated on *Cordyceps* which is in great demand and sold at high cost due to its high pharmaceutical value. The results have shown the successful growth of three isolates of *Cordyceps* both *in vitro* and *in vivo* on silkworm pupae. Earnest efforts for developing naturally coloured silk was continued during the year and protocols have been standardised through feeding silkworm larvae with dyes which produce cocoons of eight colours. Procedures have been standardised for preparation of fibroin films and silk scaffolds.

For reducing drudgery and operational costs, the engineering division has brought out a number of machines namely, high capacity leaf chopper, which can chop 500-600 kg leaf per hour suitable for commercial chawki centers and cocoon harvester for plastic collapsible mountages and mechanized bed for late age silkworm rearing.

On the sericulture extension front, it is commendable that the Institute and its nested units conducted over 800 extension communication programmes sensitizing more than 26,000 stakeholders on improved technologies and management strategies. Further, a number of technologies like INM, IPM, use of Poshan for mitigating nutritional deficiencies in mulberry, *Navinya* for management of root rot in mulberry, composting, intercropping, and mulberry tree plantation were effectively disseminated in the field. A workshop on *Development of Sericulture in Northern Karnataka* was conducted at Bagalakote in which 1500 sericulturists participated actively. Bivoltine promotion through CPP was the major focus of the Institute under which a total of 107 clusters were identified and 173 cluster chairpersons and cluster development facilitators (CDF) were trained.

Under HRD programmes, a total of 4501 persons were trained under structured and need based programmes at the Institute and its nested units, besides 151 personnel under ISDS and two Mexican scientists in silkworm breeding at the Institute.

It is laudable that the Institute has secured second position and a rolling shield for outstanding performance in implementation of Official Language policy by the Central Silk Board and RSRS, Salem bagged the second prize under Rolling Shield Scheme of the Town Official Language Implementing Committee, Salem. I am happy to mention that for the first time, a technical workshop in Hindi was organized at the institute.

On the publication front, a total of 211 publications including 34 research papers, 25 popular articles, in the Journals of National and International repute, 132 other publicity materials including news reports, silk briefs, extension manuals, books/booklets and technical bulletins were published. Further, twenty papers were presented in seminar/workshop/conferences. The institute has brought out three issues of *Indian Journal of Sericulture*, two issues of *Seridoc*, one *Resham Kiran* (*Hindi*) and one *Resheme Vahini* (*Kannada*) in addition to the Annual Report.

I wish to acknowledge the pragmatic guidance extended by the learned Chairmen and members of the RCC, RAC, RRAC and the former Director of the Institute, Dr. S.M.H. Qadri, his team of scientists and staff as well as the invaluable cooperation and support provided by the DoS of different states for achieving the set targets under R & D, training and Extension activities.

Dr. B.B. Bindroo
Director

I. ABOUT CSR&TI, MYSORE

The Central Sericultural Research & Training Institute, Mysore was established under the aegis of Central Silk Board, Ministry of Textiles, Govt. of India and started functioning at Channapattana in the year 1961, after taking over the Sericulture Research Institute of erstwhile Mysore province. It was shifted to Mysore in the year 1963. With the inclusion of the training component, the Institute was renamed as – Central Sericultural Research & Training Institute (CSR&TI), Mysore in the year 1965. The Institute as on date has completed its 52 years of dedicated services for development of sericultural industry in the country.

Today, the Institute has the distinction of being the premier institution for sericulture research *par excellence* with all modern facilities and infrastructure. Over the decades, the Institute has grown in its stature, gained National and International repute. The Institute undertakes the entire gamut of sericultural R & D activities to cater to the needs of the on-farm sector of mulberry silk industry in Karnataka, Andhra Pradesh, Tamil Nadu, Kerala, Maharashtra and Madhya Pradesh. With its well developed infrastructure and strong indigenously developed technological base, the Institute has made a mark as a leading R & D institution on tropical sericulture in the country and the institute is well recognized as a center for higher learning and advanced training on the international front. Its role in generating trained manpower has always been on high pedestals, both at domestic and international levels. So far, it has trained around 30,000 persons in different aspects of sericulture science and technology including 728 foreign nationals. Besides conducting research, training and extension activities, the institute also offers consultancy and advisory services to national and international agencies.

Vision

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

Mission

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

Mandate

- To develop mulberry sericultural technologies suitable to different agro-climatic conditions/zones.
- To conduct basic and applied research in various disciplines leading to the development of appropriate technologies.
- To test verify the proven technologies at field level for their adoptability.

- To conduct front-line and first-line demonstrations of developed technologies in the field.
- To conduct human resource development and training programmes.
- To serve as a testing centre for mulberry sericulture related rearing equipment, machines, products and technologies evolved in CSB institute or referred by other agencies.
- To coordinate with State Govts., voluntary organisations, NGOs, universities and other National institutes for collaborative research and technology transfer.

Organizational set-up

CSRTI, Mysore is the largest and most diversified institution engaged in sericulture R & D in the country, supported by about 150 scientists including Agricultural Engineers, Sociologists and Economists who are, working in close coordination for development of appropriate technologies and their transfer, both at the main institute and at the nested units spread over in the states of Karnataka, Tamil Nadu, Andhra Pradesh, Kerala, Maharashtra and Madhya Pradesh. The R & D activities and technology development are carried out in different sections under four major divisions: Moriculture, Sericulture, Extension and Training. The Director monitors the progress of the R & D activities of the Institute and the nested units with the support of Planning, Monitoring, Coordination and Evaluation cell.

Extension network

To facilitate validation and effective translation of laboratory findings to the field, the Institute has a three-tier system of extension network – Regional Sericultural Research Stations (RSRS), Research Extension Centres (REC) and Sub-Units (SU). The RSRSs, located in major sericultural zones of the southern states carry out region specific adaptive and applied research. The technology trials are conducted to recommend the technologies suited to the regional requirements besides providing training to farmers and grass root level extension staff. The RECs and sub-units share the major responsibility of technology transfer to the beneficiaries and also provide all technological inputs to support them. Maintaining active collaborations with regional Agricultural Universities, the Institute is conducting video-conferencing sessions in Karnataka, Andhra Pradesh and Tamil Nadu for effective transfer of sericulture technologies.

Training Centre

The institute is recognized as a flagship centre for generation of trained human resource in the field of tropical sericulture. It provides training in tropical sericulture both at international and national level. The Institute is affiliated to University of Mysore for conducting research in Sericulture Technology and Bioinformatics including Ph.D. programmes in sericulture. It is also recognized by Dept. of Biotechnology and Dept. of Science & Technology, Govt. of India for conducting various training programmes, especially for socio-economic development and technological empowerment of the rural poor, weaker sections and women sericulturists. Besides catering to the HRD needs of the state departments of sericulture, the Institute is also conducting international sericulture training programmes.

The Training Division of the institute is accredited by International Standared Organisation (ISO) and meets the quality standards. The training wing houses well equipped classrooms with audio visual teaching aides and the programmes are managed by qualified faculty, recognized by various Universities. Hostels to accommodate about 125 persons are available.

Infrastructure facilities available

- Well-equipped laboratories, mulberry gardens and rearing houses to carry out advanced research in sericulture science.
- Large scale rearing houses for technology validation and farmers' training.
- Model chawki rearing centre (CRC) of 6,000 dfls capacity to promote the concept of CRC.
- Sericultural Engineering Division with excellent workshop facilities to support designing, development and fabrication of machines/equipment.
- Computer center and LAN, which provides internet (2 Mbps) connectivity to all sections. The LAN also supports on-line and off-line presentations through multimedia/LCD projectors.
- Bioinformatics Center established with the financial assistance of DBT under the National Bioinformatics Network, provides database retrieval service to the scientists of different institutions involved in Seri-biotechnology research in the southern states.
- A modern library with a collection of 10448 books, 6760 bound volumes of scientific journals and 85 journals. In addition, it also maintains a collection of dissertations (292), theses (26) and technical reports (32). It also provides CD-ROM database (AGRIS, BIOSIS, BIOTECHNOLOGY CITATION INDEX, EKASWA (Patenting) and DATABASE facilities to its members.
- CSRTI regularly publishes books, bulletins, leaflets and technical papers related to sericulture. Over 35 books have been brought out till date in addition to a large number of technical and research papers published in leading national and international journals. The institute has the distinction of publishing Indian Journal of Sericulture, a biannual journal of international repute, Seridoc - documenting literature on sericultural sciences and Reshme Vahini (bimonthly) in Kannada for the benefit of stakeholders.
- KIOSK installed at Farmers' Advisory Centre provides details of all technologies and IVRS is available on the toll free number 1800-425-0010.

II. HIGHLIGHTS OF RESEARCH, TRAINING AND EXTENSION ACTIVITIES DURING APRIL 2012 TO MARCH 2013

The Institute and its nested units implemented 67 research projects/programmes, of which 03 were funded by DBT/DST. During the period, 04 projects and 10 programmes were concluded. The major achievements during the year are presented below in brief.

- In a final yield evaluation trial, one hybrid (Genotype 2) significantly out yielding the check (S13) by 20.4% under soil moisture stress conditions was identified.
- Six mulberry accessions, *M. multicaulis*, Vietnam-2, Cuckpilla, Mysore local, MR2 and Himachal local were found to be resistant to root rot pathogens, among the 35 mulberry accessions screened for disease reaction to root rot pathogens.
- A repeatable *in vitro* protocol for obtaining direct shoot regeneration (gynogenesis) from unfertilized ovary culture was standardized for genotypes, Punjab local, S36, K2 and Local.
- A consortium of endophytic biocontrol agents (BCAs) *Burkholderia cepacia*, *Bacillus subtilis*, *Pseudomonas aeruginosa* effective in controlling the root rot disease upto 90% was developed.
- A package involving application of organic inputs and crop residue management was developed, which significantly improved soil with respect to physical, chemical and biological characters. Among the five test mulberry varieties evaluated, V1 showed highest leaf yield of 60.62 MT/ha/year under the package.
- A panel of diverse mulberry germplasm was identified from the whole collection of 1065 accessions and core subsets (with 150 entries) were tested for capture of phenotypic diversity for further utilization in screening for root rot resistance.
- 3314 soil samples were analysed at the soil testing laboratories located in CSR&TI, Mysore (1769), RSRS, Anantapur (588), RSRS, Kodathi (301) and RSRS, Salem (656) and suitable recommendations were given.
- For ecofriendly management of *Meloidogyne incognita*, the root knot pathogen of mulberry, *Nemahari,* a formulation containing 75% plant derivatives and 25% chemicals was developed, which can control the disease upto 82.8% with a cost benefit ratio of 1:2.2.
- Two DNA (SSR) markers (LFL1123, LFL329) associated with thermo-tolerance in silkworm were identified.
- Two improved cross breeds *viz*., NDV6 x CSR51 and L14 x CSR50, significantly superior over the existing cross breed PM x CSR2 in respect of quantitative and qualitative traits were identified.
- More than 3.02 lakh dfls of L14 x CSR2 - an improved cross breed with potential of producing 2A-3A grade silk were field tested. The results revealed an average cocoon yield of 51.50 kg/100 dfls with a cocoon price of Rs. 229/kg of cocoon. This is a breakthrough as far as cross breed silk production is concerned.
- On Station Trial (OST) of hybrids developed for sub-optimal conditions of rearing, 2C x 4S and G11 x G19 exhibited their superiority in respect of increased survival ranging from 3.11 to 13.6 and 13.84 to 37.68% respectively in two test centres, over the controls.
- Out of eight *Cordyceps* and other species having high pharmaceutical value collected from different sources, three isolates (89, 90 & 91) were successfully grown on silkworm pupae with an infection rate of 84.4-100%. Two *Cordyceps* spp. grown *in vitro* on rice+pupae media contained 11-12 times more adenosine, almost same quantity of cordycepic acid and around seven times more cordycepin, compared to the naturally available *C. sinensis*.

- Coloured cocoons of eight new physiologically induced colours were produced and it was found that molecular weight and hydrophobicity of the dyes govern transport of dye from alimentary canal to heamolymph and finally to the silk gland in silkworms.
- Fibroin film having Silk I structure, which is water-soluble were prepared and procedure for preparation of silk scaffold by electro spinning with liquid fibroin was standardized.
- Silver and MgO nanoparticles were found effective in suppressing the flacherie disease in silkworm (40.70 to 62.37 %) caused by different bacterial pathogens.
- The efficacy of individual mother moth examination in five successive generations in eliminating the newly reported microsporidian was successfully demonstrated.
- Identified microsporidian genes controlling MetAP2 enzyme using PCR techniques through specific primers from *Nosema bombycis*.
- Biological control of Tukra and uzi infestation were popularized through production and supply of *Scymnus coccivora* (1018 boxes of 250 beetles each) and *Nesolynx thymus* (1423 units) a reduction of Tukra infection from 15-40% to 2-4% and a reduction in uzi infestation from 8-22% to 2-6% was recorded.
- Mass production of parasitoids of papaya mealybug, *Acerophagus papayae*, *Pseudleptomastix mexicana* and *Anagyrus loecki* was undertaken and over 59,000 parasitoids were supplied to sericulturists for releasing in papaya mealybug infested mulberry gardens.
- Databases pertaining to soil information, mulberry genome, important genes of mulberry, silk proteins, silkworm transcription factors were maintained and updated.
- A cocoon harvester for harvesting of cocoons from plastic collapsible mountages was designed and fabricated. The machine can harvest cocoons from one mountage within 4-5 seconds and defloss them simultaneously.
- A Mechanized silkworm rearing bed for late age silkworm rearing was developed.
- A high capacity leaf chopper, which can chop 500-600 kg leaf per hour suitable for commercial chawki centers was designed and developed.
- A modified reeling technology package was developed for effective reeling of L14 x CSR2 cocoons.
- During the year, 6,015 farmers, 2,115 trainees, 293 students visited the institute.
- A workshop on *Development of Sericulture in Northern Karnataka* was conducted at Bagalakote in co-ordination with Department of Sericulture Government of Karnataka, and Zilla Panchayath, Bagalakote. Over 1500 participated actively in the workshop.
- Under the Cluster Promotion Programme, a total of 103 clusters were identified (Karnataka-46, Tamil Nadu-28, Andhra Pradesh-17, Maharashtra-9, Kerala-2, Madhya Pradesh-1). A total of 173 cluster chairpersons and cluster development facilitators (CDF) were trained.
- Under the National flagship programme of Integrated Skill Development Scheme (ISDS) of Govt. of India, 151 persons were trained in four different entrepreneurial opportunites.
- A total number of 4501 persons were trained under structured and need based programmes at CSR&TI, Mysore and its nested units. One international training programme on silkworm breeding was also conducted for two Mexican scientists.
- Over 800 extension communication programmes were conducted by the institute and its nested units, sensitizing more than 26,000 stakeholders on improved technologies and management strategies.

- On Farm Trials were conducted by the Regional stations, RECs and Sub-units on Integrated Nuntrient Management, Poshan for mitigating nutritional deficiencies in mulberry, Navinya for management of root rot in mulberry, IPM against pests of silkworm and mulberry, New silkworm hybrids, composting technology, production of colour cocoons, RC1, RC2 and G2 mulberry varieties.
- The regional station at Salem continued to be a Centre for Higher Studies in Botany and Sericulture under Periyar University, Salem. Four M.A. and M.Sc., students of Periyar University were guided in their dissertation work.
- Under the official language implementation, a technical workshop on "Development of mulberry sericulture with new technologies" was organized at the institute. On the occasion, *Resham Krishi Margadarshika*, Hindi version of *A field guide on sericulture* was released.
- The Institute was awarded with a citation for outstanding performance in implementation of Official Language policy by the Central Silk Board.
- Regional Sericultural Research Station, Salem, won the second prize under Rolling Shield Scheme of the Town Official Language Implementing Committee, Salem.
- A total of 211 publications including 34 research papers, 25 popular articles were published in the Journals of National and International repute. In addition, 3 books, 2 booklets, 2 Booklet/Technical bulletins, 1 Technical report, 86 News/reports/silk briefs, 40 extension manuals/brochures/pamphlets were also published. Ten Papers were presented in seminar/workshop/ conferences.
- Three issues of Indian Journal of Sericulture, two issues of Seridoc, one Resham Kiran (Hindi) and one Resheme vahini (Kannada) were also published, in addition to the annual report for 2011-12.

Highlights of achievements under critical components of Results Framework Document (RFD) 2012-13

No.	Action	Unit	Target	Achmnt.	% Achmnt.
1	Projects initiated	No.	09	14	155
2	Projects concluded	No.	05	07	140
3	Improved Bivoltine hybrids developed	No.	02	02	100
4	Improved 3rd generation hybrids developed	No.	02	02	100
5	Bio-control agents supplied	No.	1750	3937	225
6	Package for silkworm rearing developed	No.	01	01	100
7	Stakeholders sensitized	No.	8000	26339	329
8	Bivoltine dfls supplied	Lakhs	4.0	34.13	853
9	Cocoon yield/100 dfls	kg	60.0	66.55	110.9
10	Forewarnings of diseases and pests issued	No.	11	26	236
11	Stakeholders trained under ISDS	No.	150	151	100
12	Stakeholders trained under other programmes	No.	4000	4501	112

III. LIST OF RESEARCH PROJECTS AND PROGRAMMES

Institute/RSRS	Ongoing		Concluded		Total		Grand total
	Project	Prog.	Project	Prog.	Project	Prog.	
CSR&TI	19	24	04	10	23	34	57
RSRS	01	09	00	00	01	09	10
Total	**20**	**33**	**04**	**10**	**24**	**43**	**67**

Sl. No.	Project Code	Project Title
HOST PLANT IMPROVEMENT		
1	PIB 3268	Development of superior mulberry varieties suitable for moisture stress environments (Phase-II) (Apr. 2002 to Mar. 2014)
2	PIB 3370	Development of superior mulberry varieties by exploitation of hybrid vigour based molecular diversity of promising parental lines (Apr. 2006 to Aug. 2013)
3	PIB 3457	Development of diseases resistance and productive mulberry genotypes with special reference to root rot and root knot diseases suitable for seri-zones of South India (Jan. 2012 to Dec. 2017)
4	PIE 3451	DNA marker aided analysis of mulberry gene bank towards a core assembly for sustainable conservation and enhanced utilization in crop improvement. (in collaboration with CSGRC, Hosur) (Oct. 2010 Sep. 2013)
5	Pilot study	Development of double haploids through *in vitro* technique for mulberry crop improvement (Apr. 2011 to Mar. 2013) [CONCLUDED]
6	AICEM	All India Coordinated Experiment on Mulberry (2011-2015)
7	MIP(A) 5001	Evaluation of elite mulberry varieties under semi arid agro climatic condition (Aug. 2010 to Mar. 2014) (RSRS, Anantapur)
HOST PLANT CROP PRODUCTION		
8	PIN 3442	Studies on the factors influencing the nutrient uptake and its use efficiency in mulberry under field conditions (Jul. 2010 to Jun. 2013)
9	PPA 3420	Studies on the comparative yield potentiality of promising mulberry varieties under different sources of organic and inorganic nutrients (Jan. 2008 to Dec. 2012) [CONCLUDED].
10	PPF 3500	Development of seri-lac culture model for income augmentation (Jun. 2012 to Dec. 2016) (RSRS, Chamarajanagara)
11	MPR 0047	Effect of conjunctive use of nitrification inhibitors for the efficient utilization of nitrogenous fertilizers for the sustainable mulberry production (Oct. 2012 to Sep. 2014)
12	PPS 3160	Maintenance of the long term manurial plot (Continuous)
13	MPR 0005	Monitoring of soil fertility status of mulberry gardens and creation of data base (Continuous)
14	CSS(A) 2105	Monitoring of soil fertility status in sericultural areas of Andhra Pradesh to improve soil health and nutrient management for enhancing quality of mulberry leaf and cocoon production (Continuous) [RSRS, Anantapur]

Sl. No.	Project Code	Project Title
15	CSS(K)2105	Monitoring of soil fertility status in sericultural areas of Karnataka to improve soil health and nutrient management for enhancing quality of mulberry leaf and cocoon production (Continuous) [RSRS, Kodathi]
16	CSS(S) 2105	Studies on soil fertility status in different sericulture areas in Tamil Nadu to improve soil health and nutrient management (Sep. 2010 to May 2013) (RSRS, Salem)
17	MPT(S) 8002	Studies on Rhizosphere microflora of mulberry varieties as influenced by different cultivation practices under alkaline soil conditions (Jul. 2010 to Jun. 2013) (RSRS, Salem)
18	MPR(S) 8003	Effect of shoot harvest techniques and biomass yield of mulberry on soil organic carbon depletion in mulberry fields (Jul. 2010 to Jun. 2013) (RSRS, Salem)
HOST PLANT CROP PROTECTION		
19	PRP 3462	Biological control of root rot disease of mulberry by endophytic bacteria *Burkholderia cepacia* and *Bacillus subtilis* strains (Nov. 2010 to Nov. 2013)
20	PRE 3486	Development of database for mulberry diseases (Aug. 2012 to Jul. 2014)
21	MPT 0046	Long-term effect of mulberry cropping system on soil biology and productivity (Jul. 2011 to Jun. 2014)
22	MPT 0040	Development of bio-nematicide for management of mulberry root-knot disease (Jan. 2012 to Dec. 2012) [CONCLUDED]
SILKWORM CROP IMPROVEMENT		
23	AIT 3445	Development of robust bivoltine hybrids of silkworm *Bombyx mori* L. tolerant to high temperature environment of the tropics through DNA marker assisted selection (Jan. 2011 to Dec. 2015)
24	MOE 3463	Popularization of the productive bivoltine silkworm double hybrid Krishnaraja with the farmers of Karnataka (Oct. 2011 to Sep. 2013)
25	AIB 3456	Development of productive polyvoltine breeds of silkworm *Bombyx mori* L. tolerant to high temperature and BmNPV (Oct. 2011 to Sep. 2016)
26	AIB 3498	Popularization of authorized silkworm hybrids among the farmers of South India (Nov. 2012 to Oct. 2014)
27	AIB 3476	Development of productive NPV tolerant BV breeds / hybrids carrying BmNOX marker assisted selection (Apr. 2012 to Mar. 2015)
28	AIB 3488	Pre-authorisation field trials of L14 x CSR2: A polyvoltine x bivoltine hybrid with superior fibre quality (Apr. 2012 to Mar. 2014)
29	AIB 3437	Studies on hybrid evaluation and identification of new polyvoltine x bivoltine hybrids of the silkworm *Bombyx mori* L. (Jan. 2010 to Dec. 2012) [CONCLUDED]
30	AIG 3438	Evaluation and on-farm trials of single and double hybrids with high amylase activity and temperature tolerance (Aug. 2008 to Jun. 2012) [CONCLUDED]
31	AIP 3478	Correlation studies on mulberry leaf and larval nutrition parameters to improve silk and egg productivity in silkworm *Bombyx mori* L. (Apr. 2012 to Mar. 2015)
32	SIM 0006	Maintenance of bivoltine silkworm races (Continuous)
33	SIM 0008	Evaluation of three way cross hybrids for commercial exploitation (Aug. 2010 to Sep. 2014)

Sl. No.	Project Code	Project Title
34	SIM 0009	Maintenance of polyvoltine silkworm breeds (Continuous)
35	SIM 0011	Maintenance of breeds developed through amylase marker assisted selection, NPV tolerance and morphological mutant stocks (Jan. 2010 to Jan. 2015)
36	SIM 0012	Inheritance analysis of bimodal emergence pattern in Pure Mysore and its introgression into evolved polyvoltine breeds (Jan. 2010- Mar. 2013) [CONCLUDED]
37	SIM 0015	Bivoltine silkworm race maintenance and multiplication (Continuous) (P4, BSF, Hassan)
38	SIM 0016	Maintenance of bivoltine breeder's stock of germplasm (Continous) (SSBS, Coonoor)
39	SIM 0017	Bivoltine shuttle breeding for development of silkworms with better plasticity (Continuous) (SSBS, Coonoor)
40	SIM 0018	Multiplication of productive and new bivoltine races, generation of seed cocoons and preparation of DFLs (Continous) (SSBS, Coonoor)
41	SPR 0013	Maintenance of bivoltine and multivoltine semi synthetic diet silkworm strains for original breed characters (Jul. 2009 to Jan. 2019)
42	SIM 0037	Evaluation of post-cocoon parameters of cocoons generated from CSRTI, Mysore and its nested units (Jan. 2012 to Dec.2013)
43	SIM 0038	Studies to determine the reeling process parameters for the new multi × bivoltine hybrids (Apr. 2012 to Mar. 2013) [CONCLUDED]
SILKWORM CROP PRODUCTION		
44	SPR 0019	Large scale in-house evaluation of new silkworm hybrids (Continuous)
45	SPR 0041	Large scale multiplication of new multivoltine and bivoltine breeds (Apr. 2012 to Nov. 2013)
46	SIM 0043	Studies on reproductive efficiency of newly evolved multivoltine and bivoltine breeds of silkworm *Bombyx mori* and egg production (Apr. 2012 to Mar. 2014)
47	SPR 0044	Development of silkworm rearing package for newly developed hybrids (Apr. 2012 to Nov. 2013)
48	CSS 2110	Field evaluation of colour cocoon production and thin denier silk, conversion to yarn and fabric for commercial use. (Oct. 2011 to Dec. 2012) [CONCLUDED]
49	SPR 0034B	Application of silver and nanoparticles to understand *modus operandi* of natural colour pigment in silkworm (Oct. 2011 to Sep. 2012) [CONCLUDED]
50	SPR 0035	Regenerated silk fibroin and its application in producing film and electrospun silk mats (Oct. 2011 to Sep. 2012) [CONCLUDED]
SILKWORM CROP PROTECTION		
51	ARP 3477	Therapeutic control of Microsporidiosis in the silkworm through characterization of Methionine Amino Peptidase enzyme genes (MetAP2) in *Nosema bombycis* (Apr. 2012 to Mar. 2015)
52	PPE 3455	Habitat studies-impact of crop diversity on conservation and performance of parasitoids and predators in mulberry crop system (Sep. 2011 to Aug. 2014)
53	PRE 3467	Evaluation of available management strategies for Giant African Snail (*Achanta fulica*) in mulberry ecosystem (Oct. 2011 to Oct. 2013)

Sl. No.	Project Code	Project Title
54	SPT 0024	Maintenance of silkworm pathogens and testing their virulance of periodic intervals (Jul. 2010 to Jun. 2013)
55	SPT 0039	Identification of factors responsible for silkworm crop loss due to diseases at field level and its impact on cocoon productivity (Jul. 2012 to Dec. 2014)
56	SPT 0045A	Identification of probiotic bacteria from the mulberry silkworm and study their antibacterial activity against the bacterial pathogen, silkworm *Bombyx mori*. (Oct. 2012 to Mar. 2014)
57	CSS 2107	Forewarning and forecasting of mulberry and silkworm pests (Continuous)
58	SPT 0014	Maintenance of mother culture for production of recommended biocontrol agents and mass release of recommended biocontrol agents of sericultural pests in CSRTI campus (Continuous)
59	SPR 0034A	Application of silver and nanoparticles to contol bacterial disease in silkworm. (Sep. 2011 to Aug. 2012) [CONCLUDED]
60	SPR 0036	Investigations on the elimination of new microsporidian infection (NIK-7Bm) from initially infected population of silkworm, *Bombyx mori* L. through successive generations (Oct. 2011 to Sept. 2012) [CONCLUDED]
OTHERS		
61	AIB 3449	Studies on the development of indigenous method for culturing *Cordyceps* and other useful species (Oct. 2010 to Sep. 2013)
SERICULTURE EXTENSION, ECONOMICS & MANAGEMENT		
62	MOE 3461	Assessment of women participation and time spent on different sericulture activities in three southern states (Apr. 2012 to Mar. 2013) [CONCLUDED]
63	MOE 3458	A study on adoption of pest and disease management strategies in sericulture (Oct.2012 to Mar.2014)
64	SEM(S) 8001	Studies on adoption of silkworm disease control measures and its impact on cocoon production in farmers' field under Tamil Nadu conditions (Jun. 2010 to Jun. 2013) (RSRS, Salem)
65	SEM(S) 8004	Studies on the adoption and impact of mulberry and silkworm pest management technologies (IPM) by the sericulturists in Tamil Nadu (Jul. 2010 to Jun. 2013) (RSRS, Salem)
66	SEM(S) 8006	A study on the adoption of recommended package of practices followed by sericulturists of different farm size in Tamil Nadu (Jul. 2010 to Jun. 2013) (RSRS, Salem)
67	Pilot study	A study on performance of bio-control agent multiplication units and seri-poly clinics established under catalytic development programme in sericulture clusters in Andhra Pradesh and Tamil Nadu (Nov. 2011 to Oct. 2012) [CONCLUDED]

IV. CONCLUDED RESEARCH PROJECTS/PROGRAMMES

1. HOST PLANT IMPROVEMENT

1.1 Development of doubled haploids through *in vitro* technique for mulberry improvement (Pilot study)

M. K. Raghunath (PI) and S. Gandhi Doss (from 01.04.2012)

Duration: Apr. 2011 to Mar. 2013

Budget: Rs. 1.40 lakhs

Objective: To standardize a protocol for *in vitro* induction of gynogenic haploids through unfertilized ovary cultures

Methodology

Seed cuttings of 5 mulberry genotypes (G4, Local female, K2, Punjab local and S36) were planted in nursery to raise the saplings, which were then planted in field as per recommended package of practices and maintained. The plants were pruned and female catkins after initiation were bagged to protect from chance pollination. The female catkins were collected after 3-4 weeks and were cultured along with *in vitro* catkins (ovaries) induced in nodal explant cultures on Murashige & Skoog (MS) and modified MS media supplemented with various growth hormones, either singly or in combinations of glycine and proline to induce gynogenesis. The shoots of gynogenic plants were subcultured on elongation media to attain shoot elongation. Gynogenic shoots along with control plants were tested for rhizogenesis.

Observations/ Results

The sprouting of nodal explants in the 5 test genotypes varied from 65-80% and *in vitro* flowering was observed to range from 20 to 40% (Table 1.1). A range of 40-60% callus formation was observed from ovary cultures. However, these calli when sub-cultured on different regeneration media, failed to regenerate. Meanwhile, the cultured unfertilized ovaries (catkins) of 4 selected genotypes showed positive response of direct regeneration (Table 1.2). Thus, a repeatable protocol for obtaining direct shoot regeneration (gynogenesis) using unfertilized ovaries was standardized for the genotypes *viz*., Punjab local, S36, K2 and local female. However, the regenerated shoots that originated from unfertilized ovaries were slender/ clumpy and exhibited slow growth.

Attempts were made to induce rhizogenesis by exploiting *in vitro* gynogenic shoots (*viz*., S36, Punjab local, K2 and local female genotypes) along with respective control on different rooting media. Rooting was observed only up to 5 % in gynogenic plants. Whereas, 60-75 % root induction was observed in control. The well-rooted plants were transferred to hardening.

Table 1.1: *In vitro* induction of female flowers from nodal explant cultures

Genotype	No. of nodal explants cultured	Percentage of shoot induction	Percentage of female flowers induction
Punjab Local	1560	75.00±07.64	40.00±03.38
Local female	2124	65.00±13.73	40.00±01.66
G4	1415	70.00±08.76	20.00±02.51
S36	1846	65.00±11.40	40.00±03.38
K2	2879	80.00±07.32	35.00±11.24

Table 1.2: Gynogenic response in selected genotypes

Genotype	No. of unfertilized ovaries cultured	Percentage of callus induction	Gynogenic response
Punjab Local	4200	56.25±06.06	++
Local female	2800	45.00±02.87	++
G4	1750	40.00±09.12	--
S36	3578	60.00±13.73	++
K2	3238	59.63±01.85	++

In the present study, a repeatable protocol for obtaining direct shoot regeneration (gynogenesis) using unfertilized ovaries was standardized for the genotypes *viz.,* Punjab local, S36, K2 and local female. This is the first report to achieve haploid plants in tested mulberry genotypes. Further, ovary culture technique was used since it is easier than ovule culture.

2. HOST PLANT CROP PRODUCTION

2.1 PPA 3420: Studies on the comparative yield potentiality of promising mulberry varieties under different sources of organic and inorganic nutrients

K. Srikantaswamy (PI), Dasappa, S. Sen and B. Nagaraj

Duration: Jan. 2008 to Dec. 2012

Budget: Rs. 28.66 lakhs

Objective:

- To study the yield potentiality of promising mulberry varieties and varietal response to organic and inorganic sources of nutrients.
- To study the soil physical, chemical and biological characterstics in different soil applications
- To work out the economic feasibility of organic farming and its suitability.

Methodology

Five test varieties, *viz*., G4, S36, RC1, V1 and S13 were subjected to different treatments *viz*., application of recommended organic + inorganic fertilizer with tillage (T0: 20 MT FYM + (NPK @ 350: 140:140 kg/ha/yr), fully organic inputs (T1: 10 MT FYM + 15 MT of well decomposed sericompost + 5 MT of vermicompost + 23 kg biofertilizer + 10 MT crop residue with no tillage and inorganic fertilizer) and full chemical supplements (T2: 455 kg N: 200 kg P : 240 kg K/ha/yr) without organic input, followed by tillage.

Observations/results

Yield data of fourteen crops were recorded in respect of five test varieties under different treatments. Significant variation was recorded among the test varieties in different treatments. The leaf yield was generally high in all the test varieties in T0 during the first year compared to T1 and T2. Whereas, in the subsequent years, significantly higher leaf yield was recorded in test varieties V1, RC1 and S13 in organically grown plot (T1) when compared to other treatments (Table 2.1). The variation in leaf yield among different varieties can be attributed to the genetic potentiality of the varieties and their differential response to varied soil treatments.

Table 2.1: Pooled leaf yield data (2009-2012)

Sl. No.	Variety	Treatment	Crops		
			I year	II year	III year
1	G4	T0	8760	12929	9350
		T1	7691	12800	8854
		T2	8873	11568	9176
2	S36	T0	9667	14722	10673
		T1	8509	13614	10072
		T2	9365	12564	9167
3	RC1	T0	9983	11702	8708
		T1	8484	13883	10373
		T2	9637	12393	8115
4	V1	T0	10522	15093	11012
		T1	10178	16221	12125
		T2	10236	13099	9632
5	S13	T0	7547	13941	10014
		T1	8890	14787	10298
		T2	8820	12001	8773
	V × T	SE	205	284	193
		CD@5%	709	805	547.3
		CV%	16.5	13.5	149.6

T0: 20 MT FYM + NPK @ 350:140:140 kg/ha/yr; T1: Organic inputs-10 MT FYM + 15MT sericompost + 5 MT Vermi compost + 23 kg biofertilizer + 10 MT *in situ* composting; T2: 455 N: 200 P: 240 K kg/ha/yr (only chemical fertilizers)

Significant variation was observed with respect to chemical, physical and biological characteristics of soil. Soil pH did not vary significantly among the treatements. Soil organic carbon content was significantly high in T1 (0.85%) followed by T0 and T2 where the carbon content was 0.69%. Higher soil organic carbon content could be due to the organic inputs and greater stratrifecation of soil as the soil is undisturbed due to absence of tillage.

Phosphorus (51.00 kg/ha) and potassium (483 kg/ha) content was significantly high in organic practice (T1) as against 23.0 Kg and 283 kg in T0 and 23.55 kg and 262 kg in T1, respectively. Micronutrients content (Copper, Zinc, Iron and Manganese) did not show significant differences. The increase in macro nutrient contents in the soil can be attributed to the nutrients suspended in soil organic matter released to the soil, which helped in meeting the crop requirement.

The microbial population (fungi, actinomycetes, bacteria, azotobacter and phosphorus solubilizing microorganisms) were significantly high in organic input application with crop residue management and no-tillage. The colony forming unit of fungi population was high in T1 (30×10^6 cfu/gm of soil) followed by T0 (10.77×10^6 cfu /gm of soil) and it was minimum in T2 (5.3×10^6 cfu/gm of soil). Similar trend was recorded in bacteria, actinomycetes and PSMs.

The cost incurred for the various organic and inorganic sources of nutrients under different treatments was assessed for the maintenance of one hectare of mulberry garden. The cost towards inputs for T2 (Rs. 73,124) and T0 (Rs. 72,560) was found to be nearly five fold higher than T1 (Rs. 15,130), which clearly indicated that the organic package is cost-effective.

The high yielding varieties V1, RC1 and S13 exhibited positive response to organic practice, recording higher leaf yield when compared to recommended practice T0 (combined application of chemical and inorganic inputs). Based on the advantages observed in the present investigation with organic farming an organic package has been developed which comprises of 10 MT FYM + 15 MT of well decomposed seri-compost + 5 MT of vermicompost + 23 kg of bio fertilizer + 10 MT *in situ* composting.

3. HOST PLANT CROP PROTECTION

3.1 MPT 0040: Development of bio-nematicide for management of mulberry root knot disease (Pilot study)

D. D. Sharma (PI), B. R. Dayakar Yadav (upto Dec. 2012), V. Nishitha Naik, Pratheesh Kumar, P. M.

Duration: January 2012 to December 2012.

Budget: Rs.0.15 lakhs

Objective: To develop a target specific eco-friendly biodegradable low cost plant based formulation for management of root knot disease in mulberry.

