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ANNUAL REPORT
2019-20

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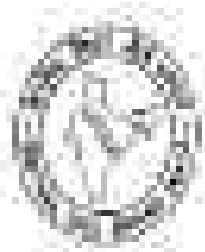
ANNUAL REPORT
2013-2014



केंद्रीय रेशम बायवल अनुसंधान एवं प्रशिक्षण संस्थान
CENTRAL SERICIGENIC FORMAL RESEARCH AND TRAINING INSTITUTE
[आई एस ओ 9001:2008 प्रमाणित/ISO 9001 : 2008 Certified]
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Central Silk Board, Ministry of Textiles, Govt. of India, Mysuru-570 008

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संपादकीय

पहाड़ी पथ पत्रिका अनुसंधान एवं शैक्षिक संस्थान, सोनू घाटी का [illegible] से जारी शैक्षिक गिरावट को प्रशासनिक संस्थानों द्वारा पूरी तरह अनदेखा किया गया है। पुनर्वास योजना का अनुपालन दूसरा है जिस तक यह प्रशासनिक संस्थान [illegible] प्रशासनिक इकाई विशेषज्ञ सभी तक और इस तरह की प्रशासनिक संस्थानों में [illegible] के अनुसार से अनुसूचित [illegible] 2024 का अनुसंधान किया गया। यह शैक्षिक अनुसंधान के विश्लेषण सोनू अनुसूचना का विश्लेषण में पुनर्वास संस्थान, विश्लेषण इसी संस्थान संस्थानों में पुनर्वास्थापन के लिए इसकी पहचान संस्थानपूर्ण का प्रयास है।

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FOREWORD

I have great pleasure in bringing out the Annual Report of Central Sericultural Research and Training Institute, Mysore for the year 2013-14. Looking back, it has been an exceptional year due to a number of remarkable accomplishments and one of them being accreditation of our institute with the ISO 9001:2008 certification which is a testimony of our strong commitment to excellence in quality management of R & D, extension and support services for development of sericulture.

During the year, the institute has received the Rajbhasha Pratibhandh Documentation (RPD) and achieved the set targets. The Institute and its regional units initiated 27 research projects/programmes including 5 external funded projects. A total of 11 research papers and 10 popular articles were published.

It is gratifying to note that research on host plant improvement has come out with three multivoltine silkworm breeds, viz., MR2X of the Institute, MR4X at Channapatnagar and MR6 at Kodathipur with 11-14% improvement in yield over ruling. A core assembly of 100 multivoltine germplasm accessions has been developed for sustainable conservation and enhanced utilization in multivoltine improvement programmes. Studies in the use of Methylated Spirit along with urea has shown the prospects of increasing the nitrogen use efficiency and organic nutrient content in the soil. Soil analysis of host plant samples in southern states has revealed that soil pH, OC and nutrient density are the major factors influencing nutrient uptake from the soil.

The Institute and its Regional Stations have offered soil testing services to over 2000 sericulturists with suitable fertilizer recommendations. It is noteworthy that for control of soil rot disease of mulberry a consortium of eco-friendly bacterial biocontrol agents have been developed which can suppress the disease upto 60%. Further, Hamatrol, the eco-friendly formulation developed for management of root knot pathogen, has been successfully tested with farmers of southern states.

For silkworm DFIS, new strategy of molecular marker assisted selection was taken up for developing the functional silkworm strains using SSR markers as well as MPV inbred silkworm strains employing PmBGX protein during the selection process and the lines are under finalization. Development of improved cross breed (CB) was continued during the year and eight BPV (Bivoltine×Pure) lines are under advance evaluation. Special emphasis has been made for popularization of the CB (L1 x C2R2) with the potential to produce 24-25 grade cbs and over 1.8 lakh DFLs have been distributed and the results are encouraging. Rearing package for both (L1 x pure breed and hybrid was developed for the benefit of the seed and commercial grains. Further, a modified rearing technology package developed for effective rearing of L1 x C2R2 cocoons is under test trial. A special team of breeding experts has been constituted for improvement of L1 x pure breed through multilocational breeding cycles and the improved lines are being monitored.

An indigenous method of culturing *Streptocos*, which is a high value product for pharmaceutical applications has been developed, both *in vitro* using silkworm and *in vivo* through culture medium in which waste has been applied. Studies have shown that metabolites, which is safe to silkworms, can be considered useful for effective management of plant pathogens in the mulberry garden. For developing new strategies for controlling cocoon, MetAP2 gene has been sequenced which showed similarity with that of honey bee and the findings could lead to identification of chemical compounds for therapeutic means. An user friendly technology for disinfection of rearing shade using micro-silk was also have been which will reduce shudgeon in silkworm rearing and also be free disinfectants. A known probiotic bacteria under a consortia to show bacteria pathogens to silkworm has been isolated.

Developing eco-friendly technologies for pest and disease management has been the major thrust of the Institute. A computer-aided decision support package developed for control of coir rot, fly has been successfully adopted in an entire village in Kanniakkoi covering over 600 coconut palms resulted in containment of coir infestation below 2%. Extensive release of microbial agents in the Institute campus has brought down the incidence of mealy bugs and Opisinotrema eriophyid below 5%.

Commendable progress was achieved in the extension front, where in over programme was successfully implemented in the clusters which has resulted in expansion of mulberry by over 1600 acres leading to a record production of 1.43 lakh of cocoons last year. To provide a platform for the CRC owners to discuss the problems and prospects, a workshop on the role of CRCs was organised involving the owners of CRCs, CSB's and DOS officials of southern states. Further, a mega farmers' workshop was organised in which over 1600 farmers representing all the districts of Karnataka participated. Remarkable achievement has been made by the Institute and related units with regard to extension communication programmes, where over 40,000 beneficiaries have been benefited in the last two months alone.

HRD has been the major focus of the Institute, where in a total of 113 beneficiaries were trained under the prestigious HRD programme of MOT. Further, over 1500 persons have been trained under short-term and short course programmes by the Institute and related units. Besides, international training programmes were organised for 21 officials each from Bangladesh and Afghanistan.

It is gratifying that for the first time, weekly seminars were organised by the Institute, in which all topics covering all facets of mulberry sericulture, training and extension areas were presented by the scientists.

The most welcome initiative during the year are introduction of the domestic allowance system since November 2003 and follow-up establishment of a state-of-the-art Video Conference studio in the Institute. These initiatives will greatly help in ensuring transparency and efficiency in administration and communication.

The Institute made an impressive progress in publication and publications covering 71 research papers, 100 publicity materials including news reports, silk crafts, extension manuals, booklets/folders and technical bulletins. Further, 87 papers were presented in various/national conferences. The Institute also brought out two issues of in-house Journal of Sericulture, two issues each of Bulletin and Research Briefs in addition to the Annual Report and the other Technical reports.

I wish to express my sincere thanks to the Member Secretary and members of the CSTB, CSB, RSRS for their valuable guidance and inputs for streamlining the R & D, training and Extension activities as well as the support of CSB/ of different states for their help in achieving the set targets. The scientists and staff of the Institute and related units deserve my full appreciation for their remarkable cooperation and support for the marvellous progress achieved during the year.

Dr. B.N. Krishna
Director

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I. ABOUT CSRTI, 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 1964. With the initiation of the training component, the Institute was renamed as – Central Sericultural Research & Training Institute (CSRTI), Mysore in the year 1965. The Institute as an apex has completed its 51 years of dedicated services for development of sericultural industry in the country. During December 2013, the Institute has been accredited with ISO 9001 : 2008 certification as a testimony of excellence in quality management in R & D, training and service oriented activities of sericulture industry.

Today, the Institute has the distinction of being the premier institution for sericulture research, as evidenced with an insistent facilities and infrastructure. Over the decades, the Institute has grown in its stature, gained National and International repute. The Institute established the active pursuit of sericultural R & D activities to cater to the needs of the six mainly silk producing States in Karnataka, Andhra Pradesh, Tamil Nadu, Kerala, Maharashtra and Madhya Pradesh. With its well developed infrastructure and strong indigenous 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 centre for higher learning and advanced training on the international front. Its role in generating trained manpower has always been on high priorities, both at domestic and international levels. So far, it has trained around 15000 persons in different aspects of sericultural science and technology including 140 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 eco-friendly, low-cost and pro-farmer technologies for effective resource utilization.
- To develop low cost innovative technologies for overall improvement of socio-economic conditions of stakeholders.
- To undertake Human Resource Development in all areas of operation.
- To promote and to validate the cutting edge technologies in the field to increase productive base of quality silk.

Mandate

- To develop machinery and allied technologies suitable for different agro-climatic conditions/zones.
- To conduct basic and applied research in various disciplines leading to the development of commodity technologies.
- To test and verify the post-harvest technologies at field level for their adoptability.
- To conduct front line & farmers demonstrations of the adopted technologies in the field.
- To conduct human resource development and training programmes.
- To serve as a testing centre for machinery & industrial material handling equipment, machines, products and technologies evolved in CIAE Institute or referred by other agencies.
- To coordinate with State Govts., voluntary organizations, NRCs, universities and other National Institutes for collaborative research and technology transfer.

Organizational setup

CIPHET, Ludhiana is the largest and most diversified institution engaged in horticulture R & D in the country supported by about 160 scientists including Agricultural Engineers, Technologists and Biochemists who are working in close coordination for development of appropriate technologies and their transfer, both at the main institute and at the centres/ 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 disciplines under five major divisions viz. basic and strategic research, extension and training. The Director monitors the progress of the R & D activities of the institute and the centres/ units with the support of Planning, Monitoring, Coordination and Evaluation cell.

Extension network

To facilitate transfer and effective adoption of post-harvest technologies in the field, the institute has a three-tier system of extension network – Regional Horticultural Research Stations (RHRS), Research Extension Centres (REC) and Sub-Unit (SU). The RHRSs, located in major horticultural 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 the technological inputs to support them. Maintaining active collaborations with regional Agricultural Universities, the institute is accounting vital contributing sessions in Karnataka, Andhra Pradesh and Tamil Nadu for effective transfer of horticultural technologies. CIPHET Institute of Farmers' Advisory Service and the farmer's resource provides details of all technologies.

Training Centre

The institute is recognized as a flagship centre for generation of trained human resource in the field of tropical horticulture. It provides training in tropical horticulture both at international and

national level. The Institute is affiliated to University of Mysore for conducting research in Sericulture Technology & Bioinformatics including Ph.D. programmes in sericulture. It is also accredited 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 wing houses well equipped classrooms with audio visual teaching aids and the programmes are managed by qualified faculty, recognized as national and national. Hostel is accommodate about 70 persons are available.

Infrastructure facilities available

- Well-equipped laboratories, modern galleries and seeking trained to carry out advanced research in sericulture science.
- Large scale rearing houses for technology validation and farmers training.
- Model chawki rearing center (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 machine equipment.
- State-of-art Biometric attendance system for employees.
- CIBTC, Mysore is the endeavor to ensure faster communication and efficient transfer of technology from the lab to field associated a new video conference studio with state-of-art technology, with which it has become easier to have effective interaction with remote units, DDS and other organizations.
- Computer center provides internet connectivity to all sections through local area network. The LAN also supports print/file sharing across the computers with ease.
- Recently newly Started established with the financial assistance of DBT under the National Bioinformatics Network, provides database retrieval service to the scientists of different institutions involved in the molecular biology research in the sericulture science.
- A modern library with a collection of 17721 books, 6562 bound volumes of scientific journals and 60 journals. In addition, it also maintains a collection of theses/dissertations (351), Reports (35) and technical reports (32). It also provides CD-ROM database (AGRIS, BIOSIS, BIOTECHNOLOGY ABSTRACTS, BIOMEDICINE, Palentology) and DATABASE facilities to its members.
- CIBTC regularly publishes books, bulletins, leaflets and technical papers related to sericulture. Over 70 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. Section – Any prevailing literature on sericultural schemes.

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II. HIGHLIGHTS OF RESEARCH, TRAINING AND EXTENSION ACTIVITIES DURING APRIL 2013 TO MARCH 2014

- The institute and its centres have implemented all research projects/programmes of ICAR & were funded by DAC/DCI/ICAR/RKVY. During the period, 17 projects and 18 programmes were conducted. The major achievements during the year are presented below in brief.

FIBRE PLANT IMPROVEMENT, PRODUCTION AND PROTECTION

- Under final year evaluation trials of multilocation Kharia trial(IC) varieties/ cultivars, three genotypes, viz., MCU-5 (Agrani), MCU-7 (Chandrajyoti) and MCU-9 (Anandjyoti) out yielded the Check, CO 2 by 20.4, 17.23 and 28.7% respectively.

- Towards developing root rot and root knot resistant hybrid(s) varieties, hybridization for bulk of 7 cytoplasmic male sterility inducers and high yielding genotypes were studied and tested for seed viability and seed germination. The F2(S1) descriptors for diff characters (morphological, reproductive, anatomical & growth) have been finalized and molecular markers for tracking the selected plants were identified.

- A panel of 200 diverse germplasm has been identified based on genetic diversity analysis of SSR marker profiles and morphological traits. A core subset of multiple genotypes consisting of 100 germplasm covering maximum genetic diversity has been developed.

- Soil and leaf samples from 200 farmers' fields in southern states were analysed and three major factors, viz., soil pH, soil organic carbon and bulk density were identified under significantly influenced nutrient status in cotton.

- Application of micronutrients mixtures along with Urea showed significant improvement in the uptake of nutrients by plants and increase nutrients in soil and leaf yield. The institute and its regional stations have offered soil testing services to the stakeholders. A total of 2000 soil samples were analysed and suitable fertilizer recommendations were provided to the farmers.

- A bio based formulation of entomopathogenic bacterial biocontrol agents comprising of one strain each of endophytic *B. cereus*, *B. subtilus* & *P. aeruginosa* has been developed for the effective suppression of root rot disease of mulberry caused by *Rhizoctonia solanacea*.

- Under CPT of Mr. Mahajan, a pilot based formulation for control of root rot disease of mulberry has been completed with 10 farmers and is at multilocation stage. Beneficial & harmful microbes were identified through screening of 100 soil samples collected from AP, KA and TN during summer, rainy and winter seasons. Positive correlation was found between microbial population and soil OC in pre & post.

- For developing a database on mulberry diseases, materials on the occurrence of foliar diseases were prepared and color images related to mulberry diseases were collected and the web page has been designed.

OILSEEDS CROP IMPROVEMENT, PRODUCTION AND PROTECTION

- Under the CDC funded project, documentation of the oilseeds market, transaction under 11 mills was conducted with farmers of Dharmapuri, Theni, Villupuram Dist, which showed an improvement of 10.87% and 6.21 % in the oilcake yield over the control, CORU 4 (CSH) and PH 4 (CSH) respectively. The results have motivated the farmers of the adjacent villages in Dharmapuri District for raising oilseed crops in place of cross crops.

- Under the HRD programme, one lady officer of CSHCN & CSRC1 have worked in southern states with 1200 farmers which showed an average yield of 64.2 kg/100 plts. The selected three way cross hybrids PCH 4 (SB43 and PCO 4 (LB57) were evaluated along with control hybrids at three RCBDs which showed that these hybrids are better than single cross hybrid CoHy 4 (SB43) and on par with double cross hybrid PCH...

- Breeding for thermo-tolerance has been taken up employing the SSR marker assisted selection using the parents yielding 1000 to 1500 and 500-600 and the lines are at BC3 generation. For developing MAS tolerant mulberry variety, the SSR marker assisted selection was undertaken and 15 lines with high HSP70 expression have been identified.

- Field evaluation of CSR 1 x 1 CSRC was conducted during the year. F1 progenies were raised and seven cuttings were generated for raising hybrid saplings. Utility evaluation of 18 lines derived from MPH and high temperature polyvoltine lines was conducted and eight lines have been short listed which are in F4 generation. Improvement of CSR 2 lines through multi-parental breeding approach was simultaneously carried out at the institute, KSRDI, Hosakote (KAR), Coimbatore and PC &DR, Kalasa. Plus plants were completed and lines with least incidence and intermediate as well as with uniform canopy, robust shoot and leaf harvest were selected for the respective units.

- Indigenous method of isolating Cordycep militaris is a high value product for biomedical and pharmaceutical applications was developed both in corn on silkworm pupa and in vitro on culture media. Patent for the process has been filed.

- Studies on nutritional quality of mulberry leaf for improvement thermotolerance of silkworm Bombyx mori (race) revealed that, the mulberry variety V1 which is rich in protein (28.7%), carbohydrates (11.6%), also found to significantly contribute to higher fitness and yield traits.

- A rearing package for C x C breed and C x V CSRC hybrids was developed for the benefit of the seed rearers as well as commercial hybrid rearers.

- Application of 2.5% methanolic plant extract prepared with mature mulberry leaf and subsequently by boiling or drying in 2.5% salt solution was recommended for the management of grasserie in mulberry garden. Research studies revealed that Metarhizium is safe to silkworm.

- Recovery of predatory beetles was found to be highest with mulberry in the vicinity of forest crop species. However, yield of beetle did not vary significantly in mulberry gardens in the vicinity of other crops.

- Systemic nature of symptoms was confirmed in mulberry plants showing viral type expressions in leaf and stem of the plants.

- In an adopted village of Chandakavadi comprising nearly representation of non-chemical package (placement of all trap viewed of 1,000 in thrice positions and packing/supply of silkworm litter) covering 70,000 DFLs of A1 crops was able to maintain out by infestation consistently about 2%.

- Release of 84 boxes of beetles, 21,000 adult beetles and 200 "Grub pack in CSRTI campus was successful in reducing moderate pest incidence especially shoot webber, leaf and bud borer pests below 2% severity. Such "Grub pack" also attracted colonies of H. thymus beneficial coleopteran into placement of all traps in rearing houses at CSRTI campus was able to keep all infestation below 2%.

- Recommended the use of bio-control agents namely beauveriabrongniartii for checking about 20% larvae of mulberry gadders through release of 75,000 predatory beetles for control of larva and about 80,000 DFCs for release of 200 packets of H. thymus adopted out to farmers through extension functionaries of sericulture areas and Maharashtra.

- The 16SrRNA gene of bacteria symbiont was sequenced and the phylogenetic analysis showed similarity to Klebsiella sp. (KF650).

- Survey on silkworm diseases has been carried out in three south Indian states viz., Karnataka, Andhra Pradesh and Tamil Nadu for identification of factors responsible for silkworm crop loss due to diseases at field level and its impact on cocoon productivity. Incidence of nucleopolyhedrosis, pebrine and bacteria were above 2%. There was no incidence of cytoplasmic diseases during the period.

- A new technology for disinfection of sterile seeds using micro bits was fine tuned. The new technology will reduce mortality in sterile seeding, saves the disinfectants and avoid exposure of farmers to chemicals.

- A chitin protein complex enzymes produced during chitin degradation by *Trichoderma* spp. was found to have antagonistic activity against pathogenic bacteria, *M. thumgenesis* and basidiomycetous fungus, *R. solani* causing sheath blight of rice. Simultaneously a purification from chitinase gene was cloned and characterized. Chitinase gene was found to be antagonistic against *M. thumgenesis* and *R. solani*.

TECHNOLOGY DISSEMINATION

- The Cluster Demonstration Programme (CDP) is implemented in Southern zone, viz., Karnataka, Andhra Pradesh, Tamil Nadu, Kerala, Maharashtra and Odisha in 100 clusters during the year, a total of 142 oil palm IPCs were distributed to the farmers of the clusters, where 4000 MT of coconut were produced with an average yield of 58.21 kg per 1000 IPCs leading to a total cost with production of 1400-97. Recovery operation was maximized to 16.21% across with 12,241 farmers.

- Under Per cultivation field trials of VCB, CLK x CCRP, a total of 1, 55 each IPCs were hosted with 240 farmers of RCRS IPCBs of southern states and Maharashtra and recorded an average coconut yield of 21.35 kg/ IPC/ Further, 32,000 IPC of CCRP(CCS) were also distributed to 32 farmers where the yield was found to be 20.6 kg/ IPC/ Under SAC of the module undertook covering of 65,000 IPCs in 30 Lakh hrs and distributed the chewit seeds to selected farmers and the an average yield of 27.1 kg/ IPC/ was recorded.

- A workshop on the "Role of CBOs in biodiversity production" was organized on 17th December 2013 at the institute in which the owners of CBOs, CDPs and DoD officials of southern states participated. Further, a farmers workshop on "Sericulture for sustainable livelihood" was also organized on 28th January 2014 in which 1500 farmers representing all the 32 districts of Karnataka state participated, along with DoD officials and private entrepreneurs.

- During the year, 272 Group Discussions, 28 Film Shows, 108 Audiovisual Programme, 67 Field days, 64 Demonstrations, 20 Exhibition, 32 Sensitization programme, 24 Exposure visit (Out, Tours, 9 Workshops, 3 Farmers Meet / Workshop were conducted by the Institute and its related units, benefitting 39,000 beneficiaries mainly on the new technology for shoot bug rearing, mulberry disease management and quality cocoon production.