Methodology

Six formulations were prepared from different combinations of various anti-nematicidal plants and chemicals. Preliminary screening was conducted on nematode infested potted mulberry plants (V1) and a check (nematode infested) for short-listing of treatments for field trial. The formulation was applied @ 5 g/plant around the root zone and data were collected on nematode parameters.

The short listed formulation from preliminary screening was tested along with recommended methods [Bionema (*V. chlamydosporium*) + Neem oil cake; application of neem oil cake and Carbofuran singly] for confirmation of results. A severely infested plot with more than 212 larvae/250 cc soil was selected and different treatments were imposed (Table 3.1). Ninety days after treatment, observations on plant growth, leaf yield and nematode infestation (number of galls/plant and egg masses/25 g root) were recorded.

The percent disease control and percent leaf yield increase over the control were calculated to judge the efficacy of the formulation.

Observations/results

Among the treatments, maximum disease control in terms of number of egg masses was observed in T6 (75% plant components: 25% chemicals) where reduction in egg masses was 82.8% (Table 3.1). The suppression of disease severity in rest of the treatments was significantly lesser.

Results revealed that the reduction of root knot disease in the formulation (75% herbals & 25% chemicals) was up to 81.5 % besides preventing the leaf yield loss to an extent of 20.2% over the check, which was on par with that of presently recommended method *viz.,* Bionema (*V. chlamydosporium*) + neem oil cake (disease control up to 82.8 % and preventing the leaf yield loss by 22.6%) and no significant difference was observed between the two treatments (Table 3.2).

The new formulation now named *Nimahari* was found significantly more effective in reducing the disease severity compared to application of Carbofuran (74.9%) or neem oil cake (65.5%).

Table 3.1: Effect of different formulations on suppression of root knot disease in mulberry

Treatment details	Disease severity					Leaf yield		
	Knots/ plant (No.)	Decrease (%)	Egg masses/ plant (No.)	Decrease (%)	N. Pop. /250 cc soil (No.)	Decrease (%)	kg/ha/ crop	Increase (%)
T0	127.0	-	107.0	-	206.0	-	6281	-
T1	63.5	50.0	54.5	49.0	99.4	51.7	6934	10.4
T2	50.1	60.5	44.4	58.5	77.8	62.2	7066	12.5
T3	46.5	63.3	40.4	62.2	72.3	64.9	7141	13.7
T4	38.2	69.9	33.8	68.4	60.7	70.5	7223	15.0
T5	29.5	76.7	26.2	75.5	46.7	77.3	7279	15.9
T6	21.8	82.8	19.3	81.9	33.9	83.5	7587	20.8
SE±	2.13	-	2.02	-	4.15	-	62.32	-
CD at 5%	6.30	-	5.48	-	11.21	-	169.00	-

T0=Check (pathogen load only); T1=100% plant components; T2=95% plant components: 5% chemicals; T3=90% plant components: 10% chemicals; T4=85% plant components: 15% chemicals; T5=80% plant components: 20% chemicals; T6=75% plant components: 25% chemicals.
N. Pop.: Nematode population

Table 3.2: Comparative efficacy of new formulation and recommended methods in suppression of root knot disease in mulberry

Treatment details	Disease severity						Leaf yield	
	Knots/ plant	Dec-rease (%)	Egg masses/ plant	Dec-rease (%)	N. Pop. /250 cc soil	Dec-rease (%)	kg/ha/ crop	Increase (%)
Check	139.0	-	112.0	-	212.0	-	6279	-
Nemahari	25.7	81.5	19.3	82.7	34.9	83.5	7547	20.2
Recommended methods								
Neem oil cake	47.9	65.5	37.7	66.3	69.0	67.0	7333	16.8
Carbofuran	34.8	74.9	27.2	75.7	50.4	76.2	7200	14.6
Bionema + Neem oil cake	23.9	82.8	17.9	84.0	30.3	85.7	7698	22.6
SE±	0.82	-	0.59	-	1.89	-	55.39	-
CD at 5%	2.20	-	1.60	-	5.10	-	149.5	-

N. Pop.: Nematode population

In the present study, the maximum suppression of root knot disease in T6 (*Nemahari*) may be attributed to the complementary effect of plant based components (75%) and chemicals (25%), by production of toxic substances. Similarly, the inhibitory effect of Salicylic acid, Boric acid and Copper sulphate is well documented for their influence on inducing plant disease resistance. The product minimizes the use of higher doses of chemicals and has no harmful effect on the beneficial microflora in soil.

The new formulation can be applied @ 40 kg/ha after mixing with 400 kg FYM (semi dry)/compost during intercultural operations or after pruning the plant or leaf harvest by making the trenches of up to 15 cm deep near the root zone of plant and covering with soil followed by irrigation. It controls the disease up to 81.9 % with cost benefit ratio od 1:2.2. Further, the product prevents 20% leaf yield loss. The formulation has been recommended for management of root knot disease.

4. SILKWORM CROP IMPROVEMENT

4.1 AIB 3437: Studies on hybrid evaluation and identification of new polyvoltine x bivoltine hybrids of the silkworm *Bombyx mori* L

P. Rama Mohana Rao (PI) (upto July 2012), V. Premalatha, V., P. G. Joge, Dayananda, C. Parameswara and K. P. Shivakumar

Duration: Jan. 2010 to Dec. 2012

Budget: Rs. 36.213 lakhs

Objective: Breeding, selection and evaluation of new Polyvoltine x Bivoltine silkworm hybrids for productivity and quality.

Methodology

Eleven bivoltine breeds, including two Foundation crosses, *viz*., CSR2, CSR2 (SL), CSR4, CSR6, CSR17, CSR26, CSR27, CSR50, CSR51, CSR2 x CSR27, CSR6 x CSR26 and nine polyvoltine breeds *viz*., ND7, ND5. NP1, NDV6, AGL3, AGL5, L14, L15, PM were identified as male and female components, respectively, based on their productive merits. Ninety nine hybrid combinations from crosses among 9 polyvoltines and 11 bivoltine were evaluated in the laboratory.

Observations

Out of 99 hybrid combinations, nine hybrids *viz*., ND7 x CSR4, ND7 x CSR26, ND7 x CSR27, NDV6 x CSR51, NP1 x (CSR2 x 27), AGL3 x CSR4, AGL3 x CSR17, AGL5 x CSR17, and L14 x CSR50 were short-listed based on multiple traits evaluation index.

Nine short listed hybrids were further screened in the laboratory and two improved polyvoltine x bivoltine hybrids *viz*., NDV6 x CSR51 and L14 x CSR50 were identified, which were further evaluated under large scale in-house trial and On Station Trials at three regional stations (Table 4.1 to 4.3).

Table 4.1: Performance of short listed hybrids in the laboratory

Hybrid	ERR by		Cocoon weight (g)	Shell weight (g)	Shell %	Reela-bility (%)	Fila-ment length (m)	Raw silk (%)	Neat-ness (p)
	No.	Wt. (kg)							
NDV6 x CSR51	9620	17.160	1.860	0.382	20.54	82.18	905	15.61	89
L14 x CSR50	9619	17.497	1.881	0.384	20.41	80.80	915	15.44	89
PM x CSR2	9607	14.667	1.613	0.288	17.85	83.00	713	13.32	86
CD @ 5%	NS	0.981**	0.101*	0.024**	1.02**	1.01*	98**	1.43*	0.56*

Table 4.2: Performance of short listed hybrids under large scale in-house trial

Hybrid	ERR by		Cocoon weight (g)	Shell weight (g)	Shell %	Reela-bility (%)	Fila-ment length (m)	Raw silk (%)	Neat-ness (p)
	No.	Wt. (kg)							
NDV6 x CSR51	9671	18.742	1.968	0.441	22.41	82.88	755	13.73	85
L14 x CSR50	9127	16.717	1.878	0.408	21.73	76.21	814	14.99	85
PM x CSR2	9015	16.272	1.849	0.338	18.28	77.38	710	13.83	85

Table 4.3: Performance of short listed hybrids under On Station Trials at RSRSs

Hybrid	ERR by		Cocoon weight (g)	Shell weight (g)	Shell %	Reela-bility (%)	Fila-ment length (m)	Raw silk (%)	Neat-ness (p)
	No.	Wt. (kg)							
NDV6 x CSR51	9069	14.736	1.649	0.324	19.64	84.20	954	15.89	86
L14 x CSR50	8308	13.792	1.676	0.361	20.94	85.08	926	15.77	89
PM x CSR2	9266	14.561	1.620	0.303	18.70	81.18	869	14.43	87

Judicious selection of polyvoltine (Nine) and bivoltine breeds (Eleven) as parents and evaluation of all possible polyvoltine x bivoltine hybrid combinations (99) in the laboratory helped to short list the hybrids. Evaluation of identified hybrids under large scale testing at in-house level simulating farmers' practices helped to critically analyse the potential of the newly identified cross breedss as against the existing cross breed. The higher survival (>80%) coupled with higher cocoon weight recorded in the newly identified cross breeds confirmed their superiority with regard to consistency in the expression of productivity traits. Higher values recorded for shell weight, raw silk were possibly due to the recombinant genetic background derived from the productive bivoltine parents utilized in the hybrid preparation.

Two polyvoltine x bivoltine hybrids *viz*., NDV6 x CSR51 and L14 x CSR50 were significantly superior over the existing cross breed PM x CSR2 in respect of quantitative and qualitative traits. Hence, it may be inferred that these newly identified hybrids can be further tested and popularized to increase cocoon productivity at farmers' level.

4.2 AIG 3438: Evaluation and on-farm trials of single and double hybrids with high amylase activity and temperature tolerance

S. K. Ashwath (PI), K. K. Sharmila, K. C. Mahalingappa (upto May 2010) and V. N. Sudha

Duration: Aug. 2008 to Jun. 2012

Budget: Rs. 3.50 lakhs

Objective:

- To test the efficacy of amylase activity as an additional parameter for selection of hybrids**.**
- To assess the thermo-tolerance of newly evolved bivoltine breeds, single hybrids & double hybrids developed through amylase selection and identification of thermo-tolerant hybrids.
- Field evaluation of short-listed hybrids with high amylase activity and thermo-tolerance through on-farm trials.

Methodology

Six oval lines of CSR2 (GEN1, 2N, 2C, 2D, 2S, 2M) and five dumb-bell lines of CSR4 (4P, 4C 4D, 4S, 4M) were used as parental breeds. Eleven single hybrids, eleven each of oval foundation crosses (FCs) and dumbbell FCs were raised and 42 double hybrid combinations were prepared. The digestive juice samples from the parents, single hybrids, foundation crosses and double hybrids were collected from the 3 day old larvae in 5^{th} instar. Amylase activity was assayed by incubating 10 µl of digestive juice in 0.2% starch as the substrate for 30 min. at 37°C and the reaction was stopped using 1% dinitrosalicylic acid followed by heating in boiling water for 5 min. OD values were recorded at 525 nm and the enzyme activity was expressed as mg of maltose released per ml for 30 min. Further, the parents, FCs and hybrids were subjected for the high temperature (36±1°C) and high humidity (85±5%RH) from 3^{rd} day of 5^{th} instar for 6 hours daily till spinning in SERICATRON and normal temperature and humidity (24°C±1°C and 65±5%RH) during cocooning. Rearing and reeling data of all the

batches were collected under three trials. Based on the performance short-listed single hybrids and double hybrids were evaluated at RSRS units under six trials followed by limited field trials.

Observations/ results

Among the single hybrids, highest amylase activity of 240.5 mg/ml was recorded in 2C x 4S followed by 2M x 4S (210.8), while the control hybrid, CSR2 x CSR4 revealed significantly low activity of 48.1 mg/ml (Table 4.4). At high temperature (36°C) and high humidity (85% R.H), 2C x 4S and 2C x 4C recorded the highest pupation of 59.30%, when compared to 35.4% in the control CSR2 x CSR4.

Table 4.4: Amylase activity and pupation rate in single hybrids under high temperature (36°C) and high humidity (85%)

Hybrid	Pupation at 25°C (%)	Cocoon weight (g)	Shell weight (g)	Shell (%)	Amylase activity (mg/ml)	Pupation at 36°C (%)
GEN1 x 4C	84.4	1.695	0.384	22.6	138.1	40.0
GEN1xCSR4	86.1	1.675	0371	22.2	95.7	49.0
2C x 4C	88.1	1.562	0.346	22.2	159.3	59.3
2C x 4S	84.9	1.647	0.366	22.2	240.5	59.3
2D x 4C	85.9	1.697	0.385	22.7	174.6	49.0
2D x 4D	84.2	1.538	0.349	22.7	204.0	35.5
2S x 4C	84.1	1.595	0.349	21.9	181.5	49.3
2S x 4S	83.5	1.560	0.337	21.6	209.3	42.7
2M x 4D	82.8	1.549	0.340	22.0	149.1	51.3
2M x 4S	82.8	1.553	0.344	22.2	210.8	50.0
GEN3 x GEN2	85.5	1.647	0.366	22.2	193.3	47.0
CSR2 x CSR4 (Ctrl)	78.5	1.589	0.344	21.6	48.1	35.4
Mean	84.2	1.609	0.357	22.2	167.0	47.3
SD	2.35	0.060	0.017	0.37	53.8	7.9
CV%	2.79	3.72	4.73	1.67	32.2	16.7

Among the double hybrids (Table 4.5), highest amylase activity (mg/ml) of 169.3 was recorded in G11 x G19 followed by G12 x G23 (146.5). In respect of thermo-tolerance, highest pupation rate was observed in G11 x G23 (60.3%) followed by G11 x G19 (58.3%). Two hybrids 2C x4S and G11x G19 were identified based on laboratory evaluation and shortlisted for on station trials (OST).

The short listed hybrids along with controls were evaluated at RSRS units of Anantapur, Chamarajanagara, Kodathi and Salem for six trials from 2010-2012. In general, the cocoon traits did not show significant differences between the test hybrids and controls. With regard to survival, single hybrid, 2C x 4S showed marginal improvement over the control at Anantapur, Salem and Kodathi, whereas at Chamarajanagara, 28% improvement was recorded. In case of double hybrid G11 x G19, 71% higher survival than the control was observed at Chamarajanagara, while it was 18% and 16% at Anantapur and Salem, respectively and there was marginal improvement at Kodathi. Further, limited field testing was conducted through REC, Madivala by distributing 1120 dfls of 2C x 4S and 1700 dfls of G11 x G19. Single hybrid 2C x 4S recorded a yield of 66.9 kg/100 dfls while 70 kg/100 dfls was realised from double hybrid, G11 x G19.

Table 4.5: Amylase activity and pupation rate in the top ranking double hybrids under high temperature (36°C) and high humidity (85%)

Double Hybrid	Pupation at 25°C (%)	Cocoon weight (g)	Shell weight (g)	Shell (%)	Amylase activity (mg/ml)	Pupation at 36°C (%)
G11 x G18	85.2	1.559	0.327	21.0	87.3	55.0
G11 x G19	82.9	1.639	0.340	21.0	169.3	58.3
G11 x G23	84.9	1.632	0.359	22.0	92.8	60.3
G12 x G18	80.0	1.725	0.363	21.1	135.6	40.3
G12 x G19	84.4	1.687	0.335	20.8	114.9	53.7
G12 x G20	88.7	1.667	0.335	21.0	125.7	45.7
G12 x G23	88.7	1.850	0.387	21.0	146.5	53.7
G13 x G18	80.4	1.762	0.370	21.0	93.1	57.3
G13 x G20	88.5	1.630	0.350	21.5	109.0	49.3
G15 x G23	90.4	1.772	0.360	20.3	110.3	47.7
FC1 x FC2 (Control)	81.2	1.714	0.358	20.9	80.1	20.7
Mean	82.6	1.661	0.348	21.0	104.8	44.4
SD	9.5	0.20	0.04	0.69	30.6	11.1
CV(%)	11.5	12.0	12.5	3.3	29.2	25.1

The selected hybrids have shown their superiority over the controls in terms of higher survival in OSTs. An yield of 67-70 kg/100 dfls has been realized. Due to the presence of high activity amylase genes and also temperature tolerance, the selected hybrids can assure yield stability under sub-optimal conditions of leaf quality and rearing management, thereby raising the yield status and returns of the small and marginal farmers leading to increased bivoltine silk production in India.

4.3 SIM 0012: Inheritance analysis of bimodal emergence pattern in Pure Mysore and its introgression into evolved polyvoltine breeds

V. N. Sudha (PI), K. K. Sharmila, S. K. Ashwath and S. Nirmal Kumar

Duration: Jan. 2010 to Mar. 2013

Budget: Rs. 0.20 lakhs

Objective:
- Inheritance analyis of bimodal emergence pattern in Pure Mysore (PM).
- Introgression of bimodal emergence trait into the evolved bivoltine breeds.

Methodology

Seven backcrosses were effected and selfing was resorted to for 6 generations. Four lines were observed for moth emergence pattern closer to PM. Five cellular replications were kept for each line, layings were prepared in each bed. The bed with higher number of male and female moths emerging at II gate (4.15 to 5.30 am) was selected for continuation of the study. The same procedure was followed for six generations. The data of 5 replications were pooled for each line for six generations.

Observations/results

The lines ND7 × (PM × ND7) and its reciprocal (PM × ND7) × ND7 showed the trend of PM emergence with slight decline of 2 % in S5 and S6 generations of the females of former and at S2 of the latter. The increase of female emergence was recorded in the subsequent generations at S5 (3%) and regained at S6 (Table 4.6).

In the combination ND7 × (ND7 × PM) the decline of males at S4 (2%) and S5 (8%) was noticed. Whereas, 10.74% of the females emerged at S2 and 1.53% at S5, overall, the female emergence was on the decreasing side when compared to S1 (22.3%). The females emerged slightly less (0.86%) at S2 and S5 (4.64%) in the line (ND7 × PM) × ND7 and the male emergence recorded was 2.61% at S4 (S3-S4) and 2.85% at S5 (S4-S5). However, there was a drastic increase of females from S5 to S6 in these two combinations (3.1 to 10.79%) and (20-16%) of males. As there was no consistency of emergence in these two lines, the other two lines ND7 × (PM × ND7) and its reciprocal have been continued as the results showed the trend towards emergence pattern of PM.

Table 4.6: Emergence pattern of male and female moths in backcross S1 to S6 progeny of introgressed ND7 lines

Generation	Emergence (%)			
	ND7 x (PM x ND7)		(PM x ND7) x ND7	
	Male	Female	Male	Female
S1	10.46	11.63	14.04	20.89
S2	11.48	12.63	8.82	10.43
S3	12.96	16.33	13.58	13.71
S4	16.98	22.26	15.65	22.11
S5	15.58	20.15	17.74	19.56
S6	23.36	20.31	21.41	21.97

4.4 SIM 0038: Studies to determine the reeling process parameters for the new multi × bivoltine hybrids

Kariyappa (PI), Y. C. Radhalaksmi and K. P. Shivakumar

Duration: April 2012 to March 2013

Budget: Rs. 1.00 lakh

Objective: To study the post cocoon parameters and standardise the reeling process parameters for newly developed multi x bi hybrid

Methodology

Process parameters of stifling, cooking and reeling were planned based on the experience and literature survey and 3 kg cocoons of L14 x CSR2 hybrid were subjected to three treatments.

Stifling

T1: 110-100-90-80-70°C; T2: 115-100-85-75-65°C; T3: 115-100-85-70-55°C - each spell of one hour duration.

Cooking

T1: Cooking conditions were maintained for bivoltine cocoons as per standardised package of CSTRI Bangaluru. 1st stage of cooking at 60 to 70°C for 90s, 2nd stage of cooking at 90 to 93°C for 120s, 3rd stage of cooking at 65 to 70°C for 90s and 4th stage 96 to 97°C for 120s.

T2: I pan - Soaking at 55°C for about 45 to 60s, low permeation temperature 65 to 70°C for 45 to 60s. II Pan - High temperature permeation at 90°C for 60 to 90 seconds, cooking at 95 to 96°C for 60 to 90s, stop heating and allow the cocoons to remain for 60s, sprinkle cold water to reduce temperature to 80°C in 76 to 90s, brushing cocoons at 80°C.

T3: 1st stage cooking at 60°C for 2.5 min., 2nd stage cooking at 80°C for 2.5 min, 3rd stage cooking at 60°c for 2.5 min and 4th stage cooking at boiling for 4 min.

T4: Conditions were maintained for cooking as per reeling package developed for multivoltine cocoons. 1st stage cooking at 40°C for 2 min, 2nd stage cooking at 80°C for 2 min, 3rd stage cooking at 40°C for 2 min, 4th stage cooking at 97°C for 3 min and 5th stage cooking at 97 to 60°C and finally brushing at 60°C.

T5: Process parameters followed for bivoltine cocoons. 1st stage soaking at 50 to 55°C for 60 to 90s, 2nd stage low permeation temp 60 to 65°C for 45 to 60s, 3rd stage high temp permeation at 90 to 93°C for 90 to 120s, 4th stage cooking at 95 to 96° for 90 to 120s, 5th stage stop heating and allow the cocoons to remain for 60s and 6th stage sprinkling cold water to reduce temp to 80°C in 180 to 240s, finally brushing the cocoons at 80°C.

T6: Simple open pan cooking.

T7: Modified open pan cooking, cocoons were introduced in the open pan-cooking vessel at 85°C and pressed slightly using the pressing disc so that the cocoons were immersed in the water for about 60 seconds. Then the cocoons were again pressed to bottom of cooking vessel and treated at 90°C for about 120 seconds. The cocoons were brought back to the top of the open pan and cold water was sprinkled to reduce the temperature from 90°C to 85°C in about 60 seconds. Then the cocoons were brushed and taken for reeling.

Reeling speed

T1: 130 rpm, T2: 150 rpm T3: 180 rpm

Raw silk obtained was subjected to testing. Data were analysed statistically. Based on the reeling performance and test results, the optimum conditions for processing were identified.

Observations/results

Stifling

The study revealed that temperature regime of 115°C-100°C-85°C-70°C-55°C for one hour each (T3) gave higher reelability, filament length, non broken filament length, raw silk recovery percentage, raw silk percentage and lower renditta.

Cooking

Seven different cooking treatments tested, treatment of the modified open pan cooking (T7) was more effective and gave higher reelability, filament length, non broken filament length, raw silk recovery percentage, raw silk percentage and lower renditta.

Reeling speed

Reeling performance at reeling speed of 150 rpm gave higher reelability, filament length, non broken filament length, raw silk recovery percentage, raw silk percentage and lower renditta.

Finally the raw silk of 10 samples reeled under the comprehensive package was sent to SCTH, Bengaluru for testing and grading. The results revealed that the grade of silk produced following this package was A-2A.

5. SILKWORM CROP PRODUCTION

5.1 SPR 0035: Regenerated silk fibroin and its application in producing film and electrospun silk mats

Kanika Trivedy (PI), S. Nirmal Kumar, Anuya Nisal[1], Ashish Lele[1], B. L. V. Prasad[1] and Mugdha Gadgil[1]

[1]National Chemicals Laboratory, Pune

Duration: Oct. 2011 to Sep. 2012

Budget: Rs.1.00 lakh

Objective: To standardize the process of producing film and electrospun silk mats from regenerated silk fibroin.

Methodology

Silk fibroin is a promising biomaterial finding increasing applications in tissue engineering and drug delivery on account of their proven biocompatibility and excellent mechanical properties. Liquid silk fibroin from bivoltine cocoons was regenerated. Further, films of different concentrations were coated at different temperatures. Similarly, different concentrations of fibroin solution were used for electrospinning at different voltages and flow rates.

Observations/ results

Studies indicated that films prepared with dilute solutions (3% w/v) at room temperature have Silk I structure which is water-soluble. Higher temperatures (50°C) and concentrations (15% w/v) induced formation of Silk II crystal structure (water insoluble).

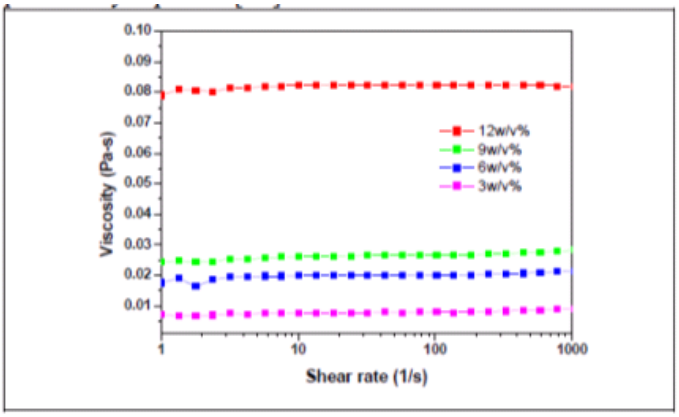

Fig. 5.1: Viscosity of electrospinning solutions of various concentrations

Electrospinning trials with different concentrations of silk solution and at different voltage were done and found that 12% w/v solutions of silk fibroin with optimized parameter of 20 kV voltage, 20 cm distance and a low flow rate of 0.2ml/hr (Fig. 5.1 & 5.2) gave the best results. The electrospun mats subjected to ammonia plasma showed increased hydrophilicity.

Further, the results demonstrated that silk fibroin solutions can be electrospun with excellent control on architecture by simply varying the silk fibroin concentration in hexfluoroisopropanol. These electrospun mats can be successfully modified by a simple layer-by-layer technique.

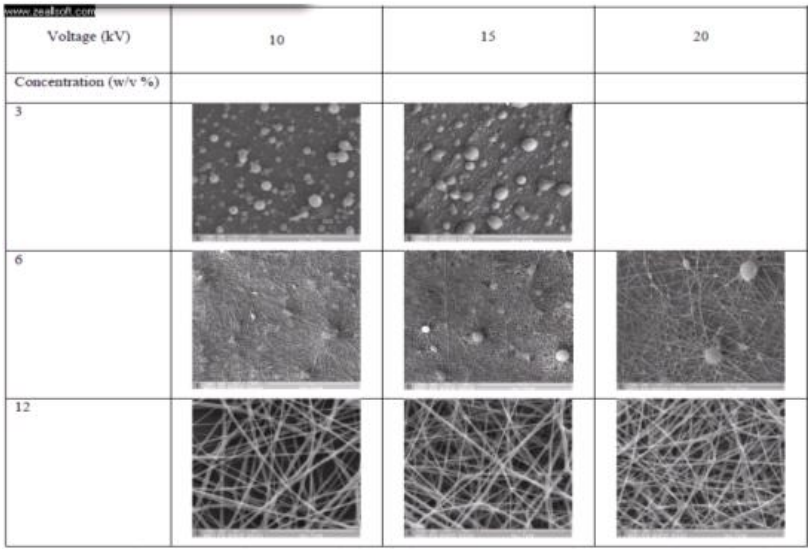

Fig. 5.2: Scanning Electron Microscopy of electrospun mats of various concentrations and voltages.

5.2 CSS 2110: Field evaluation of colour cocoon production and thin denier silk, conversion to yarn and fabric for commercial use

Kanika Trivedy (PI), M. Ramesh, Kariyappa, S. Nirmal Kumar, S. M. H. Qadri, R. Balakrishna[1], K. M. Abdul Kadhar[2], A. Basu[3], Rm. K. Sivakumar[4]

[1]Regional Sericultural Research Station, Salem, [2]Silk Conditioning and Testing House, Kancheepuram, [3]Central Silk Technological Research Institute, Bengaluru, [4]M/s. RMKV, Chennai

Duration: Oct. 2011 to Dec. 2012

Budget: Rs.1.55 lakhs

Objective:

- Large scale production of physiologically induced new natural coloured cocoons and preparation of yarn, silk fabric and garments
- Test the physical and chemical properties of naturally coloured silks

Methodology

For large scale production of 8 new physiologically induced natural coloured cocoon lots, two field trials were conducted in Tamil Nadu. Fifth instar larvae of bivoltine hybrids were used in the experiment. Concentrations of the dyes were standardized by feeding the dyes along with leaves from 4th day of 4th instar. After harvesting, cocoons were reeled and woven.

Observations/ results

In the first field trial conducted at Hosur, Tamil Nadu, 150 dfls of CSR2 x CSR4 larvae were treated with 3 different colours (K. Pink, K15 and K28) @ 50 dfls per colour. A total of 77.3 kg cocoons were harvested. Second field trial was conducted at Palakkarai village of Perundurai district, Tamil Nadu, where, 250 dfls of double hybrid Krishnaraja were treated with 5 different colours (C1-C5) @ 50 dfls per colour with 3 farmers (Fig. 5.3). A total of 191 kg colour cocoons of 5 different colours were produced.

Fig. 5.3: Coloured larvae and cocoons produced in field trials.

5.3 SPR 0034: Application of nanoparticles to control bacterial disease and to understand *modus operandi* of natural colour pigments in silkworm, *Bombyx mori* L. (in collaboration with NCL, Pune)

PART B: To understand *modus operandi* of natural colour pigments in silkworm, *Bombyx mori* L.

Kanika Trivedy (PI), S. Nirmal Kumar, M. Ramesh, Radha Lakshmi, Y. C., Sayam Sengupta[1], Mugdha Gadgil[1], Ashish Lele[1] and Anuya Nisal[1]

[1]National Chemicals Laboratory, Pune.

Duration: Oct. 2011 to Sep. 2012

Budget: Rs. 0.75 lakh

Objective: To understand relationship between chemical structure of dye, its absorption into the biochemical pathways and emergence of colour in the silkworm cocoon.

Methodology

Experiments were conducted with 7 different colours (D1-D7). The dyes were fed to larvae of silkworm hybrid CSR2 x CSR4 during 4th to 6th day of V instar. The partition coefficient for these dyes varied systematically from -1.71 to about +0.6. These groups are hydrophilic and hence have -ve log P/P0 values.

Observations/results

The absolute hydrophilic dyes are not transported from the alimentary canal of the silkworm into the haemolymph and further into the silk gland. As the hydrophobicity of the dye increases, it can be transported from the gland to the haemolymph and then to the silk gland, which is then finally reflected in the cocoon. However, extremely hydrophobic dyes, like D7 do not go through these gateways. Thus, there is a range for hydrophilicity/hydrophobicity that enables the transport of dyes across membranes. The molecular weights greater than 450mg/mol cannot be transported across the peritoneal membrane of alimentary canal into haemolymph and hence produce white cocoons. The diffusion of the dye happens across two membranes *i.e*., alimentary canal and silk gland. Experiments proved that diffusion mechanisms across both these membranes are similar in nature.

The results revealed that molecular weight and hydrophobicity are important molecular properties governing the transport of dye from alimentary canal to heamolymph and finally to the silk gland. The results help to determine other chemical structure parameters that will govern transport of dye molecule through biochemical pathways in silkworm and to design and identify newer molecules that will produce color silk.

6. SILKWORM CROP PROTECTION

6.1 SPR 0034: Application of nanoparticles to control bacterial disease and to understand *modus operandi* of natural colour pigments in silkworm, *Bombyx mori* L. (in collaboration with NCL, Pune)

PART A: Application of silver and magnesium oxide nanoparticles as bactericidal agents for the management of bacterial diseases in silkworm.

M. Balavenkatasubbaiah (PI), M. Muniratnam Reddy and B. L. V. Prasad[1]

[1]National Chemicals Laboratory, Pune

Duration: Sep. 2011 to Aug. 2012

Budget: Rs. 0.30 lakh

Objective:

- Testing the efficacy of nanoparticles for their anti-bacterial activity against the bacterial pathogens of silkworm.
- To surface modify the silver and MgO nanoparticles appropriately so that stable dispersions of the same could be prepared and used as spray during silkworm rearing for management of bacterial diseases of silkworm.

Methodology

Nano particles of silver (50, 125 and 250 ppm) and MgO (500 and 1000 ppm) were tested for their toxicity to silkworm through bioassay.They were also tested for their anti-bacterial activity against *Streptococcus* sp., *Staphylococcus* sp. and *Bacillus thuringiensis* through bioassay. The surface modified Silver (50, 100 and 200 ppm) and MgO (500 and 1000 ppm) nanoparticles were tested for the suppression of bacterial flacherie caused by different bacteria *viz*., *Streptococcus* sp., *Staphylococcus* sp. and *Bacillus thuringiensis* through bioassay.

Observations/Results

The silver (50, 125 and 250 ppm) and MgO Nanoparticles (500 and 1000 ppm) were found non-toxic to silkworms. These concentrations of Silver and MgO nanoparticles were found effective in suppression of flacherie disease caused by different bacterial pathogens of silkworm.

Surface modified Silver (50-200 ppm) and MgO (500-1000 ppm) Nanoparticles were found effective in suppression flacherie disease (40.00 to 62.00%) caused by different bacterial pathogens of silkworm (Table 6.1–6.4). These concentrations were found non-toxic to silkworm and there was no adverse effect on silkworm larval health and cocoon characters. If the production of nanoparticles economically feasible with no societal implications, the technology can be developed, verified in-house and large scale for its usage in sericulture for management of diseases.

Table 6.1: Efficacy of Nanoparticles against *Streptococcus* sp. infecting silkworms

Sl. No.	Treatment*	Larval mortality (%)	% disease reduction over Control
1	*Streptococcus* sp + Ag Nano - 50 ppm	21.67	48.40
2	*Streptococcus* sp + Ag Nano - 100 ppm	19.67	53.17
3	*Streptococcus* sp + Ag Nano - 200 ppm	18.00	57.14
4	*Streptococcus* sp + MgO - 500 ppm	19.33	53.98
5	*Streptococcus* sp + MgO - 1000 ppm	16.00	61.91
6	Inoculated Control	42.00	-
	C.D. at 5%	3.195	-

*No. of larvae = 100/treatment

Table 6.2: Efficacy of Nanoparticles against *Staphylococcus* sp. infecting silkworms

Sl. No.	Treatment*	Larval mortality (%)	% disease reduction over Ino. Control
1	*Staphylococcus* sp. + Ag Nano-50 ppm	19.33	46.79
2	*Staphylococcus* sp. + Ag Nano-100 ppm	17.00	53.21
3	*Staphylococcus* sp. + Ag Nano-200 ppm	14.33	60.56
4	*Staphylococcus* sp. + MgO-500 ppm	16.67	54.12
5	*Staphylococcus* sp. + MgO-1000 ppm	13.67	62.37
6	Inoculated Control	36.33	-
	C.D. at 5%	2.783	-

*No. of larvae = 100/treatment

Table 6.3: Efficacy of Nanoparticles against *B. thuringiensis* sp. infecting silkworms

Sl. No.	Treatment*	Larval mortality (%)	% disease reduction over Ino. Control
1	*B. thuringiensis* + Ag Nano-50 ppm	51.00	40.70
2	*B. thuringiensis* + Ag Nano-100 ppm	46.33	45.13
3	*B. thuringiensis* + Ag Nano-200 ppm	41.33	51.94
4	*B. thuringiensis* + MgO Nano- 500 ppm	44.67	48.06
5	*B. thuringiensis* + MgO Nano-1000ppm	39.33	54.27
6	Inoculated Control	86.00	
	C.D. at 5%	3.936	-

*No. of larvae = 100/treatment

Table 6.4: Effect of Silver and MgO Nanoaparticles on survival and cocoon characters

Sl. No.	Treatment*	Survival (%)	Single Cocoon wt. (g)	Single Shell wt.(g)	Silk percentage
1	Ag Nano- 50 ppm	90.67	1.561	0.358	22.93
2	Ag Nano-100 ppm	94.33	1.629	0.366	22.49
3	Ag Nano-200 ppm	93.67	1.753	0.375	21.40
4	MgO Nano-500 ppm	93.00	1.649	0.373	22.63
5	MgO Nano-1000 ppm	92.00	1.601	0.365	22.85
6	Normal Control	87.00	1.603	0.355	22.14
	C.D. at 5%	3.040	0.021	0.011	0.560

*No. of larvae = 100/treatment

6.2 SPR 0036: Investigations on the elimination of new microsporidian infection (NIK-7Bm) from initially infected population of silkworm, *Bombyx mori* L. through successive generations

M. Balavenkatasubbaiah (PI) and S. D. Sharma

Duration: Oct. 2011 to Sep. 2012

Budget: Rs. 0.50 lakhs

Objective:

- Elimination of new microsporidian infection through five successive generations from the initially infected batch.
- To study the susceptibility status of different commercially important silkworm breeds/ hybrids against new microsporidian infection.

Methodology

Spores of new microsporidian were multiplied and purified following procedure described by Sato (1980). In the first generation, silkworm larvae were per orally inoculated with new microsporidian spores after II moult (1×10^6 spores/ml/100 larvae) and the rearing was conducted till cocooning. The female moths were allowed to lay eggs. The eggs laid by infection free moths were selected for next generation rearing. The subsequent generations were reared without any inoculation of microsporidian and following the elimination process. To study the susceptibility status of 21 different commercially important silkworm breeds/hybrids, they were inoculated with spores of new microspordian after II moult (1×10^6 spores/ml/100 larvae) and data on infection during larval, pupal and moth stages were recorded.

Observations/ results

Low mortality (1.40%) was recorded during larval and pupal stages. Mortality was 80.00% during moth stage. In the 2nd generation, where microsporidian free layings were reared, 13.60 % infection was recorded in moth stage with no larval and pupal mortality. In the 3rd, 4th and 5th generations where microsporidian free layings were reared, there was no microsporidian infection in all the three stages (Table 6.5).

Evaluation of commercially important silkworm breeds/hybrids *viz*., CSR2, CSR4, CSR6, CSR26, CSR27, CSR50, CSR51, CSR2 × CSR4, CSR4 × CSR2, CSR50×CSR51, FC1 × FC2 against the new microsporidian infection revealed that all the tested breeds/hybrids were found susceptible. The percentage of infection at the moth stage ranged from 63.7 to 71.7, while the total infection was found to the 69.7 to 78.2%. Compared to bivoltine breeds, multivoltine breeds and hybrids, *viz*., PM, Nistari ,NDV6, NP1, BL67, L14, ND5, PM × CSR2, L14 × CSR2, ND7 × CSR2 were found relatively less susceptible. The percentage of infection at moth stage ranged from 56.6 to 63.3 and the total infection varied from 62 to 69%.

The results of the present study indicated that the new microspordian isolated from the rearings is less pathogenic to silkworm as very low mortality (1.40%) was recorded during larval and pupal stages when silkworms were inoculated with microsporidian spores after II moult. The results also indicated that this

microspordian infection could be eliminated in 3 successive generations if individual moth examination is done as recommended and layings of microsporidian free moths are selected for next generation.

Table 6.5: Impact of new microsporidian infection on larval health and infection in successive generations

Generation	Survival %	Mortality			% infection in moth stage
		Larva	Pupa	Total	
1st	91.00	0.80	0.60	1.40	80.00
2nd	92.00	0.00	0.00	0.00	13.60
3rd	91.00	0.00	0.00	0.00	13.60
4th	90.00	0.00	0.00	0.00	13.60
5th	92.00	0.00	0.00	0.00	13.60

7. SERICULTURE EXTENSION, ECONOMICS AND MANAGEMENT

7.1 MOE 3461: Assessment of women participation and time spent on different sericulture activities in three southern states

G. S. Geetha (PI), M. Rekha, G. Punithavathy[1], P. K. Ambika[2] and M. Raghupathi[3]

[1]Research Extension Centre, Udumalpet, [2]Regional Sericultural Research Station, Kodathi, [3]Regional Sericultural Research Station, Anantapur

Duration: Apr. 2012 to Mar. 2013

Budget: Rs. 1.50 lakhs

Objective:

- To understand the socio-economic status of women involved in sericulture activities.
- To examine the extent of participation of women in economic activities through different aspects of sericulture employment.
- To quantify time spent on different tasks done by women.
- To identify socio-economic constraints faced by women.

Methodology

The study was conducted in Kolar (Karnataka), Anantapur (Andhra Pradesh) and Dindugul (Tamil Nadu). Multi stage random sampling method was adopted for selection of sample. Two taluks from each district were selected randomly for the purpose of eliciting primary data. Within these two taluks, four villages, two in each taluk were selected for generation of data from 360 women.

Observations/results

The study indicated that, majority of the sericulture women were in the middle-aged category (35-45 yrs) with a sericulture experience of about 10 years and family size of 3-5 members. All the farmers were married (100%), with no schooling (36%) and belonged to backward classes (72%).

Participation of women was 48.38% in mulberry cultivation (on farm activities) and 74.31% in silkworm rearing. The main on farm activities carried out by women were collection of pruned sticks, shoot harvest, weeding, fertilizer application, manure application and pruning.

The silkworm rearing activities attended by women were, cleaning of rearing house, cleaning of rearing equipment, feeding of silkworm, picking of ripe worms, mounting of worms, harvesting of cocoons, deflossing of cocoons and disposal of rearing waste. The study revealed that the women spent 4.18 hours per day on

sericulture activities compared to her male counterpart who spent 3.34 hours per day. The main constrains expressed by women were, lack of family labour, inadequate access to credit, lack of technological know-how, land located at distances, lack of sericulture inputs and non-profitability of the activity.

7.2 A study on performance of bio-control agent multiplication units and seri-poly clinics established under catalytic development programme in sericulture clusters in Andhra Pradesh and Tamil Nadu (Pilot study)

B. Gangadhar (PI) and P. Kumaresan

Duration: November 2011 to October 2012

Budget: Rs. 0.35 lakh

Objective:

- To evaluate the investment pattern, technical viability, financial feasibility, economic viability and analyse the capacity utilization in the biocontrol agent multiplication units and seri-poly clinics.
- To analyze the perception of the users on the service rendered and to identify constraints in the functioning of biocontrol agent multiplication units and seri-poly clinics.

Methodology

The study was conducted by collecting data using a pre-structured interview schedule. The primary data were collected from owners of seri-poly clinics and bio-control agent multiplication units of Venkatagirikota and Palamner in Andhra Pradesh and Berigai and Gobichettipalayam in Tamil Nadu. Besides, information was also collected from twenty randomly selected users of the facilities in each area for understanding their perception of the services rendered by the bio-control agent multiplication units and seri-poly clinics.

Observations/results

Before the introduction of biocontrol agents in the clusters, the pest incidence ranged from 13-15% in case of uzi fly, 11-16% in case of mealybug, 16% in case of leaf webber and 4-6% in case of thrips. After introduction of biocontrol agents in the field, the pest incidence was reduced significantly to 4-5% in case of uzi fly, 3-4% in case of mealybug, 4-5% in case of leaf webber and 1-2% in case of thrips. The productivity and production level increased to the tune of 15 to 16% in terms of leaf yield, intake of dfls (25 to 30%) and cocoon yield (60 to 70%). Hence it is concluded that the units contribute to the sustainability of sericulture.

The Seri-polyclinics successfully functioned in Andhra Pradesh and Tamil Nadu clusters. Most of the sericulturists utilized the mobile disinfection units especially the power sprayer. Majority of beneficiaries expressed that, the mobile disinfection units have made disinfection of rearing sheds effective and easy. Some opined that, the entrepreneur owning the mobile disinfection unit is well trained and possesses sound knowledge on the use of different disinfectants and is carrying out the activity efficiently. The Sericulturists requested for more such units to cover all the villages. Disease incidence in silkworm crops was reduced after introduction of the mobile disinfection units in the area and contributed to increased stability of bivoltine crops. The bivoltine rearing increased from 3,51,500 dfls in 2007-08 to 9,50,035 dfls in 2011-12. Hence, replication of this type of mobile disinfection system in other sericultural areas would be useful to improve crop stability and cocoon productivity by virtue of systematic disinfection. The crop losses were effectively reduced and the average cocoon yield levels increased from 53.6 kg to 64.0 kg after resorting to the use of mobile disinfection unit. Cocoon productivity/ha/yr increased from 1136 to 1840 kg.

V. ONGOING RESEARCH PROJECTS/PROGRAMMES

8. HOST PLANT IMPROVEMENT

8.1 PIB 3268: Development of superior mulberry varieties suitable for moisture stress environments (April 2002 to March 2014)

8.1.1 Final yield evaluation of promising hybrids under stress and non-stress environments in different locations (in collaboration with RSRS, Chamarajanagara and RSRS, Anantapur)

Mala V. Rajan (Upto Oct. 2012) (PI), M. K. Prithvi Raje Urs (PI), Rajashekar, K., Rekha, S. M. H. Qadri, M., B. Mallikarjuna[1], D. S. Chandrashekhar[1], R. Meenal[1], M. A. Shanthan Babu[2], C. Subramanya Reddy[2], Ch. Sathyanarayana Raju[2]

[1]Regional Sericultural Research Station, Chamarajanagara, [2]Regional Sericultural Research Station, Anantapur

Objective: To develop mulberry genotypes with sustainable growth and leaf yield under soil moisture stress environments

Analysis of pooled data on growth and yield of 3 years indicated that under rain-fed conditions, genotype No. 2 out yielded the check [S13] by 20.4% (Table 8.1). Experimental plots are being maintained for sourcing seed cuttings to raise saplings for On-farm trials.

Table 8.1: Leaf yield of test genotypes under moisture stress conditions

Genotype No.	Cross	Leaf yield (kg/ plant)	Improvement over the check (%)
1	BR4 x S13	0.486	-
2	BR4 x S13	0.614	20.4
3	BR4 x S13	0.497	-
4	BR4 x Matigara	0.545	06.9
5	MS6 x S34	0.443	-
6	S13 [Check]	0.510	-
	CD at 5%	0.098	-

At RSRS, Chamarajanagara, the leaf yield data of two crops under rainfed conditions revealed that genotype No.3 showed 17.23% higher leaf yield with 0.313 kg/plant when compared to check vaiety S13 (0.267 kg). Two bioassay trials were conducted with PM x CSR2 hybrids for evaluating five new mulberry genotypes, keeping V1 as control. Data indicated that among new mulberry genotypes, genotype No. 3 has shown higher ERR, yield and superior cocoon characters over other mulberry genotypes.

At RSRS, Anantapur, two crops data on leaf yield and yield attributing parameters, leaf moisture content and leaf moisture percentage were recorded and analyzed. Pooled data of 8 crops recorded since inception of the project revealed that genotype No.3 showed 35.5% higher leaf yield (0.561 kg/plant) over the check variety, S13 (0.414 kg).

8.2 PIB 3370: Development of superior mulberry varieties by exploitation of hybrid vigour based on molecular marker diversity of parental lines (Apr. 2006 to Aug. 2013)

8.2.1 Primary yield trial of selected genotypes under irrigated conditions

M. K. Prithvi Raje Urs (PI), Rajashekar, K., V. Girish Naik and Mala V. Rajan (Upto Oct. 2012)

Objective: Primary yield trial of short-listed genotypes for identification of promising mulberry varieties

Seed cuttings of fifty four short-listed genotypes from Progeny Row Trial (PRT) were planted in nursery beds for assessment of their rooting efficiency and survival. The rooting efficiency ranged between 46 and 94%. Based on higher rooting efficiency (> 75%), 16 hybrids were short-listed for Primary Yield Evaluation (Table 8.2). Saplings of the short-listed genotypes were raised in nursery beds and eight-month-old saplings were planted in RBD with 3 replications for primary yield evaluation along with the check V1.

Table 8.2: Sixteen promising genotypes short-listed from progeny row trial (PRT)

Sl. No.	Parentage	Genetic Distance	Sl. No.	Parentage	Genetic Distance
1	G2 x AR11	0.271	9	S36 x RFS135	0.247
2	G2 x AR11	0.271	10	S36 x RFS135	0.247
3	K2 x RFS135	0.227	11	S36 x RFS135	0.247
4	G4 x RFS135	0.257	12	G4 x RFS135	0.257
5	Sahana x AR11	0.252	13	G4 x RFS175	0.256
6	G4 x S13	0.250	14	G4 x RFS175	0.250
7	G4 x S13	0.250	15	RC1 x AR11	0.268
8	G4 x S13	0.250	16	G4 x S13	0.250

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

8.3.1 Screening of available resistant sources against root rot and root knot diseases under artificial inoculations.

S. Gandhi Doss (PI), Mala V. Rajan (Upto Oct. 2012), M. K. Prithvi Raje Urs, D. D. Sharma and N. B. Chowdary

Objective: To identify and select hybrids resistant to root rot and root knot diseases through hybridization, selection and evaluation in Progeny Row Trial (PRT)

Saplings of 35 selected germpalsm accessions were raised in earthen pots for artificial inoculation study. Pathogens of root rot (*Fusarium solani* & *Rhizoctonia bataticola*) were mass multiplied on Sorghum. Root knot nematode (*Meloidogyne incognita*) was mass multiplied on the roots of susceptible mulberry genotypes raised in pots. Ninety days old saplings were subjected to artificial inoculation of root rot pathogens and root knot nematode, separately, in pots. After 90 days of inoculation, disease severity was scored by sacrificing the saplings. Disease reaction against root-rot pathogens ranged from 16.13-79.12% of rotten roots among the test genotypes. Resistance reaction was recorded in Vietnam 2, *M. multicaulis*, Cuckpilla, Belidevalaya, Mysore local, MR2 and Himachal local.

Root-knot nematode infestation ranged from 10.50 to 85 knots/ 25 g of root among the test genotypes. None of the accessions showed resistant reaction while 12 accessions showed moderate resistance response.

The accessions showing resistance reaction to root rot and root knot diseases were short-listed for hybridization programme.

8.4 PIN 3442: Studies on the factors influencing the nutrient uptake and its use efficiency in mulberry under field conditions (July 2010 to June 2013)

M. G. Sabitha (PI), N. B. Chowdary and K. Vedavyasa

Objective: To study the factors affecting the uptake of nutrients by mulberry and leaf quality under field conditions.

The soil and leaf samples were collected from farmers of Channarayapattana, Sira, Kanakapura, Anekal (Karnataka), Hindupur, Madakasira, Penukonda (Andhra Pradesh) Udumalpet, Hosur, Krishnagiri and Srivilliputhur (TamilNadu) along with base data. The soil samples were analysed for physical, chemical, mineral properties of soil and the leaf samples were subjected to biochemical analysis. It was observed that increase in soil pH lead to decrease in leaf biochemical parameters whereas, increased soil organic carbon content enhanced the composition of leaf biochemical parameters (Table 8.3 to 8.6)

Table 8.3: Physical parameters of soil samples collected from farmers' gardens

State/ Region	Bulk Density (g/cc)	Water holding Capacity (%)	Pore space (%)
Karnataka			
Channarayapattana	1.16-1.27	36.05-43.92	45.30-50.95
Sira	1.15-1.29	37.48-45.6	47.64-54.51
Kanakapura	1.10-1.32	32.55-48.61	42.14-53.88
Anekal	1.12-1.21	38.42-49.65	44.26-52.18
Andhra Pradesh			
Hindupur	1.20-1.38	32.51-42.61	35.61-49.60
Madakasira	1.26-1.34	34.68-43.28	32.69-49.55
Penukonda	1.19-1.26	40.85-60.81	51.10-73.83
Tamil Nadu			
Udumalpet	1.35-1.47	28.65-35.85	41.62-47.51
Hosur	1.20-1.37	32.69-42.50	35.21-49.20
Krishnagiri	1.25-1.32	38.72-45.63	39.67-50.29
Srivilliputhur	1.22-1.29	35.45-46.52	43.24-53.26

Table 8.4: Chemical properties of soil samples collected from farmers' gardens

State/ Region	pH	EC (mmhos/ cm)	OC (%)	Available P (kg/ha)	Available K (kg/ha)
Karnataka					
Channarayapattana	7.73-8.37	0.14-0.44	0.80-1.03	9.95-59.73	179-538
Sira	7.85-8.61	0.15-0.98	0.04-1.02	22.40-60.72	134-320
Kanakapura	7.87-8.15	0.02-0.69	0.21-0.62	30.90-106.50	134-762
Anekal	7.80-8.24	0.07-0.31	0.23-0.41	21.20-76.50	184-414
Andhra Pradesh					
Hindupur	7.64-8.65	0.09-0.12	0.34-0.39	9.45-40.30	403-627
Madakasira	6.64-9.15	0.06-0.98	0.11-0.08	5.47-60.72	90-623
Penukonda,	8.32-8.68	0.24-0.36	0.06-0.62	17.4-47.80	179-493

Tamil Nadu					
Udumalpet	7.84-8.44	0.21-0.42	0.11-0.30	5.47-60.22	134-527
Hosur	6.99-8.02	0.06-0.33	0.40-0.29	11.49-28.37	90-403
Krishnagiri	8.11-8.98	0.28-0.35	0.04-0.56	17.70-58.80	176-317
Srivilliputhur	8.42-8.78	0.45-0.62	0.42-0.62	20.40-36.52	120-350
Critical Value	6.50-7.50	< 1.00	0.65-1.00	10 - 20	110-250

Table 8.5: Mineral composition of soil samples collected from farmers' gardens

State/ Region	Cu (ppm)	Zn (ppm)	Fe (ppm)	Mn (ppm)
Karnataka				
Channarayapattana	0.48-2.48	0.20-1.60	2.40-36.00	8.00-32.00
Sira	0.74-2.36	0.10-2.60	1.60-7.20	6.00-26.00
Kanakapura	0.39-3.45	0.26-1.76	2.80-32.40	6.20-27.90
Anekal	0.64-2.42	0.21-2.40	2.30-27.90	5.70-22.60
Andhra Pradesh				
Hindupur	0.80-2.22	0.4-1.4	6.60-11.40	8.00-20.00
Madakasira	0.26-2.48	0.1-2.8	1.20-35.00	1.00-32.00
Penukonda	0.21-1.83	0.12-1.5	1.80-20.80	3.90-16.80
Tamil Nadu				
Udumalpet	0.44-1.30	0.1-0.4	1.60-5.40	1.00-6.00
Hosur	0.26-0.84	0.2-2.4	1.20-35.0	2.00-8.00
Krishnagiri	1.21-2.32	0.32-1.5	2.70-28.30	5.80-23.60
Srivilliputhur	0.28-1.26	0.62-1.2	2.50-22.40	1.50-7.80
Critical Value	0.26-2.48	0.10-2.8	1.20-35.00	1.00-32.00

Table 8.6: Biochemical analysis of leaf samples collected from farmers' gardens

State/ Region	Total Proteins (mg/g dry wt.)	Total Carbohydrates (mg/g dry wt.)
Karnataka		
Channarayapattana	148.00-162.60	105.80-113.80
Sira	106.50-128.40	98.32-102.70
Kanakapura	149.40-178.50	98.30-103.40
Anekal	153.70-207.30	79.80-112.20
Andhra Pradesh		
Hindupur	179.90-182.10	102.50-110.20
Madakasira	154.97-169.34	98.72-112.80
Penukonda	106.60-170.30	102.52-115.20
Tamil Nadu		
Udumalpet,	198.79-204. 52	104.32-115.80
Hosur	138.70-167.80	97.60-106.50
Krishnagiri	108.30-192.70	97.50-115.40
Srivilliputhur	106.90-168.40	76.20-102.60
Optimum value	230	120

9. HOST PLANT CROP PRODUCTION

9.1 MPR 0047: Effect of conjunctive use of nitrification inhibitors for the efficient utilization of nitrogenous fertilizers for the sustainable mulberry production (Oct. 2012 to Sep. 2014)

Vinod Kumar Yadav (PI), R. S. Katiyar, K. Vedavyasa and Dasappa

Objective:
- To enhance the utilization of nitrogenous fertilizers by conjunctive use of nitrification inhibitors for optimum yield in mulberry.
- To achieve reduction in chemical fertilizer application and loss due to leaching.

An experiment with variety V1 was laid in RBD with 5 treatments and 4 replications. Neem oil and Dichlorodicyanamide (DCD) were used as nitrification inhibitors. The soil samples were collected from the experimental plots and analysed to know the initial status of the soil. The first crop yield data of first year was collected, which showed the highest leaf yield in T1 followed by T2 and T3 (Table 9.1).

Table 9.1: Leaf yield data subsequent to use of nitrification inhibitors

Treatments	Leaf yield (kg/ha)	Avg. Plant height (cm)	Avg. length of longest shoot (cm)	Number of shoots/ plant	Leaf moisture (%)
T1	10335	155	125	14.5	72.4
T2	9942	148	120	13.0	71.9
T3	9725	146	121	13.5	72.0
T4	9085	140	112	11.7	72.1
T5	8967	138	113	11.2	72.3
CD at 5 %	148.57	12.06	15.11	NS	NS

T1: 350 N: 140 P:140 K kg/ha (Control)
T2: 300 N coated with neem oil (0.5% v/w):140 P:140 K kg/ha
T3: 300 N coated with Dichlorodicyanamide (0.50% w/w) :140 P:140 K kg/ha
T4: 250 N coated with neem oil (0.5%v/w) :140 P:140 K kg/ha
T5: 250 N coated with Dichlorodicyanamide (0.50% w/w):140 P:140 K kg/ha

9.2 Maintenance of the long term manurial plot (continuous)

K. Vedavyasa (PI) and Sibayan Sen

Objective: To monitor the changes in physical, chemical and biological properties and micro nutrient content of soil as a result of continuous manuring and cropping from the point of view of crop productivity and soil health.

The experiment on the effect of different levels of fertilizers and manures applied singly or in combination on mulberry leaf yield, as well as physical, chemical, biological properties and micro nutrient content of soil was continued. Mulberry leaf yield data of the eleventh year indicated significant differences among the treatments. Highest leaf yield was recorded in T7 (350N:140P:140K kg/ha/yr with FYM 20MT/ha/yr) yielding 34.70 (K2), 41.35 (S36), 52.05 (V1) MT/ha/yr. The lowest yield of 9.40 (K2), 12.70 (S36) and 13.05 (V1) MT/ha/yr was recorded in T0 (control) and was comparatively lower than the yield recorded during tenth year (Table 9.2).

Table 9.2: Effect of continuous application of fertilizer and manure on yield of mulberry (pooled data of eleventh year)

Treatment (NPK kg/ha/yr)	Leaf Yield (MT/ha/yr)		
	K2	S36	V1
T0: Control	9.40 (10.10)	12.70 (13.15)	13.05 (13.50)
T1: 300:120:120	30.15 (29.50)	38.45 (38.15)	45.90 (45.80)
T2: 300:120:120 + FYM 20 MT	34.05 (35.10)	41.30 (42.25)	50.55 (50.85)
T3: 225: 90: 90 + FYM 20 MT	32.35 (31.25)	40.85 (41.05)	48.55 (48.90)
T4: 150:120:120 + FYM 20 MT + 20 kg bio-fertilizer	30.40 (30.20)	39.10 (39.30)	47.40 (47.55)
T5: 150: 60:120 + FYM 20MT + 20 kg bio-fertilizer + 1 MT VAM	30.10 (30.00)	38.50 (38.75)	46.90 (46.75)
T6: 300:120:120 + Vermi-compost 4.8 MT	33.55 (33.80)	40.85 (40.45)	50.70 (50.65)
T7: 350:140:140 + FYM 20 MT	34.70 (35.15)	41.35 (42.65)	52.05 (52.50)
CD at 5%		1.82	

Values in parentheses are yield recorded in tenth year

The physical and chemical characteristics of soils *viz.,* soil reaction (pH), electrical conductivity, organic carbon, available phosphorus and potassium were analysed (Table 9.3). The values recorded during the period were lower in T0 i.e., organic carbon 0.27%, phosphorus 8.10 kg/ha and potassium of 84 kg/ha. The microbial biomass carbon was also estimated to know the biological condition of soil wherein higher microbial biomass carbon was recorded in treatment, which received farm yard manure. Lower values of bulk density were recorded in T5 (150:60:120kg/ha/yr with 20MT FYM/ha/yr with 20 kg bio fertilizer and VAM) compared to other treatments. The treatments which received biofertilizer and VAM in lieu of chemical fertilizer recorded lower leaf yield compared to T2 (300N:120P:120K kg/ha/yr with FYM 20MT/ha/yr). However, leaf nutrient status was on par with other treatments which received full complement of fertilizers.

Table 9.3: Effect of continuous application of manures and fertilizers on physico- chemical properties of soil

Treatment (NPK kg/ha/yr)	pH	EC (mmoh s/cm)	Organic Carbon (%)	P (kg/ha)	K (kg/ha)
T0: Absolute control	8.05	0.27	0.27	08.10	84
T1: 300:120:120	7.75	0.24	0.30	20.10	305
T2: 300:120:120 + FYM 20 MT	7.85	0.25	0.66	23.95	370
T3: 225: 90: 90 + FYM 20 MT	7.85	0.23	0.70	21.25	260
T4: 150:120:120 + FYM 20 MT + 20 kg bio-fertilizer	7.80	0.25	0.72	24.65	365
T5: 150: 60:120 + FYM 20MT + 20 kg bio-fertilizer + 1 MT VAM	7.85	0.27	0.68	17.15	370
T6: 300:120:120 + Vermi-compost 4.8 MT	7.87	0.24	0.47	22.55	380
T7: 350:140:140 + FYM 20 MT	7.75	0.23	0.59	25.25	445
F test	*	NS	*	*	*
C D at 5 %	0.16	--	0.17	2.05	22.6

Soil analysis for micro-nutrients status indicated significant differences among the treatments. Zinc ranged between 0.38 and 1.32 ppm, copper 0.20 and 0.48 ppm, Iron 9.15 and 14.15 ppm and Manganese 6.05 and 13.10 ppm. Absolute control recorded lowest content of micronutrients (Table 9.4).

Table 9.4: Effect of continuous application of fertilizers and manure on micronutrients in soil

Treatment (NPK kg/ha/yr)	Micronutrient content (ppm)			
	Zinc	Copper	Manga-nese	Iron
T0: Absolute control	0.38	0.20	6.05	9.15
T1: 300:120:120	0.82	0.36	9.20	11.30
T2: 300:120:120 + FYM 20 MT	1.28	0.37	11.35	12.55
T3: 225: 90: 90 + FYM 20 MT	1.21	0.42	12.25	12.05
T4: 150:120:120 + FYM 20 MT + 20 kg bio-fertilizer	1.29	0.33	9.65	13.15
T5: 150: 60:120 + FYM 20MT + 20 kg bio-fertilizer + 1 MT VAM	1.32	0.41	9.40	12.30
T6: 300:120:120 + Vermi-compost 4.8 MT	1.34	0.48	13.1	14.15
T7: 350:140:140 + FYM 20 MT	1.21	0.43	10.4	12.6
F- test	*	*	*	*
CD @5%	0.24	0.15	2.01	2.10

9.3 MPR 0005: Monitoring of soil fertility status of mulberry gardens and creation of database (Continuous)

K. Vedavyasa (PI) and Sibayan Sen

Objective: To monitor the soil fertility status of mulberry gardens in selected districts of Karnataka by estimating nutrient status of the soil and recommending balanced application of fertilizer & manure.

Evaluation of soil fertility in different areas indicated that soil pH in 30.7% soils varied from 6.5-7.5 and in 63.6% of soil from 7.5 to 8.5. Electrical conductivity in 95.6% of soils was less than 1.00 mmhos/cm. Organic carbon content of soil was low in 37.6% of soil whereas it was optimum in 47.6% of soils. The available phosphorus content was low in 36.5% of soils, however, in the remaining samples it was medium to high. The available potassium in most of the soils was medium to high. Majority of the soils tested were from Tumkur and Mandya districts of Karnataka. Though most of the soils were slightly alkaline in nature, they were suitable for mulberry production (Table 9.5).

Table 9.5: Soil fertility in mulberry growing areas of south India

Place	Parameters tested				
	pH	Electrical conductivity (mmhos/cm)	Organic carbon (%)	Phosphorus (kg/ha)	Potassium (kg/ha)
Mandya	5.66-8.99	0.03-2.85	0.29-1.48	0.5-306.0	90-1479
Mysore	5.17-9.70	0.07-0.46	0.05-1.03	0.5-154.8	134-1120
Hassan	4.65-8.61	0.02-0.85	0.36-1.54	0.5-215.5	45-1210
Tumkur	4.71-9.07	0.02-0.96	0.11-1.60	0.5-131.0	45-1568
Other districts of Karnataka	6.80-8.86	0.02-0.85	0.28-1.30	0.5-120.6	45-1019
Tamil Nadu	7.27-8.11	0.09-0.52	0.23-1.54	0.5-128.4	134-582
Andhra Pradesh	7.88-8.76	0.27-0.69	0.52-1.04	4.5-34.3	134-269

10. HOST PLANT CROP PROTECTION

10.1 MPT 0046: Long-term effect of mulberry cropping system on soil biology and productivity (July 2011 to June 14)

V. Nishitha Naik (PI), P. M. Pratheesh Kumar, D. D. Sharma, B. R. Dayakar Yadav, K. Vedavyasa, Rekha, M., M. T. Hematharaj[1], B. Mallikarjuna[2], P. Sudhakar[3], M. R. Subrahmanyam[4], M. P. Reddy[5], S. Vidyunmala[6], T. Mogili[7] and J. Ravikumar[8]

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Objective:
- To study the role of soil microflora and microfauna in sustainable mulberry production.
- To study the beneficial/ antagonistic microbes associated with soil health in different cropping systems.
- To investigate factors responsible for soil microorganisms to cause epidemics.

A survey was conducted to identify mulberry gardens and 190 soil samples were collected from Karnataka, Andhra Pradesh and Tamil Nadu during rainy, winter and summer seasons. An average of 155.5 × 10^6 CFU/g soil of microbes was isolated from these soil samples. Fungi, bacteria and actinomycetes were recorded at 59.6 × 10^6, 78.5 × 10^6 and 17.4 ×10^6 CFU/g, respectively. They were grouped as beneficial (71.5 × 10^6), harmful (40.4 × 10^6) & saprophytic (43.6 × 10^6). Further, soil samples were analyzed for physical and chemical properties. Beneficial microbes like *Verticillium chlamydosporium*, *Trichoderma harzianum, T. viride, Pseudomonas fluorescens, Bacillus subtilis*, *Azotobacter* sp., *Azospirillum* sp., *Streptomyces* spp. and *Nocordia* spp., were noticed in all the cropping systems (organic and inorganic farming, diseased and healthy, irrigated and rainfed). With regard to the harmful group, *Rhizoctonia bataticola* (=*Macrophomina phaseolina*); *Fusarium solani*, *F. oxysporum*, *Botryodiplodia theobromae*, etc., causing root rot disease were observed in diseased mulberry gardens. With regard to saprophytes, *Rhizopus, Aspergillus. Penicillium* and *Chaetomium* species were predominent.

10.2 PRE 3486: Development of database for mulberry diseases (Aug. 2012 - Jul. 2014)

Pratheesh Kumar, P. M. (PI), V. Nishitha Naik, D. D. Sharma and A. M. Babu

Objective:
- To develop a database pertaining to mulberry diseases in India.
- To develop a web based disease diagnosis system
- To develop distribution maps of important mulberry diseases.
- To develop a web based forewarning system on possible outbreak of the diseases to alert extension functionaries.

In order to develop a database, published literature on various aspects of mulberry diseases during 1970-1990 were collected from various sources, scanned and converted to Portable Document Format (PDF). The information such as pathogen, predisposing factors, etiology, symptomatology, distribution, resistant varieties and control measures were collected from these published literature. The literature were compiled and categorized based on various parameters fixed in the database. SEM images of various pathogens and diseases and infection process were collected for developing the database. Various templates were evaluated for their suitability to design database website on mulberry diseases using Content Management System (CMS). Based on the subject, various menus were prepared and the web page for database on mulberry diseases was designed.

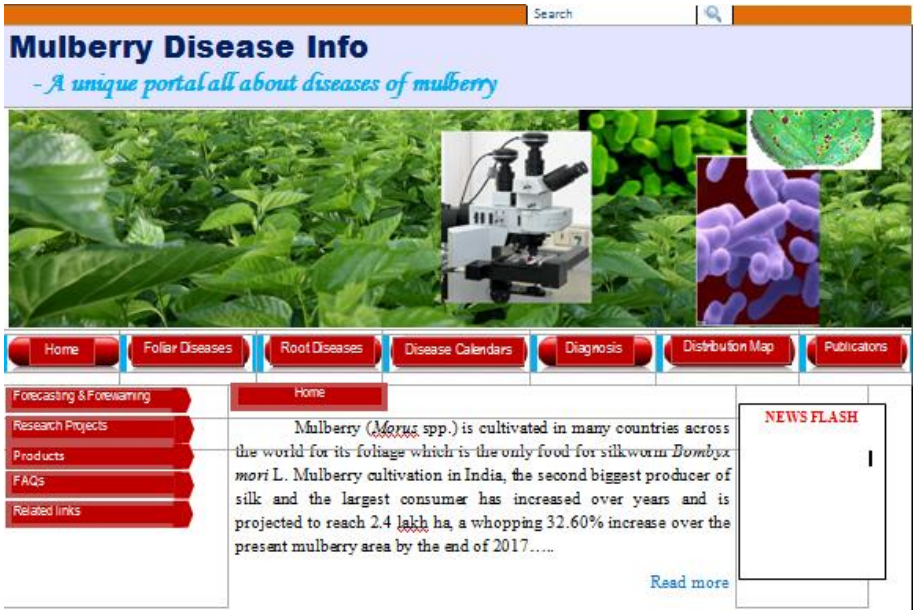

Fig. 10.1: Website database design

11. SILKWORM CROP IMPROVEMENT

11.1 SIM 0006: Maintenance of bivoltine silkworm breeds (Continuous)

N. Mal Reddy (PI), S. Nirmal Kumar, A. Naseema Begum, S. Manthira Moorthy and Y. Radhalakshmi

Objective: To maintain productive, robust, thin denier and sex-limited bivoltine breeds conforming to the original breed characteristics.

Productive bivoltine breeds, robust bivoltine breeds, thin denier bivoltine breeds and sex limited breeds were maintained for evaluating their pre and post cocoon parameters. The performance of the breeds was in conformity with the original breed characteristics and values obtained for the traits were on par with the benchmark values. The various breeds maintained for such purposes are given in Table 11.1.

Table 11.1: List of bivoltine breeds maintained

Productive	Robust	Thin denier	Sex-limited
CSR2	CSR18	CSR48	CSR2 (SL)
CSR3	CSR19	JPN7	CSR4 (SL)
CSR4	CSR46		CSR 8 (SL)
CSR5	CSR47		CSR27 (SL)
CSR6	CSR50		CSR202 (SL)
CSR12	CSR51		
CSR16	CSR52		
CSR17	CSR53		
CSR26	D2		
CSR27	D20		
	NB1		
	S8		

Bench mark: Fecundity: >450-500; Pupation rate:>90%; Cocoon weight:>1.50-1.70 g; Shell weight: >0.300-0.380g; Shell percentage: >20-22%

11.2 SIM 0008: Evaluation of three-way cross hybrids for commercial exploitation (Aug. 2010 - Sep. 2014)

A. Naseema Begum (PI), S. Nirmal Kumar, N. Mal Reddy and Kariyappa

Objective: To identify suitable three-way cross bivoltine silkworm hybrids for commercial exploitation

Twenty eight hybrids of three-way crosses were prepared by utilizing four foundation crosses, FC1 (CSR6 x CSR26), FC2 (CSR2 x 27), FC3 (CSR51 x CSR53) and FC4 (CSR50 x CSR52) along with seven oval (CSR2, CSR17, CSR27, CSR46, CSR48, CSR50 and CSR52) and seven dumbbell breeds (CSR4, CSR6, CSR19, CSR26, CSR47, CSR51 and CSR53). These hybrids were evaluated for their rearing and reeling traits. Based on cocoon uniformity and evaluation index for nine economic traits, four hybrids were selected in four consecutive cycles (Tables 11.2 & 11.3).

Table 11.2: Rearing performance of short-listed three-way cross hybrids

Three way cross hybrids	Eggs/dfl (No.)	Pupation (%)	Cocoon weight (g)	Shell wt. (g)	Shell %
FC1xCSR2	618	95.5	2.026	0.460	22.7
FC1xCSR17	624	95.4	1.946	0.430	22.1
FC3xCSR2	635	96.3	2.095	0.479	22.9
FC3xCSR17	638	96.6	1.966	0.444	22.6
Double hybrid (c)	617	95.9	1.989	0.453	22.8
CSR2xCSR4 (c)	546	95.9	1.890	0.431	22.8
CD at 5%	35	NS	0.15	NS	NS

Table 11.3: Reeling performance of short-listed three-way crosses hybrids

Three way cross hybrids	Raw silk (%)	Filament length (m)	Denier (d)	Reel-ability (%)	Neat-ness (p)	Cocoon unifor-mity
FC1xCSR2	17.5	1019	3.01	89	95	7.82
FC1xCSR17	18.4	1005	3.00	85	94	8.34
FC3xCSR2	18.9	1152	2.97	87	95	8.11
FC3xCSR17	18.3	1126	2.84	87	95	7.58
Double hybrid (c)	18.4	1060	3.01	85	94	8.68
CSR2xCSR4 (c)	17.5	997	3.05	87	95	8.02
CD at 5%	NS	45	NS	NS	NS	-

11.3 AIT 3445: Development of robust bivoltine hybrids of silkworm, *Bombyx mori* L., tolerant to high temperature environment of the tropics through DNA marker assisted selection (Jan. 2011 - Dec. 2015)

S. Manthira Moorthy (PI), S. K. Ashwath, S. Nirmal Kumar, Kariyappa and N. Chandrakanth

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

The prime objective of this project is to identify molecular markers associated with thermo tolerance in silkworm. To achieve this, it is necessary to identify thermo tolerant and susceptible silkworm breeds. Accordingly, two tolerant multivoltine (Nistari and Cambodge), two tolerant bivoltine (BHR3 and SK4C), and one susceptible bivoltine (CSR2) breeds were identified out of twenty breeds screened earlier in different high temperature regimes (32, 34, 36 and 38°C).

DNA polymorphism in the selected breeds

The DNA was isolated from the five identified silkworm breeds following phenol-chloroform method and quantified through 1% agarose gel. The DNA isolated from five breeds was screened with 83 SSR primers to detect the polymorphism. Of these 83 markers, 11 primers *viz*., LFL1123, LFL0329, LFL0407, S0801, S0813, Sat2604, Fl0648, Fl0516, Fl0656, LFL0944, LFL0658 showed distinct polymorphism among the breeds.

Bulked segregant analysis (BSA)

DNA was isolated from 25 susceptible and 25 tolerant individuals segregating from each of F2 populations and totally 200 samples of DNA were isolated from four F2 combinations. The samples were quantified and polymerase chain reaction (PCR) was carried out. Tolerant and sensitive bulks were prepared from F2 individuals by pooling aliquots containing equivalent amounts of total DNA, approximately, 50 ng/µl from each of twenty sensitive and twenty tolerant F2 progeny. To confirm the results obtained through BSA, 10 individuals each of tolerant and susceptible from each combination were also run with each marker. The amplicons were separated on 3% MetaPhor agarose gels.