- CCRP, Mysuru is also centre of attraction for agriculture farmers, students and other visitors to get a first hand information on coir and agriculture technologies. During the period a total of 24 farmers from different parts of the country, besides 2,000 students and 140 foreigners visited the institute.

- The data collected from 300 farmers on extent of adoption of pest and disease management strategies by the arecanut farmers in Karnataka, mainly Malnad and Tamil Nadu. Indicates that 60% of the farmers from Karnataka are aware of the mulberry disease control measures. The adoption level was found to be higher in mechanical measures (75% disease and 61% pest), followed by chemical (73% disease and 57% pest) and biological method (52% disease and pest). However, awareness about malbrich beetle was found only 16%.The major constraints for adoption were availability of biocontrol agents in time and in close proximity, & adequate prevention and safeguard action for disease control measures.

HUMAN RESOURCE DEVELOPMENT

- Under integrated Skill Development Scheme (ISDS) of Ministry of Textiles, Govt. of India, a total of 118 beneficiaries were trained in 27 batches on four activities viz., Cocoon harvesting, Mulberry cultivation and its pest management, Quality silkworm cocoon production and Chawki rearing.

- Besides, a total of 1041 persons were trained under structured and need based programmes at CSRTI, Mysuru and related units. In addition, 37 EDP owners were trained in Reel Utilities for a period of 3 months on commercial silkreel rearing under the non-DoS sector.

- Four batches of orientation training programme were organized for the cluster facilitators for effective implementation of Cluster Promotion Programme.

- An International Training programme of 21 days and 15 days for 21 officials each from Bangladesh and Afghanistan respectively was organized

PATENTS AND COMMERCIALISATION

- Hybrid saw tooth for machineries like cocoon cut weft, yarn count tester, cocoon sorting machine, PVC shoulder elastic, water jetting system and sour processes for using spent wefts and cutting Centrifugal Pulsator, cocoon hot-water and wet cum boiler were commercialised through M/S. Raj enterprises, Mysore.

PUBLICATIONS

- A total of one research publications including 02 research papers, 04 popular articles were published in the journals of national and international repute. In addition, 2 books 1 booklet/Technical bulletin, 42 newsletters/e-mails, 03 extension manuals/summaries were also published. Further 07 research papers were presented in seminars/workshops/conferences.
- Two issues each of Indian Journal of Sericulture, Volume and Newsletter were published in addition to the annual report of CSRTI.

ACHIEVEMENTS OF PRODUCTION RESEARCH PROGRAMME

PLANT BREEDING

- Five elite mulberry varieties (S1, RC1, RC2, Tiruchi, V1) at 4 months were under perennial agro-climatic conditions. Their 8 growth traits of the test varieties were collected for two crops, and it revealed highest yield of 24.4 kg in S1, compared to 21.2 kg in V1 and 15.4 kg in Victoria.
- Cytokinin Trilby (CTK) was screened with two bivoltine cross hybrids (PC1 x CSR27, PC1 x CSR2), single hybrid (SC x AE) and double hybrid (PC1 x SC6). The results showed that the test crosses performed better than the control with respect to cocoon and shell-cocoon ratio.
- A total of 964 cultures of *B. thuringiensis* were produced and supplied to the field for effective management of rust fly. Brood based technology demonstrations to control and rid disease by application of bacillus was conducted in 100 spot sites.
- Under PKP programme, 1,48,000 dfls of improved bivoltine hybrids (CSR18 x CSR27, CSR28 x CSR4C, SDH2 x SDH5, and NB18D2 x NB4D2) were distributed to 200 farmers and obtained an average cocoon yield of 64.78 kg / 100 dfls. Further, under the collaboration of KVK, LH x CSR2, a total of 1,700 dfls were distributed to 100 farmers in 50 crops. An average cocoon yield of 60.66 kg / 100 dfls was achieved.
- Under ASP, 100 unemployed women and youth were trained and 100 farmers in six programmes under Technology Up-gradation Programme were covered.
- A total of 240 farmers were sensitized through Life Extension Communication Programmes.
- Two Refresher Training Programmes were conducted covering 100 farmers who were educated in recent technologies of sericulture and bivoltine rearing techniques.

AGRO-CHEMICAL RESEARCH

- Development of Centrifugal culture media for mulberry augmentation was carried out to study the feasibility of its production in nursery plantation. Pot-trial-seedlings were transplanted in between mulberry tree plantation for translation of Leaf Yield and Shoot Wt was noted to plan protective irrigation.
- Evaluation of RD-1 and RD-6 varieties under water stress condition at farmers level through CPT indicated that these varieties are suitable for water stress condition. Testing of RR-12 variety at farmers' plot indicated that RR-12 is suitable for alkaline soil under irrigated condition.

- Trials of FYM resulted in improvement in soil quality and yield up to 5%. Evaluation of mulberry tree plantation was conducted to develop suitable packages for tree plantation in water stress areas. Organic farming for sustainable mulberry leaf production was assessed at field under irrigated condition which increased the leaf yield by 5.72%.

- On station trials (OST) of three way cross hybrids RCC x CSR2 and RCC x CSR17 had shown higher survival and yield than the control hybrids.

- Production and release of 100 pouches of *A. mylitta* at the silkworm seed unit, Kokrajhar from 10.01 lbs to 27 lbs. Release of 12 pouches of tasar silkworm *A. proylei* and *A. mylitta* at field level ensured overall egg infestation from 23.67% to 9.67%.

- A total of 60 farmers in three districts were trained under the CSCB and 180 farmers under inter-varietal progeny trials. Further, 5000 farmers were benefited through field participation in 16 extension communication programmes conducted.

Activities proposed

- An Station Trials (OST) were undertaken on five multivoltine varieties (RC1 and RC2 trivoltine) for management of rearing and silk practices in mulberry. Further, OST of two three-way cross hybrids (RCC x CSR17, RC1 x CSR2), single hybrid (SC1 x SC) and double hybrid (SH1 x SK1/SK2 x SC2, SJ1 x SK) and multi x six hybrids (NDVR x CSR2C, L1 x CSR2C). The results showed the superiority of the test hybrids over the controls in terms of higher cocoon and pod cocoon traits.

- During the period 400 soil samples were analysed and suitable soil amendation measures were suggested.

- Under PMT programme, a total of 44,200 DFLs of CSR 16 x CSR17, CSR42 x CSR47, SK50 x SK5C, and SK42 x SK52 were distributed to 170 farmers in Shillong and its PRIs and an average yield of 52.63 kg/100 dfls was recorded. Further 42,700 DFLs of L1 x CSR2C were distributed which crossed an yield of 64 kg/100 cocoons.

- Technologies like Mid, IPM for Tukra and Ltd, compatible inter feeding for mat rot were demonstrated to 2 lt farmers in RSRS and nearby area.

- Training was imparted to 75 persons in four rainbow-wise OOE and 370 farmers in 16 programmes under technology dissemination. A total of 132 trainees were imparted in RSRS and nearby units in which 3261 farmers were benefitted.

Activities proposed

- OST of two three-way cross hybrids (RC1 x CSR17, RC1 x CSR2), single hybrid (SC1 x SC) and double hybrid (SH1 x SK1/SK2 x SC2) and multi x six hybrids (NDVR x CSR2C, L1 x CSR2C) were taken up. The results showed the superiority of the test hybrids over the controls in terms of higher cocoon and pod cocoon traits.

- During the period, 50 soil samples were analysed and suitable soil amendation measures were suggested.

- To mitigate the loss of pupae mostly boy, a quantity of 400 pcs (2000 numbers) of Dimorphotheca pluvialis was mass multiplied and released in infested mulberry gardens.

- A total of 11,000 stakeholders were benefitted through various extension communication programmes conducted by RSRS, Sualkuchi and its constituents.

- Under PMT, 100 beneficiaries were trained to construct their self sustenance. Training was also imparted to 1,000 farmers in six batches under Technology Upgradation programme.
- The president station conditions to run a centre for higher studies in Botany and Sericulture under Pandit Deendayal Upadhyaya Gorakhpur University, Gorakhpur and 5 students are pursuing the doctoral work.

III. HIGHLIGHTS OF ACHIEVEMENTS UNDER CRITICAL COMPONENTS OF RESULT FRAMEWORK DOCUMENT 2013-14

No.	Indicator	Unit	Target	Achieved	% Achieved
1	Projects initiated	No.	18	18	100
2	Projects completed	No.	10	11	110
3	High yielding industry oriented technologies	No.	02	02	100
4	Assistance to scientists in the field	No.	10	10	100
5	Improved industrial human resources	No.	10	10	100
6	Improved IT generation human resources	No.	01	01	100
7	Adoption of ideas in the field	No.	10	10	100
8	Adoption of technologies	No.	02	07	350
9	Adoption of manpower/equipments	No.	05	04	800
10	Adoption of packages	No.	02	08	400
11	Technologies commercialized	No.	03	07	233
12	Technologies taken up for patenting	No.	02	07	350
13	Client users satisfied	No.	20000	30000	150
14	Coverage of studies	No.	90	101	112
15	Coverage of beneficiaries	No.	9000	10000	111
16	New penetration with improved industry activities	sq.km	300	1618.4	539
17	Addition in new products	No.	10	11	110
18	Saving from economy in studies	No.	01	10	1000
19	Production of biofuel run off through cultivation	MT	400	1400	350
20	Production of biofuel run off through non-cultivation	MT	110	150	136
21	Production CNG saved	MT	3000	3150	105
22	Stakeholders trained under CEC	No.	300	310	103
23	Stakeholders trained under other programmes	No.	4250	4851	114
24	SPV's of rural entity supplier	No.	5000	36177	148
25	Publication of research articles	No.	20	46	230
26	Publication of extension bulletins	No.	12	32	267
27	Publication scientific journals	No.	50	90	180
28	Forecasting & forewarning of hazard occurrences	No.	10	40	400
29	Collaborative projects taken up	No.	10	19	190

IV. LIST OF RESEARCH PROJECTS AND PROGRAMMES

Institute/Unit	Discontinued		Ongoing		Total		Grand Total
	Project	Proj.	Project	Proj.	Project	Proj.	
CIFRI/RS	11	16	12	12	23	27	50
RCBF	1	01	11	11	11	02	17
Total	12	16	11	23	34	33	67

#	Proj. Code	Project Title	Category
		PROJECTS CONCLUDED IN 2013-14 (MAIN INSTITUTE)	
1	PEN 0402	Studies on the factors influencing the nutrient uptake and its use efficiency in Indian's under field conditions (Jul. 2010 to Jun. 2013)	Input-Level assessment
2	NICRP 0201	Popularization of the promising brackish water species suitable for polyculture with the farmers of Kakrabhita (Oct. 2011 to Sep. 2013) – Funded by ICAR (NICRA)	Abiotic/Climate challenges & global warming
3	PEN 0410	Studies on the development of indigenous method for culturing Grey mullet and other estuarine species (Oct. 2010 to Dec. 2013)	Value Addition
4	PEN 0402	Biological control of mud eel disease of Indian's by ectoparasitic leeches Hyrudinaria manillensis and Dactylus aculeus infesting (Dec. 2010 to Jan. 2013) – funded by ICAR	Eco-friendly
5	PEN 0401	Shift marker-assisted selection of mudcrab genetic traits towards a cost effective for sustainable conservation and successful utilization in size improvement (Oct. 2010 to Dec. 2013) – in collaboration with CMFRI, Kochi- Funded by DBT	Cross manipulation
6	PEN 0403	Development of superior mudcrab (Scylla serrata) suitable for brackish water environments (Phase-II) (Apr. 2007 to Mar. 2014)	Abiotic/Climate challenges & climate change
7	PEN 0407	Evaluation of sustainable management strategies for Wadi Akhar Bund (Jhenda Khal) for resilient ecosystem (Apr. 2007 to Mar. 2014)	Eco-friendly
8	NICRP 0209	A study on evaluation of pond and channel management strategies in aquaculture (Oct. 2012 to Mar. 2014)	Adaptive Study
9	PEN 0404	Applied studies impact of crop diversification on conservation and performance of carbohydrase and protease in Indian's (Oct. 2011 to Aug. 2013) (Completed in Mar. 2014)	Eco-friendly
10	AP 0210	Studies on mudcrab diet, nutrition and intermediary metabolism of ammonia & lipids. (Apr. 2012 to Mar. 2014)	Nutrition Study
11	PEN 0405	Pre-acclimation field trials of L/4 x CSIS. N. polyculture in brackish ponds with optimum feed quality (Apr. 2012 to Mar. 2014) - Extended upto March 2015)	Environmental challenges & global warming

PROGRAMMES CONCLUDED IN 2013-14 [BASED ON FUTURE]

#	Proj. Code	Programme Title	Category
1	[illegible]	Biochemical studies on [illegible] and healing from treatment of [illegible] [illegible]	Laboratory
2	[illegible]	Large scale multiplication of rice [illegible] and [illegible] [illegible]	Based Production
3	[illegible]	Development of [illegible] testing package for [illegible] [illegible]	Breeding/Pathology
4	[illegible]	[illegible] of [illegible] in [illegible] [illegible]	Post Harvest
5	[illegible]	[illegible] of [illegible] [illegible] and [illegible] [illegible] [illegible] [illegible]	Multi-Centre Study

PROGRAMMES CONCLUDED IN 2013-14 [FOR 12]

#	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]

(A) ONGOING PROJECTS (Started in 12, 13 & 14 Nos. Institute)			
#	Proj. Code	Project Title	Category
1	PRF 3.03	Development of Diploids for mulberry (Morus) (Aug. 2012 to Jul. 2014)	Varietal development
2	AM 3.04	Phytoremediation of arsenic contaminated soil by Mulberry and assessment of arsenic uptake (Nov. 2012 to Oct. 2017)	Environmental challenges & global warming
3	PRB 2.05	Development of superior mulberry varieties by manipulation of hybrid vigour based molecular diversity of promising parental lines (Apr. 2009 to Nov. 2014)	Crop improvement
4	--	Popularization of culled mulberries for quality cocoon production (Apr. 2013 to Mar. 2015) funded by ISSA	Post-harvest Technology
5	AM 2.06	Development of Polymorphic SNP markers in wild, V. nigra and mining Drought marker assisted selection (Apr. 2012 to Mar. 2017)	Soil Fertility
6	AM 1.07	Therapeutic control of Microsporidiosis in the silkworm through characterization of baculovirus encoded Peptidase enhancer genes (MEPO) & nosema biomarkers (Apr. 2012 to Mar. 2015)	Protozoan Diseases
7	PB 2.02	Subtasking mulberry variety identification of QTLs conferring resistance to root rot disease by linkage disequilibrium mapping and trait introgression (Jan. 2013 to Jun. 2018) Funded by DBT	Soil fertility
8	AT 1.01	Development of mixed biofilm bioreactor of silkworm fecal matter & bacterium to fight competition and dominance of the fungus through DNA marker assisted selection (Jan. 2011 to Dec. 2015)	Env. challenges & global warming
9	AB 2.00	Studies on thermo tolerance, heat shock protein synthesis during thermal shock and interacting in silkworm, Bombyx mori L. (Jan. 2011 to Dec. 2014) (BARC 2.11 funded)	Env. challenges & global warming
10	PB 1.01	Development of Biotic Aversive, Uniformity and Stability (BAUS) descriptors for mulberry (Morus spp.) and its validation. (Apr. 2012 to Mar. 2015) – Funded by PPV & FRA, New Delhi	Mulberry Descriptors
11	AB 2.00	Development of productive polyvoltine strains of silkworm Bombyx mori L. tolerant to high temperature and RHMFV (Oct. 2011 – Mar. 2016)	Env. challenges & global warming
12	PB 2.01	Development of disease resistance and productive mulberry genotypes with special reference to root rot and root knot disease suitable for sericulture of South India (Jan. 2013 to Dec. 2017)	Soil Fertility
13	PPF 2.00	Development of semi-tac culture media for mycelial augmentation (Jan. 2013 to Dec. 2014) (ICAR-CIAE Collaborative) – funded by ICAR-CIAE, Bhopal	Post-cost reduction

Sl	Proj. Code	Programme Title	Category
1	[illegible]	Demonstration of soil fly management strategies in an adopted village of Chikmagalore taluk (Jan. 2013 to Mar. 2014)	[illegible]
2	[illegible]	Long term effect of mulberry + [illegible] on soil status and productivity (Jul. 2011 to Jun. 2014)	[illegible]
3	[illegible]	Silkcultural practices & technology transfer – Agronomical aspects (Jan. 2013 to Jun. 2014)	Human Resource
4	[illegible]	Effect of conjunctive use of fertilization methods on the efficient utilization of nitrogenous fertilizers for the sustainable mulberry production (Oct. 2013 to Sep. 2014)	Input cost reduction
5	[illegible]	Evaluation of three way cross hybrids for commercial exploitation (Aug. 2013 to Dec. 2014)	Input cost reduction
6	[illegible]	On farm trials of farmers' – a short cases formulation for control of root knot disease of mulberry (Oct. 2011 to Dec. 2013)	[illegible]
7	[illegible]	Improvement of cocoon characteristics of CSR through multi-locational breeding approach (Jan. 2013 to Dec. 2014)	Value enhancement
8	[illegible]	Identification of tolerant resistance for silkworm viral diseases at field level and its impact on cocoon productivity (Jul. 2012 to Dec. 2013)	Eco. challenges & global warming
9	[illegible]	Pre-evaluation trial trials of newly developed improved bivoltine breed and bivoltine hybrids (Oct. 2013 to Dec. 2014)	Pest/Trial
10	[illegible]	Field trial of rearing schedule for CSR x [illegible] hybrid (Jan. 2014 to Mar. 2015)	Input cost reduction
11	[illegible]	Validation of schedule for improving economic character of silkworm, Bombyx mori L. (Apr. 2013 to Mar. 2015)	Eco checks
12	[illegible] (Washington)	Evaluation of the mulberry varieties under semi arid agro-climatic condition (Aug. 2013 to Mar. 2015 - [illegible])	Eco. challenges & global warming
13	[illegible]	Ultrasonic Disinfectant machine for mulberry – Phase II (Jan. 2013 to Jun. 2015)	Eco. challenges & global warming
14	[illegible]	Maintenance of mulberry germplasm, mother culture and demonstration plots of improved mulberry varieties (Continuous)	Maintenance
15	[illegible]	Monitoring of leaf quality status of mulberry gardens in Karnataka, Andhra Pradesh & Tamil Nadu & creation of database (Continuous)	Input cost reduction
16	[illegible]	Maintenance of silkworm races, strains and breeds (DFLs, polyvoltine, improved bivoltine, CSR hybrids, multivoltine & semi-synthetic germplasm) (Continuous)	Maintenance
17	[illegible]	Maintenance of mother culture for production of commercial silkworm eggs and mass release of recommended silkworm hybrids at silkcultural areas & CSRTI campus (Continuous)	Eco checks
18	[illegible]	Mulberry silkworm germplasm maintenance & multiplication (Continuous) Update	Maintenance
19	[illegible]	Maintenance of cane breeds (Continuous – [illegible], Cocoon)	Maintenance
20	[illegible]	Bivoltine silkworm breeding for development of silkworm with better [illegible] (Continuous) – [illegible], Cocoon	Breed improvement
21	[illegible]	Library up-gradation in house evaluation of new silkworm hybrids (Continuous)	Breed Evaluation
22	[illegible]	Evaluation of post-cocoon parameters of cocoons generated from CSRTI, Mysore and its related units (Continuous)	Post-cocoon Evaluation
23	[illegible]	Forecasting and forewarning of mulberry pests (Continuous)	Input cost reduction

V. CONCLUDED RESEARCH PROJECTS/PROGRAMMES

I. HORTICULTURE IMPROVEMENT

1.1 PB-4300: Development of superior medium varieties suitable for moderate stress environments

M. A. Mallikarjuna Reddy (PI), M. A. Shankar Reddy (PI), B. Jayalakshmi (PI), N. H. Sudhakumara (upto Aug 2009), T. Nagaraj (upto Jul. 2007), J. Vijayakumarreddy (upto May 2008), Rajashekara, K. R. Balakrishna (upto Dec 2009), M. S. Pallavi (upto Dec.Review), K. Vijaya Kumar (upto Oct. 2011) and N. M. Ramesh (upto Aug. 2007), M. Prabhu (Retd.), K. Vijaya Kumar and C. Kunhikannan, Regional Sericultural Research Station, Hindupur, Regional Sericultural Research Station, Channarayapatna

Duration: April 2004 to March 2011

Budget: Rs. 5.401 Lakhs

Objective:

- To select diverse genetic resource through successive breeding to develop superior mulberry varieties to suit multiple stress environments.