Identification of SSR markers associated with thermo-tolerance

Out of 11 polymorphic markers identified, five SSR markers, *viz*., LFL1123, LFL0329, LFL0407, SO801, and SO8013 showed polymorphic bands between the tolerant and susceptible progeny segregating in the F2. The SSR primers *viz*., LFL1123, LFL0329 and SO813, generated polymorphic fragments of 225,190 and 520 bp, respectively, which were present only in the tolerant bulk and tolerant breeds (Nistari, Cambodge, BHR3 and SK4C) and were absent in susceptible bulk and susceptible breed (CSR2). Similarly they generated polymorphic fragments of 250,210 and 500 bp, respectively, which were present only in the susceptible bulk and susceptible breed (CSR2) and were not found in tolerant bulk and tolerant breeds. These three markers showed uniform pattern among all the four genetic backgrounds tested. However, LFL407 generated polymorphic fragments (tolerant: 230 bp and susceptible: 225 bp) only in three genetic backgrounds i.e., SK4C x CSR2, Nistari x CSR2 and Cambodge x CSR2 not in BHR3 x CSR2). In the same manner SO801 generated polymorphic fragments (tolerant: 240 bp and susceptible: 250 bp) only in three genetic backgrounds i.e., BHR3 x CSR2, Nistari x CSR2 and Cambodge x CSR2 not in SK4C x CSR2. A typical amplification pattern generated by LFL0329 in four different genetic backgrounds are shown in Fig.11.1.

These results clearly showed that the markers are associated with thermo-tolerance in silkworm. Further, regression analysis (Table 11.4) and stepwise regression analysis were done to identify most probable marker associated with the trait. Highest coefficient of determination (R^2 %) value was observed in LFL0329 (33.0) followed by LFL1123 (21.9), SO813 (21.8), SO801 (6.7) and LFL0407 (6.7). Further, the stepwise regression analysis (Table 11.5) revealed that LFL0329 is the most probable marker associated with thermo tolerance where highly significant R^2 value of 33% was recorded.

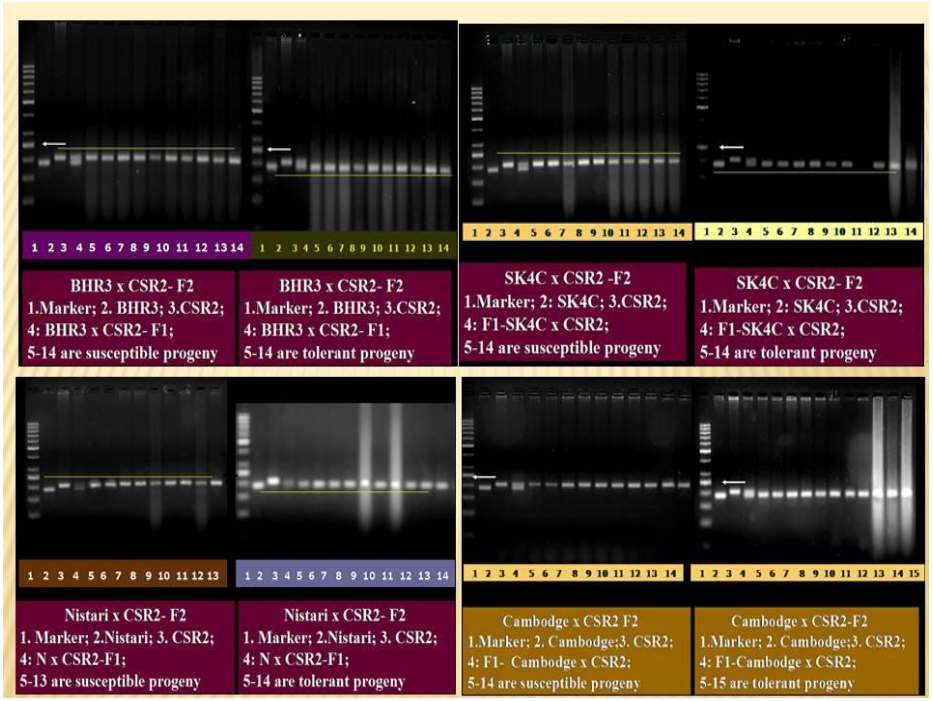

Fig.11.1: Amplification pattern of SSR primer No. LFL0329 in the tolerant and susceptible breeds. F1s and the tolerant and susceptible progeny segregating in four F2 populations of BHR2 x CSR2, SK4C x CSR2, Nistari x CSR2 and Cambodge x CSR2. Arrows denote 250 bp DNA marker. The polymorphic amplified products of tolerant (190bp) and susceptible (210bp) breeds present in the corresponding tolerant and susceptible progeny segregating in the F2, confirming the linkage of the marker with thermo-tolerance.

Table 11.4: Analysis of variance and regression analysis

Primer	Pearson correlation coefficient	R^2 (%)	F-value	Significance (P-value)
LFL1123	0.467	21.80	16.148	0.0001
LFL0329	0.575	33.00	28.604	0.0001
LFL0407	0.259	6.70	04.167	0.0460
S0801	0.259	6.70	04.158	0.0460
S0813	0.468	21.9	16.240	0.0001

Table 11.5: Results of stepwise regression analysis

Primer	R^2 (%)	Significance (P-value)
LFL0329	33.00	0.000
Excluded variables		
LFL1123	-	0.442
S0801	-	0.972
LFL0407	-	0.454
SO813	-	0.399

11.4 SIM 0016: Maintenance of bivoltine breeder's stock of germplasm (Continuous)

E. Rajalakshmi (PI) and R. Gururaj, SSBS, Coonoor

Objective: Systematic maintenance of newly evolved breeders stock of bivoltine silkworm germplasm, to its original characters, to support the genetic resource requirements of silkworm breeders.

Two maintenance rearing of breeders stock of 39 bivoltine germplasm breeds- 20 of Coonoor, (5 CNR breeds, 6 SLD breeds, 9 shuttle breeds, 6 parents, and newly included 13 races of CSR&TI, Mysore (GEN1, GEN2, GEN3, 4C, CSR2 (SL), CSR3, CSR4, CSR8 (SL), CSR12, CSR16, CSR17, CSR46, CSR47) were completed during the year in Apr./May and Oct./Nov., 12. The performance of the breeds was in conformity with the original breed characteristics and values obtained for the traits were on par with the benchmark values.

11.5 SIM 0017: Bivoltine shuttle breeding for development of silkworms with better plasticity (Continuous)

Breeding for the development of bivoltine breeds with higher productivity under semi-temperate conditions of Nilgiris and shuttle breeding for genetic variation and plasticity

E. Rajalakshmi (PI) and R. Gururaj, SSBS, Coonoor

Objective:
- To evolve new bivoltine breeds for higher productivity, under semi-temperate conditions of Nilgiris.
- To exploit the natural congenial conditions of Nilgiris for bivoltine breeding in the long run.

Eleven oval races (CNR4, SLD1, CSR17, CSR46, CSR47, CSR50, CSR202, CSR204, GEN3, D7, D15) and 4 dumbbell races (SLD8, CSR6, D13, D17) were identified based on their performance from the germplasm stock races maintained at SSBS, Coonoor as resource material for the breeding programme. The following eight breeding plans were effected (Table 11.6).

Table 11.6: Details of breeding plan and crosses made.

Breeding plan	Crosses	Breeding Plan	Crosses
SSBS 1	CSR17 x CNR4	SSBS 5	GEN3 x D7
SSBS 2	CSR 50 x SLD1	SSBS 6	CSR47 x D15
SSBS 3	CSR 202 x CSR46	SSBS 7	CSR6 x D 13
SSBS 4	CSR 204 x CSR46	SSBS 8	D17 x SLD 8

The F4, F5 and F6 generation rearings of the eight breeding plans were completed in June/July, Oct.,/Nov.,12, and Feb./Mar.,13 respectively. Inter-bed crosses between the selected batches were made and F7 dfls were prepared.

A total of 8 bivoltine breeds 4 ovals (CSR17, CSR 46, CSR 50 & CSR52) and 4 dumbbells (D20, CSR47, CSR51 and CSR53) were identified as breeding resource material and raised parental breeds in Oct.,/Nov., 12 and prepared 28 F 1 crosses. F1 rearing of the 28 crosses were completed in Feb./Mar. 2013. Cocoons were selected and F2 dfls were prepared for F2 generation rearing in April/May 2013.

11.6 SIM 0018: Multiplication of productive and new bivoltine races, generation of seed cocoons and preparation of dfls (Continuous)

E. Rajalakshmi (PI) and R. Gururaj, SSBS, Coonoor

Objective:
- To induce wide adaptability in authorized bivoltine silkworm breeds for sustainable cocoon yield.
- To evaluate CSR2 and CSR4 in varied locations - heterogeneous and unpredictable environments by applying convergent–divergent selection scheme.

Five dfls each of CSR2 and CSR4 from 3 different sources, namely, RSRS, Salem, RSRS, Kodathi and CSRTI, Mysore were reared successfully during Aug./Sept,12. Crosses were effected between the sources, dfls were prepared and preserved for the next cycle of rearing.

Further, 15 dfls of Polyvoltine L14, sourced from CSR&TI, Mysore were reared in cellular batches (entire population) in three seasons (June-July and August-September 2012, October-November 2012). Dfls were prepared at Coonoor and handed over to the breeding laboratory at Mysore.

11.7 SIM 0015: Bivoltine silkworm race maintenance and multiplication (Continuous)

G. V. Kalpana (PI) and K. B. Chandra Shekar, P4 BSF, Hassan

Objective:
- Race maintenance to supply quality bivoltine eggs to downstream multiplication centres.

A total of 1.5 acres of mulberry garden was maintained to meet the requirement of quality leaf for silkworm rearing. The leaf was harvested at an average leaf yield of 55 MT/ha/yr. Farm organic matter and sericulture residues were effectively converted into 10.5 MT of vermi-compost. The hard organic waste was converted into 9.5 MT of compost and used in the mulberry gardens.

A total of 14 bivoltine races were reared four times in the year *i.e*., May - Jun. 2012, Aug. - Sep. 2012, Nov. - Dec. 2012 and Feb. - Mar. 2013 by following silkworm race maintenance technology. Mean values of four rearing for fecundity, pupation rate, Yield / 10000 larvae by weight, single cocoon weight, single shell weight and cocoon shell percentage is presented in Table 11.7.

Table 11.7: Performance of bivoltine breeds (Mean of 4 rearings)

Breed	Fecun-dity (No.)	Pupation (%)	Cocoon yield/ 10,000 larvae (kg)	Cocoon weight (g)	Shell weight (g)	Shell %
Productive Breeds						
CSR2	579±19	96.9±1.2	19.6±1.1	1.96±0.1	0.466±0.02	23.8±0.4
CSR4	518±12	95.2±1.7	18.3±1.4	1.79±0.09	0.397±0.01	22.2±0.5
CSR6	526±29	95.0±0.7	18.1±1.9	1.79±0.1	0.380±0.02	21.3±0.2
CSR26	515±38	95.3±1.7	18.3±1.7	1.73±0.1	0.364±0.02	21.1±0.2
CSR27	548±35	96.4±0.8	17.7±0.7	1.85±0.01	0.449±0.01	24.3±0.4
CSR16	508±22	94.6±2.6	17.2±0.7	1.80±0.1	0.381±0.02	21.2±0.5
CSR17	550±19	96.1±2.1	18.3±0.63	1.89±0.08	0.424±0.01	22.5±0.7
Robust Breeds						
CSR46	512±35	96.8±1.3	17.7±0.65	1.81±0.1	0.430±0.03	23.8±0.3
CSR47	478±44	94.3±1.7	16.7±1.07	1.76±0.1	0.380±0.02	21.5±0.7
CSR50	569±12	95.8±2.5	18.8±0.9	1.94±0.1	0.452±0.02	23.3±0.4
CSR51	491±26	96.2±1.3	17.1±0.9	1.79±0.08	0.394±0.01	22.0±0.3
Gen3	546±19	95.9±2.6	19.6±0.8	2.05±0.07	0.479±0.02	23.4±0.4
Gen2	468±36	96.1±1.3	16.6±0.7	1.72±0.08	0.378±0.02	22.0±0.8
Sex-Limited Breed						
CSR2(SL)	501±8	93.9±1.7	16.6±1.3	1.83±0.14	0.384±0.03	21.0±0.3

A total quantity of 16,295 dfls of pure stock were prepared. The egg recovery ranged from 30.5% in GEN3 to 41.7% in CSR17. A total quantity of 9007 dfls of bivoltine silkworm pure stock were supplied to P3 and P2 multiplication centres of DoS and CSB units in Karnataka, Tamil Nadu and Andhra Pradesh.

11.8 AIB 3456: Development of productive polyvoltine breeds of the silkworm *Bombyx mori* L. tolerant to high temperature and BmNPV (Oct. 2011 - Sep. 2016)

Dayananda, (PI), P. Rama Mohana Rao (upto July 2012), V. Premalatha, C. Parameswara, M. Balavenkatasubbaiah and K. Chandrasekharan

Objective: Development of polyvoltine breeds tolerant to high temperature and BmNPV.

Twelve stress tolerant lines were screened for high temperature tolerance at F2, BmNPV tolerance at F3 and 18 stress tolerant lines (F4) were reared under normal rearing conditions. The performance of 18 stress tolerant lines under normal condition is depicted in Table 11.8.

Table 11.8: Performance of stress tolerant lines under optimum conditions of rearing

Sl. No.	Lines	Survival (%)	Cocoon weight(g)	Shell weight (g)	Shell %
1	RDT2	87.20	1.351	0.247	18.28
2	RDT5	89.47	1.038	0.204	19.63
3	RDT6	80.47	1.214	0.233	19.21
4	RDT7	82.60	1.289	0.240	18.63
5	RDT9	85.60	1.111	0.200	18.00
6	RDT10	80.99	1.134	0.210	18.55
7	RDT11	81.50	1.228	0.221	18.04
8	RDT13	82.50	1.234	0.224	18.12
9	RDT17	89.40	1.196	0.220	18.36
10	RDT19	87.17	1.260	0.220	17.47
11	RHT1	84.67	1.238	0.219	17.68
12	RHT2	83.13	1.267	0.247	19.51
13	RHT3	84.07	1.355	0.249	18.39
14	RHT4	85.20	1.321	0.238	18.05
15	RHT8	86.67	1.149	0.236	20.52
16	RHT9	86.20	1.175	0.227	19.36
17	RHT11	88.87	1.191	0.227	19.04
18	RHT12	86.13	1.167	0.211	18.05

11.9 SIM 0009: Maintenance of polyvoltine silkworm breeds of *Bombyx mori* L. (Continuous)

C. Parameswara (PI), V. Premalatha, Dayananda, P. Rama Mohana Rao, (upto July 2012), P.C. Santha and K. P. Shivakumar

Objective: Maintain polyvoltine breeds conforming to their original characters.

Thirty six polyvoltine breeds consisting of 2 indigenous, 1 exotic, 2 sex limited, 7 disease tolerant, 4 high temperature tolerant, 2 breeds developed through androgenesis, 2 breeds of improved fiber quality giving 2A-3A grade silk and 16 other evolved breeds were maintained conforming to their original breed characters for 5 generations. The rearing and reeling performance of some of the important breeds are presented in Table 11.9.

Table 11.9: Rearing and reeling performance of polyvoltine breeds (mean of 5 rearings)

Breed	Fecun-dity	Pupa-tion (%)	Cocoon weight (g)	Shell weight (g)	Shell %	Fila-ment length (m)	Reela-bility (%)	Raw silk (%)	Neat-ness (p)
L14	534 ±13	87.19 ±1.28	1.291 ±0.01	0.237 ±0.01	18.34 ±0.20	743	81.02	12.47	86
L15	531 ±28	87.15 ±2.65	1.265 ±0.01	0.236 ±0.08	18.61 ±0.46	651	85.81	11.17	85
AGL3	534 ±86	88.56 ±3.38	1.237 ±0.05	0.225 ±0.06	18.14 ±0.55	636	87.34	11.09	87
AGL5	502 ±07	88.37 ±0.49	1.191 ±0.01	0.219 ±0.13	18.40 ±1.30	559	82.79	10.41	86
ND7	541 ±08	90.41 ±2.50	1.315 ±0.03	0.241 ±0.01	18.82 ±0.33	554	84.15	10.36	86
ND5	553 ±36	89.18 ±0.50	1.208 ±0.00	0.220 ±0.01	18.28 ±0.83	518	81.32	9.70	86
NDV6	540 ±10	88.04 ±3.02	1.224 ±0.01	0.229 ±0.05	18.70 ±0.27	460	82.98	8.30	86
NP1	510 ±39	88.14 ±2.40	1.194 ±0.04	0.218 ±0.01	18.23 ±0.10	518	82.67	9.70	86

11.10 SIM 0011: Maintenance of breeds developed through amylase marker assisted selection, NPV tolerant and morphological mutant stocks (Jan. 2010 to Jan. 2015)

K. K. Sharmila (PI), V. N. Sudha, S. K. Ashwath and S. Nirmal Kumar

Objective:

- Maintenance of silkworm races conforming to their original characters.
- Maintenance of the homozygosity of the races developed through amylase marker assisted selection.
- Maintenance of NPV tolerant bivoltine and polyvoltine stocks.
- Maintenance of morphological marker phenotypes in mutant stocks.

During the period, 20 breeds developed through amylase marker assisted selection (GEN1, GEN2, GEN3, GEN4, 2C, 2S, 2M, 3P, 3N, 3C, 3D, 4P, 4C, 4D, 4S, 4M, 5P, 6P, 6C, 6D), 15 NPV tolerant stocks and 35 mutant stocks were maintained, conforming to their breed characteristics under two crops during Aug-Sep and Nov-Dec.2012.

Homozygosity for the amylase genes was confirmed by amylase assay in the breeds developed using amylase marker. Egg, larval and moth characteristics were observed and maintained in the mutant stocks. The rearing and reeling performance of some of the important breeds being used as parents for post- and pre-authorisation trials are presented in Table 11.10. The characteristics of the mutant stocks are given in Table 11.11.

Table 11.10: Performance of oval breeds developed through amylase marker assisted selection

Breed	Fecun-dity	ERR/10000		Cocoon weight (g)	Shell weight (g)	Shell %	Fila-ment length (m)	Denier
		By No.	By wt. (kg)					
Oval Breeds								
GEN1	582 ±4.51	8430 ±170	13.32 ±0.68	1.625 ±0.68	0.345 ±0.02	21.21 ±0.56	935 ±35	2.69 ±0.12
GEN3	579 ±19	8742 ±138	14.51 ±0.51	1.700 ±13	0.376 ±0.04	22.1 ±0.37	801 ±28	2.76 ±0.09
2C	531 ±14.5	8966 ±314	13.48 ±1.24	1.572 ±0.02	0.347 ±0.01	22.15 ±0.35	869 ±42	2.61 ±0.13
Dumb-bell breeds								
GEN2	552 ±14	8786 ±174	14.00 ±0.74	1.559 ±0.05	0.337 ±0.11	21.61 ±1.0	626 ±46	3.19 ±0.15
4C	559 ±16	9000 ±280	14.59 ±0.67	1.585 ±0.01	0.339 ±0.9	21.39 ±0.3	801 ±26	2.88 ±0.14
4D	539 ±5.5	8354 ±46	12.66 ±0.38	1.519 ±0.03	0.333 ±0.1	21.93 ±0.3	752 ±32	2.84 ±0.08
4S	534 ±22	8770 ±30	13.7 ±0.9	1.625 ±0.05	0.352 ±0.2	21.69 ±0.6	726 ±41	2.65 ±0.15

Table 11.11: Characteristics of mutant stocks

Sl. No.	Marker Genes (Linkage group)	Description	Sl. No.	Marker Genes (Linkage group)	Description
1	w-2 (10)	White egg 2, yellowish white eggs	19	st (8)	Stony, larval body hard & compact
2	Re (5)	Red egg, serosa cells red.	20	q (7)	Quail pattern of black spots on larva
3	pe; re (5)	Pink eyed white egg	21	E (6)	Extra abdonimal legs
4	elp (18)	Ellipsoid egg	22	bts (17)	Brown head & tail spots
5	Ge (1)	Giant egg	23	cts (16)	Cheek and tail spots
6	b-2 (6)	Brown egg	24	so (26)	Sooty, smoky larval body
7	sp (23)	Spindle shaped egg	25	nb (19)	Narrow breast, short thorax and stout abdomen
8	ch (13)	Chocolate newly hatched larvae	26	e (1)	Elongated II abdominal segment
9	pS (2)	Striped, black intersegmental bands	27	Ia (9)	Dominant chocolate newly hatched larva
10	pM (2)	Moricaud larval markings	28	Sel (24)	Sepialumazine, larval skin pale yellow
11	Ze (3)	Zebra larval markings	29	lu (16)	Lustrous eye in moths
12	lem (3)	Lemon coloured larval skin	30	Ws (17)	Wild wing spot in moths
13	L (4)	Multilunar spots on dorsal side	31	ZeF (3)	Zebra faded larval markings
14	K (11)	Knobbed dermal protuberances	32	Pk (2)	Pink coloured cocoon
15	mln (18)	Melanism, black head & anal plates	33	Y (2)	Yellow blood
16	Rb (21)	Red blood	34	F (6)	Flesh cocoon colour
17	U (14)	Ursa, dark brown pigment on dorsal and lateral sides of larva	35	C (12)	Golden yellow cocoon
18	tub (23)	Tubby, spindle shaped larva with short thorax & stout abdomen.			

11.11 AIB 3476: Development of productive NPV tolerant bivoltine breeds/ hybrids using BmNOX marker assisted selection (Apr. 2012 to Mar. 2015)

S. K. Ashwath (PI) and Virendra Kumar

Objective:
- To develop productive NPV tolerant bivoltine breeds using BmNOX marker.
- To identify NPV tolerant single/double hybrids through laboratory evaluation and in-house testing.

Under a previous project, a 26.5 kDa protein named BmNOX (NADPH Oxidoreductase) has been identified and characterized in the gut fluid of Nistari strain of silkworm which showed antiviral activity against BmNPV. With the goal of developing NPV tolerant bivoltne breeds employing BmNOX protein as a marker, the NPV tolerant silkworm breeds, namely, Nistari, 5N endowed with high BmNOX expression were selected as donor parents (DPs) and productive bivoltine breeds, namely, CSR2, CSR4, CSR6, CSR26 and CSR27, which are susceptible to NPV were selected as recurrent parents (RPs). The DPs and RPs were reared and F1 progeny of DP x RPs were raised. The F1s were backcrossed to their respective RPs and the BC1 progeny were reared. Digestive juice samples were collected on the 3rd day of 5th instar from the female BC progeny individually and screened by SDS-PAGE. The BC1 individuals with high BmNOX expression (Fig. 11.2) were selected and backcrossed to their respective RPs and BC2 progeny were raised. The procedure was repeated and the screening and selection was completed upto BC4.

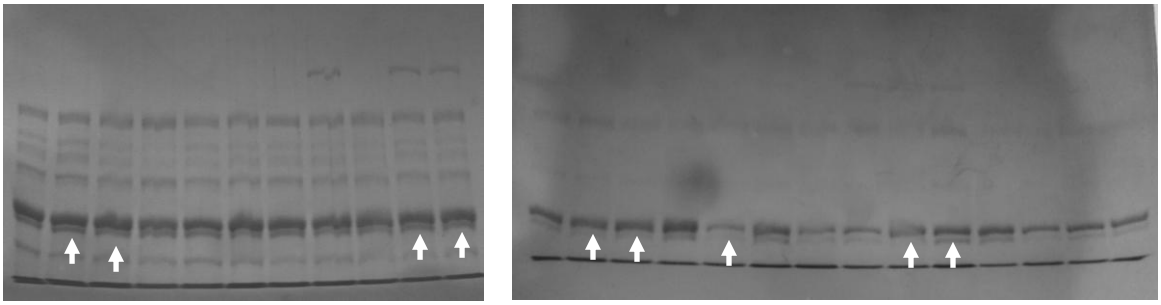

Fig. 11.2: SDS-PAGE profile of BC3 progeny segregating for differential expression of 26.5 kDa BmNOX protein. Arrows denote individuals with high expression of the protein.

The BmNOX marker assisted selection will be continued upto BC6 followed by selfing for identification of homozygous lines with high BmNOX protein expression.

11.12 SPR 0013: Maintenance of bivoltine and multivoltine semi-synthetic diet silkworm strains for original breed characters (Apr. 2009 to Mar. 2019)

M. Ramesh (PI), Kanika Trivedy, M. Munirathnam Reddy and S. Nirmal Kumar

Objective: To maintain bivoltine and multivoltine artificial diet silkworm strains for original breed characters.

Thirty four bivoltine and multivoltine strains developed through selection for rearing on semi-synthetic diet were maintained (Table 11.12). Average harvest data of two trials with bivoltine strains revealed that feed response ranged between 90.67 and 97.21, pupation rate between 85.87 & 91.39, cocoon weight between 1.386 & 1.681g, shell weight between 0.266 & 0.375 g and shell % between 18.87 & 22.61. In case of multivoltine strains, the average data of five trials showed the feed response between 91.11 and 95.66, pupation rate between 85.98 & 89.69, cocoon weight between 0.795 & 1.174 g, shell weight between 0.097 & 0.202g and shell % between 12.19 & 17.18.

Table 11.12: Semi-synthetic diet specific silkworm strains maintained

Productive bivoltine	Robust	Sex limited	Traditional	Multivoltine
CSR2(A)	CSR18(A)	CSR2SL(A)	NB4D2(A)	PM(A)
CSR4(A)	CSR19(A)	CSR8SL(A)	KA(A)	PMSL(A)
CSR5(A)	3HT(A)			C.Nichi(A)
Kinshu(A)				BL67(A)
Showa(A)				BL67SL(A)
B60(A)				96C(A)
CSR20(A)				ND7(A)M
CSR23(A)				ND7(A)P
BMN(A)				SPM1(A)
CSR6(A)				SPM2(A)
CSR26(A)				SPM3(A)
CSR27(A)				SPM4(A)
CSR50(A)				Nistari(A)
CSR51(A)				-
				-

12. SILKWORM CROP PRODUCTION

12.1 SPR 0044: Development of silkworm rearing package for newly developed breeds/hybrids (Apr. 2012 to Nov. 2013)

S. Purushotham (PI) and P. G. Joge

Objective: Development of silkworm rearing package for newly developed breeds/hybrids.

Three rearing trials of 100 dfls (50,000 larvae) of L14 pure breed were conducted with different spacings of 600, 700, 800 sq. ft. /100dfls and quantum of feed from 2000 to 2500 kgs of shoot. It was observed that 700 sq. ft. bed space with 2200 kgs of shoot feeding is optimum for seed crop rearing.

One rearing trial of the hybrid L14 × CSR2 was conducted with different spacing from 700 to 1000 sq. ft. and quantum of feed from 2200 to 2800 kgs of shoot. During the course of rearing it was observed that the performance of the breed was optimum with 800 sq. ft. bed space with 2600 kg of shoot feeding. The rearing performance of L14 and L14 x CSR2 hybrid under optimum bed spacing is shown in Table 12.1.

Table 12.1: Rearing performance of L14 pure and hybrid under optimum bed spacing

Race	Bed space (sq.ft)	Quantum feed (kg)	ERR		CocoonWt (g)	Shell Wt. (g)	Shell %
			No.	Wt. (kg)			
L14	700	2200	9384	12.51	1.36	0.25	18.38
L14 × CSR2	800	2600	9255	19.98	2.06	0.37	18.12

Testing and refinement of existing mountages for large scale rearing

Three types of self mounting models, fabricated by RSRS, Anantapur, CSRTI, Mysore and the modified rotary mountage manufactured by M/s. Concept Components, Mysore were tested. The advantages and disadvantages of the mountages are given below.

(i) Thread frame mountage for shoot rearing fabricated by RSRS, Anantapur

Advantages	1. Convenient for self mounting 2. Easy to harvest cocoons 3. Reduces the labour cost at the time of harvesting.
Disadvantages	1. The frame is too big and occupies large space 2. The frame is too thick (2”), due to which more double cocoons are spun. 3. The plastic net used in the outer and inner frames are not sufficiently strong and do not maintain required space resulting in deformed cocoons.

(ii) Self mounting model fabricated by Rearing Technology & Innovation laboratory, CSRTI, Mysore.

Advantages
1. Convenient for self mounting.
2. Easy to harvest cocoons.
3. Reduces the labour cost at the time of harvesting.
4. Occupies less space.
5. Easy for disinfection and storage.
6. Aluminum frame is light weight and easy to handle.

Disadvantages Additional support for frames is required to avoid pressed cocoons.

(iii) Self-mounting rotary mountage fabricated by M/S. Concept Components, Mysore

Advantages 1. Convenient for self mounting.

Disadvantages
1. The cardboard frames are not strong enough to bear the weight of silkworm larvae.
2. The plastic frames used for holding the mountage do not have proper grip.

3. The mountage does not rotate after mounting the larvae. This results in accumulation of faecal matter and urine, which is absorbed by the lower portion of the mountage. Thus the cubicle space is not maintained resulting in inferior quality of cocoons.

12.2 SPR 0041: Large scale multiplication of new multivoltine and bivoltine breed/hybrids (Apr. 2012 to Nov. 2013)

D. S. Somaprakash (PI) and P. G. Joge

Objective: To multiply new Multivoltine and bivoltine silkworm breeds for the prepartion of F1 hybrids for field trials.

Six rearing trials of L14 pure breed were conducted during summer (3 trials with 700 dfls), rainy (one trial with 100 dfls) and winter (2 trials with 400 dfls) seasons. The rearing performance is shown in Table 12.2.

Table 12.2: Large scale rearing performance of L14 breed

Season	ERR		Cocoon weight (g)	Shell weight (g)	Shell percentage (%)
	No.	Wt. (kg)			
Summer	5126	5.54	1.260	0.236	18.67
Rainy	9668	13.81	1.431	0.270	18.62
Winter	9446	12.14	1.319	0.253	19.19

During Sep. 2012, 50 dfls each of L14 x CSR2 and PM x CSR2 (control) were reared and was evaluated. The new hybrid was found to be superior in terms of cocoon yield and cocoon traits (Table 12.3).

Table 12.3: Rearing performance of L14 x CSR2 and PM x CSR2

Race	Yeild / 100 dfls (kg)	ERR		Cocoon weight (g)	Shell wt. (g)	Shell percentage (%)
		No.	Wt. (kg)			
L14 x CSR2	76.4	9561	19.75	2.099	0.427	20.34
PM x CSR2	73.4	9581	17.56	1.895	0.337	17.78
% Improvement over control	4.08	-0.20	12.47	10.70	26.70	14.39

12.3 SPR 0019: Large scale in-house evaluation and validation of new silkworm hybrids of silkworm *Bombyx mori* L. developed at CSRTI, Mysore (Continuous)

P. C. Santha (PI), P G. Joge and Issac Joseph

Objective: To evaluate new silkworm breeds / hybrids under large scale in- house rearing simulating to farmers' conditions

Six rearing trials of L14 and one trial of L14 × CSR2 were conducted along with PM × CSR2 as control. The rearing performance is indicated in Table 12.4. Comparison of rearing performance of L14 x CSR2 and PM x CSR2 (control) showed 3.2 to 6.7% improvement in yield/100 dfls, ERR by number and weight, single shell weight and shell percent in L14 x CSR2 over the control.

Table 12.4: Rearing performance of L14 breed and L14 x CSR2 hybrid

Race/ Hybrid	No. of Dfls	Fecundity (No.)	Hatching (%)	No. of larvae (No.)	Larval duration (D:H)	Cocoons /kg. (No.)
L14	1500	459	92.68	6,22,900	23:00	780
L14 × CSR2	300	483	91.50	1,32,500	21:12	552
PM × CSR2 [C]	100	462	93.10	43,000	22:00	586

Race	Yield/ 100 dfls (kg)	ERR		Cocoon weight (g)	Shell weight (g)	Shell %
		No.	Wt. (kg)			
L14	44.80	8280	10.639	1.419	0.253	17.83
L14XCSR2	69.30	8870	15.700	1.770	0.340	19.21
PMXCSR2 [C]	65.00	8590	15.116	1.760	0.320	18.18
% improvement control	6.6	3.2	3.9	0.57	6.25	5.7

12.4 SIM 0043: Studies on reproductive efficiency of newly evolved multivoltine and bivoltine breeds of silkworm *Bombyx mori* and egg production (Apr. 2012 to Mar. 2014)

Chikkanna (PI) and S. B. Kulkarni

Objective:
- To study the reproductive efficiency of new multivoltine and bivoltine breeds and feedback to breeders.
- Large scale egg production for pre and post authorization field trials.

Reproductive parameters were analysed during the preparation of three-way cross hybrid, FC3 x CSR17 and multi x bivoltine hybrid, L14 x CSR2. In case of FC3 x CSR17, the pairing was found to be 37.45 %, average egg yield was 63.33 g/kg cocoons and the number of eggs /g was 1700. During the preparation of L14 x CSR2 hybrid, the pairing observed was 31.72% with average egg yield of 65.54 g/kg cocoons and average number of eggs /g was 1811.

12.5 AIB 3488: Pre-authorization field trials of L14 x CSR2: a new polyvoltine x bivoltine hybrid with superior fibre quality (Apr. 2012 to Mar. 2014)

Chikkanna (PI) and S. B. Kulkarni

Objective: Large scale Production of L14 x CSR2 hybrid dfls for preauthorization field trials

A total of 13.31 lakh seed cocoons of the race L14 were generated at CSR&TI and 7.26 lakh CSR2 seed cocoons received from NSSO, which were processed in 19 lots to produce 3.17 lakhs of L14 x CSR2 dfls. The dfls were supplied to the field under pre-authorization trials. The season wise production and grainage parameters of F1 dfls are presented in the Table 12.5.

Table 12.5: Details of L14 x CSR2 dfls production in three seasons

Sl. No.	Parameters	Season			
		Summer	Rainy	Winter	Total
1	Number of lots	8	6	5	19
2	Actual weight (kg)	618.80	682.65	437.10	1738.50
3	Quantity by Number	500152	501313	329461	1330926
4	Pupation (%)	88.12	85.75	93.16	89.01
5	Pairing (%)	27.75	28.90	38.90	31.72
6	Total egg weight (kg)	36.144	42.74	35.197	114.081
7	Egg yield/kg cocoons (g)	58.40	62.60	80.52	65.64
8	Number of eggs/g	1790	1840	1805	1811
9	Hibernation (%)	6.72	5.80	9.622	7.06
10	Dfls produced	100550	116600	99900	317050

24,100 dfls were recorded as hibernated dfls which amounts to 7.06% in case of L14 x CSR2. In addition, 3950 P1 dfls of CSR2, 5350 dfls of FC1 x CSR17 were also produced.

12.6 AIB 3449: Developing an indigenous method for culturing *Cordyceps* and other useful species (Oct. 2010 to Sep. 2013)

Kanika Trivedy (PI) and M. Munirathnam Reddy

Objective: To screen different spp. of *Cordyceps* and other useful species to assess its viability *in vitro* on culture media containing silkworm pupae powder and *in vivo*, on silkworm pupae.

Mother stock cultures of 13 isolates of eight *Cordyceps* and other spp. were being maintained and multiplied 12 times during the year (Fig. 12.1). All isolates were cultured for their viability *in vitro* on culture media containing pupae powder and *in vivo* on silkworm pupae (Fig. 12.2). One *Cordyceps* sp. (Cor oph) was grown successfully *in vitro* (Fig. 12.3).

HPLC analysis of Cor. oph analysed against standard adenosine, cordycepic acid and cordycepin revealed that artificially cultured *Cordyceps* contained 11-12 times more adenosine, almost the same quantity of cordycepic acid and around 7 times more cordycepin as compared to naturally available *C. sinensis* (Table 12.6).

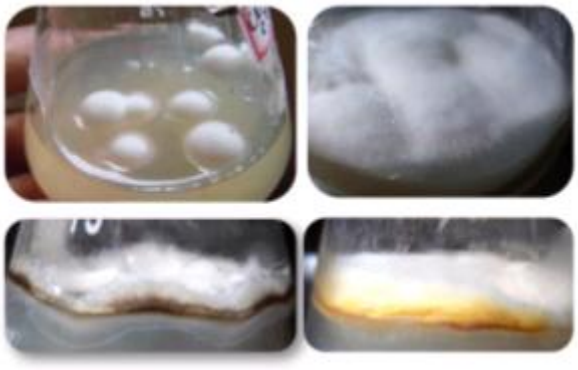

Fig. 12.1: *In vitro* mother culture *Cor oph* strain of *Cordyceps*

Fig. 12.2: *In vivo* culture of *Cordyceps* on silkworm pupae

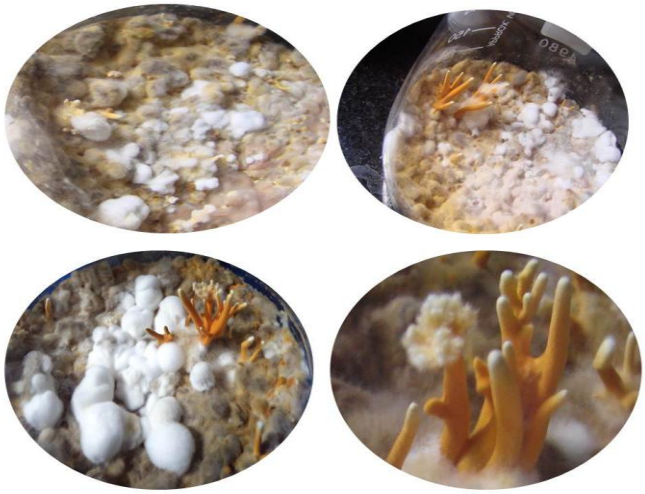

Fig. 12.3: *Cordyceps* grown in culture media with pupa powder

Table 12.6: Results of HPLC analysis of Cor. oph against standard adenosine, cordycepic acid and cordycepin

***Cordyceps* sp.**	**Adenosine**		**Cordycepic acid**		**Cordycepin**	
	Time (min.)	**Conc. (µg/mg)**	**Time (min.)**	**Conc. (µg/mg)**	**Time (min.)**	**Conc. (µg/mg)**
Cor-Oph *(fresh basis)*	9.632	0.345	10.439	6.481	12.437	0.476
Natural *C. sinensis* *(dry basis)*	-	0.028	-	7	-	0.076

12.7 AIP 3478: Studies on nutritional quality of mulberry leaf in improvement of silk, egg productivity and intermediary metabolism of silkworm *Bombyx mori* (Apr. 2012 to Mar. 2015)

M. Munirathnam Reddy (PI) and M. Ramesh

Objective: To determine the role of intermediary metabolism for improvement of nutrition and economic traits of silkworm *Bombyx mori* L.

Four trials of bioassay, grainage performance and biochemical estimations of total proteins, free amino acids, lipids, free fatty acids, carbohydrates in different tissues *viz.,* silk gland, midgut and haemolymph of CSR2, L14 and PM silkworm breeds were completed. Average data of four trials revealed that cocoon weight ranged between 1.114 and 1.664g, shell weight between 0.165 and 0.379 g, shell % between 14.80 and 22.75 and egg recovery/kg cocoons between 65.11 and 69.64 g (Table 12.7).

Table 12.7: Cocoon parameters and egg recovery details of pure breeds (Mean of four trials)

Breed	Cocoon weight (g)	Shell weight (g)	Shell %	Egg recovery (g/kg cocoons)
CSR2	1.664±0.061	0.379±0.011	22.75±0.425	66.09±5.123
L14	1.271±0.147	0.230±0.039	17.98±1.143	69.64±9.761
PM	1.114±0.080	0.165±0.016	14.80±0.766	65.11±2.554

Total protein values ranged from 21.30 to 130.45 mg/g, free amino acids from 28.26 to 106.84mg/g, the total lipid from 25.84 to 46.39 mg/g, free fatty acids from 26.14 - 37.40 mg/g. CSR2 showed the highest values for these parameters in the haemolymph followed by silk gland, while, PM had the least values. The total carbohydrates were found to range from 16.43 to 58.45 µg/mg, glycogen levels from 8.12 to 16.26 µg/mg, GG6PDH enzyme form 0.176 -0.265 µ moles/mg/h and SDH enzyme from 3.18-3.92 µ moles/mg/h.

13. REELING

13.1 SIM 0037: Evaluation of post-cocoon parameters of cocoons generated in CSRTI, Mysore (Apr. 2012 to Mar. 2014)

Y. C. Radhalakshmi (PI), Kariyappa and K. P. Shivakumar

Objective: To evaluate the cocoon characteristics and post cocoon parameters of cocoons received from sections of the institute and its nested units.

A total of 797 cocoon lots received under this project for test reeling were assessed, stifled, conditioned and stored for test reeling. 678 lots were test reeled and the reeling performance was studied and data sent to the concerned sections/units.

14. SILKWORM CROP PROTECTION

14.1 SPT 0024: Maintenance of silkworm pathogens and testing their virulence at periodic intervals (July, 2010 to June, 2013)

M. Balavenkatasubbaiah (PI), K. Chandrasekharan and A. R. Narasimha Nayaka

Objective: To maintain the silkworm pathogens in pure form and periodically assess their virulence and pathogenicity.

Pure stocks of viral pathogens *viz*., BmNPV, BmIFV, BmDNV, bacterial pathogens *viz*., *Streptococcus* sp., *Staphylococcus* sp. and *Bacillus thuringiensis,* fungal pathogens *viz*., *Beauveria bassiana, Spicaria prassina*, *Aspergillus tamarii* and *Aspergillus flavus* and different microspordia *viz*., NIK-1Bm, NIK-2Bm, NIK–3Bm, NIK-4Bm, NIK-5Bm and NIK-6Bm were maintained. Virulence of these pathogens to silkworms was tested at periodic intervals. The results indicated that all the pathogens are virulent to silkworm (Table 14.1 & 14.2).

Table 14.1: Results of virulence test of viral and bacterial pathogens

Viral Pathogen	Concentration	Mortality/ infection (%)	Bacterial pathogen	Concentration	Mortality/ infection (%)
BmNPV (POBs/ml)	1×10^7	66.63±5.00	*B. thuringiensis*	1×10^8	100
	1×10^6	47.00±4.60		1×10^7	100
	1×10^5	32.17±1.90		1×10^6	61.33±17.60
BmIFV (dilution of stock)	10^{-1}	100	*Streptococcus* sp.	1×10^8	36.67± 3.30
	10^{-2}	78.17±2.60		1×10^7	17.00±3.20
	10^{-4}	66.67±2.20		1×10^6	07.67±1.90
BmDNV (dilution of stock)	10^{-1}	100	*Staphylo-coccus* sp.	1×10^8	26.83±4.50
	10^{-2}	82.50±2.20		1×10^7	11.66±1.90
	10^{-4}	61.00±2.40		1×10^6	03.33±1.20

Table 14.2: Results of virulence test of fungal and microsporidian pathogens

Fungal Pathogen	Conc. (conidia /ml)	Mortality/ infection (%)	Micro-sporidian pathogen	Conc. (spores/ml)	% Mortality during		Mortality/ infection (%)
					Larva	Pupa	
B. bassiana	1×10^7	100	NIK- 1Bm	1×10^7	4.33±1.53	6.33±0.57	45.66±1.50
	1×10^6	97.17±3.70		1×10^6	4.33±1.53	3.66±1.60	44.00±1.00
	1×10^5	64.33±14.60		1×10^5	2.66±0.56	2.67±1.50	32.00±1.50
S. prassina	1×10^7	38.50±4.90	NIK- 2Bm	1×10^7	14.33±1.53	9.00±1.73	49.00±2.80
	1×10^6	20.67±4.30		1×10^6	10.00±0.58	1.33±0.58	45.66±1.00
	1×10^5	05.17±1.50		1×10^5	0.00	0.00±1.00	26.66±1.50
A. tamarii	1×10^7	100	NIK- 3Bm	1×10^7	10.33±0.57	1.67±0.57	57.66±1.53
	1×10^6	100		1×10^6	21.25±0.57	2.67±0.57	36.00±1.53
	1×10^5	94.33±2.50		1×10^5	0.00	0.00	26.67±1.53
A. flavus	1×10^7	100	NIK-4Bm	1×10^7	14.33±1.53	9.00±1.73	49.00±2.80
	1×10^6	100		1×10^6	9.00±2.00	6.66±0.57	52.00±1.15
	1×10^5	91.50±2.50		1×10^5	1.00±0.00	1.00±1.00	67.00±1.12
			NIK-5Bm	1×10^7	32.66±1.53	1.00±1.00	36.33±0.53
				1×10^6	4.00±1.00	4.33±0.58	34.00±2.65
				1×10^5	1.66±0.58	2.33±0.58	34.00±2.65
			NIK-6Bm	1×10^7	12.33±1.15	2.33±0.53	45.66±1.53
				1×10^6	3.66±0.57	0.66±0.57	36.00±1.00
				1×10^5	0.00	0.00	20.66±1.53

Note: Aspergillus spp. were inoculated to the silkworms after I moult. Other pathogens were inoculated after II moult.

14.2 SPT 0039: Identification of factors responsible for silkworm crop loss due to diseases at field level and its impact on cocoon productivity (Jul. 2012 to Dec. 2014)

K. Chandrasekharan (PI), A. R. Narasimha Nayaka, M. Balavenkatasubbaiah, M. Maheshwari[1], N. Shivashankar[1], V. B. Mathur[2], S. Raja Kumar[3], T. Thirunavukkarasu[4], N. G. Selvaraju[5], B. Kasi Reddy[6], P. Venkataramana[7], M.Venkateswara Rao[8]

[1]Regional Sericultural Research Station, Kodathi, [2]Research Extension Centre, Sub-unit, Maddur, [3]Regional Sericultural Research Station, Salem, [4]Research Extension Centre, Gobichettipalayam, [5]Research Extension Centre, Udumalpet, [6]Research Extension Centre, Madakasira, [7]Research Extension Centre, Vikarabad, [8]Research Extension Centre, Eluru

Objective: Estimation of extent of crop loss due to the silkworm diseases through fortnightly survey in 3 areas in the three states of Karnataka, Andhra Pradesh and Tamil Nadu.

Fortnightly survey on the silkworm disease incidence was conducted from October, 2012 to March, 2013 in the selected areas of the three states. Number of larvae/ sq ft. during the V inster was recorded and the total number of larvae on the day of survey was estimated. 10% of the bed area was observed for silkworm disease *viz*., Grasserie, Flacherie, Muscardine and Pebrine. The percent prevalence of each disease was determined. Cocoon yield details of the sampled rearers was also collected after the completion of crop (Table 14.3).

Table: 14.3: Disease incidence

District surveyed	Percentage incidence			Cocoon yield (kg/100 dfls)
	Grasserie	Flacherie	Muscardine	
Bengaluru Urban	2.00	1.86	0.00	74.08
Kolar	0.38	3.08	0.02	74.92
Mandya	1.28	3.47	0.25	60.35
Ranga Reddy	2.22	0.73	0.58	66.60
W. Godavari (Eluru)	8.93	1.75	0.93	56.83
Anantapur	0.79	1.22	0.77	67.68
Salem	0.96	0.75	0.00	60.37
Erode	0.40	2.10	0.00	69.88
Tirupattur	0.27	0.31	0.00	77.58

14.3 SPT 0045A: Identification of probiotic bacteria from the mulberry silkworm and study their antibacterial activity against the bacterial pathogens of silkworm, *B. mori* L. (Oct. 2012 to Mar. 2014)

K. Chandrasekharan (PI), M. Balavenkatasubbaiah and A. R. Narasimha Nayaka

Objective:
- Isolation and multiplication of probiotic bacteria from mulberry silkworm.
- To study their antibacterial activity against pathogens of silkworm.

Isolated one bacterium from the gut of mulberry silkworm and maintained in pure form on nutrient agar medium. The isolation trials indicated the presence of many bacteria other than the pathogenic species, which may be probiotic in nature.

14.4 PPE 3455: Habitat studies - Impact of crop diversity on conservation and performance of natural enemies in mulberry eco-system (Sep. 2011 to Aug. 2014)

J. B. Narendra Kumar (PI), B. T. Srinivasa, M. Noble Morrison[1], R. Meenal[2], and V. B. Mathur[3]

[1]Research Extension Centre, Madiwala, [2]Regional Sericultural Research Station, Chamarajanagara, [3]Research Extension Centre, Sub-unit, Maddur

Objective: To determine the occurrence of insect pests and natural enemies in mulberry eco-system under irrigated, semi-irrigated and rain-fed conditions in relation to other crops grown in the vicinity.

Data on the incidence of mulberry pests and abundance of natural enemies were recorded at monthly intervals in 15 mulberry gardens each in irrigated (Mandya district), semi-irrigated (Kolar district) conditions and 10 mulberry gardens in rain-fed (Chamarajanagara) conditions with crop diversities of Sugarcane, Paddy (irrigated), Tomato, Marigold (semi-irrigated) and mixed crop species (rain-fed) keeping mulberry gardens surrounded by mulberry as control.

Irrigated belt of Mandya district

In all the mulberry gardens with crop diversity of Mulberry:Sugarcane, Mulberry:Paddy and Mulberry:Mulberry (control), incidence of leaf roller and tukra mealybug did not vary significantly with leaf roller incidence of 10.68%, 10.32% & 9.83%, respectively. Incidence of mealybug was 4.12%, 2.53% & 3.2%. Among the natural enemies, *Scymnus coccivora* was recorded in 2.57, 1.77 & 2.57% respectively followed by *Menochilus sexmaculatus* (1.42, 0.98 & 1.18) and *Apanteles* sp. (0.92, 0.77 & 0.63%). No relationship with crop diversity surrounding mulberry was observed.

With regard to recovery of *Scymnus* beetles after inoculative release, there existed a relationship with the crop diversity. Highest recovery (509.7%) was recorded in control (Mulberry:Mulberry) followed by Mulberry:Sugarcane (395.6) and Mulberry:Paddy (298.1%). This clearly showed that mulberry itself may be considered as a banker plant, which supports natural enemies, especially Coccinellids under irrigated conditions.

Semi-Irrigated belt of Kolar district

In all the mulberry gardens with crop diversity of Mulberry:Tomato, Mulberry:Marigold and Mulberry:Mulberry (control), incidence of thrips and tukra mealybug did not vary significantly with Thrips incidence being 7.86%, 6.87% & 7.28%, respectively followed by tukra mealybug at 4.95%, 4.4% & 5.85%. Among the natural enemies, *S. coccivora* (2.93, 3.73 & 3.7%) and *M. sexmaculatus* (2.63, 2.62 & 2.17%) were recorded. No relationship with crop diversity surrounding mulberry was recorded.

With regard to recovery of *Scymnus* beetles after inoculative release, there existed a relationship with the crop diversity. Highest recovery (416.1%) was recorded in Mulberry:Marigold followed by Mulberry:Mulberry *ie*., control (336.9%) and Mulberry:Tomato (264.2%). This clearly indicated that Marigold may be considered as a banker plant, which supports natural enemies, especially Coccinellids.

Rain fed belt of Chamarajanagara district

In the rainfed gardens with crop diversity of mixed crop species, pest incidence was negligible, except for termite problem of 8.4% (control: 9.4%) especially from January to April when the mulberry plants were almost without foliage. No relationship existed between crop diversity and pest incidence.

With regard to recovery of *Scymnus* beetles after inoculative release, there existed a relationship with the crop diversity. Highest recovery (665.9%) was recorded in Mulberry:Mixed crop species, followed by Mulberry:Mulberry *ie*., control (178.1%). This clearly revealed that mixed crop species comprising of cowpea, red gram, cotton, horse gram, maize, castor *etc*., may be considered as very good eco-feast crop plants, which support natural enemies, especially Coccinellids.

14.5 PRE 3467: Evaluation of available management strategies of giant african snail, *Achatina fulica* Bowdich in mulberry eco-system (Apr. 2012 to Mar. 2014)

B. T. Srinivasa (PI), J. B. Narendra Kumar, P. M. Pratheesh Kumar, and M. R. Subrahmanyam[1]

[1]Research Extension Centre, Sub-unit, Kanakapura

Objective:
- To monitor giant African snail population in hot spot area and estimate mulberry leaf yield loss.
- To identify suitable mechanical and chemical methods for the management of giant African snail in mulberry crop system.
- To determine safe period of the effective chemicals used in management of giant African snail.

Five mulberry gardens were selected in the two hot spot areas of Ramanagara and Kanakapura. Regular field survey was carried out in these areas for recording snail incidence and determine leaf yield loss. No snail population was recorded in the field due to severe drought situation. Snail culture was maintained in the laboratory on cabbage and carrot for conducting experiments on evaluation of botanicals, bio-formulations and chemicals against the molluscan pest. Besides, *Aeromonas* bacterial culture was also cultured in the laboratory.

Two bio-formulations namely *Aeromonas salmonicida* and *A. hydrophila* each at 1 x 10^8 cells/ml were sprayed on 10 snails in four replications. The treatment with *A. salmonicida* resulted in 60% mortality at 20 days after treatment (DAT) and 100 % mortality at 25 DAT. However, treatment with *A. hydrophila* did not cause any mortality. Three botanicals *Artimisia absinthium, Adathoda vesica* and Navinya (product for control of root rot in mulberry) were tested against 10 snails in four replications.These three products were not found effective as no mortality was recorded.

Three chemicals, Metaldehyde, DDVP and Copper oxy-chloride were tested for their efficacy against 10 snails each in 4 replications. Placement of Metaldehyde (2.5% pellets) and dusting of copper oxy-chloride (50% WP) caused 100% mortality after 48 h. However, spray of 0.2% DDVP caused 55.5% mortality after 48 h.

14.6 SPT 0014: Maintenance of mother culture for production of recommended bio-control agents and mass release of recommended bio-control agents of sericultural pests in CSR&TI Campus (Continuous)

Vinod Kumar (PI), J. B. Narendra Kumar, B. T. Srinivasa, A. V. Mary Josepha

Objective:
- To maintain nucleus culture of uzi fly parasitoids and their host insect.
- To maintain nucleus culture of parasitoid and predators of mulberry pests and their host insects.
- To release bio-control agents in CSRTI campus for control of mulberry pests and uzi fly.
- To mass produce bio-control agents and supply to stake- holders.

Nucleus cultures of five parasitoids namely *Nesolynx thymus*, *Exoristobia philippinensis*, *Tetrastichus* sp., *Trichopria* sp. and *Dirhinus* sp., two predators of mealy bug *Cryptolemous montrouzieri* & *Scymnus coccivora* and one egg parasitoid of lepidopteran pest *ie*., *Trichogramma chilonis* besides host culture of House fly, pink mealy bug and *Corcyra cephalonica* were maintained throughout the year. During the period, a total of 3,767 pouches of *N. thymus*, 8,375 *C. montrouzieri* beetles (67 boxes), 2,80,500 *S. coccivora* beetles (1,122 boxes) and 461 Tricho-cards were produced.

1443 pouches (144.3 lakh adults) of *N. thymus,* 48,000 predatory beetles (200 boxes) and 322 Tricho-cards were released in CSRTI campus, which resulted in keeping pest incidence below 5%. A total of 1,423 pouches of *N. thymus*, 3,875 *C. montrouzieri* beetles (31 boxes) and 2,16,000 *S. coccivora* beetles (864 boxes) were sold generating an income of Rs. 1,50,090.

14.7 CSS 2107: Forewarning and forecasting of mulberry and silkworm pests (Continuous)

M. A. Shekhar (PI), B. T. Srinivasa, J. B. Narendra Kumar, A. V. Mary Josepha, B. Mallikarjuna[1], M. Noble Morrison[2], S. Radhakrishnan[3], S. Balasaraswathi[4], A. Gnanakumar Daniel[5], T. V. S. S. Rao[6] and Srinivasalu Reddy[7]

[1]Regional Sericultural Research Station, Chamarajanagara, [2]Research Extension Centre, Madiwala, [3]Regional Sericultural Research Station, Salem, [4]Research Extension Centre, Krishnagiri, [5]Research Extension Centre, Samayanallur, [6]Research Extension Centre, Eluru and [7]Regional Sericultural Research Station, Anantapur

Objective: To monitor the incidence of major mulberry pests in Karnataka, Tamil Nadu and Andhra Pradesh and issue forewarning to stakeholders.

Fortnightly survey on prevalence of mulberry and silkworm pests was conducted in CSR&TI, Mysore. Data was also collected from 7 nested units, RSRS, Chamarajanagara, REC, Madiwala, RSRS, Anantapur, REC, Eluru, RSRS, Salem, REC, Krishnagiri and REC, Samayanallur. The results are presented in Table 14.4.

Table 14.4: Average incidence (%) of major mulberry pests and uzi fly

Centres	Major pests of mulberry			Uzi fly
	Tukra mealy bug	Leaf roller	Thrips	
CSRTI, Mysore	2.42 (0.62-7.5)	0.92 (0-4.5)	1.72 (0-5.32)	1.61 (0.5-2.5)
REC, Madivala	5.48 (0.5-11.25)	4.25 (0-20.0)	8.58 (2.35-26.13)	0.22 (0-0.58)
RSRS, Ch'Nagara	1.84 (0-6.0)	0 (0)	2.65 (0-9.5)	1.45 (0-6.83)
RSRS, Salem	5.32 (1.46-10.28)	3.71 (0-8.86)	8.86 (0.52-32.1)	1.77 (0.8-6.26)
REC, S'nallur	5.00 (0.74-10.04)	13.67 (5.6-35.1)	6.84 (0.3-15.28)	1.87 (1.37-2.24)
REC, Krishnagiri	3.36 (1.08-7.06)	3.76 (0-9.08)	5.55 (1.12-11.08)	2.58 (0.66-5.01)
RSRS, Anantapur	16.25 (4.34-34.8)	0 (0)	7.23 (1.64-19.08)	4.76 (0-11.25)
REC, Eluru	7.96 (0-19.65)	2.48 (0-11.0)	17.82 (3.15-25.14)	2.88 (0-14.44)

Figures in parenthesis indicate the range.

14.8. Establishment of Sub-Distributed Centres (Sub-DIC) under Biotechnology Information system network programme (BTISNet) of Dept. of Biotechnology, Govt. of India

Coordinators: S. M. H. Qadri and S. K. Ashwath

Objective:

- Maintain information repository of silkworm and mulberry germplasm resrouces.
- Develop and maintain database of silkworm and mulberry genome resources.
- Conduct training and workshops to create awareness in the area of bioinformatics.
- Guide students in project and dissertation work.
- Host database through website and provide online support for seri-biotechnology and seri-bioinformatics resources.

Eight databases *viz*., Silkprot, SilkTF, Mulberry genome database, Silk e-lab, Database of DNA sequences for important plant genes in mulberry, Soil info, Database on mulberry pests and diseases and Database on silkworm pests and diseases were updated and maintained. A two day workshop on Bioinformatics and its applications was held in which 32 scientists from CSRTI, Mysore and Regional stations participated. The workshop deliberated on basic genetics, silkworm and mulberry biotechnology, integration of proteomics and genomics, bioinformatic tools and techniques, IT applications, internet application using open source software, biologicl databases, structural biology, 3D structure of protein visualization and drug designing.

15. SERICULTURE EXTENSION, ECONOMICS AND MANAGEMENT

15.1 MOE 3458: A study on adoption of pest and disease management strategies in sericulture (Oct. 2012 to Mar. 2014)

B. Gangadhar (PI), M. R. Subrahmanyam[1] T. Mogili[2] and T. Thirunavukkarasu[3]

[1]Research Extension Centre, Kanakapura, [2]Research Extension Centre, Venktagirikota, [3]Research Extension Centre, Gobichettipalayam

Objective:
- To estimate the extent of damage caused by different pests and diseases on mulberry and silkworm.
- To determine adoption level of management practices for the pests and diseases of mulberry and silkworm.
- To investigate the impact of key personal, psychological, socio-economic and institutional factors on adoption of pest and disease management practices, and
- To document constraints faced by the farmers in adoption of pest and disease management practices.

Primary data was collected from a sample of 60 farmers in Chittoor district of Andhra Pradesh and 40 farmers in Ramanagara district of Karnataka.

15.2 AIB 3488: Pre-authorization field trials of L14 x CSR2 (Apr. 2012 to Mar. 2014)

Executive Authority: S. M. H. Qadri, V. Sivaprasad[1], Arindam Basu[2]

Project Coordinator: S. Nirmal Kumar

Investigators: Rama Mohana Rao (up to 31-07-2012), Dayananda, V. Lakshmanan, P. G. Joge, T. Thippeswamy, J. P. Renukeswarappa, S. Purushotham, D. S. Somaprakash, Issac Joseph, Chikkanna, S. B. Kulkarni, G. S. Vindhya, S. B. Nagaraju, M. Balavenkatasubbaiah, K. Chandrasekharan, Y. C. Radhalakshmi, K. P. Shivakumar, Kariappa, S. Lakshmanan, C. Jaishankar[3], R. Balakrishna[4], Ch. Satyanarayanaraju[5], D. S. Chandrashekar[6], Subhash V. Naik[2], B. M. Mahadevaiah[2]

[1]National Silkworm Seed Organisation, Bengaluru, [2]Central Silk Technological Research Institute, Bengaluru, [3]Regional Sericultural Research Station (RSRS), Kodathi, [4]RSRS, Salem, [5]RSRS, Anantapur, [6]RSRS, Chamarajanagara

Objective: Large scale pre-authorisation evaluation of new silkworm hybrid L14 x CSR2 with respect to cocoon yield and quality in comparision with PM x CSR2

A total of 3.02 lakh dfls of L14 x CSR2 and 10,000 dfls of PM x CSR2 were distributed through RSRSs and RECs of Andhra Pradesh, Karnataka, Tamil Nadu and Maharastra states.

Table 15.1: Rearing peformance of L14 x CSR2

#	State	No.of farmers (No.)	Dfls distributed (No.)	Yield/100 dfls (kg)	Rate/kg cocoons (Rs.)
1	Karnataka	753	176400	52.52	278.0
2	Andhra Pradesh	238	66500	50.52	261.5
3	Tamil Nadu	280	38750	52.89	270.5
4	Maharashtra & MP	80	20700	52.94	185.5
	Total/ Average	**1351**	**302350**	**51.50**	**248.86**

16. SERICULTURE ENGINEERING

16.1. Design and development of tools, equipment and machines for sericulture

a. Cocoon harvester for collapsible plastic mountages

A Cocoon Harvester to facilitate the rearers for quickly harvesting the cocoons from plastic collapsible mountages was designed and developed. Prototype of the machine developed took on an average 4-5 seconds to harvest cocoons from one plastic mountage. There was no damage to the cocoons and were also deflossed after their detachment from plastic mountage. The machine also separated dust and litter from cocoons. The machine was released at sericultural farmers' workshop at Bagalakote on 4th January 2013. The machine will be offered to National Research Development Corporation, New Delhi, for commercialization.

Fig. 16.1: Machine for harvesting cocoons from collapsible plastic mountages

b. Mechanized rearing beds for late-age silkworm rearing

The mechanized rearing beds for late-age rearing of silkworms were designed and developed in view of shortage of workers and increases in wages to facilitate large scale silkworm rearing. The first prototype has been designed and developed which is under study/testing for further improvement. The system consists of PVC stands of uniform width. A dusting unit has also been mounted on the rack, which operates very conveniently. A unit for facilitating shoot feeding to silkworm is under development.

Fig. 16.2: Mechanized rearing beds for late-age silkworm rearing

Fig. 16.3: Dusting unit on the mechanized rearing beds

c. High capacity leaf chopper

Work was carried out on design and development of high capacity leaf chopper for chawki centres. The capacity of the presently available leaf chopper is 150-200 kg/h and there is not much scope to enhance its capacity. Since there is a demand from chawki rearing centres for leaf choppers with higher capacity of atleast

500-600 kg/hr, modifications in feeding mechanism of the machines have been carried out to feed loose mulberry leaves, as the original machine is designed for cutting fodder crops, which have long stalks. The preliminary testing of the machines showed the machine can chop atleast 500 kg of mulberry leaves in one hour.

Fig. 16.4: High capacity mulberry leaf chopper for commercial chawki rearing centres

16.2. Training on mechanization in sericulture

During the year 700 persons were imparted training on different aspects of mechanization in sericulture and silkworm rearing houses. 6,000 farmers, students, reelers, *etc*., who visited the Sericultural Engineering Division were also sensitized.

16.3. Fabrication & supply of machines

During the year, the following units costing Rs. 1.99 lakhs were fabricated and supplied to stakeholders, sericulture institutions and organizations.

Seri-heaters	- 40 units @ Rs. 4,500/unit
Mulberry cutting preparation machine	- 02 units @ Rs. 9,000/unit
Plastic mountage folding tool	- 05 units @ Rs. 200/unit

17. REGIONAL SERICULTURAL RESEARCH STATION, KODATHI, KARNATAKA

17.1 CSS(K) 2105: Monitoring of soil fertility status in sericultural areas of Karnataka to improve soil health and nutrient management for enhancing quality mulberry leaf and cocoon production (Aug. 2010 to Jul. 2013)

C. Jaishankar (PI), P. Sudhakar, N. Shivashankar, M. T. Himantharaj[1], M. R. Subrahmanyam[2], S. K. Bhargava[3] and M. Noble Morrison[4]

[1]Research Extension Centre, Chitradurga, [2]Research Extension Centre, Kanakapura, [3]Research Extension Centre, Bidarguppe and [4]Research Extension Centre, Madivala

Objective:

- To evaluate soil fertility status in different sericultural areas of Southern Karnataka and recommend suitable soil amelioration measures for maintaining soil health and nutrient management desired for mulberry.
- To promote awareness among the Sericultural farming community on improvement of soil properties thereby increase quality of leaf and cocoon productivity.

During the period 301 soil samples received from different centres were analysed. Out of this 249 samples were from the sub-units of RSRS and the remaining were from DOS, Karnataka (24) and DOS, Tamil Nadu (28). The results are presented in Table 17.1.

Table 17.1: Range of soil reaction and nutrient parameters of the soil samples analysed

Parameters	Place					
	Haro-hally	Chitra-durga	Madi-wala	Pawa-gada	Kanaka-pura	Koppal
No. of samples	12	68	12	38	91	28
pH	5.40-7.15	5.69-8.21	6.23-7.86	6.01-8.63	5.48-8.03	6.55-8.82
EC(dS/m^2)	0.165-0.573	0.091-1.288	0.052-0.555	0.118-0.840	0.076-0.829	0.092-0.535
Organic carbon (%)	0.272-0.600	0.116-1.257	0.116-1.339	0.121-0.969	0.113-0.990	0.171-1.029
Available P (kg/ha)	36.60-249.40	0.74-347.20	18.70-107.50	15.70-161.20	4.50-134.00	11.90-102.30
Available K (kg/ha)	107.5-376.3	107.5-1182.7	554.8-2472.9	182.2-1021.4	218.0-851.0	--

18. REGIONAL SERICULTURAL RESEARCH STATION, CHAMARAJANAGARA, KARNATAKA

18.1 PPF 3500: Development of seri-lac culture model for income augmentation (Jun. 2012 to Dec. 2016)

K. Srikantaswamy (PI), Mohansundaram[1] and Sibayen Sen[2]

[1]Indian Institute of Natural Resins and Gums, Ranchi, [2]Central Sericultural Research & Training Institute, Mysore

Objective:

- To work out the additional income generating out of lac culture and its economics in relation to mulberry leaf production.
- To asses the soil fertility status of the soil from lac plot and control.
- To find out the cross infectivity studies, if any, from mulberry to lac plant and vice versa.

Seedlings of Lac host plants raised in nursery beds and polythene bags were transplanted with a spacing of 240 cm x 90 cm in between the existing mulberry trees (240 cm x 240 cm) in the RSRS farm. Regular cultural operations like weeding, life saving irrigation and manuring *etc*., were carried out. The seedlings of lac host plant are under establishment. Soil samples were collected before and after the lac host plant transplantation to asses the fertility status.

19. REGIONAL SERICULTURAL RESEARCH STATION, ANANTAPUR, ANDHRA PRADESH

19.1 CSS(A) 2105: Studies on the soil fertility status in different sericultural areas of Andhra Pradesh to improve soil health and nutrient management (Aug. 2010 to Jul. 2013)

P. S. Reddy (PI) and Ch. Satyanarayana Raju

Objective:

- To evaluate soil fertility status in different sericultural areas of Andhra Pradesh and recommend suitable soil amelioration measures for maintaining soil health and nutrient management desired for mulberry.
- To promote awareness among the Sericultural farming community on improvement of soil properties thereby increase quality of leaf and cocoon productivity.

During the year 588 soil samples were analyzed. Soil samples were received from almost all sericulture pockets in the state of Andhra Pradesh. The consolidated data on pH, EC, OC, phosphorus and potash are presented in Table 19.1. The data indicates that pH variation was significant in West Godavari ranging from 3.91

to 7.68. OC ranged from 0.092 to 0.969, phosphorus from 4.97 to 230 and potash from 134 to 1254. In general the pH ranged from 3.91 to 9.05, EC from 0.01 to 0.91, OC from 0.048 to 1.995, Phosphorus from 2.98 to 497 and potash form 25 to 1478. Recommendations were provided to the farmers along with soil test report.

Table 19.1: Consolidated data on pH, EC, OC, P_2O_5 and K2O in the soils of Andhra Pradesh

Place	No. of samples	pH	Electrical conductivity (mmhos/cm)	Organic carbon (%)	P_2O_5 (kg/ha)	K_2O (kg/ha)
Kalyanadurgam	14	7.11-7.88	0.03-0.28	0.35-0.94	5.48-80.14	134 - 538
Madakasira	69	6.53-8.29	0.01-1.04	0.09-0.97	4.97-116	134-1254
West Godavari	52	3.91-7.68	0.01-0.30	0.15-0.96	4.92-75	90-986
Kadapa	57	6.75-9.05	0.06-0.91	0.10-0.93	1.49-91	123-1478
Gorantla	51	6.09-8.07	0.03-0.40	0.10-0.95	4.97-85	134-1165
Dharmavaram	62	7.02-8.72	0.05-0.60	0.05-0.99	3.48-84	90-1030
Rayachoty	45	7.15-8.85	0.02-0.35	0.30-1.85	2.98-105	43-987
V. Kota	45	6.48-8.16	0.03-0.21	0.21-1.11	37-47	25-985
Kadiri	35	6.84-8.54	0.03-0.43	0.16-1.60	3.48-86	25-984
Madanapalli	63	7.08-8.24	0.03-0.66	0.05-1.83	3.48-103	34-965
Vikarabad	90	6.02-8.06	0.01-0.41	0.15-1.80	19.36-99	234-1035
Palamaner	03	7.45-8.30	0.04-0.07	0.25-0.94	11-32	314-890
Aanantapur	01	7.49	0.06	0.25	11.44	314
Hindupur	01	7.39	0.08	0.843	115	269

20. REGIONAL SERICULTURAL RESEARCH STATION, SALEM, TAMIL NADU

20.1 MPT(S) 8002: Studies on rhizosphere microflora of mulberry varieties as influenced by different cultivation practices under alkaline soil conditions (Jul. 2010 to Jun. 2013)

N. Dhahira Beevi (PI) and R. Balakrishna

Objective: To estimate the rhizosphere microbial population including beneficial flora like asymbiotic nitrogen fixers and phosphorus solubilisers in the rhizosphere of mulberry grown under different set of cultivation practices.

The treatments were imposed in ten farmers' gardens in Gobichettipalayam and two in Krishnagiri area during April to September for two crop seasons. After imposing treatments, rhizosphere soil samples were collected for microbiological analysis and the microbial load was estimated. Significantly higher population of bacteria, fungi and actinomycetes were recorded in drip irrigation + green manuring treatment in all the three seasons (Table 20.1).

Table 20.1: Rhizosphere microflora as influenced by different cultivation practices

Treatments	CFUs/g of dry soil					
	Bacteria ($1x10^7$)		Actinomycetes ($1x10^3$)		Fungi ($1x10^5$)	
	Apr. to Jun.	Jul. to Sep.	Apr. to Jun.	Jul. to Sep.	Apr. to Jun.	Jul. to Sep.
T1: Flood irrigation	9.29	12.95	0.05	1.16	2.95	4.50
T2: Drip irrigation	13.15	18.61	1.29	1.09	5.84	4.93
T3: Flood irrigation + Green Manuring	12.65	17.92	1.15	2.95	6.80	6.29
T4: Drip irrigation + Green Manuring	15.39	28.15	1.47	2.90	7.19	12.84
Significance at 5%	3.21	3.14	NS	0.84	1.05	1.26

Each value is average of twelve farmers

20.2 MPR (S) 8003: Effect of shoot harvest and biomass yield of mulberry on soil organic carbon depletion in mulberry fields (Jul. 2010 to Jun. 2013)

S. Masilamani (PI) and N. Dhahira Beevi

Objective:
- To estimate input and output of biomass incorporation/production in farmers' mulberry gardens.
- To quantify loss of organic carbon and develop new technology for improving soil organic carbon status in mulberry fields.
- To fine tune the existing recommendations, if required.

The benchmark survey was completed and farmers were identified for imposing treatments. The following treatments were imposed.

T0: Control (Existing practices)

T1: FYM + Sericultural compost + Vermicompost @ 20 + 5 + 5 MT/ha/yr; Biofertilizer 20 kg/ha/yr in 5 splits; Phospho-bacteria 10 kg/ha/yr in 2 splits; green manure Dhaincha (*Sesbanica aculeate*) 2 crops/yr during monsoon & 50% of recommended dose of chemical fertilizers (NPK)

T2: FYM + Sericultural compost + Vermicompost @ 20 + 5 + 5 MT/ha/yr; Biofertilizer 20 kg/ha/yr in 5 splits; Phosphobacteria 10 kg/ha/yr in 2 splits; green manure Dhaincha (*Sesbanica aculeate*) 3 crops/yr; & 25% of recommended dose of chemical fertilizers (NPK)

T3: FYM + Sericultural compost + Vermicompost @ 20 + 5 + 5 MT/ha/yr; Biofertilizer 20 kg/ha/yr in 5 splits; Phosphobacteria 10 kg/ha/yr in 2 splits; green manure Dhaincha (*Sesbanica aculeate*) 4 crops/yr & 25% of recommended dose chemical fertilizers (NPK).

Four harvests were made during the period and there was no significant difference observed among the treatments for first and second crop. However, treatments 3 & 4 have shown significant increase in leaf yield in Crop-III & IV.