Methodology:

Twenty five mulberry germplasm accessions from CSGRC, Hosur and CSR & T, Irrigare were short listed as parents based on 14 economic characters following relative score technique. A total of 30 crosses were made in two cycles and a progeny of 2047 hybrids were raised. Adopting a five steps screening under reduced soil moisture conditions, elevens genotypes with highly desirable traits, moderate breeding were selected during the first steps. Leaf yield, growth, morpho-biochemical parameters, rearing and survival percentage were studied for two years in the next three stages to finally arrive at 10 promising hybrids. These hybrids were planted for PYP at three locations, CSRTI, Mysore, RSRS, Kodathipur and RSRS, Channarayapatna along with five germplasm accession and check varieties (S-13, S-54 and V-1). The PYP was planted in a rcb design with 4 replications. The PYP was conducted under moderate stress and low stress conditions to shortlist hybrids for PYT based on important morpho-physiological characters and cast yield in both environments. Genetic analysis was carried out for broad classification and six promising hybrids were promoted to PYT. The PYT experiments were established in all three locations in RBD with 4 replications along with S-13 as check. The final yield evaluation was done for three years and selected hybrids were also subjected to silkarea.

Observations/Results:

The initial selection of parents was done among the germplasm accessions based on 14 characters associated with drought resistance measuring relative score technique (Table 1.1).

Table 1.1: Parameters considered for selection of parents

Leaf yield	Photosynthesis rate	Length of the petiole
Number of shoots	Leaf area	Leaf thickness
Petiole to lamina ratio	Thickness of cuticle	Stomatal frequency
Chlorophyll content	Moisture content	Moisture retention capacity
Biomass of root	Dry weight of root	

Thirty-six crosses were made among twenty (12 female and 8 male selected parents (Table 1.2) in two rounds to raise a progeny of 2047 hybrids.

Table 1.2: List of germplasm accessions selected for hybridization

Mulberry genotypes selected for hybridization			
Morus multicaulis	S 13	S 34	V 1
White sapling	Local	LF 1	CB 1
Kalimpong	S 799	RH 1	Punjab local
Thailander	Himachal local	MS 8	Pebbles +1
KFD 2	S 1	Dudhiya 1	LF 2

The seedlings were transplanted in screening plot and shoots after 4 months and one year old ms rearing (Agrifarm) soon after pruning, after 60 days of pruning 111 hybrids showing poor germination were rejected and data on total shoot length, no. of shoots/plant, no. of leaves / shoot were recorded for the rest of the hybrids. Based on the above data observations 144 hybrids were short-listed. Data on DFHD values, leaf emergence, transpiration rate, stomata resistance, 100 leaf weight, moisture content, moisture retention capacity and leaf area were recorded for these 144 hybrids (Table 1.3).

Table 1.3: Variability in the short-listed hybrids (144) for leaf yield, yield contributing and physiological characters

Parameter	Leaf yield (g/plant)	Total shoot length (cm)	No. of shoots / plant	Moisture content (%)	Moisture retention (%)	Transpiration rate (µg cm² min⁻¹)	Stomatal resistance (sec/cm)
Season I (July- Sept. 2013)							
Range	700-950	650-1010	9-11	68.9-75.4	70-72	1.19-1.3	2.10-1.78
Mean	825	770	10.20	72.56	71.33	16.58	1.90
SE	95.20	80.5	2.80	3.80	1.80	0.48	1.05
CV (%)	42.40	39.80	27.33	2.60	0.85	80.23	60.00
Season II (Oct. - Dec. 2013)							
Range	1100-1300	980-1120	9-11	62.77	42.80	1.52-1.62	2.30-2.04
Mean	207	1048	10.20	71.66	58.30	12.20	1.75
SE	1.27	67.1	2.30	2.60	6.40	0.68	1.84
CV (%)	31.20	28.13	43.80	3.70	10.70	84.20	80.20
Season III (Feb. - Apr. 2014)							
Range	1200-1500	1170-1380	9-10	69.77	47.87	1.20-1.30	2.71-1.90
Mean	2.80	1284	10.40	71.80	58.40	11.68	1.80
SE	95.30	87.5	2.80	2.90	6.10	0.62	1.84
CV (%)	32.70	29.80	27.10	4.00	8.72	81.84	80.00

The hybrids were further subjected to rooting evaluation to finally select 20 hybrids with a rooting ability of 100%. The details of the hybrids selected for PYR are listed in Table 1.4.

Table 1.4: Hybrids short-listed for PYR

Sl. No.	Cross	Year of selection
1	[illegible]	13
2	[illegible]	13
3	[illegible]	13
4	[illegible]	13
5	[illegible]	13
6	[illegible]	13
7	[illegible]	13
8	[illegible]	13
9	[illegible]	13
10	[illegible]	13
11	[illegible]	13
12	[illegible]	13
	Total	144

The 32 months along with one promising accession and three checks (CO 3, CO4 and PY) were evaluated in three locations at Mysore, Chamarajanagar and Hardanahalli under natural moisture and irrigated conditions. The data on leaf yield, morphophysiological traits were recorded. At Mysore genotypes 1, 4, 6, 7 and 21 significantly out yielded the check CO 3 under soil moisture stress. Genotypes 1, 4, 7, 17 and 28 yielded higher than the check Y1 under hot-arid environment. At Chamarajanagar genotypes 4, 6, 7, 16 and 32 significantly out yielded the checks. It is under soil moisture stress. Genotypes 4, 6, 7, 17 and 32 yielded higher than the check Y1 under non-stress environment. At Hardanahalli genotypes 7, 16, 18, 25, 28, 31 and 32 significantly out yielded the checks CO 3 under soil moisture stress. Genotypes 4, 7, 28 and 32 yielded higher than the check Y1 under hot-arid environment (Table 1.a).

Table 1.a. Leaf yield of selected genotypes under soil moisture stress and non-stress environments.

a. Location: Mysore

Soil moisture stress		Non-stress	
Genotype No.	Leaf yield (kg/ha/yr)	Genotype No.	Leaf yield (kg/ha/yr)
1	52952	1	52952
4	53259	4	57547
6	49799	6	50007
7	53655	7	50187
21	50579	28	52647
CHECK (CO 3)	46460	CHECK (Y1)	44674
CD at 5%	4673		4399
CV (%)	10.05		7.98

b. Location: Chamarajanagar

Soil moisture stress		Non-stress	
Genotype No.	Leaf yield (kg/ha/yr)	Genotype No.	Leaf yield (kg/ha/yr)
4	61133	4	60733
6	52067	6	54667
7	49867	7	52100
16	48133	17	50667
17	50133	32	50667
32	51700	34	48800
CHECK (CO 3)	41466	CHECK (Y1)	45066
CD at 5%	2815		3713
CV (%)	9.77		17.74

c. Location: Hardanahalli

Soil moisture stress		Non-stress	
Genotype No.	Leaf yield (kg/ha/yr)	Genotype No.	Leaf yield (kg/ha/yr)
4	70000	4	68667
16	72800	7	75000
18	71400	17	68667
25	69867	28	67067
31	70800	32	62267
32	72000		
CHECK (CO 3)	57866	CHECK (Y1)	64133
CD at 5%	4871		5981
CV (%)	11.29		15.11

The ten most promising accessions were multiplied and planted in the three locations, after conducting trial performance in PYT, primary yield stability (PYS) Trial. The Evaluation (EVA) experiment with five best genotypes and check CO 4, in which cuttings, stalk or leaf yield and yield contributing characters were recorded for three years. Biochemical analysis was conducted for assessment of leaf quality in the selected genotypes. The results of the EVT are presented in Table 1.b.

Table 1.6.a, b, c: Leaf and yield contributing characters of promising cultivars in PYT under sub-tropical zone of Punjab

a. Ludhiana, Kharif

Entry No.	Cross	Yield (kg/plant)	TL (No.)	LLS (cm)	TBL (cm)	MC (%)	MRC (%)
1	[illegible]	0.482	7.33	17.72	9.82	76.44	74.87
2	[illegible]	0.514 (23.4%)	8.67	14.89	11.83	77.23	74.78
3	[illegible]	0.457	7.33	14.06	10.57	75.17	73.17
4	[illegible]	0.446	6.66	13.28	8.83	71.67	70.33
5	[illegible]	0.443	7.29	14.78	9.61	73.89	72.29
6	[illegible]	0.518	8.67	14.04	11.12	75.56	73.56
	CD at 5%	0.094	NS	NS	NS	2.74	NS

b. Ludhiana, Chandigarh

Entry No.	Cross	Yield (kg/plant)	TL (No.)	LLS (cm)	TBL (cm)	MC (%)	MRC (%)
1	[illegible]	0.516	8.40	16.67	12.13	84.67	82.67
2	[illegible]	0.479	4.80	13.33	9.13	82.00	80.40
3	[illegible]	0.51 (21.43%)	8.79	15.17	11.80	84.67	83.26
4	[illegible]	0.390	4.26	13.17	9.13	84.00	82.00
5	[illegible]	0.513	8.60	16.53	11.93	84.67	83.1
6	[illegible]	0.397	5.60	11.33	9.13	82.00	80.07
	CD at 5%	0.038	NS	0.38	NS	1.14	NS

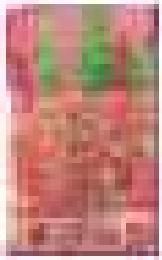
c. Ludhiana, Hoshiarpur

Cross No.	Cross	Yield (kg/plant)	TL (No.)	LLS (cm)	TBL (cm)	MC (%)	MRC (%)
1	[illegible]	0.442	6.66	17.6	9.57	69.08	66.82
2	[illegible]	0.414	6.11	17.6	8.83	68.66	66.67
4	[illegible]	0.491 (20.47%)	6.67	18.0	9.67	71.37	70.68
4	Pusa hybrid [illegible]	0.462	5.36	17.1	8.62	70.34	68.58
5	Pusa hybrid [illegible]	0.516	5.38	18.0	8.84	70.46	70.16
6	[illegible]	0.414	6.61	17.5	8.14	70.22	70.21
	CD at 5%	0.039	0.41	0.16	0.52	0.54	1.46

TL = No. of locules/ plant; LLS = Length of the longest locule; TBL = Pulp locule weight; MC = Moisture content in fruit; MRC = Moisture retention capacity of leaves after 5 hrs of harvest

At the end of the project period, three hybrids were selected for the three zones. Two of the three genotypes selected at Ludhiana and Chandigarh are hybrids of, [illegible] x 3-1-1 and the one selected at Hoshiarpur is a hybrid of [illegible] x 1-1. The hybrids have been nominated as [illegible] (Kharif), [illegible] (Chandigarh kharif) and [illegible] (Hoshiarpur) based on their PYT number. The hybrids with [illegible] hybrid obtained was done with the three locules and they were found on par with [illegible] in respect of yield, and bearing parameters.

The selected varieties are being multiplied at the respective stations for further validation through multilocational trials under coastal zones conditions.

Parameters			
	[illegible]	[illegible]	[illegible]
Apertures	Almost hollow	Moderately hollow	Moderately hollow
Skin	Pericarp	Waxy	Waxy
Placental type	[illegible]	[illegible]	[illegible]
Placenta	Opened	Opened	Opened
No. of locules / fruit	6.00	4.70	4.00
Total weight of locules (kg)	1.1kg	900.00	90
Fruit shape	Circular	Circular	Round
Fruit surface	Smooth	Smooth	Glabrous, thick & smooth
Fruit yield (kg/plant)	3.2 kg	3.0kg	2.5 kg
Fruit yield (t/ha) (Yield)	16.0	15.04	12.50

1.2 : (Hill SHC): Studies on the factors influencing the nutrient uptake and its use efficiency in Hisardry under field conditions.

B. G. Sankhla (PI), S. G. Choudary and K. Indira rao

Location: Jay on (Hisardry)

Duration: Re. & Ex. Lands

Objective: • To study the factors affecting the uptake of nutrients by Hisardry and the soil quality under field conditions

Methodology

During the evaluation process soil and leaf samples was collected from 100 farmers of three southern districts (Hisardry - 4 blocks, – 40 farmers), Krishna Pradesh - 4 districts – 40 farmers and Tamil Nadu - 2 districts – 20 farmers). Cattle samples were collected for estimation of soil parameters such as soil chemical analysis (pH, EC, OC, P and K, micronutrients - Fe, Zn, Mn, Cu). The soil physical parameters like bulk density, percent pore space and water holding capacity were analysed. The leaf samples were analysed for nutritional problems and deficiency level, and micronutrients (N, P, K, S, Ca, Mg, Cu, Fe, Zn) and Mn) parameters. The details on leaf yield and cotton harvest were collected from the farmers. The data has been subjected for correlation studies to find out the factors responsible for the plant nutrient uptake at various level.

Observations/Results

The soil nutrient components showed relatively higher range of variation in Hisardry in Karnataka (52.2–47.2 kg/ha), while the lowest values were observed in Hisar, TN (7.45-17.42 kg/ha). Available potassium was found to be higher in Gadwal in AP (126-805 kg/ha), while exchangeable was seen in Hisar (80 - 356 kg/ha). Analysis of micronutrients revealed higher Cu content in Hisardry, AP (1.26 - 2.10 ppm), while lower values were observed in Hisar (0.28 – 1.65 ppm). The Zn was found to be higher in Gadwal (0.80 - 1.20 ppm, which was lower in Ludhiana (0.18 - 0.40 ppm). Iron content was found in samples of Hisardry (11.6- 32.0 ppm), while lower values found in Ludhiana (1.28 - 5.40 ppm). Higher

range of the data observed in Diakhaloka (4.1 to 6.8 pond and those samples showed lower values (4.0 - 6.0 pond).

The soil organic status showed higher values of N (1.1 - 1.08; 0.93 - 1.07 %), while it was low in Chlamydosporina (0.14 - 0.70 %). Values of Phosphorus and Potassium are not very among the soil samples which ranged from 0.7 to 0.44 % and 0.47 to 1.02 % respectively. With regard to micronutrients, higher range was recorded for Copper in Fimbriatum (2.8 - 12.0 ppm), while lower values were found in Pentaceae (1.0 - 2.6 ppm). Zinc was found to be high in Fimbriatum (3.0 - 1.0 ppm), while Pentaceae showed lower values (0.4 - 0.6 ppm). Higher range of Iron content was observed in P. fimbriatum (4.5 - 9.6 ppm), which was found in Chlamydosporina (2.1 - 5.7 ppm). Manganese was found to be higher in Pentaceae soil samples (7.1 - 7.5 ppm) and lower values were seen in Fimbriatum (1.5 - 2.0 ppm).

The nutritional parameters in the leaf samples showed higher values of protein (10.5 - 24.5 mg/g) in most samples, which was found in the trees in V. radia (18.0 - 24.0 mg/g). The ascorbic content was higher in Pentaceae (7.0 - 10.0 mg/g), while samples of V. radia showed relatively lower values (6.0 - 12.7 mg/g). The annual yield per acre was found to be highest (1200 - 1700 kg) in Fimbriatum area, while relatively lower yields were obtained in Pentaceae (700 - 1000 kg). The kernel yield per acre was higher in Pentaceae (200 - 400 kg) which was lower (240 - 300 kg) in Fimbriatum.

To know the factors responsible for the uptake of nutrients, correlation analysis was carried out using the soil chemical parameters like pH, EC, OC, and physical parameters like soil texture, pore space and water holding capacity (WHC) as well as N, P and K as independent variables. The dependent variables in the soil sample were available P and K, micronutrients Cu, Zn, Fe and Mn, the results of which are shown in Table - 17.

Table - 17. Correlation between soil parameters and micro nutrients in the soil

Independent variables	Dependent variables					
	Av. P	Av. K	Cu	Zn	Fe	Mn
pH	0.336**	0.542	0.170	0.250**	-0.048**	0.242**
EC	0.219*	0.056	0.178	0.034	0.064	0.207*
SOC	0.321**	0.419*	0.164	0.691**	0.220*	0.662**
SD	0.038	-0.218*	0.308**	0.155*	0.213*	0.212*
WHC	0.084	0.087*	0.811**	0.826**	0.142	0.898
Porosity	0.028	0.031*	0.833**	0.171*	0.888	0.901
Sand %	0.067	0.043	0.001	0.002	0.038	0.003
Silt %	0.087	0.172	0.847**	0.178	0.048	0.139*
Clay %	0.087	0.194*	0.089**	0.087	-0.140*	-0.030*

The data clearly showed that soil pH had negative impact on available nutrients like phosphorus, zinc, iron and manganese in the soils, while organic carbon, showed positive relationship with macro and micronutrients in soil. The soil density exhibited negative impact on macro and micronutrients in the soil, while WHC and porosity showed positive effect on Potassium Cu and Zn.

The dependent variables in leaf samples were N, P, K and micronutrients, Cu, Zn, Fe and Mn and the results are depicted in Table - 18. The data showed that pH and soil density has positive impact in micronutrients in the soil, while WHC and porosity showed negative effect on the micronutrients.

Table - 18. Correlation between soil parameters and micro / macro Nutrients in the leaf

Independent variables	Dependent variables						
	Leaf N	Leaf P	Leaf K	Cu	Zn	Fe	Mn
pH	0.078	0.067**	0.011	0.208**	0.049	0.218**	0.068**
EC	0.167*	0.115	0.024**	0.242**	0.202	0.113	0.139
SOC	-0.116*	0.081	0.128	-0.140*	0.016	0.063	0.061*
SD	0.063	0.018	0.073	0.078**	0.071**	0.198**	0.058
WHC	0.029	-0.038**	0.130	-0.171*	-0.021**	0.119	-0.170*
Porosity	0.142*	-0.031**	0.028	-0.100**	-0.201**	-0.196*	-0.162**
Sand %	-0.176*	0.064	0.048	0.064	0.061	0.049	0.168*
Silt %	0.066	0.038	0.018	-0.138*	-0.138*	0.070	0.021
Clay %	-0.021	-0.077**	0.036*	-0.188*	0.025	0.079	0.115

Correlation coefficient for each independent variables and the conditional dependent like Protein, Carbohydrate as well as the leaf and cocoon yield were also analysed as shown in Table 1.6. The soil pH and EC showed negative impact on proteins, carbohydrates and leaf yield, while OC and MBC showed positive effect on these parameters.

Table 1.6: Correlation between soil parameters and leaf nutrition, leaf yield and cocoon yield

Independent variables	Dependent variables			
	Protein	Carbohydrate	Leaf Yield	Cocoon Yield
pH	-0.240**	-0.324**	-0.253**	-0.094
EC	-0.329**	-0.218**	0.081	0.014
OC	0.247**	0.051	0.342**	0.198
BD	-0.048	0.171*	0.261**	0.116
MBC	0.097	0.182**	0.283**	0.075
Porosity	0.093	0.167**	-0.275**	-0.110
Sand	-0.123	0.048	0.145*	0.132
Silt	-0.140*	0.041	0.036	0.024
Clay	-0.075	0.082	0.018	0.099

*, ** and *** denote significance at 0.05, 1 % and 0.001 % respectively

The overall results indicated that two soil chemical parameters such as pH, EC and three soil physical properties such as Bulk Density, maximum water holding capacity and Percent pore space are the major factors for alteration of macrofauna networks in soil and mulberry leaf. The analysis showed that the inputs applied by the farmers to the mulberry gardens in three states Karnataka, Andhra Pradesh & Tamil Nadu are having adverse effect on the soil fertility status, decrease productivity and cocoon yield. These factors are to be worked upon the importance of soil testing and appropriate application of chemical and organic manures as per the soil test based reports.

1.5 RAE 2007: Study over two added analysis of mulberry gene bank towards a core assembly for sustainable conservation and enhanced utilization in crop improvement (CSRT sponsored project in collaboration with CSGRC, Hosur)

P. Dinesh Babu (PI), M. A. P. Jyothi and B. Thimmaiah Krishnappa, C. R. Ramesh (upto 30.06.2011), J. G. Ramesh, and S. Jhansi Lakshmi
CSGRC, Hosur

Duration: October 2010 to December 2014

Budget: Rs. 33.30 Lakhs

Objectives:
- Identification of a panel of diverse mulberry germplasm accessions to saturate/fine mapping for marker (fingerprints and SNP/SSRs) assay analysis – CSRTI, Mysore
- Construction of a core subset of mulberry germplasm by phenotypic and molecular marker (SSRs) analysis – CSRTI, Mysore & CSGRC, Hosur
- Evaluation of panel of diverse mulberry germplasm for other important traits viz., sprouting, sericigenic, rooting, leaf quality, pest combating traits and bio-morphological characters – CSGRC, Hosur

Methodology:

The mulberry germplasm accessions were collected from two gene bank at CSGRC, Hosur. In addition some of the collections (exotic/promotion and breeders' collection) maintained at CSRTI, Mysore was also utilized in the project. The whole collection (421 comprising of 120 accessions was established under Hosur soil for the characterization of leaf quantitative and qualitative traits. The characters were recorded based on the norms proposed by Datson (1994) and Thangavelu et al. (2000). High molecular weight genomic DNA was isolated from young mulberry leaves and 70 selected mulberry varieties. SSR markers were amplified in 10 µl reaction volume and the amplicons were resolved in 8% non-denaturing PAGE and visualized by silver staining.