20.3 SEM (S) 8001: Studies on adoption of silkworm disease control measures and its impact on cocoon production in farmers' fields under Tamil Nadu conditions (Jul. 2010 to Jun. 2013)

C. A. Mary Flora (PI) and R. Balakrishna

Objective:
- To delineate the extent of adoption by different categories of farmers and find out factors influencing the adoption levels.
- To find out the reasons for non-adoption or partial adoption and suggest fine tuning of technologies for overcoming the constraints.

Data on knowledge, adoption levels of silkworm disease control measures were collected from 140 sericulturists of Salem and Namakkal districts. In Salem district, the knowledge level was 81% on silkworm disease preventive measures followed by silkworm disease control measures during silkworm rearing (75.33%) and disease management practices under low temperature and high humidity conditions (73.15%), whereas, the adoption level was 77.34% on silkworm disease preventive measures followed by silkworm disease control measures during silkworm rearing (60.33%) and disease management practices under high temperature and low humidity conditions (55.43%). In Namakkal district, the level of both knowledge and adoption was maximum on silkworm disease preventive measures (78% and 87.33%), followed by silkworm disease control measures during silkworm rearing (65% and 56.67%) and disease management practices under low temperature and high humidity conditions (64.85% and 55.29).

20.4 SEM (S) 8004: Studies on adoption of mulberry and silkworm pest management technologies (IPM) by the sericulturists in Tamil Nadu (Jul. 2010 to Jun. 2013)

S. Balasaraswathi (PI)

Objective:

- To find out the impact of IPM on use of pesticide and biocontrol agents.
- To find out the level of knowledge and adoption of mulberry and silkworm pest management (IPM) practices by the sericulturists in Tamil Nadu.
- To identify the factors influencing and constraints for adoption of pest management practices.
- To fine-tune the recommended IPM packages.

Data on adoption of IPM of mulberry and silkworm pests were collected from 70 sericulturists in Salem and Krishnagiri districts by interview method with the help of structured questionnaire. Adoption levels of IPM practices of mulberry pests were found to be full in 8.6% (2.9 to 17.1%), partial in 60.7% (47.1 to 68.6%) and non-adoption in 30.7% (21.4 to 48.6%). The adoption level of IPM of uzifly was observed to be full in 21.4%, partial in 75.7% and non-adoption in 2.9% in Krishnagiri and Salem districts. Non availability of IPM inputs on time (20.0%), low adoption by neighbourhood farmers (32.9%), difficulty in adoption of IPM practices (31.4%), were the constraints expressed by the farmers. Among the respondents, 42.9% were aware of the IPM practices but not convinced, 7.1% had no belief in IPM practices, 4.3% had no incidence of pests and 7.1% were not aware of IPM practices.

20.5 SEM(S) 8006: A study on the adoption of recommended packages of practices followed by sericulturists of different farm size in Tamil Nadu (Jul. 2010 to Jun. 2013)

S. Rajakumar (PI), S. Balasaraswathi and S. Lakshmanan

Objective:

- To find out the level of adoption of recommended packages of practices by different farm size groups in traditional and non-traditional regions
- To find out factors influencing the adoption levels of packages and constraints, if any
- To fine tune the technologies for improving the level of adoption
- To find out the socio-economic profile of farmers of different farm sizes in traditional and non-traditional regions.
- To work out the economics of sericulture on different farm size groups in traditional and non-traditional regions.

To assess the level of adoption of new sericulture technologies and also to find out the extent of the association of the socio-economic profile of farmers with different farm sizes, a structured questionnaire was prepared and data was collected from 60 farmers each in Krishnagiri and Erode districts. Four categories of farm sizes, *viz*., 1 acre, 1 - 2 acre, 2 - 3 acre and above 3 acre were covered. The adoption indices of mulberry and sericulture technologies in Erode was found to be higher with 92% and 84%, whereas in Krishnagiri, it was from 82% and 74%, respectively. It was also observed that adoption indices of mulberry cultivation technologies were higher than that of silkworm rearing technologies in both areas. With regard to mulberry cultivation, majority of the farmers both in Erode and Krishnagiri expressed that the major constraints for adoption was high cost of input, non availability of labour, non availability of credit facilities and lack of awareness.

A significant association was found between adoption level of sericulture technologies and the socio-economic variables like age, education level, experience, annual income, land holdings, training undergone,

information seeking behavior, mass media participation and social participation. The input cost in cocoon production per acre in Erode was Rs.1.65 lakhs (C: B 1:152) and in Krishnagiri Rs.1.10 lakhs (C: B 1:149).

20.6 CSS(S) 2105: Studies on the soil fertility status in different sericultural areas of Tamil Nadu to improve soil health and nutrient management (Sep. 2010 to May 2013)

N. Dhahira Beevi (PI), J. Ravikumar and R. Balakrishna

Objective:

- To evaluate the soil fertility status in different sericultural areas of Tamil Nadu and recommend suitable measures to maintain soil health and nutrient management.
- To recommend suitable reclamation measures for problematic soils and promote awareness among the farmers on improvement of soil properties and leaf productivity.

A total of 3941 soil samples from 12 districts of Tamil Nadu were analyzed for pH, EC, OC, P and K. The categorization of soil samples based fertility status and other parameters are shown in Tables 20.2 & 20.3.

Table 20.2: Categorization of soils

Parameters	Acidic	Neutral	Alkaline	Highly alkaline
pH	<6.3	6.3-7.2	7.3-8.3	>8.3
	Normal	Critical	Injurious	-
EC (mmhos/cm^2)	<1.00	1.0-2.0	>2.0	-
	Low	Medium	High	-
OC (%)	<0.65	0.65-1.00	>1.00	-
Avail. P (kg/ha)	<15	15-25	>25	-
Avail. K (kg/ha)	<120	120-240	>240	-

Table.20.3: Percentage of soil samples in different categories

pH		EC (mmhos/cm)		OC (%)		Avail. P (kg/ha)		Avail. K (kg/ha)	
Range	%	Range	%	Range	%	Range	%	Range	%
<6.3	00.67	<1	99.55	<0.65	47.43	<15	97.98	<120	0.00
6.3-7.2	35.12	1-2	00.23	0.65-1	23.04	15-25	01.57	120-240	0.00
7.3-8.3	64.21	>2	00.22	>1	29.53	>25	00.45	>240	100.00

Based on the results, suitable reclamation measures along with recommendations were given to farmers. Awareness was created among farmers through training on *Soil Fertility and Integrated Nutrient Management (INM)* and the importance of soil testing was advocated.

VI. PROJECTS FUNDED BY EXTERNAL FUNDING AGENCIES AND COLLABORATIVE PROJECTS

(A) DBT funded projects

A.1 PIE 3451: DNA marker aided analysis of mulberry gene bank towards a core assembly for sustainable conservation and enhanced utilization in crop improvement (Nov. 2010 to Oct. 2013) (in collaboration with CSGRC, Hosur)

V. Girish Naik (PI), M. K. Prithvi Raje Urs, R. Ramesh Krishnan

S. R. Ramesh[1] and K. Jhansi Lakshmi[1]

[1]Central Sericultural Germplasm Resources Centre, Hosur

Objective:

- Identification of a panel of diverse mulberry germplasm amenable to association mapping by marker (genomic and EST SSRs) aided analysis [CSRTI, Mysore]
- Construction of a core sub-set of mulberry germplasm by phenotypic and molecular marker (SSRs and AFLPs) analysis [CSRTI, Mysore & CSGRC, Hosur]
- Evaluation of panel of diverse mulberry germplasm for other important traits *viz*., sprouting, senescence, rooting, leaf quality, yield contributing traits and key morphological characters [CSGRC, Hosur]

The genomic DNA of 997 mulberry germplasm accessions were assembled/isolated from the whole collection (1065 acc.) of the gene bank. A total of 156 mulberry specific microsatellite (SSR) markers were utilized for screening and identification of polymorphic markers for genotyping. The list of SSR markers along with the source is provided in the Table A.1.

Table A.1: Mulberry specific SSR markers (genomic and genic) utilized for screening

Sl. No.	Source	No. of SSR markers
1	UAS, Bangalore	131
2	China (from publication)	10
3	CSRTI, Mysore (designed form EST sequences in NCBI)	09
4	CCMB, Hyderabad (from publication)	06
	Total	**156**

A total of 300 mulberry germplasm accessions under unique collections, were genotyped using 50 polymorphic SSR markers. The groups of germplasm accessions, which were subjected to DNA profiling by SSR markers, are listed in the Table A. 2.

Table A.2: Groups of mulberry germplasm profiled using SSR markers.

Sl. No.	Genotyping groups	No. of acc.
1	Kernel (Breeders' interest genotypes) [UC]	36
2	Japanese and other collection [NUC]	36
3	Chinese and other collections [NUC]	36
4	Exotic + indigenous collections (groups I to VIII) [UC]	466
	Total	574

UC: unique collection, NUC: non-unique collection

Based on the genotypic and phenotypic diversity of unique collection panels of 300 diverse mulberry accessions were identified. Assessment of the panel based on phenomic data was suggestive of the diverse nature of the entries. Genotyping of Kernel accessions (Breeders' interest genotypes) was carried out using 70

(50 polymorphic + additional 20) SSR markers. Dice dissimilarity coefficients ranged from 0.011 (RFS-135 and RFS-175) and 0.610 (Muki and Lamia Bay). PIC values ranged from 0.000 to 0.823 with a mean of 0.276. The number of alleles ranged from 1 to 9 with an average of 3 alleles/primer. Fig. A.1 shows clustering based on SSR marker data. STRUCTURE analysis inferred that majority of the kernel accessions are admixtures.

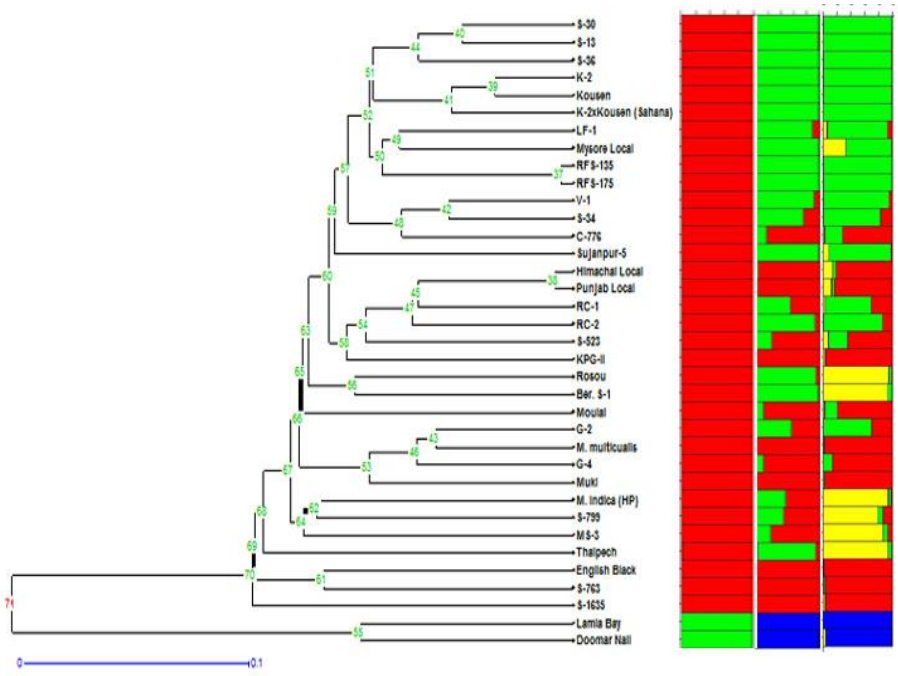

Fig. A.1: Clustering of Breeders' interest genotypes (Kernel) along with STRUCTURE (*k* = 2 - 4) based on microsatellite allelic data.

For the first time, a large number of mulberry specific microsatellite markers were employed to elucidate the diversity, structure and breeding history of mulberry in India using breeders' collection. The heterozygous nature of mulberry was supported by allelic richness (A_R) with a mean of 1.36. Doomar Nali, a wild genotype from Andaman Islands was distinct with maximum number of unique alleles. UPGMA, PCoA and STRUCTURE analysis corroborated with the known genetic relationships and origin. The groupings by STRUCTURE (*k* = 4) confirms parallel breeding efforts undertaken in the eastern, southern and northern regions of the country. The study emphasizes the need for broadening the genetic base of cultivated mulberry by harnessing the natural variation through construction of a core subset. Pedigree was reconstructed for most of the genotypes without having all the potential parents in the analysis. The pedigree reconstruction was consistent with the known records, besides providing interesting leads on the evolution of Indian mulberry varieties.

A.2 PRP 3462: Biological control of fungal root rot disease of mulberry by endophytic bacteria *Burkholderia cepacia and Bacillus subtilis* strains (Nov. 2010 - Nov. 2013)

V. Gunashekar (PI) and B. R. Dayakar Yadav

Objective:

- To study the effect of cell free culture filtrates (CCF) of endophytic bacteria, *Burkholdera cepacia*, *Bacillus subtilis* and *Pseudomonas aereginosa* on radial growth and dry mass of root rot pathogen *Rhizoctonia bataticola*.
- Development of rifampicin resistant bio-control agents (BCAs) and bio-formulations of BCAs and root rot pathogen *Rhizoctonia bataticola*.
- *In vivo* evaluation of BCAs in controlling root rot disease of mulberry.

Biocontrol agents (BCAs) *B. cepacia, B. subtilis and P. aeruginosa* were found effective in suppression of *Rhizoctonia bataticola in vitro.* Talc based formulations of BCAs were effective in controlling root rot disease of mulberry under glass house conditions. The talc-based formulations were viable up to 120 days.

Cell free culture filtrates of *Burkholderia cepacia, Bacillus subtils* and *Pseudomonas aeruginosa* were tested for suppression of *Rhizoctonia bataticola* radial growth and dry mycelial mass at 10%, 25% and 50% concentrations. At 25% and 50% concentrations (v/v) all the strains completely suppressed the growth of *R. bataticola.* At 10% concentration of CCF *B. cepacia* suppressed the radial growth up to 91.75% followed by *P. aeruginosa* (85%) and *B. subtilis* (75%). Similarly, the fungal dry mass decreased as the CCF concentration was increased in all the strains (Table A.3). Rifampicin resistant mutants of *B. cepacia, B. subtilis* and *P. aeruginosa* (100 µg / ml.) were generated and antagonistic nature against root rot pathogen and compatibility among mutants were confirmed (Fig. A.2).

Table A.3. Effect of cell free culture filtrates (CCFs) of selected antifungal strains on radial growth and mycelial dry mass of *R. bataticola*.

Sl. No	Bacterial strain	CCF %	Colony diameter (cm)	Dry mass (g)	% Inhibition
1	*Burkholderia cepacia*	50	00.00.	0.018	92.00
		25	00.00	0.048	81.01
		10	00.66 (91.75%)	0.093	61.50
2	*Bacillus subtilis*	50	00.00	0.029	95.91
		25	00.00	0.071	90.19
		10	02.00 (75 %)	0.225	68.92
3	*Psudomonas aeruginosa*	50	00.00	0.020	97.23
		25	00.00	0.020	96.68
		10	01.20 (85 %)	0.024	96.40
4	Consortium of three Bacteria	50	00.00	0.013	94.62
		25	00.00	0.029	88.01
		10	00.60 (92.5%)	0.065	73.55
5	Control 1*	Nil	08.00	0.724*	-
6	Control 2**	Nil	08.00	0.242*	-
	CD at 5%		0.110	0.056 (C1) 0.052 (C2)	- -

*Control for *B. subtilis* and *P. aeruginosa*

**Control for *B. cepacia* and consortium

Figures in parenthesis indicate the % decrease over control

Mass multiplication of BCAs on talc based formulation and it viability.

Efficient *rif*+ *B. cepacia, B. subtilis* and *P.aeruginosa* were mass multiplied in talc based formulation and stored in conical flasks at room temperature. The viability of BCAs was estimated based on cfu/g talc powder at thirty day intervals. The cfu ranged from 145 -150 at 30 days and it gradually reduced as the days progresed. At 120th day it ranged from 7 - 8 × 10^{8} cfu/g talc (Table A.4).

Table A. 4. Viability of antagonistic bacteria in talc based formulation cfu/ml x 10^8

Baceterial strains	Days after inoculation				
	30	60	90	120	150
B. cepacia	150	49	18	8	1
B. subtilis	152	52	19	9	2
P. aeruginosa	149	48	15	7	1

***In vivo* control of root rot disease of mulberry by endophytic *B. cepacia, B. subtilis* and *P. aeruginosa* under green house conditions.**

Efficacy of the bacterial strains against root rot disease was evaluated under green house condition with mulberry cuttings and saplings planted in pots. The effect on the disease varied with the bacterial strain. Highest survival of mulberry cuttings was recorded in treatment with *P. aeruginosa* (Table A.5).

Table A.5. Effect of BCAs on survival of mulberry cuttings in the presence of root rot pathogen *R. bataticola*

Treatment	No.of cuttings planted	Cuttings dead after infestation (Days after plantation)					Total dead	Survival (%)
		30	45	60	75	90		
B. cepacia	25	2	3	0	2	0	7	72
B. subtilis	25	3	0	2	1	2	8	68
P. aeruginosa	25	1	2	1	2	0	6	76
Control	25	5	2	5	3	2	17	32
Absolute control	25	0	0	0	1	1	2	92

Fig. A.2: Compatibility of BCAs *B. subtilis P. aeruginosa* and *B. cepacia*

B. DST funded project

B.1 MOE: 3463 Popularization of productive bivoltine silkworm double hybrid *Krishnaraja* with the farmers of Karnataka (Oct. 2011 to Sep. 2013)

A. Naseema Begum (PI), S. Nirmal Kumar, S. M. H, Qadri and Sowmya Shree.

Objective: To popularize productive bivoltine silkworm double hybrid *Krishnaraja* (CSR6 x CSR26) x (CSR2 x CSR27) among the farmers of Karnataka.

Initially a survey was conducted and ten farmers were identified for testing the double hybrid along with the control hybrid in five villages of Srirangapattna taluk, Mandya District. The experiment was conducted with 5 farmers in each season with 1000 dfls. Six trials were conducted by distributing 6000 dfls during 2012-13. The average cocoon yield/100 dfls in *Krishnaraja* was 66.1 kg as against 56.9 kg in control hybrid, CSR2 x CSR4.

The cocoons were transacted at Ramanagaram cocoon market. The rate/kg in *Krishnaraja* was Rs.290/kg as compared to Rs.256.30/ kg in control hybrid (CSR2 x CSR4) cocoons (Table B.1 & B.2).

Table B.1: Comparative rearing performance of double hybrid Krishnaraja and CSR2 x CSR4 (Mean of 5 crops)

Hybrid	Total yield (Kg)	Yield /100 dfls (kg)	Rate / kg cocoon (Rs.)
Krishnaraja	3888.3	64.80	297.40
CSR2 x CSR4 (Control)	3432.0	57.20	261.00

Table B.2: Comparative reeling performance of double hybrid Krishnaraja and CSR2 x CSR4

Hybrid	Cocoon weight (g)	Shell weight (g)	Shell (%)	Reela-bility (%)	Fila-ment length (m)	Denier (d)	Raw silk (%)	Neat-ness (p)
Krishnaraja	1.508	0.322	21.35	80	869	2.65	15.66	94
CSR2 x CSR4 (Control)	1.420	0.288	20.31	74	765	2.56	15.41	94

C. Project in collaboration with Seribiotech Research Laboratory, Bengaluru

C.1 ARP 3477: Therapeutic control of microsporidiosis in silkworm through characterization of methionine amino peptidase enzyme genes (METAP2) in *Nosema bombycis* (Apr. 2012 to Mar. 2015)

A. R. Narasimha Nayaka (PI) and [1]K. M. Ponnuvel (SBRL, Bengaluru)

[1]Seribiotech Research Laboratory, Bengaluru

Objective:

- Identification of microsporidian genes controlling MetAP2 enzyme using PCR techniques through specific primers from *Nosema bombycis.*
- Cloning and characterization of MetAP2 of microsporidia.
- Development of a process controlling microsporidiosis using certain chemical compounds in the silkworm.

Microsporidia DNA preparation

The *Nosema bombycis* spores were multiplied by inoculating to the susceptible silkworm breed. After multiplication, *N. bombycis* spores were collected and purified using standard protocol and disrupted using acid-washed 500-µm glass beads. Proteinase K was added to the disrupted spores and the solution was incubated for 15 min at 65°C. DNA was then prepared by phenol/chloroform extraction followed by ethanol precipitation. Purified microsporidian DNA was dissolved in TE buffer used for PCR reaction.

Identification of *Nosema bombycis* MetAP2 genes

To obtain the *Nosema bombycis* MetAP2 genes, a strategy of homology cloning using the polymerase chain reaction (PCR) and degenerate primers to areas of conservation between yeast and mammalian MetAP2 genes was employed. Primer pairs M1 [D(A/V)(R/L)VCDIG] 5'GAYGYIMIBTITGYGAYATIGG3': :M3-[KVAQFEHT] 5'GTRTGYTCRAAYTGIGCIACYTT3', and M2 [QFKIHGG] 5'CARTTYAARATH CAYGGIGG5': :M4 [RGDDY] 5'ARATRTCRTCICCICG3' were designed based on an alignment of the other microsporidian MetAP2 genes. PCR was performed in Eppendorf PCR machine.

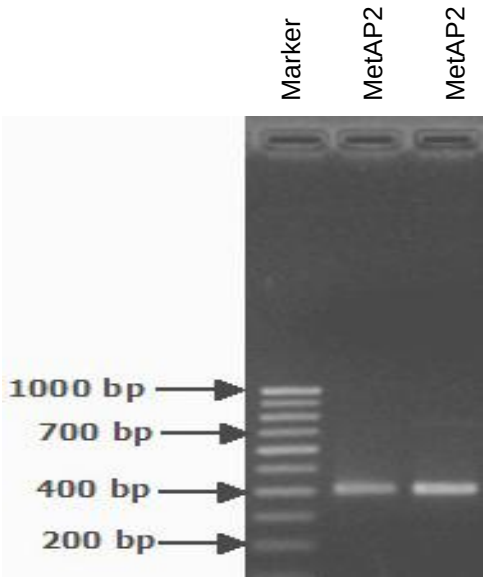

Fig. C.1: PCR amplification of *Nosema bombycis* Methionine Amino peptidase genes (MetAP2) enzyme.

Microsporidian genes controlling MetAP2 enzyme using PCR techniques through specific primers from *N. bombycis* have been identified for further characterization.

D. Multi-institutional projects

D.1 AIB 3498: Popularization of authorized silkworm hybrids among the farmers of south india (Nov. 2012 to Oct. 2014)

The Director, CSRTI, Mysore (Zonal Co-ordintor)

The Director, NSSO, Bengaluru

The Director, CSTRI, Bengaluru

The Director, APPSRDI, Hindupur

The Director, KSSRDI, Bengaluru

Commissioners/Directors of Sericulture, Karnataka, Andhra Pradesh, Tamil Nadu and Maharastra.

Objective: To popularise the authorised hybrids for commercial exploitation.

The parental dfls of silkworm races, CSR16, CSR17, CSR46, CSR47, GEN3 and GEN2 were supplied by CSR&TI, Mysore to NSSO for raising seed cocoons and subsequent generation of hybrid seed. A total quantity of 44,000 dfls of CSR16 x CSR17, 27,500 dfls of CS46 x CSR47 and 24,350 dfls of GEN3 x GEN2 were supplied to farmers of Karnataka, Andhra Pradesh and Tamil Nadu through RSRSs/ RECs

The hybrid CSR16 x CSR17, CSR46 x CSR47 and GEN3 x GEN2 recorded an average cocoon yield of 61.24, 38.73 and 60.66 kg /100 dfls, respectively. The control hybrid CSR2 x CSR4 recorded cocoon yield of 63.30 kg/100 dfls. (Tables D.1 to D.4)

Table D.1: Performance of CSR16 x CSR17

State	Dfls (No.)	No. of rearers	Actual yield (kg)	Yield / 100 dfls (kg)	Cocoon weight (g)	Shell weight (g)	Shell %
Andhra Pradesh	26100	100	15377.89	58.92	1.759	0.368	20.90
Tamil Nadu	14700	88	9940.30	67.62	1.737	0.382	22.00
Karnataka	3200	7	1628.75	50.89	1.615	0.375	21.45
Total/Avg	44000	195	26946.94	61.24	1.704	0.375	21.44

Table D.2: Performance of CSR46 x CSR47

State	Dfls (No.)	No. of rearers	Actual yield (kg)	Yield / 100 dfls (kg)	Cocoon weight (g)	Shell weight (g)	Shell %
Andhra Pradesh	19650	71	7436.05	37.84	1.787	0.368	20.6
Tamil Nadu	800	6	341.50	42.69	1.797	0.365	20.3
Karnataka	7050	30	2873.50	40.76	1.493	0.304	20.4
Total/Avg	27500	107	10651.05	38.73	1.692	0.346	20.4

Table D.3. Performance of GEN x GEN2

State	Dfls (No.)	No. of rearers	Actual yield (kg)	Yield / 100 dfls (kg)	Cocoon weight (g)	Shell weight (g)	Shell %
Andhra Pradesh	4050	15	2360.20	58.27	1.824	0.392	21.49
Tamil Nadu	5050	33	3115.80	61.69	1.759	0.361	20.55
Karnataka	15250	79	9295.30	60.95	1.754	0.375	21.37
Total/Avg	24350	127	14771.30	60.66	1.770	0.373	21.07

Table D.4: Performance of CSR2 x CSR4 (Control)

Total/Average	Dfls (No.)	No. of rearers	Actual yield (kg)	Yield / 100 dfls (kg)	Cocoon weight (g)	Shell weight (g)	Shell %
Total/Avg	9900	28	6266.1	63.3	1.775	0.370	20.8

VII. CENTRAL OFFICE PROJECTS & PROGRAMMES (NATIONAL)

1. All India Co-ordinated Experiment on Mulberry (AICEM) Phase-III

Duration	2011 to 2015
Zonal Coordinator	S. M. H. Qadri
Investigators	**Mala V. Rajan (PI)** [Upto Oct. 2012], **M. K. Prithviraje Urs (PI),** Rajashekar, K., Rekha, M. and N. B. Chowdary.
Objective	To test mulberry varieties in different agro-climatic zones of India, for isolating region specific varieties

Test centers in southern zone

State	Test centre
Karnataka	CSRTI, Mysore. Karnataka State Sericulture Research & Development Institute, Bengaluru. Research Extension Centre, Madivala.
Tamil Nadu	Research Extension Centre, Krishnagiri. Tamil Nadu Agricultrue University, Coimbatore.
Andhra Pradesh	Regional Sericultural Research Station, Anantapur. Research Extension Centre, Vikarabad. Research Extension Centre, Rayachotty. Andhra Pradesh State Sericulture Reseach & Development Institute, Hindupur.

Saplings of mulberry genotypes FYT-99/G4, C2038, Suvarna and Vishala evolved by different research Institutes raised and were planted in the experimental plot for evaluation. Seed materials of test genotypes were also supplied to 22 test centers in 3 different seri-zones of India. Data on sprouting and survival were recorded.

Test genotypes included in AICEM (Phase-III)

Genotype	Name	Originator
MV1	C2038	CSRTI, Berhampore.
MV2	FYT/99-G4	CSRTI, Mysore.
MV3	SUVARNA	KSSRDI, Bengaluru.
MV4	VISHALA	KSSRDI, Bengaluru.
MV5	VICTORY-1	CSRTI, Mysore.

2. Mulberry Silkworm Race Authorisation Programme (MSRAP) Phase-VIII

Duration	Jan. 2011 to Dec. 2012
Zonal Coordinator	Director, CSRTI, Mysore
Investigators	N. Malreddy and A. Naseema Begum
Objective	To evaluate the test hybrids in different regions.

A total of 13 centres are under the jurisdiction of the Institute. The details of the test center, multi x bi and bi x bi test hybrids are given below.

Sl. No.	Test centre	Type of hybrids tested
1	RSRS, Kodathi, Karnataka	Multi x Bi., & Bi x Bi
2	RSRS, Chamarajanagara, Karnataka	Multi x Bi
3	Govt. Silk Farm, DOS, Thandavapura, Karnataka	Multi x Bi., & Bi x Bi
4	Govt. Silk Farm, DOS, H. Malligere, Karnataka	Multi x Bi., & Bi x Bi
5	RSRS, Ananthapur, A.P.	Multi x Bi., & Bi x Bi
6	DOS, Shadnagar, A.P.	Bi x Bi
7	DOS, Srikakulam, A.P.	Multi x Bi
8	RSRS, Salem, T.N.	Multi x Bi
9	SSBS, Coonoor, T.N.	Bi x Bi
10	DOS, Udumalpet, T.N.	Bi x Bi
11	Farmers Training Centre, DOS, Vaniyambadi, T.N.	Multi x Bi., & Bi x Bi
12	Govt. Silk Farm, DOS, Nandagaon, Maharashtra	Multi x Bi., & Bi x Bi
13	BSF, Suleram, Maharashtra	Multi x Bi., & Bi x Bi

Sl. No.	Multi x Bivoltine hybrids	Sl. No.	Bivoltine x Bivoltine hybrids
1	FVB1 x FVB12	1	(AP71 x AP9) x (AP72 x AP8)
2	PM x NK2	2	AP71 x AP72
3	PM x FC2	3	NK2 x HND
4	NDV6 x CSR2	4	CSR50 x CSR51
5	ND7 x CSR2	5	(CSR52 x CSR50) x (CSR51 x CSR53)
6	N(M) x (SK6 x SK7)	6	CSR 21 DR x CSR28 DR
7	M6DP (C) x SK4C	7	CSR2 x CSR4 [C]
8	PM x CSR2 [C]	8	(CSR6 x CSR26) x (CSR2 x CSR27) [C]

VIII. ON STATION TRIALS CONDUCTED BY RSRSs

1. RSRS, Kodathi, Karnataka

a. Evaluation of resource constraint mulberry varieties RC1 and RC2 at the semi-arid conditions of RSRS, Kodathi

The plantation of RC1, RC2 and K2 was raised in 0.25 acres and survival percentage was recorded as 96.21% for RC1, 93.30% for RC2 and 97.4% for K2. Growth and yield data of two crops were recorded. The results indicated that the variety RC2 is better in growth and yield than RC1.

b. Evaluation of multi x bi hybrids

One trial on 2 new multi x bi hybrids, L14 x CSR50 and NDV6 x CSR51 was taken up with PM x CSR2 as control. The rearing performance revealed that among the test hybrids, NDV6 x CSR51 performed better in respect ofo survival (ERR 9705) shell weight (0.401 g) and shell percentage (21.34) compared to other test hybrid and PM x CSR2.

c. Evaluation of bi x bi hybrids

Three trials on 2 new bi x bi hybrids, 2C x 4S and (single hybrid) and G11 x G19 (double hybrid) were taken up with CSR2 x CSR4 and FC1 x FC2 as controls. The results on the rearing performance of the new hybrids revealed that the single hybrid 2C x 4S and double hybrid G11 x G19 were better compared to control with respect to survival (ERR-8992 & 9093), cocoon weight (1.763 & 1.764 g) and shell weight (0.364 & 0.381 g). With regard to reeling performance, G11 x G19 was better for filament length (946.40 m), denier (2.4) and reelability (84.2%).

d. Evaluation of three way crosses

Four trials on newly developed three-way crosses *viz*., FC1 x CSR2, FC3 x CSR17 were taken up with FC1 x FC2 as control. The hybrid, FC3 x CSR17 performed better for survival (ERR-8485) shell weight (0.364 g) and shell percentage (21.37). Reeling performance of the test hybrid FC3 x CSR17 was found better for filament length (906.97 m).

2. RSRS, Chamarajanagara, Karnataka

a. Evaluation of RC1 and RC2 mulberry varieties under water stress condition

Average leaf yield data of two crops indicated that, RC2 gave the highest yield of 4,341 kg/ha/crop followed by RC1 with 4,161 kg/ha/crop and check variety (S13) with 3,133 kg/ha/crop. Improvement in leaf yield was 35.69% and cocoon yield / 100 dfls was 54 kg. Saplings were raised at RSRS, Farm and supplied to farmers for taking up second on farm trial. Plantation was established and maintained with proper cultural operations.

b. Testing of productive bivoltine single and double hybrids developed through amylase marker assisted selection

Three on Station Trials (OST) were conducted with G11 x G19 and 2C x 4S keeping FC2 x FC1 and CSR2 x CSR4 as control. The data indicated that the new double hybrid G11 x G19 was superior with higher ERR by number (9017) and by weight (10.753 kg) in comparison to control hybrid FC2 x FC1. Similarly, the new single hybrid 2C x 4S showed higher ERR by number (8921) and by weight (10.619 kg) in comparison to control hybrid CSR2 x CSR4. However, the control hybrids showed higher cocoon wt., shell wt. and shell ratio % than the test hybrids

3. RSRS, Anantapur, Andhra Pradesh

a. Testing of new multi × bi hybrids, L14 × CSR51; NDV6 × CSR50, PM x CSR2 (control)

Two new multivoltine x bivoltine hybrids, NDV6 x CSR51 and L14 x CSR50 were tested. One rearing trial was conducted during May, 2012. The rearing and reeling performance was compared with PM x CSR2. The results showed superiority of L14 x CSR50 in terms of higher survival (ERR 7840) and NDV6 x CSR51 in respect of post-cocoon traits (Fil. Length-821 m), NBFL-657 m, raw silk% 14.5 and silk recover 86.52% when compared to PM x CSR2.

b. Testing of new bivoltine x bivoltine hybrids

Two bivoltine x bivoltine hybrids FC3 x CSR17 and FC1 x CSR2 were tested with 3 rearing trials and compared with two controls, CSR2 x CSR4 and (CSR6 x CSR26) x (CSR2 x CSR27). The rearing and reeling performance was analysed which revealed that survival (ERR 7816) was significantly higher in FC3 x CSR17 while post-cocoon traits were superior in FC1 x CSR2 (Fil. Length-894 m, raw silk-14.7%, raw silk recovery-63.91) when compared to the control hybrid CSR2 x CSR4.

c. Testing of productive bivoltine single and double hybrids developed through amylase marker assisted selection

The new bivoltine x bivoltine hybrids 2C x 4S and G11 x G19 were compared with the existing bivoltine hybrids FC2 x FC1 and CSR2 x CSR4 under two trials. Comparision of the rearing and reeling data indicated superiority of the new hybrids over the control in terms of better post-cocoon traits like reelability (82.62 & 80.08), NBFL (614 & 634 m) and raw silk % (14.3 & 1486).

4. RSRS, Salem, Tamil Nadu

a. Testing of new multivoltine x bivoltine hybrids

One trial was completed with new Multi x Bivoltine hybrids *viz*., L14 x CSR50, NDV6 x CSR51 and PM x CSR2 (control). NDV6 x CSR51 performed better in respect of single cocoon weight (1.570 g), L14 x CSR50 recorded higher single shell weight (0.330 g) and shell percentage (21.09%). Regarding the reeling characters, L14 x CSR50 was superior with average filament length of 928.69 m, non-breakable filament length of 743.69 m and raw silk percentage of 15.59 followed by NDV6 x CSR51 with 84.42% reelability and 2.37 denier.

b. Testing of productive bivoltine single and double hybrids developed through amylase marker assisted selection

Two trials were completed with new bivoltine single hybrid, 2C x 4S and bivoltine double hybrid, G11 x G19. Ten dfls each of the above hybrids along with CSR2 x CSR4 and FC2 x FC1 (control) were reared following standard rearing packages. Results of the trial indicated that the performance of new hybrids were at par with their respective controls.

c. Testing of new bivoltine hybrids

Two trials were completed with new bivoltine hybrids *viz*., FC3 x CSR17, FC1 x CSR2 and FC1 x FC2 (Control). Results of the trial indicated that FC3 x CSR17 performed better in respect of ERR No. (9824), ERR wt. (15.39 kg), cocoon weight (1.612 g), shell weight (0.353 g) and shell % (21.90%) followed by FC1 x CSR2 with better ERR No. and wt. (9215 & 17.204 kg), cocoon weight (1.913 g), shell weight (0.448 g) and shell % (23.42%). Regarding the reeling parameters, FC3 x CSR17 was better with 1138.83 m average filament, 942.48 m non-breakable filament length and 2.4 denier followed by FC1 x CSR2 with 1113 m average filament length, 938.22 m non-breakable filament length, 2.43 denier and 17.16% raw silk recovery.

IX. SERICULTURE EXTENSION, ECONOMICS AND MANAGEMENT

G. S. Vindhya, Dr. K. S. Chandrakanth, S. B. Nagaraju, B. Gangadhar, Dasappa, Srilatha, R. S. Katiyar, G. S. Geetha

1. Model commercial Chawki rearing

In the model commercial CRC, a total of 117100 dfls of CSR hybrids and 12150 dfls of L14 x CSR2 were reared in 32 batches and chawki worms supplied to 706 sericulturists from 525 villages. The average cocoon yield recorded with adopted farmers was 69.32 kg /100 dfls for CSR hybrids. A total of Rs. 4,91,872 was collected as service charges. A total of 300 farmers/officials/NGOs/DOS officials were trained in chawki rearing techniques.