All the statistical and computations were carried out using suitable packages in R. unless indicated otherwise. Modified Rogers genetic distance measure was used for mixed ploidies having both qualitative and quantitative traits. Neighbour Joining method was used to generate dendrograms using Rogers genetic distance. Allele plots were converted into allelic frequency and used in the calculation of Modified Rogers genetic distance (MRD) using custom R&A and R scripts. MRD genetic distance was used to generate dendrogram based on NJ method in DARwin software and the same was also used in PCoA analysis. Structure 2.3.3 was used to infer population structure of the WC, UC panel of diverse germplasm and core subset. Delta K (Evanno et al., 2005) was used to determine the optimum assumed population size (K). Phenotypic data of WC (1364 acc.) was used to sample UC (340 acc.) using maximization method implemented in DARwin software and matrix minimum distance clusters by proportional sampling (DARwin). Panel of diverse germplasm (350 acc.) and core subset (190 acc.) were sampled from SSR data using Simulated Stochastic method (SimSt) (Kilichoni et al., 2014) and by mixed modified search using Core Hunter software. Both genotypic data and SSR data were compared to sample panel and core collection with same number of accessions as samples using SSR marker data. The SSR and phenotypic marker data were also used in PowerCore for sampling diverse entries.

Diversity analysis

A total of 78 mutagenic genotypes designated as Bambara collection (Jumbo) as secondary accessions was genotyped using 10 multiplex genetic SSR markers (Kilichoni et al., 2014). The whole collection (WC) consisting of 1364 mutagenic germplasm was analyzed to sample a UC using 26 key phenotypic markers. Cluster analysis based on phenotypic markers resulted in 20 distinct groups (Ward's minimum variance method). A total of 1638 unique collections were sampled based on genetic distance and the number of entries was sampled proportional to the size of the cluster (min=4 method). The accessions included in mutagenic breeders' trained genotypes (farmers' classification strategy, FARMAT) was also used for developing the UC (340) from the WC and compared with of (340=4 method). Overall, the classification of UC by Min=4 method retained 70% of the range of the WC compared to that of maximization method (91%), but in the nine traits analyzed, all more as 7 traits showed >90% range retention to the former method.

The WC was profiled using multiplex genetic polymorphic SSR markers. These 10 SSR markers generated a total of 142 alleles with an average of 14 alleles per loci. Allelic frequency data of whole collection was used to calculate Modified Rogers genetic distance (MRD). MRD values were used to calculate principal components in Principal Coordinates Analysis (PCoA) and the first two principal components were plotted in scatter plot. Scatter plot describes the diversity in the WC. Majority of the accessions were far apart, and few genetically similar and redundant accessions showed close association (Fig 1.1).

Figure 1.1: Scatter plot showing the distribution of diversity in the whole collection

Intra-allelic allelic data was used in STRUCTURE analysis and the program was run for the K values (K=1 to 10) in ten replicates each using 20000 burn-in and 20000 MCMC values. DeltaK value increased with increase in K values whereas Delta K value was maximum at K=4 (Fig. 1.2).

Figure 1.2: STRUCTURE bar plot explaining the genetic structure of MG Run1

A few mulberry cultivars of the mixed subcontinent grouped with Chinese and Japanese collections, which confirmed the presence of exotic ancestors in Indian mulberry cultivars. Indian and mulberry formed separate group indicated the reproductive and taxonomic isolation from rest of the accessions. Other Asian mulberry accessions belonging to G. nigra and G. alba formed separate group. Exotic mulberry accessions collected from other parts of the world also formed a separate group. The presence of large number of admixtures in the grouping indicated the spread of mulberry far from the places of origin. We attempted to sample a diverse germplasm of mulberry and, therefore, we decided to adopt core collection strategy. A total of diverse germplasm were sampled by using all polymorphic SSR markers and as well as by combining SSR and phenotypic markers. Various sampling strategies like SimRI were used for sampling genotypically distant entries and Core Hunter for sampling diverse entries to maximize maximum number of alleles. Size of the panel is maintained uniformly as 200, irrespective of sampling strategy and type of data used.

As expected, SimRI method sampled genotypically distant entries with High Entry to Nearest Entry (E-NE) distance (0.47). In contrast, Core Hunter sampled diverse entries by retaining higher number of alleles along with some genetically close entries to capture rare alleles. Panel sampled using SSR markers as well as in using combined data were evaluated using wide range diversity criteria of 12 quantitative traits. Panel sampled by using combined data showed maximum more range than sampled using SSR marker data alone (Table 1.10).

Table 1.10: Performance of core samples using SimRI and Core Hunter method

Sampling method	Percentage of allelic richness	Mean genetic distance (H-E)	Minimum genetic distance (H-NE)
SSR data			
SimRI_panel (200)	99.47	0.599	0.427
Core_panel (200)	99.73	0.597	0.231
Combined data			
SimCI_panel (200)	99.11	0.358	0.248

However, combined data marked only fourty more than the core, indicating higher correlation between phenotypic and core classes. Another major genetic variation was accounted for some of diverse germplasm and used in the generation of the cluster and PCoA analysis. In the accession, Bhadravati collection genotypes formed separate group along with some of the indigenous and exotic germplasm. Most mulberry accessions belong to the G. serrata formed separate cluster and the other was mulberry species - G. indica and formed a distinct cluster. However, both these clusters have close association, when compared to the rest of the accessions, which indicates the taxonomic distinction and reproductive isolation with other mulberry collections. Cultivated Indian mulberry species like G. alba and G. indica species clustered in clusters and thus supporting the taxonomic ambiguity existing in the classification of these two species. . At the K, genotypes of the Bhadravati collection formed separate group except few that were outside they are wild mulberry species. Core collection with 150 entries was sampled from unique collections using different sampling strategies including SimRI and Core Hunter for SSR marker data and SimRI and Advanced for combined data.

Performance of different sampling strategy in core collection development was similar to the one observed in the case of diverse germplasm (Table 1.11).

Table 1.11 Performance of core collection sampled using different sampling strategies

Sampling method SSR data	% of alleles retained	Mean MD (M.A)	Mean MD (M.Nei)
DIVMAX (MC)	87.50	0.8116	0.8163
Core Hunter I (cd)	89.84	0.8286	0.8341
Combined data			
DIVMAX (cd)	87.50	0.8000	0.8061
PowerCore (M)	100	0.8333	0.8333

Core mother sampled a size subset with greater number of genes retained as with random strategy with greater ease to manipulate entry datasets. PowerCore sampled M-method is using combined data and the size of the core collection in PowerCore is determined automatically based on the diversity of the whole collection. The clustergram of entries of the core subset obtained by his method can be sub-divided into four groups (Fig. 1.4), wherein' collection germplasm accessions placed in a separate cluster along with four Indigenous and one exotic entry. In-one of the cluster, Indigenous and exotic entries were not associated, indicating the spread of mutagen from the place of origin to the rest of the world. Genomic mutation is propagated globally through stem cuttings, preventing the mixing of genomes of exotic mutants with the native cultivators. Wild mutants belonging to 12 species and 32 accession formed a separate cluster, indicating the taxonomic and reproductive isolation from the rest.

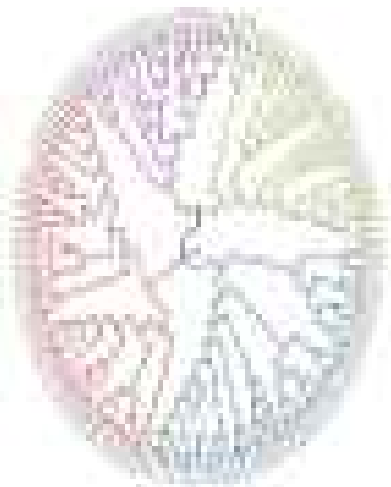


Figure 1.3 Rainbow illustrating the diversity of the core collection sampled using DivMS SSR data

Data 6 value showed maximum at k=4 and decreased progressively with the increase in k value. However, the same resulted population size (k=4) was determined based on an arc at the base level of diverse germplasm. The grouping of genotypes was similar to the one depicted in case of the parent. The genotypes of proposed collection formed a separate group along with some of the Orissan and Japanese entries. Wild mutagenic species of rice, indigenous entries and exotic mutants were separated in three groups. The accession 1, 17 and mutagenic species IC0R2 from the whole genome and rice SSR formed separate groups of all possible combinations. All the markers were analysed for mutagenic microsatellite database (MutMiSSD) and markers from EST sequences were functionally annotated and those from whole genome were mapped on the chromosomes. Integrative maps, chromosome to aid the selection of markers based on the function and location. Primer type and characters were integrated in the database to design primers for PCR and to visualize markers on chromosomes, respectively. MutMiSSD can be accessed at www.cbrmysore.in/mutmiss or http://10.10.10.22/mutmiss . These new SSR markers will be useful in genotyping of the panel of diverse germplasm for association mapping of traits of interest in mutagenic genetic stocks/varieties.

II. HOST PLANT PROTECTION

2.1 PRP 3.601 Biological control of fungal root rot disease of mulberry by *Aeromyelitis sachets Burkholderia cepacia* and *Bacillus subtilis* strains (DBT funded project)

V. Sivaprakasam (PI), G.R. Sankar Yadav, Laxmi T. I. C. S. and B. M. R. Sastri (Co-PI)

Duration: November 2012 to November 2014

Budget: Rs. 13.0 Lakhs

Objectives:

- Effect of soil free culture filtrates (CCF) of antagonistic bacteria, *Burkholderia cepacia* and *Bacillus subtilis* and *Pseudomonas aeruginosa* on radial growth and colony characters of root rot pathogen *Rhizoctonia bataticola*
- Development of fluorescent labelled monoclonal antibody (MCA) and bio-formulations of MCA and root rot pathogen *Rhizoctonia bataticola*
- *In vivo* evaluation of efficacy of bio-control agents against root rot disease of mulberry under glass / green house conditions.

Methodology

Survey was undertaken at Kodur, Channapatnagar, Hebbal, Kalasapur, Kanakapura districts. Soil and root samples were collected from farmer's fields of healthy and root rot affected mulberry to see the association of biotic antagonistic bacteria. Bacteria was isolated and identified following standard procedures. 70 isolates of *Burkholderia cepacia* and 30 isolates of *Bacillus subtilis* and 3 *Pseudomonas aeruginosa* were screened in vitro for their antagonistic activity towards *R. bataticola* using dual culture method and also cell free culture filtrates were tested following standard procedures. Effect of antagonistic bacteria on the fungal morphology of *R. bataticola* was done following staining (Lee et al., 2012). Four effective isolates from mulberry root ecosystem were tested for exoenzyme production. Chitinase assay (Chitin agar assay as described by Sahayaraj & Namasivayam (1997) and was modified by Mukherjee et al. (2006) was used. Polymerase chain reaction (PCR) was carried out in a volume of 25 µl containing 1 µl of genomic DNA of *B. cepacia*, *B. subtilis* and *P. aeruginosa* strains were generated to quantify the population of antagonistic endophytic bacteria population in soil and in mulberry root, stem and leaf. 50% inhibition of *B. cepacia*, *B. subtilis* and *P. aeruginosa* strains were made, nutrient following (Vidhyalakshmi et al., 1998; Reddy, 1999; Tilak, 1992) and pathogens and multiplied following the method of Nandha Kale, (2004). *In vivo* evaluation of BCAs was conducted under pot culture conditions using challenge inoculation method using mulberry cuttings / saplings in pot culture experiments following standard methods. To study the establishment of BCAs are inoculated, 7th & 15th days *B. cepacia*, *B. subtilis* and *P. aeruginosa* were re-isolated from the root and leaf of the inoculated plants following standard procedures of frequent dilutions plate technique (Johnson et al., 1959).

Observations/Results

On the culture filtrates of *B. cepacia*, *B. subtilis* and *P. aeruginosa* were tested on the suppression of *R. bataticola* radial growth and dry mycelial mass at 10%, 20% and 30% concentration. At 30% and 40% concentration (v/v) of the broths considered maximum for growth of *R. bataticola*. At 10% concentration of CCF of *B. cepacia* suppressed the radial growth up to 21.72% followed by *P. aeruginosa* 30.0% and *B. subtilis* (19.4%). Similarly, the fungal dry mass was decreased as the CCF concentration was increased in all the strains (Table 2.1). Antagonistic endophytic bacteria of *B. cepacia*, *B. subtilis* and *P. aeruginosa* at 30 µg / ml were considered. Further antagonistic nature against root rot pathogen and compatibility of the nutrients were confirmed (Fig. 2.1).

Efficient *Pf*- *B. cepacia*, *B. subtilis* and *Pseudomonas* were mass multiplied on talc based formulations and stored in various media at room temperature. The viability of BCAs was estimated based on drug talc polymer as dry dry materials. The dry fungal biomass 1.1x 1.0 g/l at 30 days and it gradually reduced as the days increased. At 120 day interval it was ranged up to 7.4 x 10^{7} cfu/g talc (Table 2.2). Further evaluation is in progress.

Table 2.1 Effect of cell free culture filtrates (CFF) of selected antifungal isolates of B. subtilis, P. aeruginosa and B. cereus on radial growth and sporulation in vitro of P. palmivora

Sl.No	Bacterial isolate	CFF %	Colony diameter in cm	Dry mass (g)	% inhibition
1	Bacillus subtilis	50	10.00	0.016	0
		25	10.00	0.048	61.67
		10	10.00 (0% ITH)	0.050	61.68
2	Bacillus subtilis	50	10.00	0.025	55.51
		25	10.00	0.071	56.19
		10	10.00 (0% ITH)	0.035	66.67
3	Pseudomonas aeruginosa	50	10.00	0.022	57.23
		25	10.00	0.023	58.88
		10	10.00 (0% ITH)	0.024	58.40
4	Consortium of three Bacteria	50	10.00	0.013	54.02
		25	10.00	0.034	68.61
		10	10.00 (0% ITH)	0.038	73.68
5	Control 1	NB	10.00	0.143*	–
6	Control 2	NB	10.00	0.143*	–
	SEm±		0.116	0.004 (LT) 0.006 (CD)	–

*LT – control for B. subtilis and P. aeruginosa; CD- Control for B. cereus and consortium
Figure in parentheses indicates the % suppression of radial growth when compared with control

Fig 2.1 Compatibility of PGPRs, B. subtilis, P. aeruginosa and B. cereus in vitro

Host resistance against phytophthora pod rot under controlled conditions was evaluated in pots with mature cuttings and seedlings as the mother by propagation only with cuttings. The control and supplemental effect on disease varied with the bacterial isolates. Among the bacterial isolates used, P. aeruginosa showed the highest survival of cuttings (Table 2.2). Most of control on mature seedlings in earlier experiments, as the mother is a hard, woody perennial plant and the earlier studies revealed that the disease in seedlings can be checked when the days of inoculation of pathogen

Table 2.2: Viability of antagonistic bacteria on talc based formulation (cfu / ml x 10⁷)

Bacterial strains	Number of days after formulation				
	30	60	90	120	180
B. cereus	1.53	1.40	1.10	0.8	0.7
B. subtilis	1.54	1.42	1.15	0.9	0.8
P. aeruginosa	1.40	1.28	1.02	0.7	0.6

Table 2.3: Effect of EBCs on survival of bacterial cultures in the presence of root rot pathogen R. solanacearum

Treatments	Soil drench: Cultures dead after infection days after disinfection started							
	30	60	90	120	150	Total dead	Total survival	% Survival
B. cereus	20	2	2	0	3	0	7	13
B. subtilis	18	3	3	2	1	2	9	11
P. aeruginosa	20	1	2	1	2	0	5	15
Control	20	2	2	3	3	2	12	8
Absolute control	20	5	5	5	1	1	3	20

3. SURVEILLANCE AND MANAGEMENT

3.1 [illegible] Population of productive bi-multiline double hybrid (R 2000 x R 2005) x (CH 5 x CH 27) Hirdemandir' with the farmers of Kumaon

Scientist(s) involved: [illegible]

Duration: October 2013 to September 2014

Budget: [illegible]

Objective: 1. To encourage on-farm diversity of potato hybrid Hirdemandir with the farmers of Kumaon

Methodology

A survey was conducted in Bageshwar, Nainital, Almora, Pithoragarh and Champawat districts of Kumaon to find the villages out of all farmers. 5 villages based on farmers' variety preference, seed and irrigation facilities were selected. Ten farmers in five villages were selected for testing of double hybrid along with the control F1 hybrid (CH5 x CH27) in comparative trials. The following activities were carried out before distribution of the double hybrid seed to the farmers. The planting material was tested in the laboratory and 25% of double and control hybrid were prepared. The disease free seed tubers of double and control hybrid were distributed to the farmers.

A total of 11 trials of the double hybrid 'Hirdemandir' (CH5 x CH27) x (CH5 x CH27) were conducted along with the control F1 hybrid (CH5 x CH27) with the farmers each at Bageshwar, Pithoragarh and Champawat districts. A total of 1000 kg each of double hybrid seed were prepared and chemically treated and distributed to farmers along with control F1 hybrid (CH5 x CH27) in comparative trials. Recommended agronomic practices were followed in the trials. Observations on germination, plant stand, vigour, plant height, number of stems per plant, number of tubers per plant, tuber size, tuber shape, tuber yield, tuber dry matter, tuber specific gravity, tuber eye depth, tuber skin colour, tuber flesh colour, tuber dormancy, tuber sprouting, tuber cooking quality, tuber taste, tuber texture, tuber after cooking darkening, tuber chipping colour, tuber chipping quality, tuber fry colour, tuber fry quality, tuber processing quality, tuber keeping quality, tuber shape uniformity, tuber uniformity

analysis at the institute. The ranking parameters viz., filament length, strength, mic value, uniformity and elongation were studied. The data of three hybrids namely Intermediate (CSHG x CSHG) x (CSHG x CSHG), single hybrid (CSHG x CSHG) and cross breed (PH x CSHG) in respect of 13 parameters were analysed by Kruskal-Wallis Statistical method.

Results/Discussion

There was significant improvement observed in double hybrid for most of the traits when compared with the single hybrid and cross breed. The results of double hybrid showed an improvement of ginning yield of 38.87 and 6.27 %, cotton weight of 3.44 and 10.09 % and boll percentage of 1.45 and 9.66% over single hybrid and cross breed. With respect to seeding traits, the double hybrid showed an improvement of seed kernel percentage of 6.45 and 23.19%, filament length of 9.87 and 19.42% and roundness of 7.38 and 8.29 % as compared to single hybrid and cross breed. Moreover, the double hybrid have fetched more income gross realization and showed 1 lakh and 20 kg improvement as against single hybrid and cross breed. (Table 4.1)

Table 4.1: Comparative performance of the double hybrid Intermediate (CSHG x CSHG) x (CSHG x CSHG) / single hybrid CSHG x CSHG and cross breed

Hybrid	No. of pods	No. of locules	Seed cotton yield per plot (kg)	Yield per hectare (kg/ha)	Lint/ seed weight (g)	Pod weight (g)	Ginning (%)	Mature bolls (%)	Filament length (mm)	Mic value	Mic (%)	Uniformity (%)	Cotton yield per hectare (kg/ha)
DH	1000	5	1150	6240	3.80	5.68	33.0	97	29.8	4.01	10.2	84	2496
SH	1000	5	826	5040	3.64	5.53	32.7	95	26.6	4.00	10.0	81	2016
CB	1000	5	1000	5400	3.60	5.57	32.1	91	27.8	3.99	9.9	82	2160
Kharif / Irrigated Summer													
Hybrid	--	--	1111	6237	3.80	5.68	33.1	97.0	29.8	4.01	10.2	84.7	2.51
Critical value at 5% level	--	--	--	--	--	--	--	--	--	0.4	--	--	--
Kharif													
Mean SD			0.01	0.03	1.02	0.29	1.01	0.28	0.9	0.45	0.04	1.04	0.04
Mean SE			0.01	0.2	0.01	0.16	0.01	0.16	0.5	0.3	0.2	0.6	0.02

Mandya district, which is famous for sugarcane industry, accounts 2nd place in sericulture activities. It supports more than 20000 sericulturists with 24000 hectares of mulberry plantation. Strategic role of Mandya district was awarded for popularization of double hybrid 'Kaveriraja'. The farmers of Srirangapatna area reeling two productive silkworm x bivoltine hybrid as all the seasons except during Bivoltine season (Aug – Nov) they also reel productive bivoltine single hybrid (CSR2 x CSR4). The cross breed is popular among the sericulturists in the selected area and they rear in all seasons in their rearing houses. The bivoltine hybrid reeling requires separate reeling furnace and adaptation of recommended package of practices. Hence the farmers rear silkworm x bivoltine hybrid which yields inferior quality silk. Two factors is the biggest pave obstacle for reeling of double hybrid in Srirangapatna area. Due to the better performance of double hybrid, cocoon quality is various environmental conditions. Ogden (4th / kg of double hybrid due to superior quality of silk), more cocoon yield / kg in double hybrid, easy reeling of filament shades due to round cross-section and the farmers of the adjacent villages in Srirangapatna Taluk are reeling double hybrids in place of cross breed.

Popularization of the double hybrid has motivated the farmers for reeling of bivoltine silkworm double hybrid in place of cross breed. As a result of the reeling of double hybrid their economy has boosted. This would in turn motivate other farmers to take up Bivoltine silkworm rearing and consequently Bivoltine cocoon production will increase there by resulting in higher production of raw silk in future.

11 AIB 1440: Studies on the development of indigenous method for culturing *Dioscorea* and other useful species.

Ramesh Krishnaiah KN and M. Ramakrishnan Nadar

Duration: October 2010 to September 2013

Budget: Rs 7.94 lakhs

Objective:
- To isolate different spp. of *Dioscorea* and other useful species in nature
- To study in vitro culture media containing sugar alcohol and in vivo in different pulses

Methodology:

In isolation of a different identified in pulse cultures of *Dioscorea* bulbil were collected from different sources (vegetative). The viable mycelial cultures are being successful and maintained in PDA(potato dextrose agar) PDA and Carboxymethyl Cellulose agar (cmc) (CMC) media every month and kept at 15° - 20°C for growth optimized at 25° C. Different liquid media (mm/l) were standardized containing different composition of chemicals and amount of *dioscorea* bulbil agar/ pulses powder or without pulses, sterilized, cooled, inoculated culture to the prepared media. The growth of mycelia culture in cmc/ml was observed for 10 days. Green leaf meal ready for the inoculation in solid media (in vitro) conditions. Different solid media were prepared with different combinations of different pulses, cereal, rice, barley grains, wheat soybean media, starch etc., sterilized, cooled and inoculated by culture broth or direct culture, followed by incubation at 24-28°C for 30-40 days, shaken at 80-100 rpm at 24-28°C in dairy shaker for 4 days or 20 days then to ambient temperate. Specific rate of inoculum of specific culture was inoculated to the tuber of *dioscorea* most preferably at 24-28°C with natural moisture, aeration and mounting of the inoculum. Infected pulses were separated and spread on wet cotton and observed the development of symptoms. Hyperbolic growth and fruiting bodies on pulses and solid media were recorded. The quality control of food was done by quantification of major bioactive constituents through HPLC against standard compounds (*D. bulbifera*), antioxidant and anti-microbial and adhesive isolated from tuber extract.

Observations/Results:

Thirteen isolates of *D. bulbifera* spp. were collected from different sources and being maintained and sub-cultured 32 times on nutrient cultures in two different media PDA and CMC/1%. The initial colour of all the isolates were cotton white and the mycelium stain of *Dioscorea* spp. The mature colour of the mycelium was variable of the isolates which are presented in Table 1.2.

Table 1.2: Details of isolates of *Dioscorea* spp.

S	Original name	Code no.	Initial colour of mycelium
1	*Dioscorea bulbifera* L. common (dark)	DB 01	Cottony white
2	*Dioscorea bulbifera* L. common (dark)	DB 02	Cottony white
3	*Dioscorea bulbifera* L. common (dark)	DB 03	Cottony white
4	*Dioscorea bulbifera* PKM-1	DB PKM-1	Water stain and culture pigment
5	*Dioscorea bulbifera* PKM-2	DB PKM-2	Cottony white
6	*Dioscorea bulbifera* (Kolar)	DB Kolar	Cottony light yellow pigment small balls
7	*Dioscorea bulbifera* (Kolar)	DB Kolar	Leathery light pink
8	*Dioscorea bulbifera* (Chamarajanagar)	DB Chamarajanagar	Cottony light pink small balls
9	*Dioscorea bulbifera* (Chamarajanagar)	DB Chamarajanagar	Light pink black white, aerial growing
10	*Dioscorea bulbifera* (Mysore)	DB Mysore	Cottony white
11	*Dioscorea bulbifera* (Mysore)	DB Mysore	Cottony white
12	*Dioscorea bulbifera* (Mysore)	DB Mysore	Cottony white
13	*Dioscorea bulbifera* (Mysore)	DB Mysore	Cottony white

Broths were prepared with different compositions and aliquots specific three different compositions were finalized. Broth cultural inoculums was standardized. Broths were inoculated and kept in dairy shaker after 5-10 rpm at 25-28°C for 9-10 days or without shaker at 25-28°C for 9-10 days. Different spp are showed different patterns in broth culture depending upon strains spread.

In in vitro, three isolates (SI, SI & SII) where sporia of fungi culture was successfully inoculated in Sabouraud Dextrose Broth (SDB), SDB + NaCl and SDB + 1% Glucose. Broth inoculated with sporia of SDB + 1% Glucose showed maximum mycelial growth (Table 1.1).

Table 1.1: In vitro growth of Colletotrichum capsici isolates in different liquid media

Isolates (i, SI, SII & SIII)	No. of spores collected	% Germination	Length of filaments (mm)	No. filaments per papilla
SI	147	85.4	20-30	30-50
SII	170	100	25-35	50-100
SIII	30	100	40-50	5-10

Sporangia were harvested and measured. The length of each sporangia (1442 nm) along with dried weight of the media and fruiting body weight were recorded. Biological efficiency (BE) was calculated for every batch of culture and found to be 2.47-42.11 %. Table 1.2. After the optimal time growth in SDB, the mycelia inoculated to 100 Jaipur media to observe its growth fruiting bodies in solid media. Fruiting bodies were observed in three different species, viz., SI, SII and SIII PCRI. Sporangia were harvested and measured in MP. The length of each sporangia in Jaipur SI measured to be 1545 nm and biological efficiency (BE) was found to be 12.19-41.24 % (Table 1.2).

Table 1.2: In vitro biomass of fruiting body formation in Jaipur (SI, SII & SIII)

Papaya isolates	FW (g)	LS (mm)	FW+HW (g)	BE(%)
I	1.20	0.0	1.44	5.76
II	1.66	0.0	1.66	6.27
III	1.12	0.0	1.22	0.71
IV	1.00	2.0	1.01	0.01
V	1.21	2.0	1.24	0.72
Avg	1.24	20.42	1.31	1.36

Note: BE = Biological efficiency, FW = Fresh weight, LS = Length of stromal, FW+HW = Fresh body weight, BE = Biological efficiency, CV = Coefficient of variation, SD = Standard deviation

Table 1.3: In vitro biomass of fruiting body formation in Jaipur

Age of culture (days)	FW (g)	LS (mm)	FW (g)	BE (%)
20	0.011	0.00	0.122	0.01
40	0.044	0.00	0.044	0.16
60	0.122	0.00	0.122	1.04
80	0.210	0.00	0.224	0.20
Avg	0.109	0.00	0.102	0.01

Note: BE = Biological efficiency, FW = Fresh weight, LS = Length of stromal, FW+HW = Fresh body weight, BE = Biological efficiency

Fruiting body of Jaipur SI are long fruiting body, up to 1 cm wide, club shaped, the stem is from the base, difficult to clearly distinct "cap" but the upper portion was light brown color turned to reddish brown and smooth when young. The mycelium is effusive-ramified around normally about 5 cm wide media. The spores are thread like and segmented breaking into individual segments. Fruiting body was

observed in Cbi Pre 30. Oblong to elliptic cocoons with compacted valve with 2.8 to 3.2 mm thick and 2.2 to 2.6 in Cbi Pre 30 and Cbi Pre 50 hybrids respectively.

HPLC analysis of major bioactive constituents of Cordyceps - Cordyceps Cbi biosynthesizes cordycepic acid (D-mannitol) and adenosine. Estimation of active principles of Cordyceps cultured in the laboratory were quantified against standard. Adenosine present in all the isolates ranged from 0.08 to 0.23 µg/mg (average 0.14±0.05). Cordycepic acid present in all the isolates (0.078 to 0.27 µg/mg) except in Bh, Bl, K, N, Cbi, Cbi Pre and Cbi Pre 50 (not detected). Highest amount of cordycepic acid was recorded in Cbi Pre 30 (0.27 µg/mg) followed by Cbi Pre 50 (0.26 µg/mg) and Cbi Pre 50 (0.24 µg/mg) where fruiting bodies were observed. Results revealed that artificially cultured Cordyceps Cbi contains 1.3 to 3 folds more adenosine and better quality of cordycepic acid and around 4.24 folds more cordycepic as compared to naturally available C. sinensis.

11: AIP 1212: Studies on mulberry leaf nutrition on intermediary metabolites of silkworm *Bombyx mori* L.

Dr. Ravindrakumar Reddy (PI) and M. Ramesh Gupta (Co-PI)

Duration: April 2012 to March 2014

Budget: Rs. 7.50 lakhs

Objective:
1. Correlation of mulberry leaf nutrition on intermediary metabolites and economic parameters of hybrids of silkworm *Bombyx mori* L.

Methodology

Two silkworm hybrids Li Nichang and Cainuo(Pure) were reared to evaluate improved cross breed and highly productive multivoltine hybrid in the present study. Mulberry variety, S1635 (V1) was used for feeding the larvae. The economic traits selected for the study included fecundity, weight of fifth instar larva, larval duration, single cocoon weight, single shell weight, shell percentage.

The larvae from first day of fifth instar were collected daily with a regular interval of 24 h till end of fifth instar. The haemolymph was collected, the midgut and silkgland tissues were collected from five to six larvae of fifth instar by dissecting the larvae in ice cold saline. A 24 h (h) homogenate of the tissue was prepared in ice cooled distilled water. The homogenates were centrifuged at 4000 rpm for 10 minutes. The clear supernatants were used for enzyme analysis. The haemolymph, midgut and silkgland were estimated for the following biochemical parameters. The total protein content was estimated by the method of Lowry *et al.* (1951), glycogen content and free amino acid content by the methods of Hodge and Osbi (1954) as described by Sadasivam and Manickam (1997). Total carbohydrates by Dubois *et al.* (1956), Glycogen by Montgomery (1957), the activity of Succinate dehydrogenase (SDH) was assayed by the method of Cox and Lands (1962), total lipids by Folch *et al.* (1957) and fatty acids by Falholt *et al.* (1973) were studied.

Observations/Results

Five days of cocoons and biochemical estimations of total proteins, free amino acids, total fats, fatty acids, carbohydrates and glycogen in different tissues *viz.*, silk gland, mid gut and haemolymph of CSRTI x CSR4 and Li x CSR2 silkworm hybrids were completed. Data revealed the range of cocoon weight between 1.232 and 1.414 g, shell weight between 0.194 and 0.232 g, shell % between 15.63 and 16.43 (Table 1.6).

The cocoon weight, shell weight and shell percent were significantly high in CSRTIxCSR4 hybrids than Li x Nichang compared to Li x Cainuo hybrids and their shell to cocoon ratio ranged from 15.24 to 15.63 and 15.24 to 15.96 respectively. In CSRTIxCSR4 haemolymph showed maximum protein and amino acid values (45.5 and 125.8 mg/ml respectively). The least values of protein and amino acids in the mid gut of Li x CSR2 were 28.20 and 70.2 mg/gm respectively. The range of total lipid values and free fatty acid values were observed to be 12.64 to 30.02 and 29.23 to 45.26 mg/g of ml respectively. In CSRTIxCSR4 midgut showed maximum value (46.78 mg/g) and the least value was obtained in the haemolymph of Li x CSR2 (22.34 mg/ml). The total carbohydrate and glycogen were found vary from 15.41 to 32.46 and 8.12 to 16.23 mg/g of ml respectively. In CSRTIxCSR4 haemolymph showed a maximum glycogen and

storages where 30.45 and 10.23 mg/ml antioxidant and total values of semi-ripe fruits and storage in the range of 1 to 2000 days. It is also to 0.1 mg/g respectively (Table 3.7).

Table 3.6 Pooling performance of different hybrids

Name	Type	C.V% (g) V1	S.E% (g) Kha	Kh (g) V1	Kh (g) Kha	Wt/B (%) V1	Wt/B (%) Kha
CHRH-334	I	1.23	1.456	6.200	0.345	22.23	2.145
	II	1.745	1.642	6.541	0.456	22.45	2.541
	Ave.	1.745	1.628	6.321	0.321	22.45	2.145
	SE	±0.071	±0.014	±0.17	±0.024	±0.054	±0.042
L-Hirsutum	I	1.562	1.789	6.234	0.162	16.17	0.89
	II	1.642	1.824	6.344	0.214	17.11	0.64
	Ave.	1.236	1.762	6.241	0.189	17.12	0.83
	SE	±0.077	±0.065	±0.018	±0.021	±0.032	±0.041

The maximum amino acid levels with concomitant increase in the levels of total and soluble proteins in the pot grass, seed sprout and root grass found in CSHG shoots and tubers that on 21 mulberry leaves compared to cow, sheep sheep leaves on V1 variety showed maximum carcinogenes in the elephant, hybrid river and mitigal tissues were considered to CSE. The results supports the possibility that some mulberry which V1 which is rich in protein (26.7%), carbohydrates (72.6%), are fed to silkworms, it is efficiently used for the physiological formulation and micronutrient in poor diseases.

Table 3.7 Biochemical constituents in different tissues of V1 hybrid silkworm

Silkworm Race	Tissue	Viability Viability	Fifth instar Proteins (mg/g or ml)	Free amino acids (mg/g or ml)	Carbohydrates (mg/g or ml)	Total Lipids, triglycerides (mg/g or ml)	Glycogen (mg/g or ml)
CSR2 X CSR4	Haemolymph	M	45.23-145.6	56.23-120.3	45.23-65.23	65.23-145.45	5.23-15.23
		SM	45.23-134.5	114.23-153.1	45.23-65.23	65.23-145.45	5.23-15.23
	Silk gland	M	23.23-65.41	23.23-72.23	23.23-45.23	23.23-45.23	3.23-12.3
		SM	23.23-61.54	23.23-72.23	23.23-45.23	23.23-45.23	3.23-14.5
	Ovigenic	M	45.23-134.5	65.23-145.23	45.23-65.23	23.23-45.23	3.23-15.23
		SM	45.23-145.65	65.23-145.23	45.23-65.23	23.23-45.23	3.23-15.23
CH X CSR2	Haemolymph	M	23.45-67.54	23.23-45.23	23.23-45.23	23.23-45.23	3.23-12.23
		SM	23.23-45.23	23.23-45.23	23.23-45.23	23.23-45.23	3.23-12.23
	Silk gland	M	23.23-45.54	47.23-65.23	23.23-45.23	23.23-23.23	2.23-12.23
		SM	23.23-45.23	23.23-45.23	23.23-23.23	23.23-23.23	3.23-12.23
	Ovigenic	M	23.23-45.23	23.23-45.23	23.23-45.23	23.23-45.23	3.23-12.23
		SM	23.23-45.23	23.23-45.23	23.23-45.23	23.23-45.23	3.23-12.23

4. SUPERVISED CROP PRODUCTION

4.1 **SFR Title:** Development of silkworm rearing package for newly developed breeds/hybrids

S.Pyrosakthivel (PI) and S. D. Gunapradeepan

Duration: April 2013 to November 2016

Budget: 1.2 lakhs

Objective: • To develop silkworm rearing package for newly developed breeds/hybrids

Methodology

L14 pure breed bivoltine rearings were conducted with 200 dfls from 28,000 larvae (100dfls including 5% X 2DFS) as control. The rearings were conducted with different spacings viz., 600, 700, 800 Sq ft / 100dfls and quantum of feed from 2000 to 2800 kgs of shoot and a suitable rearing package was developed for L14 breed and L14 x CSR2 hybrid. The other rearings practices like disinfection, hygiene, use of bed disinfectants as per the norms were followed during the rearings.

Observations/Results

Development of rearing package for L 14 pure breed

The L14 breed developed in the multivoltine breeding section was taken for the development of rearing package. A total quantity of 1600 dfls reared in 8 times in all the three seasons i.e., Summer, Rains and Winter. The following observations made during the assessments of rearing package. The average incubity of the eggs obtained from 100 bi-bed and the larval duration varied from 21 to 24 days depending on the seasons. The cocoon characteristics like cocoon wt (g), Shell wt (g) and Shell % were found to range from 1.200 to 1.40, 0.320 to 0.330, and 17.7 to 19.0 respectively.

Three trials of L14 pure breed rearings with 100 dfls (5000 larvae) each with three replications was conducted with three spacings i.e., 600, 700 and 800 Sq ft / 100dfls with quantum of feed from 2000, 2200 and 2400 kgs of shoot (Table 4.1). It was found that 700 Sq ft bed space with 2200 kgs of shoot feeding is optimum for seed cocoonage.

Table 4.1 Rearing performance of L 14 pure breed with different spacings and quantum of feed

Rearing parameters	Bed space (sq ft) / Quantum of feed		
Bed space (sq ft)	600	700	800
Quantum of feed (kg)	2000	2200	2400
Larval weight (g)	28.6	27.9	27.4
Yield/ 10,000 larvae (kg/ no. number)	7824	8264	8287
Single cocoon weight (g)	1.600	1.567	1.421
single shell weight (g)	0.320	0.326	0.284
Shell %	19.72	19.58	19.47

Development of rearing package for L 14 x CSR2 hybrid

L14 x CSR2 hybrid rearing with three replications and three spacings, viz., 700, 800 and 1000 Sq ft with the quantum of feed from 2000, 2600 and 3200 kgs of shoot was carried out (Table 4.2). The results clearly showed that the performance of the hybrid is optimum with 800 Sq ft bed space with 2600 kgs of shoot feeding. The cocoons gone short from the bed is not sent to reeling section for analysis of raw cocoon characters in order to assist that the silk produced is of 24 years.

Table 4.2: Rearing performance of F_1 (4 x CSR2) in mid-silk different seedcrops and quantum of feed

Rearing parameters	Bed space (sq ft) per Quantum of feed		
Bed space (sq ft)	750	500	1000
Quantum of feed (kg)	2250	1500	3000
Larval weight (g)	11.0	10.0	10.0
Yield/100 larvae by number	80.0	85.0	90.0
Single cocoon weight (g)	1.98	2.05	2.00
Single shell weight (g)	0.33	0.42	0.41
Shell %	16.61	20.41	20.50

Rearing strategies developed for F_1 breed and hybrid will be provided to the seed farmers as well as commercial cocoon crop for harvesting good cocoon crops.

4.2. **MPR Mulberry:** Large scale multiplication of new mulberries and its cultivation practices

S. K. Samapundo, PR I and S. Ravindran

Location: Kodathi and Thalaghattapura

Support: CSB, Delhi

Objective: 1. Large scale multiplication of productive mulberry varieties

Methodology

The layings of newly developed breeds and hybrids developed by the breeding laboratories were evaluated in large scale under tropical rearing conditions. During the rearing period all the rearing parameters like hatching percentage, weight of matured larvae, larval duration, yield/100 larvae, yield/10,000, single cocoon weight, shell weight, shell percentage and filament length were recorded.

Observations/Results

Six rearing trials of F_1 pure breeds were conducted during summer (2 trials with 100 dfls), rainy (one trial with 100 dfls) and winter (2 trials with 200 dfls) seasons. The rearing performance is presented in Table 4.3.

Table 4.3: Large scale rearing performance of F_1 breeds

Season	Yield		Cocoon weight (g)	Shell weight (g)	Shell percentage (%)
	No.	Wt. (kg)			
Summer	9138	9.60	1.260	0.246	19.57
Rainy	9688	10.81	1.410	0.270	19.63
Winter	9558	10.16	1.518	0.330	21.73

A total of 9.56 lakh F_1 seed cocoons were generated which were utilized for preparation of F_1 layings under pre-seed authentication programme of CSB-2 for further field evaluation.

Further, to offer seeds of F_1 (4 x CSR2) and F_1 (4 x CSR4) cocoon were reeled and data recorded. The reelability was found to be superior in terms of cocoon yield and cocoon traits (Table 4.4).