2. Supply of seed cuttings and saplings of improved mulberry varieties

Name of the Centre	Mulberry area (ha)	Name of the Centre	Mulberry area (ha)
1. CSRTI, Mysore	60.70	18. REC, Hosur	139.15
2. RSRS, Kodathi	0.10	19. REC, Krishnagiri	0.81
3. REC, Chitradurga	12.34	20. REC, Samayanallur	18.21
4. REC, SU, Koppal	22.26	21. REC, Udumalpet	35.81
5. REC, SU, Kinakahalli	7.93	22. REC, SU, Srivilliputhur	21.35
6. REC, Eluru	125.45	23. REC, SU, Vaniyambadi	4.86
7. REC, Kalyandurgam	35.92	24. REC, Palakkad	8.09
8. REC, Madakasira	177.25	25. REC, SU, Kalpetta	2.83
9. REC, Rayachoti	37.64	26. REC, Amravati	51.80
10. REC, Venkatagirikota	75.27	26. REC, Baramati	24.89
11. REC, Vikarabad	22.26	27. REC, Parbhani	45.93
12. REC, SU, Penukonda	20.23	28. REC, Hoshangabad	48.56
13. REC, SU, Bidar	29.95	29. REC, SU, Aurangabad	42.59
14. CPC, Hindupur	22.26	30. REC, SU, Maddur	50.78
15. CDC, Palamaner	237.55	31. REC, SU, Shivamogga	5.46
16. RSRS, Salem	142.85		
17. REC, Gobichettipalayam	6.88	**Total**	**1537.98**

3. Training of stakeholders

Name of the Centre	No. of persons trained								Total
	DDM	MC & DM	INM	OF	SWCP	SFM	IPM	VA	
RSRS, Kodathi	45	45	45			15	15		165
REC, Bidaraguppe	30	30	45						105
REC, Chitradurga	45	45	45						135
REC, Madivala	105						30		135
SU, Kanakapura		75	60						135
SU, Koppal	30	15	30						75
RSRS, Ch. nagara	15	45		45	30			20	155
SU, Kinakahalli	15	45						20	80
RSRS Anantapur	45	30		75	30	30			210
REC, Eluru	30	30		45					105
REC, Kalyandurgam	30	30		30		15			105
REC, Madakasira	30	30		45		15			120
REC, Rayachoty	30	15		30					75
REC, Venkatagirikota	45	45		45					135
REC, Vikarabad	30	30		30					90
SU, Penukonda	30	30		30	15				105
SU, Bidar	15	15		15					45
CPC, Hindupur	30	30		30	15				105
CDC, Palamaner	30	45		30					105
RSRS, Salem	30	30		30	30	30			150
REC, Gobi. palayam	30	45		30	45	30			180
REC, Hosur	30	30		30	30	30			150
REC, Krishnagiri	15	15		15	15	30			90
REC, Samayanallur	30			30	30	30			120
REC, Udumalpet	45	30		45	30	30			180
SU, Srivilliputhur	30	30		30	30	30			150
SU, Vaniyambadi		15		15					30
REC, Palakkad	15	15		30	15				75
SU, Kalpetta		15		30					45
REC, Hoshangabad	30	30	15						75
REC, Baramati	30	30	15						75
REC, Parbhani		45	15						60
REC, Amaravati	45	30							75
SU, Aurangabad	30	30							60
SU, Maddur	15		15						30
SU, Shivamogga	15	15							30
Total	**1020**	**1035**	**285**	**735**	**315**	**285**	**45**	**40**	**3760**

DDM: Disinfection and disease management; MC&DM: Mulberry cultivation and disease management; INM: Integrated nutrient management in mulberry; OF: Organic farming; SWCP: Silkworm crop protection; SFM: Soil fertility management; IPM: Integrated pest management - silkworm & mulberry; VA: Value addition

4. Performance of CSR hybrids in the command areas of RSRSs

Sl. No.	Name of the Centre	No. of rearers	No. of dfls reared	Average cocoon yield (kg/100 dfls)
1	REC, Chitradurga	1243	226950	65.30
2	REC, Madivala	289	122500	68.10
3	REC, SU, Kanakapura	746	79140	66.20
4	REC, SU, Koppal	194	39100	59.50
5	REC, Eluru	875	200900	60.00
6	REC, Kalyandurgam	292	69925	62.45
7	REC, Madakasira	930	225050	65.30
8	REC, Rayachoti	44	9050	60.00
9	REC, Venkatagirikota	3574	899800	65.20
10	REC, Vikarabad	223	87225	62.20
11	REC, SU, Penukonda	160	33850	64.80
12	REC, SU, Bidar	23	16650	59.00
13	CPC, Hindupur	855	201850	61.50
14	CDC, Palamaner	713	203200	64.50
15	RSRS, Salem	571	73179	70.50
16	REC, Gobichettipalayam	1094	191275	67.27
17	REC, Hosur	853	156530	68.60
18	REC, Krishnagiri	146	21000	70.40
19	REC, Samayanallur	621	104870	74.10
20	REC, Udumalpet	996	1492550	74.70
21	REC, SU, Srivilliputhur	305	60500	65.30
22	REC, SU, Vaniyambadi	58	9100	66.00
23	REC, Palakkad	260	22182	78.82
24	REC, SU, Kalpetta	18	2350	74.16
25	REC, Amravati	140	27950	91.94
26	REC, Baramati	170	118600	60.00
27	REC, Parbhani	220	33049	62.16
28	REC, Hoshangabad	76	10100	56.30
29	REC, SU, Aurangabad	97	19960	60.75
30	REC, SU, Maddur	1069	120000	61.33
31	REC, SU, Shivamogga	73	25300	60.20
	Total	**16928**	**4903685**	**66.02**

5. Income generation at RSRSs and nested units (Rs.)

Name of the Centre	Source					Total
	Soil analysis charges	Sale of cocoons	Sale of cuttings & saplings	Sale of chawki worms	Others	
SSBS, Coonoor	-	1,15,834	-	-	43,425	1,59,259
RSRS, Kodathi	-	2,75,000	33,300	-	-	3,08,300
REC, Bidaraguppe	-	400	38,600	-	-	39,000
REC, Chitradurga	-	89,100	-	-	-	89,100
REC, Madivala	-	49,300	12,700	-	-	62,000
REC, SU, Koppal	-	31,800	-	-	-	31,800
RSRS Chamarajanagara	-	33,805	430	-	1030	35,265
REC, SU, Kinakahalli	-	-	1,100	93,630	-	94,730
RSRS Anantapur	-	29,300	2,600	-	12,251	44,151
REC, Rayachoti	-	57,207	-	-	6,000	63,207
REC, Vikarabad	-	-	3,200	-	9,000	12,200
REC, SU, Bidar	-	52,602	26,031	-	10,797	89,430
RSRS, Salem	23,245	13,376	1,000	-	31,585	69,206
REC, Krishnagiri	-	-	3,200	50,200	2,000	55,400
REC, Samayanallur	-	22,307	-	-	-	22,307
REC, Udumalpet	-	-	-	-	930	930
REC, SU, Srivilliputhur	-	-	-	-	182	182
REC, Palakkad	-	-	-	-	315	315
REC, SU, Kalpetta	-	-	-	-	536	536
REC, SU, Aurangabad	-	-	-	-	909	909
Total	**23,245**	**7,70,031**	**1,22,161**	**1,43,830**	**1,18,960**	**11,78,227**

6. Extension communication programmes conducted by RSRSs and nested units

Name of the Centre	GD	FS	EX	FD	AP	EP	DE	FM	WS/ SE	ST
RSRS, Kodathi	12	-	-	8	-	3	6	2	1	5
REC, Bidaraguppe	7	-	-	1	-	1	-	-	-	1
REC, Chitradurga	8	-	-	5	-	1	3	-	-	2
REC, Madivala	8	-	-	8	-	1	-	-	-	2
REC, SU, Kanakapura	6	-	-	8	-	1	6	-	-	1
REC, SU, Koppal	5	-	-	1	-	1	-	-	-	2

Name of the Centre	GD	FS	EX	FD	AP	EP	DE	FM	WS/ SE	ST
RSRS Chamarajanagara	9	9	2	6	-	-	-	-	1	1
REC, SU, Kinakahalli	3	3	1	1	-	-	-	-	-	1
RSRS Anantapur	3	-	-	-	2	2	-	-	2	1
REC, Eluru	6	6	4	5	4	1	-	-	-	-
REC, Kalyandurgam	6	6	4	4	4	1	-	-	-	1
REC, Madakasira	8	6	4	4	6	1	-	-	-	1
REC, Rayachoti	6	6	4	4	4	1	-	-	-	-
REC, Venkatagirikota	6	6	4	4	5	1	-	-	-	-
REC, Vikarabad	6	6	4	4	4	1	-	-	-	1
REC, SU, Penukonda	6	8	4	4	4	1	-	-	-	-
REC, SU, Bidar	5	2	4	5	3	1	-	-	-	1
CPC, Hindupur	6	6	4	4	4	1	-	-	-	1
CDC, Palamaner	6	6	4	4	4	1	-	-	-	-
RSRS, Salem	2	-	2	3	-	2	7	-	1	-
REC, Gobichettipalayam	6	-	3	3	5	1	7	-	-	-
REC, Hosur	5	-	1	4	6	1	9	-	-	-
REC, Krishnagiri	5	-	2	2	4	1	6	-	-	-
REC, Samayanallur	5	-	2	4	5	1	9	-	-	-
REC, Udumalpet	6	-	2	5	6	1	4	-	-	-
REC, SU, Srivilliputhur	5	-	2	4	5	1	9	-	-	-
REC, SU, Vaniyambadi	4	-	-	-	5	-	7	-	-	-
REC, Palakkad	5	-	2	4	8	1	6	-	1	-
REC, SU, Kalpetta	5	-	1	4	3	1	6	-	-	-
REC, Amravati	11	-	-	6	-	-	-	3	-	-
REC, Baramati	12	-	2	6	6	3	-	-	-	1
REC, Parbhani	7	-	-	2	4	1	7	-	-	1
REC, Hoshangabad	14	-	-	4	-	-	2	-	-	-
REC, SU, Aurangabad	7	-	-	2	1	-	7	2	-	2
REC, SU, Maddur	26	-	-	1	-	-	13	-	-	1
REC, SU, Shivamogga	2	-	-	-	1	-	6	-	-	-
Total	**249**	**70**	**62**	**134**	**103**	**34**	**120**	**7**	**6**	**26**

GD: Group discussion, FS: Film show, EX: Exhibition, FD: Field day, AP: Awareness programme,
EP: Enlightenment programme, DE: Demonstration, FM: Farmers meet, WS: Workshop; ST: Study tour.

X. HUMAN RESOURCE DEVELOPMENT

S. D. Sharma, S. N. Pallavi, Issac Joseph, Vineet Kumar, A. S. Suma and R. Bhagya

a. Management Development Programme (MDP)

Sl. No	Name of the course	Duration	Number of persons trained
1	Refresher course (officers/officials)	05 days	26
2	Chawki Rearing	08 days	31
3	Late age silkworm rearing	10 days	18
4	Soil analysis	05 days	11
5	Organic farming	05 days	26
6	Mechanization	04 days	8
7	Extension management	05 days	9
8	Integrated pest & disease management	05 days	9
9	Production of bio-control agents	06 days	1
	Sub-total	-	**139**

b. Technology Up-gradation Programme (TUP) - for sericulturists

Sl. No	Name of the course	Duration	Number of persons trained
1	Chawki rearing	08 days	138
2	Late age silkworm rearing	10 days	52
3	Production of bio-control agents	06 days	11
4	Integrated pest and disease management	06 days	29
5	Mulberry cultivation	05 days	28
6	Awareness programme for sericulturists	05 days	46
7	Mechanization	04 days	12
	Sub-total	-	316

c. Certificate course

Sl. No	Name of the course	Duration	Number of persons trained
1	Intensive bivoltine silkworm rearing	35 days	27
	Total	-	**27**

d. Training under Integrated Skill Development Scheme

Sl. No.	Name of the course	Duration	No. of persons trained
1	Commercial chawki rearing	15 days	36
2	Mulberry cultivation	15 days	32
3	Cocoon handicrafts	15 days	25
4	Quality bivoltine cocoon production	15 days	58
	Total	**-**	**151**

e. International Training Programme

Two trainees from Mexico participated in a 12 days training programme on bivoltine silkworm breeding. Apart from the course curriculum, field visits were also organized to expose the participants to sericulture at farmers' level.

f. Programmes on request

The training division gets request from sericulturists, unemployed youth, Non Government Organizations, Universities, Departments of sericulture, etc., to train their staff in improved sericultural technologies from time to time. Accordingly, the additional programmes were planned and 257 candidates were trained under various request-based programmes.

Sl. No.	Name of the course	Duration	Number of persons trained
1	Late age rearing (officials)	10/15 days	19
2	Intensive practical training (officials)	15 days	36
3	Orientation in research (students)	10 days	03
4	Extension management (officials)	06 days	10
5	Intensive bivoltine training (officials)	34 days	03
6	Integrated pest & disease management (officials)	08 days	11
7	Sericulture technology (officials)	15 days	10
8	Production of bio-control agents (officials)	05 days	01
9	Mulberry sericulture (officials)	04 days	23
10	Post Graduate Diploma in Sericulture	05 days	26
11	Late age silkworm rearing (farmers)	10 days	23
12	Chawki rearing (farmers)	08 days	38
13	Mechanization (farmers)	04 days	25
14	Mulberry cultivation (farmers)	06 days	10
15	Intensive training on bivoltine sericulture (farmers)	90 days	01
16	Awareness programme (farmers)	05 days	15
17	Reeling technology (farmers)	09 days	03
	Total	**-**	**257**

g. Demographic data of participants in training programmes

Sl. No.	Name of the training programme	No. of beneficiaries trained						Total
		SC	ST	OBC	Gen	Male	Female	
1	Management development programme	16	4	76	43	124	15	139
2	Technology upgradation programme	19	14	154	129	300	16	316
3	Certificate course	5	10	6	6	21	6	27
4	Training under integrated skill development scheme	75	37	297	224	557	76	633
	Total	**115**	**65**	**533**	**402**	**1002**	**113**	**1115**

h. Training of stakeholders at RSRS and nested units

Sl. No.	Name of the course	Number of persons trained
RSRS, Salem & nested units		
1	Disinfection and disease management	225
2	Mulberry crop protection	255
3	Organic farming	285
4	Silkworm crop protection	225
5	Soil fertility management	210
RSRS, Chamarajanagara & nested units		
6	Disinfection and disease management	30
7	Mulberry crop protection	60
8	Organic farming	45
9	Silkworm crop protection	30
10	Value addition	40
RSRS, Anantapur & nested units		
11	Disinfection and disease management	345
12	Mulberry crop protection	330
13	Organic farming	405
14	Silkworm crop protection	60
15	Soil fertility management	60
RSRS, Kodathi & nested units		
16	Disinfection and disease management	255
17	Mulberry cultivation and disease management	210
18	Integrated nutrient management in mulberry	225
19	Soil fertility management	15
20	IPM of silkworm and mulberry pests	45
Units directly administered by CSR&TI, Mysore		
21	Disinfection and disease management	165
22	Mulberry cultivation and disease management	180
23	Integrated nutrient management in mulberry	60
	Total	**3760**

i. Practical training in bivoltine silkworm rearing

To support the training courses, silkworm rearing was organized in 10 batches. A total of 1085 dfls were reared with an average hatching percentage of 95.01, single cocoon weight of 1.775, shell percentage of 21.36. The average cocoon yield obtained was 82.14 kg/100 dfls.

Performance of bivoltine hybrids under different training programmes

Season	No. of dfls	Hatch-ing (%)	Cocoon weight (g)	Shell weight (g)	Shell (%)	Yield/ 100 dfls	Rate /kg (Rs.)
Mar.-Apr. 2012 *	75	94.95	1.521	0.320	21.13	83.02	286.30
May-Jun. 2012 *	150	96.58	1.670	0.345	20.71	87.33	318.20
Jun.-Jul. 2012 *	150	95.42	1.970	0.444	22.58	95.97	346.10
Jul.-Aug. 2012 *	110	94.50	1.928	0.423	21.91	88.97	385.00
Sep.-Oct. 2012 *	150	95.02	1.958	0.424	21.68	90.33	340.10
Oct.-Nov. 2012 *	150	94.30	1.918	0.401	20.90	89.78	370.80
Nov.-Dec. 2012 *	100	96.78	1.982	0.422	21.55	99.00	372.20
Jan.-Feb. 2013 *	50	88.29	1.575	0.349	22.31	52.80	382.20
Jan.-Feb. 2013 #	50	97.11	1.378	0.255	19.19	49.81	282.00
Feb.-Mar. 2013 *	100	97.13	1.853	0.400	21.59	84.41	389.70
Total / Avg.	**1085**	**95.01**	**1.775**	**0.378**	**21.36**	**82.14**	**347.26**

***** Double Hybrids; # L14 x CSR2

j. ISO 9001:2008 accreditation

The first year surveillance audit on Quality Management Services (QMS), and two internal audits were also conducted and accreditation was renewed.

k. Revenue generation

A total income of Rs. 6.969 lakhs was generated from the sale of cocoons, course fee, accommodation charges, *etc*.

XI. PROGRAMMES BEING IMPLEMENTED IN COORDINATION WITH DOS OF DIFFERENT STATES (AT A GLANCE)

Sl. No.	Name of the Project/ Programme	Duration	States involved/ covered	See Page No.
1	Pre-authorisation field trials of L14 x CSR2: A new Polyvoltine x Bivoltine hybrid of silkworm *Bombyx mori* L. with superior fibre qualities	Apr. 2012-Mar.2014	Karnataka, Andhra Pradesh, Tamil Nadu, Maharashtra and Madhya Pradesh	62
2	Popularization of authorized silkworm hybrids among the farmers of south India	Nov. 2012-Oct. 2014	Karnataka, Andhra Pradesh, Tamil Nadu, Maharashtra and Madhya Pradesh	75
3	All India Co-ordinated Experiment on Mulberry (AICEM) Phase-III	Aug. 2011-Dec. 2015	Karnataka, Andhra Pradesh, Tamil Nadu	77
4	Mulberry Silkworm Race Authorisation Programme (MSRAP) Phase- VIII	Jan. 2011-Dec. 2012	Karnataka, Andhra Pradesh, Tamil Nadu	77
5	Technology demonstrations – Integrated nutrient management, Integrated pest management, composting & vermi-composting, mulberry tree plantation, Efficacy of Poshan and Navinya, Intercropping in mulberry	Continuous	Karnataka, Andhra Pradesh, Tamil Nadu, Maharashtra and Madhya Pradesh	84
6	Training under Integrated Skill Development Scheme (ISDS)	Nov. 2012-Oct. 2016	Karnataka, Andhra Pradesh, Tamil Nadu, Maharashtra and Madhya Pradesh	86

XII. ACTIVITIES REGARDING OFFICIAL LANGUAGE IMPLEMENTATION

During 2012-13 Official Language policy has been implemented well at Central Sericultural Research and Training Institute, Mysore. Compliance of section 3(3) of the Official Languages Act has been ensured. The progress in implementation of Hindi was reviewed from time to time by conducting meetings of the Official Language implementation committee.

Organisation of Hindi workshop, Hindi day, Hindi fortnight, publication of technical books in Hindi, publication of Hindi magazine have been done and Hindi noting-drafting incentive scheme has been implemented. In addition to general Hindi workshops, an Official Language Technical Workshop was organised on 06.02.2013.

During this year i.e. in June 2012 the Institute has received citation under Official Language rolling shield scheme of CSB for the excellent performance made in Official Language during the; year 2010-11. Action taken on the various items of official language implementation during the period is as follows :

1. Compliance of section 3(3) : The papers coming under section 3(3) of Official Languages act 1963 have been issued in bilingual.

2. Compliance of Rule 11 : All types of forms, letter heads, Rubber stamps, Notice boards, Envelopes, Identity cards, etc are in bilingual. Check points (at Xerox cell, Stores section, Despatch section and the concerned officer) have been devised to ensure the same.

3. Hindi Correspondence : During the year the percentage of letters sent in Hindi to different regions were more than the prescribed targets. 98.5%, 77.3% and 70.9% letters were sent in Hindi to Central Govt. Offices of A, B and C regions respectively and 98.5% and 94.3% letters in Hindi to State Govt Offices and individuals of A & B regions.

4. Organisation of meetings of the Official Language Implementation Committee : The progress of implementation of the Official Language has been reviewed from time to time by conducting OLIC meeting in every quarter. During the year 2012-13 Official Language Implementation Committee meetings were organised on 16.06.2012, 27.09.2012, 24.12.2012 and 15.03.2013 and follow up action on the decisions taken on the meeting was taken.

5. Organisation of Hindi Workshop : Hindi workshop was organised in each quarter for the officials of the Institute to provide information as to use of Hindi in the official work and the information of Official Language Policy. During the year, 34 officers and 24 staff have been trained in Hindi workshops organised on 30.06.2012, 27.09.2012, 21.12.2012 and 01.03.2013 separately for technical and administrative officials, officers and scientists.

6. Organisation of Official Language technical workshop : In addition to the above mentioned workshops, Official Language technical workshop was organised on "Development of mulberry sericulture – with new technologies" in which 150 scientists participated. The articles presented during the occasion were compiled and released as a souvenir. Apart from this the Hindi version "Resham Krishi Margadarshika" translated by two scientists of this institute was also released during the technical workshop.

7. Implementation of noting-drafting incentive scheme : To encourage the officers and staff of this institute and its subordinate offices to do their work originally in Hindi, CSB's liberalised noting-drafting incentive scheme was implemented in which cash awards are given for writing prescribed words in Hindi. During the year cash awards were given to 8 officials on the valedictory function of Official Language fortnight held on 14.09.2012. Apart from this 13 officials of subordinate offices were also awarded prizes under this scheme.

8. Publication of Hindi book/booklets : A souvenir was released during official language technical workshop organised on 06.02.2013. Along with this the 'Resham Krishi Margadarshika' translated by two scientists of this institute was also released. The training calender was also published in bilingual. Two issues of 'Resham Kiran' (Half yearlyhouse journal) of this institute was also published.

9. Notification of the subordinate offices under 10(4) of the Official Languages rules : The offices in which 80% of the staff are having working knowledge in Hindi, are notified under 10(4) of the official languages rules. Apart from this office, 6 subordinate offices have also been notified.

10. Organisation of Hindi competitions : Official Language fortnight was organised from 01.09.2012 to 14.09.2012 during which 10 different Hindi competitions viz. 1. Correct writing 2. Dictation, 3. Memory test, 4. Group discussion, 5. Elocution, 6. Noting-drafting and administrative glossary, 7. technical glossary, 8. songs, 9.what does the picture speak? and 10. Antyakshri competitions were organised. The winners of the competitions were awarded with first, second, third and consolation prizes.

11. Work on computers in Hindi : Compliance of section 3(3), forms, standard drafts, quarterly progress report and evaluation report, work related to meetings carried out smoothly on computers. Unicode system is activated in all computers which facilitates to do work in Hindi, English and other Indian languages.

12. Awards : During the year i.e in June 2012 the institute was awarded with a citation under the Official Language Rolling shield scheme of CSB for the excellent performance made in the implementation of official language policy of the union for the year 2010-11.

Apart from this, RSRS, Salem, a subordinate office of the institute, was awarded second prize under the Rolling Shield Scheme of the Town Official Language implementation committee, Salem for excellent performance made in Official Language Policy during 2011-12.

XIII. ADMINISTRATIVE REPORTS

Central Sericultural Research & Training Institute, Mysore, Karnataka & its nested units

Regional Sericultural Research Stations (RSRS)
1. Kodathi, Karnataka
2. Chamarajanagara, Karnataka
3. Anantapur, Andhra Pradesh
4. Salem, Tamil Nadu

Research Extension Centres (REC)		
1. Bidaraguppe	8. Venkatagirikota	15. Palakkad
2. Chitradurga	9. Vikarabad	16. Amaravati
3. Madivala	10. Gobichettypalayam	17. Baramati
4. Eluru	11. Hosur	18. Parbhani
5. Kalyandurgam	12. Krishnagiri	19. Hoshangabad
6. Madakasira	13. Samayanallur	
7. Raychoti	14. Udumalpet	

Sub-units of Research Extension Centre (REC-SU)		
1. Kanakapura	5. Bidar	9. Aurangabad
2. Koppal	6. Srivilliputhur	10. Maddur
3. Kinakahalli	7. Vaniyambadi	11. Shivamogga
4. Penukonda	8. Kalpetta	

Cluster Promotion Centre (CPC)
1. Hindupur

Cluster Development Centre (CDC)
1. Palamaner

Retirement/resignation/expiry of personnel during the year

The following are the names and designations of personnel who retired or resigned, whose contributions to the growth and development of the industry are sincerely acknowledged.

Name	Designation	Date
I. Retired		
1. Shri. M. D. Ambekar	STA (SG)	30.04.2012
2. Shri. S. Venkateshachari	Asst. Tech.	30.04.2012

3. Dr. R. L. Katiyar	Scientist-C	30.06.2012
4. Shri. Veeranna	STA (SG)	30.06.2012
5. Shri. Boraiah	Tech. Assistant	31.07.2012
6. Dr. P. Rama Mohana Rao	Scientist-C	31.07.2012
7. Shri. Basava	Asst. Tech.	31.07.2012
8. Shri. Rangaswamy	Attender	31.08.2012
9. Shri. V. Seetharaman	STA	30.09.2012
10. Shri. C. Siddaiah	Staff car driver, Gr. I	30.09.2012
11. Shri. M. Mahadevaiah	STA	30.11.2012
12. Dr. K. S. Chandrakanth	Scientist-D	30.11.2012
13. Shri. B. Nagaraj	Scientist-D	31.12.2012
14. Dr. B. R. Dayakar Yadav	Scientist-D	31.12.2012
15. Dr. D. S. Chandrashekar	Scientist-D	31.01.2013
16. Shri. V. K. Sharma	Dy. Director (A&A)	28.02.2013
17. Dr. S. M. H. Qadri	Director	31.03.2013
18. Shri. Abbas Khan	Tech. Asst.	31.03.2013
II. Resigned		
1. Dr. Mala V. Rajan	Scientist-D	18.10.2012

The following two colleagues passed away during the year and their contributions to the growth and development of sericulture are gratefully acknowledged.

1. Shri. G. N. Prabhuswamy	Tech. Asst.	30.08.2012
2. Smt. Sreelatha	Scientist-C	30.11.2012

Budget (Rs. In lakhs):

Plan	Non-Plan	Total
497.25	3,851.22	4,348.47

R & D & ADMINISTRATIVE PERSONNEL OF CSR&TI AND IT'S NESTED UNITS

I. R & D Personnel

A. CSR&TI, Mysore

Dr. S. M. H. Qadri, Director

Planning, monitoring, coordination & evaluation
Dr. B. R. Dayakar Yadav, Sci-D
Mr. H. M. Munikrishnappa, Sci-C
Mr. Rajashekhar, K., Sci-C
Dr. Raveendra M. Mattigatti, Sci-C

Mulberry Breeding, Genetics & Tissue Culture
Dr. Mala V. Rajan, Sci-D
Dr. M. K. Prithvi Raje Urs, Sci-C
Mr. Rajashekar, K., Sci-C
Dr. M. K. Raghunath, Sci-C
Dr. S. Gandhi Doss, Sci-C
Dr. N. B. Chowdary, Sci-C
Ms. Rekha, M., Sci-C

Mulberry Pathology
Dr. B. R. Dayakar Yadav, Sci-D
Dr. D. D. Sharma, Sci-C
Dr. V. Nishitha Naik, Sci-C
Dr. P. M. Pratheesh Kumar, Sci-C

Sericulture Division
Dr. S. Nirmal Kumar
Dr. S. Lakshmanan

Silkworm Breeding Laboratory I
Dr. A. Naseema Begum, Sci-D
Dr. N. Mal Reddy, Sci-C
Dr. S. Manthira Moorthy, Sci-C

Silkworm Genetics
Dr. V. N. Sudha, Sci-C
Dr. K. K. Sharmila, Sci-C

Silkworm Physiology
Dr. Kanita Trivedy, Sci-D
Mr. M. Ramesh, Sci-C
Dr. M. Munirathnam Reddy, Sci-C

Agronomy
Dr. Dasappa, Sci-C
Dr. K. Srikantaswamy, Sci-C
Dr. V. Gunasekhar, Sci-C
Mr. Vinod Kumar Yadav, Sci-B

Soil Science & Chemistry
Mr. K. Vedavyas, Sci-C
Dr. Sibayan Sen, Sci-B

Mulberry Physiology
Dr. Mala V. Rajan, Sci-D
Ms. M. G. Sabitha, Sci-C
Dr. N. B. Chowdary, Sci-C

Molecular Biology
Dr. V. Girish Naik, Sci-C

Farm Management
Dr. T. Thippeswamy, Sci-D
Mr. J. P. Renukeswarappa, Sci-C
Dr. C. M. Babu, Sci-C

Silkworm Breeding Laboratory II
Dr. P. Rama Mohana Rao, Sci-C
Ms. V. Premalatha, Sci-C
Dr. Dayananda, Sci-C
Mr. C. Parameshwara, Sci-C
Dr. P. C. Santha, Sci-C

Molecular Biology II
Dr. S. K. Ashwath, Sci-D
Dr. Virendra Kumar, Sci-C

Silkworm Pathology
Dr. M. Balavenkatasubbaiah, Sci-D
Mr. A. R. Narasimha Nayaka, Sci-C
Dr. K. Chandrasekharan, Sci-C

Rearing Technology & Innovation
Dr. P. G. Joge, Sci-D
Mr. S. Purushotham, Sci-C

Pest Management

Dr. M. A. Shekhar, Sci-D

Dr. Vinod Kumar, Sci-C

Mr. B. T. Srinivasa, Sci-C

Mr. J. B. Narendra Kumar, Sci-C

Dr. A. V. Mary Josepha, Sci-C

Technology Validation & Demonstration Centre (TVDC)

Dr. D. S. Somaprakash, Sci-C

Dr. P. C. Santha, Sci-C

Reeling

Dr. Y. C. Radhalakshmi, Sci-C

Dr. Kariappa, Sci-C

Mr. K. P. Shivakumar, Sci-C

Training Division

Dr. S. D. Sharma, Sci-D

Dr. S. N. Pallavi, Sci-C

Mr. Issac Josph, Sci-C

Ms. A. S. Suma, Sci-C

Dr. Vineet Kumar, Sci-C

Dr. R. Bhagya, Sci-C

Grainage

Dr. Chikkanna, Sci-D

Mr. S. B. Kulkarni, Sci-C

Sericulture Extension, Eonomics & Management Divsion

Dr. G. S. Vindhya, Sci-D

Dr. K. S. Chandrakanth, Sci-D

Dr. S. B. Nagaraju, Sci-C

Dr. B. Gangadhar, Sci-C

Dr. Dasappa, Sci-C

Ms. Srilatha, Sci-C

Dr. R. S. Katiyar, Sci-C

Dr. G. S. Geetha, Sci-C

Sericulture Engineering Division

Dr. Satish Verma, Sci-E

Mr. Mathew John, Asst. Exe. Eng.

B. Nested units of CSR&TI, Mysore

RSRS, Kodathi

Dr. Jaishankar, Sci-D

Mr. N. Shivashankar, Sci-C

Dr. P. Sudhakara Rao, Sci-C

Dr. M. Maheshwari, Sci-C

Ms. K. L. Philomena, Sci-C

Dr. P. Sudhakar, Sci-C

Dr. P. K. Ambika, Sci-C

Mr. Hanumantharayappa, Sci-C

REC, Madivala

Dr. M. Noble Morrison, Sci-C

REC, Bidaraguppe

Dr. S. K. Bhargava, Sci-C

RSRS, Anantapur

Mr. Ch. Satyanarayana Raju, Sci-D

Dr. C. Subramanya Reddy, Sci-D

Dr. P. Srinivasulu Reddy, Sci-C

Mr. M. A. Shanthan Babu, Sci-C

Dr. M. Raghupathy, Sci-C

Mr. M. Chandrashekar, Sci-C

Dr. N. Shivarami Reddy, Sci-C

REC, Rayachoty

Dr. M. Venkatachalapathy, Sci-C

Ms. S. Vidyunmala, Sci-C

REC, V. Kota

Dr. T. Mogili, Sci-C

Dr. Lakshmanan Velusamy, Sci-C

REC, Chitradurga

Dr. M. T. Himantharaj, Sci-D

Dr. A. Umesh, Sci-B

REC, KOPPAL

Mr. Y. N. Sanath Kumar, Sci-B

REC, Sub-Unit, Kanakapura

Dr. M. R. Subrahmanyam, Sci-C

RSRS, Chamarajanagara

Dr. D. S. Chandrashekar, Sci-D

Dr. B. Mallikarjuna, Sci-C

Dr. K. Kesavachayulu, Sci-C

Dr. K. Srikantaswamy, Sci-C

Dr. R. Meenal, Sci-C

REC, Sub-Unit, Kinkanahalli

Mr. K. C. Mahalingappa, Sci-C

RSRS, Salem

Dr. R. Balakrishna, Sci-D

Mr. R. Vijayakumar, Sci-C

Dr. S. Radhakrishnan, Sci-C

Ms. C. A. Mary Flora, Sci-C

Mr. S. Rajakumar, Sci-C

Mr. R. Anbazhagan, Sci-C

Mr. J. Ravikumar, Sci-C

Dr. S. Mahiba Helen, Sci-B

REC, Krishnagiri

Dr. S. Masilamani, Sci-C

Dr. S. Balasaraswathi, Sci-C

REC, Samayanallur

Mr. A. Gnankumar Daniel, Sci-C

Mr. T. Sivasubramonian, Sci-C

REC Gobichettypalyam

Mr. A. Mani, Sci-C

Dr. N. Dhahira Beevi, Sci-C

Mr. T. Thirunavukkarasu, Sci-C

REC, Udumalpet

CDC, Palamaner

Dr. G. Venkataprasad, Sci-C

REC, Eluru

Dr. M. Venkateswara Rao, Sci-C

Mr. T. V. S. Srinivasa Rao, Sci-C

REC, Bidar

Mr. Ishwar, Sci-C

REC, Vikarabad

Mr. B. Narasimhamurthy, Sci-C

Dr. P. Venkataramana, Sci-C

REC, Penukonda

Dr. A. Venugopal, Sci-C

REC, Madakasira

Dr. B. Kasi Reddy, Sci-C

CPC, Hindupur

Dr. M. Pitchi Reddy, Sci-C

CPC, Kalyandurgam

Mr. Boya Vijaya Naidu, Sci-C

REC, Palakkad

Ms. M. Siamala, Sci-C

Ms. K. Sarala, Sci-C

REC, Sub-Unit, Kalpetta

Ms. P.V. Soudaminy, Sci-C

SSBS, Coonoor

Mr. R. Gururaj, Sci-D

Ms. E. Rajalakshmi, Sci-C

P4 BSF, Hassan

Dr. G. V. Kalpana, Sci-C

Dr. K. B. Chandrashekhar, Sci-C

REC, Maddur

Dr. V. B. Mathur

REC, Shivamogga

Dr. H. Jayaram

REC, Parbhani

Mr. A. J. Karande

REC, Baramati

Mr. N. G. Selvaraju, Sci-C
Ms. G. Punithavathi, Sci-C

REC, Vaniyambadi

Mr. O. K. Gopinath, Sci-C

REC, Hosur

Dr. P. Samuthiravelu, Sci-C
Mr. Y. Humayun Sharief, Sci-C

REC, Srivilliputhur

Mr. B. Mohan, Sci-C
Mr. N. Sakthivel, Sci-C
Mr. Ram Prakash

REC, Sub-Unit Aurangabad

Mr. Rahul Singh

REC, Amaravathi

Dr. R. V. Kushwaha

REC, Hoshangabad

Dr. Pradeep Shukla
Mr. R. K. Khare

II. ADMINISTRATIVE PERSONNEL

Mr. A. Manoharan, DD (F)
Mr. Vijay Kumar Sharma, DD (A)
Mr. A. H. Neve, DD (A)
Mr. Hiriyanna, AD (AA)
Mr. R. Arasappa, AD (AA)
Mr. Eswarappa, AD (AA)
Mr. S. Yoganarasimha, AD (AA)
Dr. B. Jayaramulu, DD (OL)
Mr. K. Dhanaraj, DD (Comp.) upto 19.11.2012
Mr. V. Ganesan, DD (Comp.) from 15.11.2012
Ms. V. Jayashree, AD (OL)
Mr. B. S. Pappu, AD (Pub)
Mr. B. Y. Talawar, LIO

Staff Position as on 31.03.2013

Category	Sanctioned	Filled	Vacant
Director	1	1	0
R & D	171	143	28
Technical	198	169	29
Administrative	175	155	20
Support	87	71	16
Total	**632**	**539**	**93**

XIV. RESEARCH ADVISORY COMMITTEE

Chairman
Prof. K. Narayana Gowda
Vice Chancellor
University of Agricultural Sciences
GKVK, Bengaluru-560 065

Dr. Rajeev Varshney,
Principal Scientist & Director,
Centre of excellence in Genomics
ICRISAT, Patancheru,
Hyderabad 502 324, Andhra Pradesh

Dr. R. R. Prasad,
Professor & Head,
Centre for Equity and Social Development,
National Institute for Rural Development,
Hyderabad-500 030, Andhra Pradesh

Dr. Nagaraju,
Prof. & Head, Plant Virology,
Dept. of Plant Pathology,
University of Agricultural Sciences,
GKVK, Bengaluru -560 065

Dr. K.T. Sampath,
Former Director of NIANP,
FF 02, Passion Paradise,
45, I Main, I Block,
Thyagarajanagar, Bengaluru -560 030

Commissioner of Sericulture
Govt. of Tamil Nadu, Post Box No.90
Foulke's Compound, Analmedu,
Salem- 636 001, Tamil Nadu

Director of Sericulture,
Govt. of Maharashtra,
New Administrative Building,
No.2, B-Wing, Civil Lane, VI Floor,
Nagpur-440 010, Maharashtra

The Commissioner,
Directorate of Sericulture,
Govt. of Madhya Pradesh,
Lower Basement, Satpura Bhavan
Bhopal-461 004

The Director,
Central Silk Technological Research Institute,
Central Silk Board, BTM Layout,
Madivala, Bengaluru -560 068

Prof. Maheshwaran,
Dept. of Genetics and Plant Breeding,
Tamil Nadu Agricultural University,
Coimbatore- 641 003
Tamil Nadu

Dr. S. Vadivelu,
Former Principal Scientist &
Head, NBSS & LUP,
No. A-106, Nagarjuna Garden,
F-Block, Sahakar Nagar,
Bengaluru -560 092

Dr. R. J. Rabindra
Dean, College of Post Graduate Studies,
Central Agriculture University
Umiam, Barapani - 793 103
Meghalaya

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

Commissioner of Sericulture
Govt. of Andhra Pradesh
Road No. 72, Prashasan Nagar
Jubilee Hills
Hyderabad – 500 033, Andhra Pradesh

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

Director, Central Silk Board,
CSB Complex, BTM Layout,
Madivala, Bengaluru -560 068

The Director,
National Silkworm Seed Organization,
Central Silk Board, IV Floor, CSB Complex,
BTM Layout, Madivala,
Bengaluru-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,
Seri-Bio-Tech. Research Laboratory,
CSB Campus, Sarjapur Road,
Carmelram Post, Kodathi,
Bengaluru -560 035.