Table 4.4: Reeling performance of F_1 (4 x CSR2) and F_1 (4 x CSR4)

Hybrid	Yield / 100 dfls (kg)	Raw silk		Cocoon weight (g)	Denier (d)	Shell percentage (%)
	No.	Wt. (kg)				
F_1 (4 x CSR2)	76.1	66.0	9.79	2.039	2.427	22.24
F_1 (4 x CSR4)	73.1	66.0	12.58	1.894	2.697	17.79
% improvement over control	+3.9	-5.27	12.47	-12.79	26.73	-14.22

6. SILKWORM CROP PROTECTION

6.1 PPR 1402: Model studies: Impact of crop diversity on the conservation and performance of natural enemies in multivoltine eco-system

J. B. Ashwathappa Kumar (PI), S. T. Chandrappa, V. S. Mallikarjuna Gowda, Mahadeva M. Swamy and K. Manjunatha

Duration: October(s) 2011 to February 2014

Budget: Rs. 3.5 lakhs

Objective:
1. To determine the occurrence of insect pests and abundance of natural enemies in multivoltine eco-system under irrigated semi irrigated and rainfed conditions in relation to cropping pattern in the locality.

Methodology

For the study Hebbenkuppe, Nallenahalli, D'Halli, Madapuranahalli and Thimmanahalli villages are selected in irrigated region of Kanakapura district. The new sericulture farmers are multivoltine cocoons cultivated by irrigated and partly rainfed. Kommahalli, Kyatanahalli, Agrahara, Shankarahalli & Sunkenahalli villages are selected in the rainfed region of Kolar district under the multivoltine cocoons cultivated by Private Institutions & Individual Silk diversities. Like wise Kallahalli & Venkatapura villages are selected in rain fed region of Chamarajanagar district under the multivoltine cocoons cultivated mixed crop agriculture crop diversities. In all the above regions, multivoltine cocoons cultivated by multivoltine silkworm considered as control.

Data on the incidence of major multivoltine pests were collected at regular monthly intervals in the gardens under each crop diversity (a total of 20 multivoltine gardens from 5 districts). Similarly, enumeration of natural enemies available in 100 plants in each of the above 20 multivoltine gardens was also recorded. Recorded season number of predatory ants and beetles in each of the rainfed and irrigated the incidence percentage of the same after 10-15 days of release. Data were compiled and tabulated in brief otherwise.

Observations/Results

The monthly survey data on the incidence of available insect pests of multivoltine in the 5 districts is tabulated at Table 6.1. It is observed that number of insect pests were as high as 12 each in both irrigated & rain fed multivoltine gardens of Kanakapura, Kolar, Chamarajanagar districts whereas in semi-irrigated district of Kolar it was 10 (Table 6.1). In the irrigated multivoltine gardens, a new species of beetle Sp. Staphylinidae (Coleoptera) as well as a new caterpillar pest Cosmia emissaria (Geometridae) have been recorded to be eating mainly flesh. Also, in Thimmanahalli only, a rare multivoltine garden Hippotion sp. non insect pest were found damaging multivoltine shoots at saplocation base and also feeding on tender leaves, especially during rainy season. In the semi-irrigated region of Kolar district, weevils are causing damage to multivoltine shoots and may prove as a threat in future. After surveys of multivoltine they were found to be harbouring some predacious insect pests.

Table 6.1: Insect pests recorded in the multivoltine gardens of three selected districts

Sl.No.	Multivoltine Pests	Kolar (Irrigated)	Kolar (Semi-irrigated)	Chamarajanagar (Rainfed)
1	Myrmeleon obscurus Walker (Neuroptera: Myrmeleontidae)	++	++	+
2	Pericallia ricini Fabricius (Lepidoptera: Arctiidae)	+	+	+
3	Diacrisia oblique Walker (Lepidoptera: Arctiidae)	+++	+++	+
4	Glyphodes bivitralis Guenee (Lepidoptera: Pyralidae)	++	+++	+
5	Spilarctia obliqua (Lepidoptera: Arctiidae)	++	+	+
6	Leucinodes orbonalis Guenee (Lepidoptera: Pyralidae)	+	+	+

7	[illegible]	+++	-	-
8	[illegible]	+	+	+
9	[illegible]	+	+	+++
10	[illegible]	++	+	+++
11	[illegible]	+	++	+
12	[illegible]	-	-	+++
13	[illegible]	++	++	-
14	[illegible]	-	-	+
15	[illegible]	++	-	+
	Total No.	11	11	10

(+++Abundant ++Less than abundant +Occasional to rare -Absent or below detection level)

The monthly survey data on the natural enemies in the nutmeg ecosystem in the 3 districts is furnished at Table 2.2. It is evident that total number of natural enemies available were: 12 species in organic gardens followed by semi-organic (9) and least (4) in den the gardens. It was observed that entomophagous pathogen is very well established in both organic as well as semi-organic and effectively checking the further spread of the exotic pest, coconut mealybug. The exotic bug predator, *Cryptolaemus montrouzieri* has the ability to turn the modern gardens as though it exists in both organic and semi-organic gardens. All are very much desirable.

Table 2.2. Natural enemies observed in the nutmeg gardens of three selected districts

Sl.No.	Natural Enemies	Kasaragod (organic)	Kozhikode (semi-organic)	Thiruvananthapuram (Non-Org)
1	[illegible] (Coleoptera: Coccinellidae)	+	+	+
2	[illegible] (Coleoptera: Coccinellidae)	+	+	+
3	[illegible] (Coleoptera: Coccinellidae)	+	+	+
4	[illegible] (Coleoptera: Coccinellidae)	+	+	+
5	[illegible] (Coleoptera: Coccinellidae)	+	+	+
6	[illegible] (Coleoptera: Coccinellidae)	+	+	+
7	[illegible] (Neuroptera: Chrysopidae)	+	+	+
8	[illegible] (Hemiptera: Reduviidae)	+	+	+
9	[illegible] (Hymenoptera: Formicidae)	+	+	+
10	[illegible] (Hymenoptera: Formicidae)	+	+	+
11	[illegible] (Hymenoptera: Encyrtidae)	+	+	+
12	[illegible] (Hymenoptera: Encyrtidae)	+	+	+
13	[illegible] (Hymenoptera: Eulophidae)	+	+	+
14	[illegible] (Hymenoptera: Eulophidae)	+	+	+
15	[illegible] (Hymenoptera: Eulophidae)	+	+	+
	Total No.	15	9	8

(+ = Present - = Absent)

The data collected under irrigated condition in Maiduguri district, investigated mulberry gardens of rose diseases and also in the fish fed mulberry gardens of Chanchaga region revealed that the incidence of major mulberry pests and natural enemies did not vary significantly between the two districts.

It was observed that rose diversity had relationship with the recovery of predatory coccinellid species (Table 3.3). Under irrigated condition, in control gardens, recovery was highest (472.5%) followed by Mulberry Sugarcane (415.0%) and Mulberry paddy (357.5%). Under semi-irrigated condition, recovery was almost on par between control gardens and mulberry mapped (Ubi x S. tuberosa hexaploid), shrubs in midterm. Tomato system, it was very less (20.0). Under rain fed condition, recovery was highest in Mulberry based crop gardens (80.0%), followed by control gardens (77.5%).

Table 3.3: Recovery of predatory beetles fed on mealybugs under irrigated, semi-irrigated & rain fed conditions (average of 4 trials)

Region	Treatment & crop diversity	Recovery (%)	Rank of treatment
	T1: Mulberry+sugarcane	415.00[a]	2
Kano/Jos	T2: Mulberry+ Paddy	357.50[b]	3
(Irrigated)	T3: Mulberry+ Mulberry (control)	472.50[a]	1
	T4: Mulberry+ Tomato	220.00[c]	4
Kano	T5: Mulberry+ Marigold	120.00[cd]	5
(Semi-irrigated)	T6: Mulberry+ Mulberry (control)	200.00[c]	4
Jos region	T7: Mulberry+ Mixed crop	80.00[d]	7
(Rainfed)	T8: Mulberry+ Mulberry (control)	212.50[c]	6
Between trees	-	196.13	-
Between	-	0.0001	-
SE (±)	-	0.00	-
CD (P)	-	0.0000	-
CV (%)	-	0.00	-

Mean values with alphabet in common are not statistically significant using Fisher's Least Significant Difference

It is a general phenomenon that increased chemical control measures can accelerate the impact of natural enemies. Although several hypothetical explanations have been suggested, the mechanism behind the positive effects of mixed cropping are still only partly understood. In agriculture using cash mulberry gardens other crops are also existing in their vicinity and hence those crop as a test tool to study their impact on the pest incidence and abundance of natural enemies. The present study has revealed that irrigated crops such as sugarcane, paddy under irrigated condition, tomato, marigold under semi-irrigated condition and mixed crop gardens under rain fed condition are not having any impact on the incidence of insect pests on mulberry. The literature available on this type of study with respect to mulberry is scanty. However the crops in the vicinity have great impact on proliferation and multiplication of various beneficial predators like Coccinellid predators. This is evident from the data collected on the counts of natural enemies under the trials.

Crop Diversities Selected for the Study

Irrigated ecosystem of Mandya district

Mulberry : Sugarcane

Mulberry : Paddy

Semi-irrigated rainfed ecosystem of Kolar district

Mulberry : Finger millet

Mulberry : Mango tree

Rain fed condition of Chamarajanagar district

Mulberry : Sorghum, Cowpea

Mulberry, Castor, Cotton

11 PSE 3407: Evaluation of ecological management strategies of giant African snail, *Achatina fulica* Bowdich in mulberry ecosystem

G. T. Basalingappa (PI), J. S. Hanamant Kumar, G. K. Gurumallesappa and Prithviraj Kumar

Duration: April 2013 to February 2014

Budget: Rs. 1.5 lakhs

Objectives:
- To monitor snail population in mulberry area and estimation of nutrient status of soil and leaf.
- Identify suitable mechanical and chemical methods for the management of giant African snail in mulberry crop ecosystem.
- Determine the safe period of the effective chemicals for silkworms and in management of giant African snail.

Methodology:

Snail incidence was recorded in 5 mulberry gardens each in 3 hot spot areas of Ramanagara and Kanakapura at fortnightly intervals in 1 m x 1 m quadrant at 5 random places in each plot. In order to estimate the leaf yield loss, snail damaged leaves were collected from 10 each of infested & non-infested mulberry plants and recorded. To find out the most preferred attractant plant material for luring by the snails, papaya stem, cucumber, cabbage and mulberry shoots were evaluated in an isolation chamber of size 15' x 15' with established mulberry plants having 25 x 2 ft spacing along with control.

The Bio-formulations such as *Aeromonas formicans* and *A. hydrophila* (1 x 10⁷ cells/ml) diluted to distilled water, two botanicals namely Neem oil (3%) and *Jatropha* plants (3%) by making powder dissolved in 1 lit distilled water evaluated for their efficacy in killing the snails. The observation on the mortality was recorded at 4 days interval up to 20 days. With regard to chemicals, the molluscicide 2.5% metaldehyde bait of Deltacide (250 kg with 250g permethrin 2ggjery and 1000g wheat flour) and Methomyl (1g chemical with 250g jaggery and 250 ml water) were evaluated against snails.

Safety of most effective chemicals i.e., metaldehyde was determined against silkworm by direct contact (5-10 grubs on 100 silkworms in a plastic rearing tray of size 1.5' x 1') as well as by feeding the leaves harvested from mulberry plants applied with metaldehyde pellets to silkworm from 1st molt stage to 4th molt. The mortality of silkworms was recorded at daily intervals. Field trial with most effective chemicals i.e., metaldehyde was conducted at Kotteneyuru in Dr. D. Hole during a fortnightly (bait laid) by placing metaldehyde pellets @ 2kg/acre in-between gaps in the evening hours with moist soil condition. The % mortality of snails was recorded after 24 hrs of treatment.

Observations/Results:

Snail's mark survey conducted during Nov/Dec 2013 in the hot spot area of Ramanagara and Kanakapura area revealed an average snail incidence of 27.8%. However, during the project period, no snail incidence was reported from the selected mulberry gardens in the above area. A leaf area loss of 12.28% was recorded during September 2013 in a 0.2 Acre area.

Under mechanical methods, various trapping materials were evaluated which revealed that highly attractive materials for snail was papaya stem waste followed by mulberry shoots with best preference to cabbage. Hence papaya stem waste can be used for trapping the snails in the mulberry gardens in the absence of which mulberry shoots can be used.

The Bio-formulations such as *Aeromonas formicans* & *A. hydrophila* were evaluated for their efficacy in killing the snails. On spraying *A. formicans* with a dilution of 6x10⁷ cells/ml, till 16 days no mortality was recorded. However, 60%, 80% and 100% mortality was observed after 20, 24 & 28 days after treatment respectively. With regard to *A. hydrophila*, no mortality was observed. The bio botanicals namely neem oil and *Artemisia scoparia* leaf had no effect on snails.

With regard to chemicals, the Molluscide, 2.5% Metaldehyde, mixture of Deltacide and Methomyl (40 GR) were evaluated against snails. Among the above 3 chemicals, Metaldehyde was found to be more

effective (Table 5.4). Imidacloprid caused a mortality of 70% 2 days after treatment and 100% mortality 4 days after treatment.

Table 5.4: Laboratory Evaluation of insecticide against snails (% of 3 Mols)

Treatment	% Mortality (day wise)					
	Day 1	Day 2	Day 3	Day 4	Day 5	Day 7
Metaldehyde	6.67	70.00	86.66	100	100	100
Control	0	0	0	0	0	0
Imidacloprid	0	2.33	27.33	70.00	97.33	99.67
Control	0	0	0	0	0	0
Methomyl	0	1.11	6.67	43.33	83.33	78.88
Control	0	0	0	0	0	0

The field trial with application of Metaldehyde bait consumed at 2nd day of application (Table 5.5) and subsequent decrease trend and the suppression of snails recorded were 80.33 and 97.8% respectively (Tables 5.5 5.6).

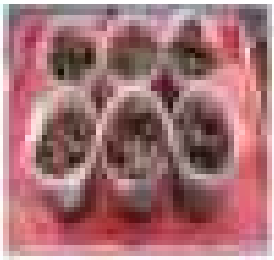
Table 5.5: Field trial with Metaldehyde for snail control at Chikkanna Village in Fig. 5. from Table

Sl. No	Name of the farmers & village	Mollusc's average (no.)	Bait consumed (50 grams pellets) (Before / a)	Live snails/50 plants after (a)	Suppression (%)
1	Ranganaiky	1.0	2.00	0.0	97.7
2	Mahadevaiah	1.0	2.00	1.0	95.0
3	Jayamma	1.0	2.00	0.0	96.0
	Average	3.0	6.00	1.0	96.67

Table 5.6: Field trial with Metaldehyde bait for snail control at Kuttapuram, Tamil Nadu

Sl. No	Name of the farmers & village	Mollusc's average (no)	Bait consumed/50 plants (Before / a)	Live snails/50 plants (post-treat / a)	Suppression (%)
1	Krishna	3	6.00	0.0	97.5
2.	Murugesh	3	6.00	0.67	93.5
3	Thangamman	3	6.00	1.0	92.5
4	Chandrasekaran	3	6.00	0.33	95.0
5	Kuberaj	3	6.00	0.0	97.5
	Total/Av.	15	30.00	1.00	97.33

Laboratory studies of bio-formulations and chemicals for the safety of silkworms were carried out. Effect of bioagents were tested for safe rearing. Effects of bioagent pills on formulations such as Azospirillum brasilense, A. chroococcum, Bacillus subtilis, Pseudomonas fluorescens were studied. Effect of Metaldehyde used in molluscicidal formulations was also studied. Effect of Metaldehyde used in molluscicidal formulations was investigated on feeding the mulberry leaves harvested from mulberry plants applied with Metaldehyde pellets as well as by direct contact of Metaldehyde with silkworms. Pellets were eaten and no effect in the mulberry gardens to kept 3 meters the snails. The big Metaldehyde pellets are required to be spread in one acre of mulberry garden. It attracted more during evening hours in early seasons for effective snail management. Metaldehyde pellets can also be placed in holding places of snails, compost pits, watering pots for suppression of snail population. Metaldehyde was found safe to silkworms.



5.3 MPT work: Detection of virus in cashew in Kwara and Kogi area of Nigeria, a post study

Key Scientists: [illegible]

Duration: February 2013 to March 2014

Budget: Rs 2.75 lakhs

Objectives: 1. To determine the status of viral pathogens in nursery

Methodology:

Survey was conducted in the two agro zone of Kwara and samples were collected. Nursery plots in ICRAF, Ilorin were surveyed and plants having viral type symptoms were collected. Cuttings collected from Kwara and ICRAF in poly bags carried and infected plants were grafted and planted in net house after cutting the branches. A total of 30 healthy V1 plants were raised in pots for grafting studies. Regrafting was done from healthy to infected plants and vice versa.

Observations/Results:

Of the grafted plants already planted, all the three plants in the first batch expressed symptoms like stunted growth, curls, flexibility of the stem, round and smaller leaves etc., similar to the original plants in V1 plant expressed symptoms. After nine months old these plants developed symptoms. For plants collected from ICRAF did not develop any symptom. The cuttings collected from symptom expressed plants showed 20-30% survivability. The established plants developed from these cuttings expressed symptoms like leaf/stem change, leaves, rolling, rugosity, curling and puckering. The buds taken from plants having different symptoms expressed symptoms after establishment. The buds grafted on healthy plants which were

taken from the plants collected from Sanskaons showing stunted growth, necks constricting, flaccidity etc., developed the cache symptoms after development. The fidelity tests developed in the plants were instrumental in showing the grafted bud only. Several plant grafted with buds collected from mosaic expressed plants also developed yellowing and leaf texture change. Results indicated that the causative agent of the disease is present in the plant and it is systemic. The isolation and identification of the causative agent has to be done to study the mode of the spread of disease and for its effective management (Fig. 4.1 & 4.2).

Fig. 4.1: Plants showing stunted growth and Pollen-shaped yellow spots

Fig. 4.2: Symptoms developed in the host grafted plants

4.4 BPP 0020: Maintenance of virulence pathogens and testing their virulence on genotypic tolerance.

PI: [redacted] and A. Chandrashekaran and A.K. Hazarika Kalyan

Duration: July 2010 to June 2013

Budget: 2.50 lakhs

Objectives:
- To maintain and maintain the various phytopathogens in pure culture forms.
- To assess the virulence and pathogenicity of the pathogens periodically.

Methodology

Isolation and purification of *Sm*MPV subviruses as per Gajpreet et al. (1999) and Shanmugham (2011) and virulence test by inoculation, isolation and purification of *Sm*MPV and *Sm*MMV as Nakagaki et al. (1991) and Saini (1992) and maintenance and virulence test by inoculation, isolation and culture of absolute fungal pathogens as per Mehrotra (1997) and virulence test by inoculation, isolation and culture of *Streptococcus faecalis* and *Staphylococcus aureus* as per Cruickshank (2000) and virulence test by inoculation, isolation and culture of adequate bacterial and fungal pathogens and fungicide screening as standard method using specialized chemicals agar, Nakagaki et al. (2000) and virulence test by inoculation, isolation and culture of *Aspergillus flavus* and *Aspergillus terreus* by serological method using cotton-agar-cotton, Dox agar (DeAndon and Donaldson, 1999) and virulence test by inoculation, isolation and purification of *Aspergillus parasiticus* and other mycotoxins by Salit and Hallenbeck (1992) method and virulence test by inoculation.

Observations

Four strains of the pathogens viz. *Sm*MPV, *Sm*MPV, *Sm*MPV, bacterial pathogens viz. *Streptococcus* sp., *Staphylococcus* sp. and *Bacillus mycoides*, Fungal pathogens viz. *Sclerotium rolfsii*, *Sclerotia phaseoli*, *Aspergillus terreus* and *Aspergillus flavus* and different mycotoxins viz. M1, M2, M1+M2, M1+G1, M1+G2, M2+G1, M2+G2, M1+G1+G2 were maintained. Tested the virulence of these pathogens to silkworms at particular intervals in different concentrations and they were found virulent to silkworms. Mortality/infection recorded in silkworms in all the tested pathogens. The mortality/infection increased as the concentration of pathogen increased. All the tested pathogens viz. *Sm*MPV, *Sm*MPV, *Sm*MPV, *Streptococcus* sp., *Staphylococcus* sp. and *Bacillus mycoides*, *Sclerotium rolfsii*, *Sclerotia phaseoli*, *Aspergillus terreus*, *Aspergillus flavus* and different mycotoxins viz. M1, M2, M1+M2, M1+G1, M1+G2, M2+G1, M2+G2, M1+G1+G2 were found virulent to silkworms and are being maintained in our farms.

5.2 IPT 10404: Identification of probiotic bacteria from the mulberry silkworm and study their antibacterial activity against the bacterial pathogens of silkworms, *Bombyx mori* L.

K. Chandrashekaran, P.K. Lakshmi Vidya, G.P.S. A. V. Mahi, Jossekha Mk, Shruti Aggarwal, D.S.S., M. Mahendra Kumar and A. K. Nataraja Murthy

Duration: October 2012 to March 2014

Budget: 1.00 lakhs

Objectives:

- Isolation of probiotic bacteria from mulberry silkworm
- Testing the antibacterial activity of the isolated probiotic bacteria against the bacterial pathogens of silkworms in vitro method.

Methodology

Isolated and probiotic bacteria from the midgut of mulberry silkworm and maintained the pure culture of the isolates for experimental purpose. Identified the isolated probiotic bacteria. Tested anti bacterial activity of the probiotic bacteria against the bacterial pathogens of mulberry silkworm viz., *Bacillus thuringiensis*, *Streptococcus* sp. and *Staphylococcus* sp. by *in vitro* method (Fleming *et al.*, 1985 and Schillinger and Lücke 1989). The antibacterial activity of the isolate was tested using different methods like well diffusion method and disc method. Finally standardized the agar well method as per Fleming *et al.*, 1985 and Schillinger and Lücke, 1989. 0.05ml was added positive if the width of the clear zone around the colonies of the isolates bacteria was 0.4 mm or larger. Tested the anti bacterial activity of four *Lactus* probiotic bacteria collected against the bacterial pathogens of mulberry silkworm viz., about *thuringiensis*, *Streptococcus* sp. and *Staphylococcus* sp. by *in vitro* method as above.

Observations

Isolated one non pathogenic bacterium from the midgut of silkworm (Figs. 5.2.1-5.2). The isolate was maintained in pure form and the culture revived regularly. The isolate is a Bacillus sp. The isolate has antagonistic activity against *Bacillus thuringiensis* of mulberry silkworm. Average zones of the zone was 0.96 cm (Fig. 5.2). The antibacterial activity of four *Lactus* probiotic bacteria, *Streptococcus thermophilus*, *Lactobacillus acidophilus*, *Lactobacillus plantarum* and *Lactobacillus casei*, were also tested against the bacterial pathogens of silkworm viz., *Bacillus thuringiensis*, *Streptococcus* sp. and *Staphylococcus* sp. of the above four probiotic possess antagonistic activity against *Bacillus thuringiensis*, average value of the zone is 0.91 cm and *Streptococcus* sp., average value of the zone is 1.1 cm of mulberry silkworm, *Bombyx mori* L. (Figs. 5.2.2, 5.2.3). Results indicated that the isolated probiotic bacterium has antagonistic activity against *Bacillus thuringiensis* of mulberry silkworm. *Bacillus subtilis* a known probiotic bacterium also has antagonistic activity against *B. thuringiensis* and *Streptococcus* sp. of mulberry silkworm. These two bacteria can be tested *in vivo* to study their role in controlling bacterial diseases of mulberry silkworm after studying their compatibility.

Fig. 5.2.1 The probiotic bacteria isolated from silkworm

Fig. 5.2.2 The probiotic bacteria tested from silkworm

Fig. 5.3. Antibacterial activity of the leaves against *B. thuringiensis*

Fig. 5.4. Clear zone formed around the *B. subtilis* colony against *B. thuringiensis*

Fig. 5.7 & Fig. 5.8. Clear zone formation around the *B. subtilis* colony denotes its antagonistic action against the *B. thuringiensis*

6. WORKSHOPS/ EXTENSION

6.1 NAIP (NAIP) - A Study on adoption of pest and disease management strategies in sericulture

B. Gangadhar (PI), M. R. Sachidhanandam, T. Nagaraj, T. Thirupathaiah and G. S. Reddy

Duration: October 2012 to March 2014

Budget: 1.77 lakhs

Objectives:

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

Methodology

The study was conducted in three districts viz., Ramanagaram district of Karnataka, Chittoor district of Andhra Pradesh and Erode district of Tamil Nadu. The data were collected through personal interview method with the help of pre-structured questionnaire to get the information on adoption of ICM of leaf spot, leaf roll, powdery mildew, root rot and control measures and IPM of mulberry pest like pink, hairy bug, jassids, hairy bug, leaf roller, thrips, white fatty caterpillar and cutworm and the silkworm diseases like grasserie, flacherie and muscardine and silkworm disease and pest of all its. The information was also collected on the socio-economic status

knowledge level of farmers on mulberry diseases, mulberry pests, silkworm diseases and pest, decision making with respect to their control and adoption of integrated pest management (IPM) packages.

Observations/Results

The adoption level of ITF under mulberry diseases including mechanical, chemical and biological control measures were fully adopted by 84.0% in Andhra Pradesh and 81.0% adoption in Karnataka. The extent of adoption was highest at 84.0% in case of Tamil Nadu. Adoption level of mulberry pest was at an extent of 82.0%, 87.0% and 91.0 % in case of Tamil Nadu, Andhra Pradesh and Karnataka, respectively (Table 6.1).

Table 6.1 : Adoption level of Integrated Technology Package of mulberry diseases and Pest (%)

Adoption level	Andhra Pradesh	Karnataka	Tamil Nadu
I. Mulberry diseases			
Non-adoption	16.0	19.0	16.0
Full adoption	84.0	81.0	84.0
II. Mulberry pest			
Non-adoption	18.0	09.0	18.0
Full adoption	82.0	91.0	82.0

Adoption level of silkworm disease including flacherie, grasserie and muscardine were recorded at an extent of 89.0% in Andhra Pradesh, 86.0% in Karnataka and 89.0% in Tamil Nadu. The extent of adoption of ITF for pest including exclusion method, physical method and biological method were 84.0% full adoption in Andhra Pradesh, while the same was 84.0% in Karnataka and 85.0% in Tamil Nadu (Table 6.2).

Table 6.2: Adoption level of Integrated Technology package of silkworm diseases and pest (%)

Adoption level	Andhra Pradesh	Karnataka	Tamil Nadu
I. Silkworm diseases			
Non-adoption	11.0	14.0	11.0
Full adoption	89.0	86.0	89.0
II. Silkworm pest			
Non-adoption	16.0	16.0	15.0
Full adoption	84.0	84.0	85.0

After adoption of technology packages, there was substantial increase in productivity of mulberry leading to increase in the intake of DFL, cocoon yield and income generation of all the three states (Table 6.3).

Table 6.3: Overall impact of adoption level of diseases and pest package on cocoon yield and net profit

Economic parameters	Andhra Pradesh		Karnataka		Tamil Nadu	
	Before adoption	After adoption	Before adoption	After adoption	Before adoption	After adoption
Total DFL raised (100 dfls) per year	800	1100	900	1100	800	1100
Avg. cocoon yield (kg / 100 dfl)	80.00	95.00	85.00	95.00	80.00	90.00
Avg. Rate/kg	200.00	220.00	200.00	220.00	200.00	220.00
Income per year (Rs.)	1,60,000	2,09,000	1,70,000	2,09,000	1,60,000	2,09,000

Reasons for low adoption of technologies

Majority of the sericulturists expressed non-availability of bio-control agents in time, which act as major constraints for adoption of IPM practices (26.0%). Majority of the farmers expressed that negative result farmers have not given good impact of technology immediately after adoption (12.0%). About 11 %

farmers expressed their lack of knowledge about the control agents. Some farmers expressed that it is difficult to use formulated agents every crop period and hence it is difficult to adopt. (1.7%). Majority of the farmers expressed awareness about the biocontrol agent pebrine but not cytoplasmic (11.0%). Some of the farmers stated that high cost of bio-control agents (20.0%) is also a constraints and requested for release of bio-control agents by the institutes / officers free of cost in the area.

The study points out the need for adequate level of knowledge and the adoption of the farmers on the occurrence of diseases and pest and their management practices revealed that the farmers are aware majority of the harmful pest of Mulberry and silkworm. Most of the farmers were aware of the bio-control agents as well as IPM of silkworm pest. The major constraints were found to be non-availability of the bio-control agents. Most of the farmers opined that they control the mulberry or DFS is prompt supply of the bio-control agents at lower or free of cost and to the place where there is existing crop. Though the farmers were well aware of the harmful pests of mulberry and silkworm, they were lacking in the technical know about the IPM. It is necessary to educate the farmers on IPM practices to mulberry and silkworm and its effectiveness in suppressing the pest population.

A. REGIONAL SERICULTURAL RESEARCH STATION, SALEM

7.1 (EM) S 3041: Studies on adoption of Silkworm disease control measures and its impact on cocoon production in farmers' field under Tamil Nadu conditions

E. A. Mary Flora (PI) and R. Balakrishnan (Co-Investigator) (CSRTI)

Duration: June 2013 to June 2015

Budget: 3.10 lakhs

Objectives:

- To find out the knowledge level of sericulturists about the recommended silkworm disease control measures
- To find out the extent of adoption of recommended silkworm disease control measures
- To identify and evaluate the factors associated affecting the adoption level of silkworm disease control measures

Methodology

The study was made by covering a sample of 75 farmers each from Harur & Uthiramallur blocks to know the adoption level of silkworm disease control measures. The package of practices of silkworm disease control measures published by CSRTI, Mysore was taken as the recommended packages of silkworm disease control measures. Based on relevance and inter-relationship, as many as 22 recommended silkworm disease control measures / technologies were further grouped into following five technology packages to study the overall awareness and adoption level: Silkworm disease prevention technology, Disease Control measures in silkworm rearing, Disinfection and Hygiene maintenance during silkworm rearing, Mulberry management practices under low temperature and high humidity conditions and Mulberry management practices under high temperature and low humidity conditions. The data was collected through interview method with a pre-structured questionnaire. The simple Percentage analysis was used for the study based on the objectives.

Observations/Results

The results obtained on knowledge level and adoption level for different technology packages are furnished in Table 7.1 (a-e).

Table 7.1. Knowledge level of aflatoxin disease control measures among farmers of Eastern and Nyanza districts

Technology	Knowledge (%)					
	Eastern			Nyanza		
	Full	Partial	No	Full	Partial	No
I	61.00	14.20	4.67	36.00	14.00	6.00
II	76.40	23.60	0	66.00	34.00	0
III	55.20	44.80	0	56.00	44.00	0
IV	73.10	26.90	0	64.00	32.00	3.00
V	64.10	35.90	0	51.00	38.00	9.71

Table 7.2. Adoption level of aflatoxin disease control measures among farmers of Eastern and Nyanza districts

Technology	Adoption Level (%)					
	Eastern			Nyanza		
	Full	Partial	No	Full	Partial	No
I	72.34	21.28	1.33	67.00	32.67	0
II	85.33	14.67	0	94.67	10.33	0
III	74.00	26.00	0.42	93.00	60.00	7.0
IV	51.20	48.80	7.00	90.00	90.00	67.1
V	64.10	35.7	7.00	94.67	57.00	9.71

The study indicates that low coverage and adoption of aflatoxin and hygiene in aflatoxin control is poor in both the districts. One of best alternatives as per recommendations and handling of diseased groundnut etc., are the post- adoption technology components. Further, the season specific disease management practices are also found accepted by the farmers. The adoption level is more with big farmers followed by medium and small - farmers. The major reasons for partial non adoption of some technologies as expressed by farmers were lack of complete knowledge about aflatoxin disease control measures, high cost of technology materials, health hazards encountered on use of pesticides, traditional practices and unawareness of negative effects by partially adoption of certain technologies. The farmers who adopted the aflatoxin disease control measures in a classroom level experienced continuous crop success and stability and they are making doubled throughout the year and some of them were already switched over to shelling less than 100 kg/day. Hence, it is important to identify the poor adopters and most suitable training to make them aware about aflatoxin disease control measures besides conducting frequent field demonstrations.

In order to increase the adoption level of aflatoxin disease control measures, the progressive farmers have to be identified and by keeping them as models, other farmers should be motivated to adopt the technologies. To create awareness on the technology components, the farmers must be educated about the benefits/ advantages of the technologies through television/radio/newspapers, combination of technologies, training etc.

7.3. IMPI (to initiate studies on mycotoxigenic fungi/aflatoxin at strategic varieties as influenced by different cultivation practices under relative conditions)

B. Shaba'a Nawal (PI), S. Kaaniman and R. Nukenine (upto June 2013)

Duration: July 2011 to June 2014

Budget: 0.05 Lakhs

Objective:
- To estimate the mycotoxigenic microbial population including aflatoxin producing fungi and mycotoxin (aflatoxin) flora and comparative substrates in the rhizosphere of groundnut grown under different set of cultivation practices under drought and relative conditions.

Methodology

Selection of farmers who are practicing different irrigation practices under light relative conditions were made through survey method in Kisumu and Kisii region districts. Further selection of the farmers were made under each category. To study the soil status (pH, EC, OC%, available P and K). Disease index

rhizosphere soil samples were also collected for analysis for two years. Serial dilution plate count technique was employed using specified media for different organisms. Survey conducted in 40 farmers gardens providing different types of cultural practices and identified 20 farmers for project implementation. Collected soil samples from the identified farmers and analysed for physical and chemical properties before imposing treatment. Average soil pH ranged from 6.2 to 6.7 and EC 0.10 mmhos/cm. Treatments were imposed to identified farmers gardens for the three seasons.

Observations/Results

The studies data revealed higher bacterial, fungal and actinomycete population in the rhizosphere of the treatment grass manure with one irrigation in all the three seasons studied in comparison to other treatments. Among the identified microflora Azospirillum population was predominant in all the treatments compared to Azotobacter and PSB. Maximum population of Azospirillum (72x10^6, Azotobacter (12x10^6, Phosphobacteria (11x10^6 were observed in the rhizosphere of grass manure with one irrigation treatment. Among the fungal population dominant types were different forms of saprophytic fungi like Helicosum, Aspergillus, Rhizoctonia, Fusarium and Gliocladium were observed. However Penicillium and Aspergillus were predominant and highly prevalent in all the seasons. Increased microbial population in rhizosphere of the grass increases the soil fertility. The most potential nitrogen fixing bacteria, Azospirillum strain was found to be repeatedly occurring in the rhizosphere which could be effectively utilized for developing biofertilizing consortia for alkaline soils under Tamil Nadu condition. Trends revealing in mulberry gardens of south India since time in a year can be considered in the first through GPTs so that they could be made for suitable changes in the interactions of plants in lieu of decomposing various organic materials and improving the organic carbon content and nutrient uptake.

11. MPR 16 0306: Effect of wood derived biomasses and biomass yield of mulberry on soil organic carbon status in mulberry fields

   a. Mahadevan (PI), S. Jayaprakash etc., for Chandra Babu

   Duration: July 2016 to June 2021

   Budget: 3.07 lakhs

   Objectives: a. To estimate the organic carbon loss in the soil of mulberry field

   b. To develop suitable recommendation to improve soil organic carbon in the mulberry fields for sustainable crop production

Methodology

To estimate the soil organic carbon loss in mulberry field following treatments were used. Collection of Bench mark data on soil properties (pH, EC, P & K) prior imposing the treatment. Collection of data on crop yield, shoot and dominant yield and observation of soil properties (pH, EC, P & K) were made after a period of two years for comparison.

Treatment Details:
T0 - Control (Recommended dose of FYM/Pongamy & Chemical fertilizer N:P:K: 280:140:140 kg/ha/yr)
T1 - Wood harvest - 20% of FYM/Pongamy & Chemical fertilizer N:P:K: 280:140:140 kg/ha/yr

Similarly, management of soil organic carbon in mulberry field was studied with following treatments to three replications in randomized block design. Bench mark data on soil properties (pH, EC, P & K) were collected prior to imposition of the treatments. After a period of two years data were collected on soil properties (pH, OC, EC, P & K), and compared with wood and fibre as yield.

Treatment Details:

T0 - Control (Existing practices (2 MT/ha/yr & Chemical fertilizer N:P:K: 280:140:140 kg/ha/yr)
T1 - POM + Pericarpial compost + Vermicompost + 20 + 5 + 5 MT/ha/yr; Mulberry: 20 kg/yr/ha; Silk worm: Pongamy cake (1 kg/yr) in 2 splits; Green manure - Dhaincha / Sesbania aculeata 5 crops/yr in the rotation @ 50% of Recommended Chemical Fertilizer (NPK)

T2 : FYM + Biofertilizer consortia + Vermicompost + ZnSO4 + Borax @ 5 kg/ha + Soil application of Trichoderma viride @ 2.5 kg/ha + Foliar application of Pseudomonas fluorescens @ 10 kg/ha in 2 splits (seed treatment + soil application) + Foliar application of Neem based botanical (Nimbicidine 0.03%) @ 2.5 l/ha at 30 DAS and 45 DAS

T3 : FYM + Biofertilizer consortia + Vermicompost + ZnSO4 + Borax @ 5 kg/ha + Soil application of Trichoderma viride @ 2.5 kg/ha + Foliar application of Pseudomonas fluorescens @ 10 kg/ha in 2 splits (seed treatment + soil application) + Foliar application of Neem based botanical (Nimbicidine 0.03%) @ 2.5 l/ha at 30 DAS and 45 DAS + Chemical pesticides (4 sprays)

Observations/Results

The biomass production in leaf harvest method was found to be 20% more compared to shoot harvest method. Decrease in pH, EC, available N and increase in organic carbon (OC) content was observed in mulberry field where leaf harvest technique was practiced (Tables 7.2, 7.4).

Table 7.3. Biomass production in mulberry field plots by different harvest techniques

Sl. No.	Treatment	Leaf yield (kg/ha/yr)	Shoot yield (kg/ha/yr)	Total Biomass (kg/ha/yr)
1	Leaf harvest (T1)	18400	11600	30000
2	Shoot harvest (T2)	18400	17316	35716
		Student's T value (Observed)		25.19
		Tabular value at 5.0% level of probability		4.3

Table 7.4. Soil Parameters in two different treatments

Sl.No	Soil Parameters	Leaf harvest Plots (T1)		Shoot harvest Plots (T2)	
		Before start	After 2 years	Before start	After 2 years
1	pH	8.05	8.0	8.01	8.14
2	OC	0.43	0.55	0.71	0.66
3	EC	0.286	0.207	0.268	0.227
4	P	18.1	19.9	8.0	11.4
5	K	365	1.03	300	1.00

The biomass yield found to be less in treatment – T1 (T1) when compared to rest of the treatments and the difference was found to be significant at 5%. Decrease in pH from alkaline level and increase in organic carbon content (OC) was observed in high organic input treated mulberry plots (Table T7.3 & T7.4). This shows that leaf practice increases biomass production to a tune of 23% more in mulberry fields when compared to leaf harvest which is the main cause for increase in pH and decrease in organic carbon contents. In order to sustain soil health, it is very much essential to increase the organic input to mulberry fields. In this study, input incidence treatment 2 (T2) is to be recommended to the farmers to maintain soil health and production in sustainable manner.

Table 7.5. Biomass yield in different treatments

Sl. No	Treatment	Leaf yield (kg/ha/yr)	Shoot yield (kg/ha/yr)	Total Biomass (kg/ha/yr)
1	T1	18400	11600	30000
2	T2	18400	17316	35716
3	T3	19760	19641	39401
4	T4	19760	20849	40609
		Paired Observed		4.67
		Tabular value at 5.0% level of probability		4.30

Table 7.3: Soil parameters in different treatments

S. No.	Soil Parameter	Result Mark	After 3 years	Remarks
Control (T1)				
1	pH	8.20	8.20	Increase in pH observed
2	OC	0.74	0.72	No improvement in OC
3	EC	0.227	0.27	
4	P	12	8.4	
5	K	108	120	
Treatment (T1)				
1	pH	8.20	8.01	pH remain unchanged
2	OC	0.80	0.73	Increase in OC observed
3	EC	0.227	0.251	
4	P	13.1	4.8	
5	K	104	108	
Treatment (T2)				
1	pH	8.20	7.82	Decrease in pH observed
2	OC	0.83	0.72	Increase in OC observed
3	EC	0.202	0.231	
4	P	12.7	5.1	
5	K	112	128	
Treatment (T3)				
1	pH	8.4	7.82	Decrease in pH observed
2	OC	0.82	0.84	Increase in OC observed
3	EC	0.227	0.423	
4	P	10.1	10.4	
5	K	108.8	132	

7.4 ICAR S. SRM: Studies on the adoption of mulberry and silkworm pest management technologies (TMT) by the sericulturists in Tamil Nadu

S. Balasubramanian (PI) and R. Gopichandra (with effect from 2014)

Duration: July 2010 to June 2013

Budget: 6.11 lakhs

Objectives:

- To find out the level of knowledge and adoption of mulberry and silkworm pest management (IPM) practices by the sericulturists of Tamil Nadu.
- To identify the factors influencing the adoption of IPM by the sericulturists in Tamil Nadu.

Methodology:

Collection of data on IPM of mulberry and silkworm pests from TC sericulturists in Salem and Krishnagiri districts by the interview method with the help of structured questionnaire to get the information on adoption of IPM in terms mainly egg, age/larval, egg, cocoon harvest and moths. The IPM practices for major pests of mulberry and silkworm (as mentioned in Table 7.1).