The Director,
Karnataka State Sericulture Research &
Development Institute,
Thalaghattapura, Bengaluru - 560 062

The Director,
Andhra Pradesh State Sericulture Research &
Development Institute,
Kirikera, Hindupur-515 211,
Andhra Pradesh

The Director,
Karnataka State Sericulture Research &
Development Institute,
Thalaghattapura, Bengaluru - 560 062

The Director,
Andhra Pradesh State Sericulture Research &
Development Institute,
Kirikera, Hindupur-515 211,
Andhra Pradesh

Shri. Somashekar
S/o. Shri. Shivananjegowda,
Marigudi Beedhi, K. R. Pete Taluk,
Mandya District

Shri. R. Jagadeesh,
S/o Shri. D. Ravindranath,
388, Survey No.117, Gandhemadu Grama,
Elekere, Channapattana Taluk,
Ramanagar District-571 501, Karnataka

Sri. G. Gurumurthy Chetty
S/o. G. Appi Chetty
Dandapalli P.O.
Gangavaram mandal,
Chittoor Dist., Andhra Pradesh

Sri. D. Ahammed Sab
S/o. Sri. Dastigiri Sab
Silk reeler,
5-11-358, Rahammatpur,
Hindupur-515 201,
Anantapur Dist, Andhra Pradesh

Sri. N. R. Ramachandran,
S/o. Sri. Narayanaswamy
No. 29/A, Mukkathripalayam Street,
Anandapuram Village P.O. 605 201
Gingee Taluk, Vilupuram Dist.
Tamil Nadu

Sri. M. Ravi,
S/o. N. Muthuswamy
Karatur, Natamangalam P.O.,
Behind Divya theater,
Salem – 636 010
Tamil Nadu

Invitees

Officer Incharge,
Regional Sericultural Research Station
Central Silk Board,
Ministry of Textiles, Govt. of India,
P.B. No.50, Rapthadu, Anantapur-515 001
Andhra Pradesh

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

Officer Incharge,
Regional Sericultural Research Station
Central Silk Board,
Ministry of Textiles, Govt. of India,
Near Railway Station, Nanjangud Road,
Chamarajanagara-643 101, Karnataka

Officer Incharge,
Regional Sericultural Research Station
Central Silk Board,
Ministry of Textiles, Govt. of India,
Veeranam Road, Allikuttai Post,
Vaikkalapattarai, Salem-636 003, Tamil Nadu

The Deputy Secretary (Insp.),
Regional Office of Central Silk Board,
Ministry of Textiles, Govt. of India,
No. 16, Mittal Chambers, Nariman Point,
Mumbai-400 021, Maharashtra

The Deputy Secretary (Tech.),
Regional Office of Central Silk Board,
Ministry of Textiles, GOI, Prasashan Nagar, No.72,
Jubilee Hills, Hyderabad-500 096, Andhra Pradesh

The Deputy Secretary (Tech.),
Regional Office of Central Silk Board,
Ministry of Textiles, Govt. of India,
No.28/22, K.K. Salai, Kaveri,
Rangan Nagar, Saligramam,
Chennai- 600 093, Tamil Nadu

Details of Review meeting held during the year

Sl. No.	Meeting	Date
1	Research Council (RC)	28th - 29th June 2012 04th - 5th December 2012
2	Research Advisory Committee (RAC)	27th - 28th July 2012 25th - 26th February 2013
3	Regional Research Advisory Committee (RRAC)	18.03.2013 at Salem, Tamil Nadu 02.05.2012 at Anantapur 18.01.2013 at Chamarajanagara

XV. TRAINING ATTENDED

Institute/Place	Subject
Central Silk Board, Bengaluru	Trainers Training Programme (12.09.2012 to 14.09.2012) **Participant:** Suma, A. S.
Central Silk Board, Bengaluru	Training Programme for Cluster Promotion Programme facilitators(23.03.2013 to 25.03.2013) **Participants:** Balavenkatasubbaiah, M.;Dasappa.; Jaishankar, C.; Joy Naliath John.; Karande, A. J.; Mallikarjuna, B.; Masilamani, S.; Mogili, T.; Naseema Begum, A.; Pallavi, S. N.; Prasad, G. V.; Rajasekhar, K.; Ramprakash.; Sarala, K.; Selvaraju, N. G.; Shivarami Reddy, N.; Shivashankar, N.; Srinivasa, B. T.; Subrahmaniam, M. R.; Subramania Reddy, C.; Thippeswamy, T.; Thirunavukkarasu, K.; Vindhya, G.S.
International Mangement Association, New Delhi, programme conducted at Goa	Training the trainers Programme (06.09.2012 to 08.09.2012) **Participant:** Sharma, S. D.
CSRTI, Mysore	Soil Testing (09.07.2012 to 13.07.2012) **Participant:** Ambika, P. K.

XVI. PARTICIPATION OF SCIENTISTS IN SYMPOSIA/SEMINAR/WORKSHOP/CONFERENCES

Scientists of this institute and nested units were given exposure on the recent advances in R&D through presentation and participation in the National and International Symposium/Seminar/Workshop/Conference in the country and abroad.

i) International

Sl. No.	Symposium/Seminar/ Workshop/ Conference
1	International Conference on Solid waste management and exhibition at INFOSYS, Mysore (29.07.2012 to 01.08.2012) **Participants:** Subrahmanyam, M. R.; Srikantaswamy, K.
2	3rd International Conference on Solid Waste Management organized by Mysore City Corporation, Mysore, Centre for Quality Management System, Jadavpur University, Kolkata and International Society of Waste Management, Air and Water, Mysore.(30.07.2012 to 01.08.2012) **Participant:** Venugopal, A.
3	International Conference on Anthropogenic impact on environment and conservation strategy at Dept. of Zoology, University of Ranchi and Xavier College, Ranchi (02.11.2012 to 04.11.2012) **Participants:** Subrahmanyam, M. R.; Srikantaswamy, K.
4	International Conference on Anthropogenic Impact on the Environment and Bioremediation at Dept. of Zoology, Sri Venkateswara University, Tirupati (26.11.2012 to 28.11.2012) **Participants:** Kasi Reddy, B.;Reddy, M. P.; Srinivasulu Reddy, P.
5	International Conference on Biological inorganic chemistry, organised by Department of Chemistry, Periyar University (20.02.2013 to 22.02.2013) **Participant:** Rajakumar, S.

ii) National

Sl. No.	Symposium/Seminar/ Workshop/ Conference
1	Mulberry silkworm breeders meet at Central Silk Board, Bengaluru (28.05.2012 to 29.05.2012) **Participants:** Ashwath, S. K.; Mal Reddy, N.; Manthira Moorthy, S.; Naseema Begum, A.; Radhalakshmi, Y.C.; Sharmila, K. K.; Sudha, V. N.
2	Collaborative research programme on silkworm breeding at CSRTI, Mysore (12.09.2012 to13.09.2012) **Participants:** Dayananda.; Parameshwara, C.; Santha, P. C.
3	Workshop on *Nano technology and its applications in Sericulture* at CSRTI, Mysore (10.10.2012) **Participants:** Ashwath, S. K.; Babu, A. M.; Babu, C. M.; Balakrishna, R.; Balavenkatasubbaiah, M.; Bhagya, R.; Chandrasekharan, K.; Chikkanna.; Chowdary, N. B.; Dasappa.; Dayananda.; Gandhi Doss, S.; Gangadhar, B.; Geetha, G. S.; Girish Naik, V.; Gunasekhar, V.; Issac Joseph.; Jaishankar. Joge, P. G.; Kanika Trivedy.; Katiyar, R. S.; Kirsur, M. V.; Lakshmanan, S.; Lakshmanan, V.; Mal Reddy, N.; Mallikarjuna, B.; Manthira Moorthy, S.; Munikrishnappa, H. M.; Munirathnam Reddy, M.; Nagaraja, S. B.; Nangaraj, B.; Narasimha Nayaka, A. R.; Narendra Kumar, J. B.; Naseema Begum, A.; Nirmal Kumar, S.; Nishitha Naik, V.; Parameshwara, C.; Pratheesh Kumar, P. ; Purushotham, S.; Qadri, S. M. H.; Radhakrishnan, S.; Radhalakshmi, Y. C.; Raghunath, M. K.; Rajashekhar, K.; Ramesh, M.; Raveendra M. Mattigatti; Renukeswarappa, J. P.; Sabitha, M. G.; Santha, P. C.; Satish B. Kulkarni.; Satish Verma.; Sharma, D. D.; Sharma, S. D.; Sharmila, K. K.; Shekhar, M. A.; Sibayan Sen.; Somaprakash, D. S.; Srinivasa, B. T.; Sreenivasalu Reddy, P.; Srikantaswamy, K.; Sudha, V. N.; Sudhakara Rao, P.; Suma, A. S.; Thippeswamy, T.; Vedavyasa, K.; Venkateswara Prasad, G.; Vindhya, G. S.; Vineet Kumar.; Vinod Kumar.; Vinod Kumar Yadav.; Virendrakumar.
4	Workshop on Bioinformatics and its applications conducted by Bioinformatics Centre, CSR&TI, Mysore (29.11.2012 to 30.11.2012) **Participants:** Babu, C. M.; Balakrishna, R.; Balasaraswathi, S.; Chandrasekhar, M.; Chandrasekharan, K.; Chowdary, N. B.; Gangadhar, B.; Katiyar, R. S.; Mani, A.; Manthira Moorthy, S.; Meenal, R.; Mogili, T.; Munirathnam Reddy, M.; Nishitha Naik, V.; Noble Morrison, M.; Punithavathy, G.; Rajashekar, K; Sakthivel, N.; Santha, P. C.; Sharmila, K. K.; Shivashankar, N.; Sivasubramonian, T.; Ishwer.; Srinivasa, B. T.; Subramanya Reddy, C.; Sudhakar, P.; Thippeswamy, T.; Venkateswara Rao, M.; Vijayakumar, R.; Vineet Kumar.; Vinod Kumar Yadav
5	Rajbhasha technical workshop at CSR&TI, Mysore (06.02.13) **Participants:** Aswath, S. K.; Babu, A. M.; Chowdary, N. B., Balavenkata Subbiah, M.; Bhagya, R.; Chikkanna.; Dayanand.; Sharma,.D. D.,; Gandhi Doss, S.; Gangadhar, B.; Geetha, G. S.; Girish Naik, V.; Gunashekar, V.; Jayaramulu, B.; Jayashree, V.; Joge, P.G.; Kanika Trivedi.; Kariyappa.; Katiyar, R. S.; Kulkarni, S. B.; Lakshmanan, S.; Mal reddy, N.; Manthira Murthy, S.; Mary Josepha, A. V.; Mukund V. Kirsur.; Munikrishnappa, H. M.; Muniratnam Reddy.; Nagaraj, S. B.; Narasimha Nayaka, A. R.; Narendra Kumar, J. B.; Naseema Begum, A.; Nirmal Kumar, S.; Nishita Naik, V.; Pallavi, S. N.; Parameshwara, C.; Pratheesh Kumar, P. M.; Prithviraje Urs, M. K.; Purushottam, S.; Radhalakshmi, Y. C.; Raghunath, M. K.; Rajashekar, K.; Ramesh, M.; Ravindra M. Mattigatti.; Renukeshwarappa, J. P.; Sabitha, M. G.; Satish Verma.; Shantha, P.C.; Sharma, S. D.; Sharmila, K. K.; Sibayen Sen.; Somaprakash, D. S.; Srinivas, B. T.; Sudha, V. N.; Suma, A. S.; Tippeswamy, T.; Vedavyasa, K.; Vindhya, G. S.; Vineet Kumar.; Vinod Kumar Yadav, B.; Vinod Kumar.; Virendra Kumar.
6	Sericulture farmers workshop at Bagalkote (04.01.2013) **Participants:** Balavenkatasubbaiah, M.; Chikkanna.; Chowdary, N. B.; Sharma, S. D.; Suma, A. S.; Vindhya, G. S.; Srinivasa, B. T.; Gangadhar, B.; Katiyar, R. S.; Himantharaj, M. T.
7	Workshop on Dissemination of solar passive building for silkworm rearing, jointly organized by Silkworm Seed Technology Laboratory (SSTL), Central Silk Board, Kodathi, Bengaluru and The Energy Resources Institute (TERI) at SSTL, Bangaluru. (06.03.2013) **Participants:** Jaishankar, C.; Joge, P. G.; Philomena, K. L.; Purushotham, S.; Sakthivel, N.; Shivashankar, N.; Somaprakash, D. S.

8	Sericulture Workshop & Exhibition at Keelaghatta (Maddur) (14.09.2012) **Participant:** Srinivasa, B. T.
9	National workshop on Success of Classical Biological Control of Papaya Mealybug in India, at NBAII, Bengaluru (20.10.2012) **Participants:** Mary Josepha, A.V.; Narendra Kumar, J. B. ; Sakthivel, N. ; Shekhar, M. A.; Srinivasa, B. T.; Vinod Kumar.
10	National seminar on Application of Science & Technology to promote Agriculture growth and value addition at JSS College, Mysore (02.012.2012 to 03.012.2012) **Participants:** Gandhi Doss, S.; Urs, M. K. P.
11	Climate change, forest ecosystem and bio-diversities – Vulnerability and adaptation strategy at Forest Research Institute, Dehradun (17.12.2012 to 24.12.2012) **Participant:** Urs, M. K. P.
12	Farmers Workshop at Kolar jointly organized by RSRS, Kodathi and DOS, Karnataka (17.09.2012) **Participants:** Jaishankar.; Noble Morrison, M.; Shivashankar, N.; Subrahmanyam, M. R.; Sudhakara Rao, P.
13	National symposium on Innovative Approaches and Modern Technologies for crop productivity, Food Safety and Environmental Sustainability. Thrissur, Kerala (19.11.2012 to 20.11.2012) **Participants:** Ravikumar, J.
14	Conservation agriculture strategies for resource conservation and mitigation of climate change at CRIDA, Hyderabad (24.09.2012 to 03.10.2012) **Participant:** Mallikarjuna, B.
15	Lac production and lac host plant cultivation exposure training, at Indian Institute of Natural Resins and Gums, Ranchi (01.11.2012 to 07.11.2012) **Participant:** Srikantaswamy, K.
16	Sericulture Workshop: Bivoltines for Prosperity (04.06.2012) **Participants:** Ch. Satyanarayanaraju.; Chandrasekhar, M.; Narasimha Murthy, B.; Sivarami Reddy, N.; Venkateswara Rao, M.
17	National Seminar on Cutting Edge Technologies in Vanya Silk Research – India at Department of Sericulture, Govt. Degree College, Kadiri (04.01.2013 to 05.01.2013) **Participants:** Ch. Satyanarayanaraju.; Kasi Reddy, B.; Venugopal, A.
18	National Seminar on Futuristic Agricultural Extension for Livelihood Improvement and Sustainable Development by International Society of Extension Education, ANGRAU, Hyderabad (18.01.2013 to 21.01 2013) **Participant:** Ch. Satyanarayanaraju
19	Sericulture Workshop at Sangareddy, Medak District (25.03.2013) **Participants:** Ch.Satyanarayanaraju.; Narasimha Murthy, B. ; Raghupati, M.; Shanthan Babu, M. A.; Srinivasulu Reddy, P.; Venkataramana, P.
20	National symposium on Impact of climate change on Biodiversity organized by Dept. of Zoology, Periyar University, Tamil Nadu (23.01.2013) **Participant:** Rajakumar, S.
21	National Conference on Food Processing Technology for Health Progression organized by Dept. of Food Science and Nutrition, Periyar University, Tamil Nadu. (09.01.2013 to 10.01.2013) **Participant:** Rajakumar, S.
22	National Seminar on Biotechnological Intervention in Plant and Microbial Interaction for Crop Sustainability organized by Department of Biotechnology, Periyar University, Tamil Nadu. (30.01.2013 to 31.01.2013) **Participant:** Rajakumar, S.
23	State Level Workshop on Sericulture - conducted by Department of Sericulture, Government of Tamil Nadu. (14.04.2012) **Participant:** Sakthivel, N.

XVII. SERVICES RENDERED

Analysis of materials received from various entities was undertaken and generated revenue of Rs. 1,59,315/-

Sl. No.	Particulars	Number of samples	Revenue Amount (Rs.)
1	Soil	1769	99,966/-
2	Bed disinfectants (Vijetha, Vijetha Supplement, Ankush, Vijetha Gold, Ankush, Amruth)	36	46,628/-
3	Room disinfectants (Asthra, Serichlor, Sanitech)	14	2,755/-
4	Leaf	13	7,214/-
5	Press mud, FYM, Waste vegetable slurry, bio-digestor	9	2,067/-
6	Water	21	685/-
	Revenue Generated	**Total**	**1,59,315/-**

XVIII. ROYALTY RECEIVED

Premia paid and Royalty received from NRDC, Bengaluru pertaining to various products innovated and commercialized by this institute during 2008-09 and 2009-10 as communicated by Central Office are as follows:

Sl. No.	For the Year	Reference letter No.	Premia (Rs.)	Royalty (Rs.)
1	2008-09	No. CSB-31/7(2)/2012-RCS dtd. 15.05.2012	70,000.00	4,22,638.00
2	2009-10	No. CSB-31/7(2)/2012-RCS dtd. 14.05.2012	35,000.00	2,34,827.00

XIX. RIGHT TO INFORMATION ACT 2005 (RTI)

Name of CPIO: Dr. S. M. H. Qadri, Director, CSRTI, Mysore

Sl. No.	Date of request	Date of compliance and letter No.
1	14.05.2012	No. CSB/RTI/SEEM/RTI Act/2012-13 dated 31.05.2012
2	01.05.2012	No. CSB/RTI/SEEM/RTI Act/2012-13/72-73 dated 16.05.2012
3	15.04.2012	No. CSB/RTI/SEEM/RTI Act/2012-13/434-435 dated 22.10.2012
4	02.06.2012	No. CSB/RTI/SEEM/ES/2510/2008-2009 dated 25.06.2012
5	30.06.2012	No. CSB/RTI/SEEM/RTI Act/2012-13/292 dated 25.07.2012
6	05.07.2012	No. CSB/RTI/SEEM/RTI Act/2012-13/290 dated 25.07.2012
7	04.07.2012	No. CSB/RTI/ACCNTS/PBS/RTI/2012-13/275-276 dated 24.07.2012
8	05.10.2012	No. CSB/RTI/SEEM/RTI Act/2012-13/423-424 dated 15.10.2012
9	12.07.2012	No. CSB/RTI/SEEM/RTI Act/2012-13/326 dated 16.08.2012
10	13.07.2012	No. CSB/RTI/SEEM/RTI Act/2012-13/272-273 dated 24.07.2012
11	24.07.2012	No. CSB/RTI/SEEM/RTI Act/2012-13/324-325 dated 07.08.2012
12	22.08.2012	No. CSB/RTI/ES/1417/91/Vol.II dated 23.08.2012
13	05.09.2012	No. CSB/RTI/SEEM/RTI Act/2012-13/408 dated 25.09.2013
14	11.09.2012	No. CSB/RTI/SEEM/RTI Act/2012-13/407 dated 03.10.2012
15	03.10.2012	No. CSB/RTI/SEEM/RTI Act/2012-13/479 dated 29.10.2012
16	06.10.2012	No. CSB/RTI/SED/RTI Act/2012-13/770 dated 25.10.2012
17	09.10.2012	No. CSB/RTI/SEEM/RTI Act/2012-13/432 dated 22.10.2012
18	28.12.2012	No. CSB/RTI/SEEM/RTI Act/2012-13/612 dated 16.01.2013
19	02.02.2013	No. CSB/RTI/RIA/2012-2013/727 dated 20.02.2013

XX. LIST OF DIGNITARIES WHO VISITED THE INSTITUTE

Sl. No.	Name of visitors/ dignitaries	Address	Date of visit
1	Mr. Shravan P. Hardikar, IAS	Collector, Yavatmal, Maharashtra	16.04.2012
2	Mr. Naval Kishore, IAS	CEO, Zilla Parishat, Yavatmal, Maharashtra	23.04.2012
3	Mr. R. Y. Gaikwad, IAS	Chief Secretary, Govt. of Maharashtra, Mumbai	29.04.2012
4	Mr. M. Shivanna	Member, NCSC, Govt. of India, New Delhi	02.08.2012
5	Dr. K. Kawakami,	JICA, F.U., Survey Mission, Japan	09.08.2012
6	Mr. Koji Yamada	JICA Research Institute, Tokyo, Japan	29.08.2012
7	Mr. Ammette Kicono	Team Leader, Brclays, Uganda	23.11.2012
8	Mr. N. S. Bisse Gowda	Chairperson, CSB, Bengaluru	21.03.2013

XXI. METEOROLOGICAL DATA

Meteorological data for the Year 2012

Station: CSR&TI, Mysore

Month	Temperature [°C]			Humidity [%]			Rainfall [mm]
	Maximum	Minimum	Average	Maximum	Minimum	Average	
January	31.10	7.70	19.40	89.00	23.00	56.00	0.00
February	35.20	11.10	23.15	96.00	17.00	56.50	0.00
March	36.40	14.80	25.60	88.00	19.00	53.50	0.00
April	36.50	19.40	27.95	86.00	23.00	54.50	124.30
May	35.70	19.90	27.80	85.00	28.00	56.50	28.70
June	34.20	14.80	24.50	97.00	19.00	58.00	31.60
July	33.00	19.40	26.20	91.00	50.00	70.50	18.40
August	33.50	18.30	25.90	88.00	51.00	69.50	52.10
September	33.50	17.60	25.55	96.00	40.00	68.00	53.90
October	33.20	16.60	24.90	95.00	93.00	94.00	138.20
November	31.40	10.70	21.05	98.00	39.00	68.50	37.40
December	32.00	11.00	21.50	96.00	41.00	68.50	13.20
Extm. High	36.50	19.90	28.20	98.00	93.00	95.50	138.20
Extm. Low	31.10	7.70	19.40	85.00	17.00	51.00	13.20
					Total Rainfall		**497.80**
					No. of rainy days		**38**

Station: RSRS, Kodathi

Month	Temperature [°C]			Humidity [%]			Rainfall [mm]
	Maximum	Minimum	Average	Maximum	Minimum	Average	
January	27.69	17.23	22.5	75.0	51.0	63.0	0.00
February	33.00	15.00	24.0	76.0	56.0	66.0	0.00
March	35.00	17.00	26.0	65.0	45.0	55.0	0.00
April	35.25	19.95	27.6	67.5	36.0	51.8	27.50
May	36.00	19.00	27.5	69.5	62.0	65.8	0.00
June	35.00	20.00	27.5	86.0	67.0	76.5	0.00
July	32.00	21.00	26.5	79.0	70.0	74.5	0.00
August	31.00	20.00	25.5	87.0	61.0	74.0	106.25
September	32.00	20.00	26.0	90.0	67.0	78.5	85.00
October	33.00	18.00	25.5	85.0	71.0	78.0	96.25
November	30.00	16.00	23.0	88.0	71.0	79.5	5.00
December	30.00	16.00	23.0	84.0	71.0	77.5	13.75
Extm. High	36.00	21.00	28.5	90.0	71.0	80.5	106.25
Extm. Low	27.69	15.00	21.3	65.0	36.0	50.5	5.00
					Total		**333.75**

Station: RSRS, Chamarajanagara

Month	Temperature [°C]			Humidity [%]			Rainfall [mm]
	Maximum	Minimum	Average	Maximum	Minimum	Average	
January	30.40	13.40	21.90	68.90	48.40	58.65	0.80
February	33.10	14.50	23.80	61.00	36.00	48.50	0.00
March	35.40	18.50	26.95	61.00	26.00	43.50	0.00
April	35.60	20.60	28.10	69.10	46.10	57.60	55.70
May	34.10	21.30	27.70	76.10	52.10	52.10	77.80
June	32.00	20.30	26.15	70.00	57.90	63.95	3.20
July	30.80	20.10	25.45	74.60	61.40	68.00	62.00
August	30.80	19.80	25.30	75.70	63.70	69.70	40.00
September	32.10	19.30	25.70	71.70	55.10	63.40	23.20
October	30.90	18.60	24.75	75.30	59.40	67.35	102.80
November	30.00	15.40	22.70	71.10	54.20	62.65	52.00
December	30.90	14.20	22.55	65.40	47.90	56.65	3.80
Extm. High	35.60	21.30	28.45	75.70	63.70	69.70	102.80
Extm. Low	30.00	13.40	21.70	61.00	26.00	43.50	0.80
					Total		**421.30**

Station: RSRS, Anantapur

Month	Temperature [°C]			Humidity [%]			Rainfall [mm]
	Maximum	Minimum	Average	Maximum	Minimum	Average	
January	33.0	17.0	25.0	65.0	40.0	52.5	0.00
February	35.0	19.0	27.0	65.0	30.0	47.5	0.00
March	38.0	22.0	30.0	60.0	31.0	45.5	04.80
April	40.0	26.0	33.0	55.0	28.0	41.5	72.00
May	41.0	27.0	34.0	52.0	26.0	39.0	0.00
June	38.0	22.0	30.0	65.0	40.0	52.5	32.60
July	34.0	24.0	29.0	70.0	45.0	57.5	100.00
August	31.0	25.0	28.0	76.0	48.0	62.0	70.40
September	34.0	23.0	28.5	82.0	65.0	73.5	63.80
October	35.0	23.0	29.0	80.0	66.0	73.0	90.80
November	34.0	17.0	25.5	78.0	62.0	70.0	27.80
December	33.0	17.0	25.0	74.0	56.0	65.0	0.00
Extm. High	41.0	27.0	34.0	82.0	66.0	74.0	100.00
Extm. Low	31.0	17.0	24.0	52.0	26.0	39.0	4.80
					Total		**462.20**

Station: RSRS, Salem

Month	Temperature [°C]			Humidity [%]			Rainfall [mm]
	Maximum	Minimum	Average	Maximum	Minimum	Average	
January	35.83	21.36	28.59	67.13	41.86	54.49	58.40
February	32.96	23.06	28.01	73.19	59.51	66.35	118.00
March	33.60	24.00	28.80	79.20	48.60	63.90	96.00
April	31.50	24.00	27.70	80.80	62.20	71.50	120.00
May	29.40	21.80	25.60	80.80	74.10	77.40	121.00
June	31.60	23.00	27.30	80.20	61.60	70.90	224.00
July	28.80	22.30	25.50	78.70	61.70	70.20	238.00
August	29.50	19.00	24.25	71.00	60.10	65.50	0.00
September	30.60	20.40	25.50	69.10	48.00	58.50	11.20
October	30.70	19.40	25.00	39.60	31.30	35.40	0.00
November	32.00	20.90	26.40	60.40	37.70	49.00	3.00
December	34.00	19.70	26.70	59.80	23.20	41.80	0.00
Extm. High	35.83	24.00	28.91	80.80	74.10	77.45	238.00
Extm. Low	28.80	19.00	23.90	39.60	23.20	31.40	3.00
					Total		**989.60**

XXII. PUBLICATIONS

Research papers A. International journal		11
B. National journals		23
Popular articles		25
Books		03
Booklet/Technical bulletin		02
Technical report		01
News/reports/silk briefs		86
Extension manuals/brochures/pamphlets		40
Papers/Abstracts of presented in	A. International	13
seminar/workshop/ conference	B. National	07
Grand Total		**211**

International

Babu, A. M.; Kumar, J. S.; Mishra, P. K.; Yadav, D. and Qadri, S. M. H. (2012) Root-knot development in mulberry infested with *Meloidogyne incognita. Arch. Phytopathol.*, 45(20):2414-2424.

Gandhi Doss, S.; Chakraborti, S. P.; Roychowdhuri, S.; Das, N. K.; Vijayan, K. and Ghosh, P. D. (2012) Development of mulberry varieties for sustainable growth and leaf yield in temperate and subtropical regions of India. *Euphytica,* 185(2):215-225.

Geetha, G. S. and Vindhya, G. S. (2012) Agency and opportunity structure as two bases of women's economic empowerment: The case of silk industry. *Global Advanced Research J. of Social Science (GARJSS),* 1(7):136-141.

Mal Reddy, N.; Nirmal Kumar, S.; Naseema Begum, A.; Moorthy, S. M. and Qadri, S. M. H. (2012) Performance of bivoltine silkworm hybrids of *Bombyx mori* L. involving parental foundation crosses of different generation. *International J. Res. Zool.*, 2(1): 1- 5.

Moorthy, S. M. and Kar, N. B. (2012) Studies on suitability of using bivoltine x multivoltine silkworm hybrid in seed crop and its utilization as male parent for preparation of multi x (bivoltine x multivoltine) commercial silkworm hybrids in tropical conditions. *International J. Res. Zool.*, 2 (1): 6-10.

Moorthy, S. M.; Das, N. K. and Mandal, K. (2012) Genotype x Environment interaction and stability analysis in bivoltine silkworm genotypes of *Bombyx mori* L. *International J. Biol. Pharmacy and Allied Sciences*, 1(10):1443-1449.

Mukhopadhyay, T. K.; Bhattacharya, S. S.; Moorthy, S. M. and Kundu, J. K. (2012) Breeding and isozyme variability of a superior multivoltine strain of *Bombyx mori*. *Iranian J. Entomol*., 2:1-6.

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Rita Banerjee; Das, N. K.; Gandhi Doss, S. ; Saha, A. K.; Bajpai A. K. and Bindroo, B. B. (2012) Narrow sense heritability estimates of bacterial leaf spot resistance in pseudo F2 (F1) population of mulberry (*Morus* spp.). *European J. Plant Pathol*., 133:537-544.

Vineet Kumar; Kodandaramaiah, J. and Rajan, M. V. (2012) Leaf and anatomical traits in relation to physiological characteristics in mulberry (*Morus* sp.). *Turkish J. Bot.,* 36(6): 683-689.

National

Ashwath, S. K.; Sharmila, K. K.; Mahalingappa, K. C.; Sreekumar, S.; Nirmal Kumar, S.; Thippeswamy, T. and Qadri, S. M. H. (2011) Evolution and evaluation of silkworm breeds and hybrids developed by amylase marker assisted selection. *J. Seric. Technol*., 2(2):108-113.

Balavenkatasubbaiah, M.; Chandrasekharan, K. and Qadri, S. M. H. (2012) Susceptibility of different popular breeds and hybrids of the silkworm, *Bombyx mori* L. to green muscadine disease. *J. Exp. Zool. India,* 15(2):527-531.

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1. Soil health in mulberry gardens and nutrient management (in Kannada)
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3. Disinfection and hygiene in silkworm rearing (in English)
4. Silkworm body and rearing bed disinfectants (in English)
5. Mulberry Krishi (in Malayalam)
6. Hippunerale thotadha mannina arogya mattu Poustikathe nirvahane (in Kannada)
7. Male ashtritha pradeshakke sukthavada hosa hipunerale thaligalu (in Kannada)
8. Male ashritha pradeshadalli hippunerale thotada sthapane mattu nirvahane (in Kannada)
9. Hippunerale besayadalli savayava gobbaragala balake (in Kannada)
10. Male ashritha pradeshadalli maragaddi hippunerale besaya (in Kannada)
11. Male ashritha hippunerale thotadalli anthara bele besaya (in Kannada)
12. Poshan – Hippunerale thotadalli poustikamshagala korathe nirvahane (in Kannada)
13. Naveenya – Hippunerale gidagala berukole roga niynthrana (in Kannada)
14. Hippuneralege thagaluva keetagala nirvahana (in Kannada)
15. Neeravari pradeshagalige athika goodina iluvari hagu uthama dharjeya kaccha reshme uthpadhanege hosa misra thali L14 x CSR2 (in Kannada)
16. Hosa sakthisali sonku nivaraka: Asthra (in Kannada)
17. Pattupurugulalao pempakamio uzi eega – samgra nirvana yojamanyam (in Telugu)
18. Pattipugulalao soke vyadhulu – vati nivaranopayalu (in Telugu)
19. Mulberry cheeda purugulu – samagra sasyasa rakshana (in Telugu)
20. Mulberry thota – yajamanyapaddatulu (in Telugu)
21. Pattupurugula pemparkam – sanketika amshalu (in Telugu)
22. Disinfection and maintenance of hygiene in silkworm rearing (in Tamil)
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24. Important technologies in silkworm rearing (in Tamil)
25. New bivoltine hybrids (in Tamil)
26. Soil health management and analysis (in Tamil)
27. New silkworm hybrids (in Tamil)
28. Modified chawki kit plot maintenance in existing garden (in Tamil)
29. Recycling of sericultural wastes by vermi-composting (in Tamil)
30. Recycling of sericultural wastes as compost (in Tamil)

31. Management strategies of Papaya mealybug in mulberry (in Tamil)
32. Green manuring in mulberry (in Tamil)
33. Drip irrigation system in mulberry (in Tamil)
34. Control of papaya mealybug in mulberry (in Tamil)
35. Pattupuzhu valarthal: Marganirdeshangal (in Malayalam)
36. Chetak – for management of foliar and root diseases (in Tamil)
37. Mounting of silkworms for spinning of cocoons (in English)
38. Mulberry platations for mechanized cultivation (in English)
39. Reshamkeet palan grih (in Hindi)
40. Resham utpadan mem yantrikaran (in Hindi)

Seminar/ Workshop/Symposium

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1. Babu, A. M.; Dayakar Yadav.; Kumar, V. and Qadri, S. M. H. (2012) Fructification of foliar pathogens of mulberry under SEM., pp. 104-105.

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1. Balasaraswathi. S, Qadri, S. M. H., Masilamani, S. and Balakrishna, R. (2012). Induced systemic resistance through various organic cakes on the management of Pink mealybug *Maconellicoccus hirsutus* (Green) infesting mulberry. Abstract present in the second National Symposium on Innovative approaches and Modern technologies for crop productivity, food safety and environm,ental Sustainability held at Thrissur on 19/20 November 2012, p.

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2. Katiyar, R. S. and V. K. Yadav (2013) Shahatoot samvardhan mein naveen proudyogikiyon ka yogadaan pp. 9-12.
3. Qadri, S. M. H. and S. Nirmal Kumar (2013) Dakshin Bharat mein resham utpaadan – kal, aaj aur kal. pp. 1-6.
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Extension Division

RSRS, Ananthapur

- REC, Madakasira
- REC, Rayachoty
- REC, Vikarabad
- REC, V.Kota
- REC, Eluru
- REC,Kalyanadurgam
- SU, Bidar
- SU, Penukonda
- CPC, Hindupur
- CDC, Palamner
- SU, Giddalur
- SU, Suryapet
- SU, Chebrolu
- SU, Atmakur
- SU, Metpally

RSRS, Ch.Nagar

- SU, Kinakanahalli
- **SSBS, Coonoor**
- **P4-BSF, Hassan**
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- REC, Bidaraguppe
- REC, Chitradurga
- REC, Madivala
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- SU, Kanakapura
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RSRS, Salem

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- REC, Palakkad
- SU, Avinashi
- SU,Vaniyampadi
- SU, Kalpetta
- SU, Berigai
- SU, Trichy

- SU, Shimoga
- REC, Hoshangabad
- SU, Osmanabad
- SU, Maddur
- SU, Jalna
- SU, Burhanpur
- SU, Aurangabad

BSF - Basic Seed Farm (1)
CDC - Cluster Development Centre (2)
CPC - Cluster Promotion Centre (1)
REC - Research Extension Centre (19)
RSRS- Regional Sericultural Research Station (4)
SU - Sub Unit of REC (28)
SSBS- Satellite Silkworm Breeding Station (1)







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