Table 7.1 IPM practices for major pests of mulberry and silkworm and

Sl. No.	Particulars of practices
I	Pest complex (Mealybug, Whitefly, Thrips, Mites)
a	Cultural/preventive practices
	Clipping and destruction of affected portions
B	Chemical control method
	Spraying 0.1% DDVP two times at 10 days interval
C	eco-control method
	Release of predatory beetle (Cybocephalus nipponicus) @ 100 adults/acre
II	Leaf webber (Diaphania pulverulentalis)
a	Cultural/mechanical practices
	Manual collection and destruction of larvae
	Collection and burning of dry leaves and weeds harbouring pupae
	Setting up of light traps @ 2 traps per acre to kill adults
B	Chemical control method
	Spraying 0.1% DDVP on the mulberry before pruning
C	eco-control method
	Release of predatory beetle (Cybocephalus nipponicus) @ 200 adults/acre
III	Pyralid weevil (Pachnoda marginella)
a	Cultural/mechanical practices
	Clearing and destruction of affected portion
	Deep ploughing
	Pruning during pit of plant to manage and weed out the pest
B	Chemical control method
	Soil application viz. 0.05% carbofuran followed by 0.1% DDVP 8-10% soap solution
C	Bio-control
	Bio control method
	Release of parasitoids (Acerophagus papayae) @100 per acre
III	Scales (Pseudaulacaspis pentagona)
a	Cultural/mechanical practices
	Spraying strong jet of water on the twigs and washout the pest
B	Chemical control method
	Two sprays viz. 0.05% carbofuran followed by 0.1% DDVP 8-10% soap solution in 10 days interval
C	Bio-control method
	Release of chrysopids @ 100/acre
V	Leafy (Pseudaulacaspis pentagona)
a	Cultural/mechanical practices
	Provision of rainshade for silkworm and more of the rearing house
	Collection and burning of silkworm from the rearing house
	Setting up of rat traps
B	Chemical control method
	Application of nuvan during 3rd and 5th age in silkworm rearing
C	eco-control method
	Release of pupal parasitoids Xanthopimpla flavolineata (10,000 no.) for rearing 100 dfls from 5th age of silkworm rearing

Observations/Results

Adoption levels of IPM practices of mulberry pests were full adoption 10.3% (3 to 17.7%), partial adoption 66.7% (53.3 to 81.7%) and non-adoption 23.0% (13.3 to 29.7%). IPM practices of Leaf fly revealed full adoption 20.7%, partial adoption 76.3% and non-adoption 3.7% in Kunigal district. Adoption levels of IPM practices of mulberry pests in Salem district were full adoption 7.7% (0 to 17.7%), partial adoption 66.7% (53.3 to 77.7%) and non-adoption 25.3% (13.3 to 46.6%). The adoption levels of IPM practices of Leaf fly in Salem district were full adoption 17.7%, partial adoption 82.3% and non-adoption 0.0%. Among the mulberry pests the maximum adoption of physical/mechanical control was recorded with leaf webber (22.7%)

and in case of chemical control the adoption level was medium with index (34.2%) which as against mostly recorded the maximum adoption of 67.1% with respect to biological control methods and followed by bridge (2.9%). Majority of the respondents (80.7%) were partial adopters. Only 19.3% of the respondents were non-adopters with regard to adoption IPM practices for mulberry pests. Non availability of IPM inputs (27.5%), non adoption by neighborhood farmers (24.5%), IPM practices difficult to adopt (21.6%), doubt about the IPM practices suited conditions (13.8%), no belief in IPM practices (7.1%), no incidence of pests (4.9%) and non adoption of IPM practices (7.1%) were the constraints expressed by the farmers in adoption of IPM practices for the mulberry pest silkworm pests. The data on the awareness about the pesticide applications revealed that 80% of the respondents have awareness on ecological effects, 81.4% on health hazards, 90.2% on pesticide residue in mulberry plants and only 7.1% on the reduction of natural enemy complex in the mulberry ecosystem.

There is an urgent need to intensify the efforts to organize extension educational programmes, like trainings, demonstrations, field days etc., by the extension agencies to motivate the farmers to accept and adopt the IPM practices in the study area. Dissemination of information on the impact of IPM of mulberry and silkworm pests in the regional languages needs to be initiated through extension programmes. Special emphasis should be given to promote eco-friendly bio control methods against mulberry and silkworm pests. Availability of technical inputs should be made easy at the door steps of farmers. Demonstrations should also be emphasized on the benefits of using insecticides as well as the merits of using eco-friendly methods for the management of mulberry and silkworm pests through FLD programmes. Identification of entrepreneurs and training in the government as well as private laboratories for mass multiplication and supply of biocontrol agents to interested government schemes is proposed to be taken up.

5.a Ph.D. thesis: A study on the adoption of recommended package of practices followed by sericulturists of different farm sizes in Tamil Nadu

Name of the student: R. Rajeswari (PG and Ph.D. Research Scholar)

Duration: July 08 to June 2011

Budget: Rs. Nil

Objectives:

- To find out the level of adoption of recommended package of practices of Sericulture followed by different farm size groups in traditional and non-traditional regions
- To find out the factors influencing the adoption levels of recommended Sericulture packages
- To find out the constraints for the non-adoption or partial adoption of recommended sericulture packages
- To suggest the strategies / measures for improving the level of adoption of recommended sericulture packages of practices
- 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 in different farm size groups in traditional and non-traditional regions

Methodology:

A total sample of 120 farmers was selected from different villages of Krishnagiri and Theni districts following sampling. Thus from the district of samples were drawn at random and were divided into four farm size groups such as Marginal (1 acre), Small (1.01-2.50 acre), Medium (2.51-5.00 acre) and Large (above 5.01 acre) and covered under the study. A well structured interview schedule was used for collection of details of socio-economic characteristics, knowledge, adoption and constraints encountered by the farmers in the adoption of packages of practices developed by the Research institute and evaluation of their practices. The following statistical tools percentage analysis, Simple correlation coefficient and benefit cost ratio were used for the study based on the nature of data and objectives of the study.

Observations/Results

Adoption level of recommended package of practices and aquaculture technologies in Khordha and Kalahandi district are depicted in Tables 1.6, 1.7a. The adoption of the recommended practices was found high in Khordha as majority of them to the extent of 61.3 % to 91.1 % across the farm size holdings possessed full knowledge and a maximum of 87.5% to 91.25 % across the holdings adopted the recommendation fully. In Kalahandi majority of the farmers had partial knowledge and majority of them had partially adopted the technology. The adoption gradient of aquaculture technologies (both maximum and minimum) of the farmers in Khordha was found to be higher to an extent of 55% and 44% (pooled) respectively as against 40% and 34% (pooled) in Kalahandi respectively.

The adoption level of mulberry cultivation technologies like mulberry variety (100 & 98%), spacing (100 & 93 %), application (98 & 78%) & soil were found to be at 78% & more (pooled) and Kalahandi (pooled) farmers respectively. The farmers of Khordha were inclined to utilization of the water for irrigation of mulberry gardens and also sensitive to the additional requirement of mulberry gardens. The adoption level of drip irrigation (87.5%) & soil moisture application were found to be high (73.0%) in Khordha. In Kalahandi though the most of the farmers aware the knowledge on drip irrigation & the growth promoting majority of them were found to be non adopters of the technologies to the extent of 70% and 87 % respectively. The grass manure costs as all inter crop as mandatory for the improvement of soil health and hence the gainful momentum in the study area.

The economic constraints by the farmers (Table 1.10) under FCS-I was high cost of cultivation (100%) followed by 50.0 percent of farmers facing the problem of non availability of labours. Whereas 66.6, 91.7 and 79.6 percent of respondents had problems like high cost of inputs, occurrence of pests and diseases and non availability of saling, respectively. In case of FCS-II across farmers (100%) were facing the problems of non availability of labor followed by 50.0, 50.0 and 50.0 percent of respondents were facing the problems like lack of improved mulberry and silkworm breeds, high cost of cultivation and non availability of good quality seeds respectively. The other constraints expressed by the respondents were lack of inadequate equipments, low cocoon price (75.0%), non availability of labourers (71.5%), lack of temperature controlled sheds (75.0%) and occurrence of pests and diseases (66.6%). Constraints experienced by the farmers with respect to FCS-III and IV were lack of water resources to supplementary irrigation (100%), high cost of cultivation (100%) and non availability of labourers (50.0%) were the major problems expressed by the respondents followed by high cost of inputs (66.6%), non availability of HYV mulberries in time (75.0%), non availability of hands (70.0%), lack of disease resistant mulberry varieties (50.0%) and lack of adequate technical silkworm rearing (50.0%). It is essential to consolidate the sericulture based integrated farming system concept to help the farmers to utilize the resources effectively and maximize the productivity and net farm income on a sustainable basis.

Table 1.6. Adoption level of recommended package of practices in Khordha and Kalahandi districts

Farm	Khordha (%)			Kalahandi (%)		
size	Full	Partial	No	Full	Partial	No
I	61.30	38.60	0.00	28.71	28.85	78.58
II	80.30	20.67	15.03	66.60	33.01	10.74
III	91.25	44.50	2.50	53.20	42.45	4.45
IV	88.10	73.80	14.55	46.00	38.00	12.14

Table 7.13. Adoption level of selected technologies in Kinnow cultivation in Abohar

Technology	Surveyed (%)			Postsurveyed (%)		
	Full	Partial	No	Full	Partial	No
Nursery Cultivation						
Use of quality rootstock	100	0	0	90	10	0
Budding	100	0	0	90	10	0
Time of budding	100	0	0	90	10	0
Use of pesticides	81.0	19	0	90	10	0
Use of fungicides	77.0	19	4.00	90	10	0
Use of fertilizers	59.0	33	8.0	90	10	0
Use of irrigation	0	4.00	96.0	0	0	100
Use of chemical fertilizers	50	50	0	90.0	10	0.0
Use of FYM	10	10	80	10	10	80
Use of green manure	10	10	80	10	10	80
Orchard Planting						
Use of quality planting material	100	0	0	90	10	0
Time of planting	100	0	0	90	10	0
Recommended spacing	100	0	0	90	10	0
Use of pits	100	0	0	90	10	0
Use of FYM	100	0	0	90	10	0
Use of fertilizers	90	10	0	90	10	0
Use of micronutrients	10	10	80	10	10	80
Use of pesticides	10	10	80	10	10	80
Use of fungicides	10	10	80	10	10	80
Use of irrigation	10	10	80	10	10	80

Table 7.14. Reasons for partial and non adoption of selected technologies

Form Code No.	Nursery Cultivation & Orchard Planting	Reasons (n) (%)	
		Score	Percentage
No. 1			
1	High cost of cultivation	100	100
2	Non availability of labour	70.0	80
3	High cost of inputs	80.0	90
4	Occurrence of pest / disease	90.0	90
5	Non availability of loan	70.0	80
No. 2			
1	Non availability of loan	90.0	100
2	Lack of improved Nursery & Orchard tool	80.0	90
3	High cost of Cultivation	80.0	90
4	Non availability of good quality seed	60.0	70
5	Inadequate equipment	70.0	80
6	Low Market Price	70.0	80
7	Non availability of labour	70.0	80
8	Lack of technical knowledge	50.0	60
9	Occurrence of Pests & Disease	50.0	60
No. 3,5,6			
1	Lack of water by irrigation	100.0	100
2	High Cost of Cultivation	90.0	90
3	Non availability of Labour	80.0	80
4	High cost of Input	80.0	80
5	Non availability PPI material in time	70.0	80
6	Non availability of loans	60.0	70
7	Lack of Orchard, standard nursery	60.0	70
8	Lack Market Information Network	60.0	60

VI. ONGOING RESEARCH PROJECT & PROGRAMME

A. ROOT PLANT IMPROVEMENT

A1 ITID 9310: Development of superior resistance varieties by stacking of favorable disease resistance genes based on molecular marker diversity of germplasm pool (Light soils) to root rot disease (SR-R)

A1.1 Primary yield trial of selected genotypes under irrigated conditions

M. R. Phillips Raja Rao (PI), Priyadarshini, R. and K. Ramesh Naik

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

Sixteen promising lines developed from a hybrid population of cross 4000 - based white sorghum among 15 parental combinations of white and promising resistant genotypes and subsequent two line population comprising five trial and testing evaluations, were planted in a primary yield evaluation experiment (RR 1) at this station (Kharif).

Data on growth and leaf pest during 4 intervals of 1 year were recorded. The initial results at the end of the 4th cycle of one indicated the superiority of 5 varieties over the check V1 (Table 6.1).

Table 6.1: Performance of four promising hybrids during the first four harvests of third year

Lines	Parental combination	Leaf blight Aggregate			
		Group A	Group B	Group C	Group D
SH 2 x MR-11	5.271	0.499	0.500	0.410	0.750
SH 2 x SRS-12	5.251	0.523	0.514	0.524	0.510
SSG 2 x SRS-12	5.241	0.720	0.772	0.552	0.700
SH 4 x PPR-12	5.231	0.638	0.671	0.797	0.750
V1 - Check	-	0.977	0.840	0.900	0.480
CD (5% level)					
CV (%)	-	NS	0.162	0.164	0.7 [illegible]

A1 PR 3307: Development of disease resistant and productive backcross genotypes with special reference to root rot and root knot disease suitable to the rainfarmed of south India (Sowing 3rd to December 1977)

A1.1 Selection of parents showing resistance response to root rot / root knot disease and hybridization

S. Gandhi Babu (PI), M. R. Phillip Raja Rao, S. S. Dhanve (upto 31.03.2012) and M. Chowdary (upto 31.08.13)

Objective: - To identify and select promising / biotypes to root rot and root knot diseases through hybridization, selection and field evaluation in progeny row trial (PRT).

Hybridization was effected among eight female and five male genotypes screened earlier based on their disease response to root rot and root knot pathogens in artificial inoculation studies. Wide disease reaction against root rot pathogens ranged from 16.1 % – 76.1% Loss of tillers among the tested genotypes, resistance reaction was recorded in 'Indamanu' M. incognita, Cuddalore, Maldandigarai, Mysore local, Lilhot and Himachal local. Root knot nematode infestation ranged from 10.42 to 89 Gouls/ 250 g of root among the tested genotypes with none showing resistant reaction. 12 accessions showed moderate resistance reaction to root knot nematode. A total of 11 crosses were made and a cumulative population of 1000 seedlings was raised (Table 6.2).

Table 6.2. Details of cocoon and seed germination

Sl. No.	Crosses	Seed viability (%)	Seed germination (%)
1	Mirrochal local x CSR2	99.29	98.48
2	Mirrochal local x Cuprum local	99.50	98.97
3	Mirrochal local x Chinky white	94.23	93.45
4	Mirrochal local x FC1	95.12	97.20
5	Mirrochal local x Mirrochal	99.60	97.44
6	Mirrochal x Mirrochal local	99.48	96.14
7	M. multicaulis x FC1	91.10	90.07
8	M. multicaulis x Mysore local	97.40	92.78
9	M. multicaulis x Cuprum local	99.66	98.54
10	M. multicaulis x Bivi CSR2	97.70	97.15
11	M. multicaulis x Mysore local	99.87	99.27
12	Punjab local x FC1	94.20	91.14
13	Punjab local x Mysore local	98.60	96.29
14	Bellandavalga x FC1	99.87	98.18

6.3 RBP 3007: Maintenance of mulberry germplasm, mother culture and demonstration plot (continuous)

M. P. (Pilibhit Rate dm (Pb) Rajasthan, P, and S. Concert Dass

Objective: • To maintain valuable mulberry germplasm accessions for utilization in mulberry improvement programmes, multiplication of breeders seed plots of improved mulberry supply of seed material to sister stream multiplication centres and maintenance of demonstration plots for the benefit of stakeholders visiting the institute.

Maintained 72 mulberry germplasm accessions for utilization in breeding programmes. Raised breeders seed and other improved mulberry varieties and trained farmers in the demonstration plot.

6. HOST PLANT PRODUCTION

6.1 MPR 3007: Effect of conjunctive use of vermiculture compost for the efficient utilization of nitrogenous fertilizers for the sustainable mulberry production (October 2012 to September 2015)

Mirochal local Rate (Pb) Decrease, PLO, Kalbal and S Dan

Objectives: • To enhance the utilization of nitrogenous fertilizers by conjunctive use of vermiculture fertilizers for optimum yield in mulberry

• Reduction of the chemical fertilizer input application and Leaching

Table 5.1: Effect of nitrification inhibitor on mulberry growth and anti-oxidant enzyme activity of first crop

Treatments	Leaf yield kg/ha	Plant height (cm)	Length of longest shoot (cm)	No. of shoot/ plant	Leaf moisture content (%)
T1	8542	142	132	142	72.4
T2	9623	149	138	149	73.6
T3	11668	162	147	162	75.8
T4	9987	154	141	153	73.9
T5	9054	145	131	147	73.1
LSD P=0.05	147.27	14.05	8.11	9.0	0.9

T1: 200 N, 140 P, 140 K kg/ha (Recommended dose as control)
T2: 200 N coated with Neem oil (0.04% v/v) 140 P, 140 K kg/ha
T3: 200 N coated with DCD** (0.80% w/w) 140 P, 140 K kg/ha
No plant manure with nitrification inhibitor was applied in T2 and T3
*N, DAP treated with 200 N:200 P2O5:140 K2O Kg/ha
P.M.: as per package as per recommendation
** DCD = Dicyandiamide

The data presented in the Table 5.1 indicate that application of urea along with nitrification inhibitor significantly improved the leaf yield and plant height over recommended dose of fertilizer. The results indicated the possibility that nitrification inhibitor could increase nitrogen use efficiency.

Table 5.2: Effect of nitrification inhibitor on nitrogen, phosphorus and potassium content in mulberry shoot

Treatments	Nitrogen Content (%)	Phosphorus Content (%)	Potassium Content (%)
T1	3.10	0.12	1.08
T2	3.38	0.47	1.14
T3	3.81	0.14	1.13
T4	3.34	0.13	1.17
T5	3.44	0.11	1.11
LSD (P=0.05)	0.209	0.031	0.043

The data presented in Table 5.2 showed that the uptake of nitrogen by the plant is significantly higher in all the treated plot over the control. This indicated that the application of nitrification inhibitor along with urea could play a role in retention of nitrogen in treated soil for a longer period.

Table 5.3: Effect of nitrification inhibitors on soil, OC, P and K available in soil

Treatments	pH	EC (mmho/cm)	OC (%)	Available P (kg)	Available K (kg)	Bacterial population cfu/ml*
T1	7.6	0.45	0.14	85.00	375.64	1.48
T2	7.7	0.44	0.20	116.48	409.79	1.48
T3	7.6	0.39	0.22	126.08	393.84	1.08
T4	7.7	0.34	0.24	124.00	377.42	1.22
T5	7.6	0.40	0.20	126.80	371.76	1.44
LSD (P=0.05)	NS	NS	0.01	11.80	17.07	0.19

The data presented in Table 5.3 indicated that that application of nitrification inhibitor enriched soil urea significantly improved the organic carbon content in soil as compared with control. However, the bacterial population decreased from 1.48 in the control to 1.22 x 10^{-7} cfu/g of soil. This indicated that nitrification inhibitors also lower the growth of nitrifying bacteria like nitrosomonas and nitrobacters in soil, which is responsible for transformation of urea to nitrate form of nitrogen, NO_3^-.

that is available to the plant. This leads to increase in nitrogen use efficiency in the soil as well as uptake by the plant.

8.3 SRR 5008 : Monitoring of soil fertility status of mulberry gardens in Karnataka, Tamil Nadu and Andhra Pradesh (Continuous)

K. Vijayaraja kumar, Roy, Dhanpal, Ravi, M.N. Sudhakara and J. Ravi Kumar

Objectives: i. to monitor the soil fertility status of mulberry gardens of Karnataka, Tamil Nadu and Andhra Pradesh ii) estimating a balance nutrient status of the soil and recommend rationale use of fertilizers & manures as per soil analytical results.

Fertility studies conducted for soils samples of soils from mulberry gardens of south India adopted under rainfed conditions. Soil analysis results for Tumkur district revealed that soil reaction (pH) varied from 7.8 to 8.4 (alkaline), normal in 66.6% soils; electrical conductivity (EC) in 97.8 % of soils was less than 1.0 micromhos/cm, organic carbon (OC) content of soils was less than normal (0.5%) in 1.26 % to 0.6 % of soils, available phosphorus content was high (> 25 kg/ha) in 40.0 % of soils and available potassium was high (>240 kg/ha) in 73.3 % soils. The corresponding values for Kolar district were 99.1, 100.0, 68.4, 99.4 and 100.0 % and those for Chikkaballapur were 94.6, 97, 93.8, 98.2 and 42.8 %.

Similar trends were observed from corresponding soil analytical results of Coimbatore (pH, 100.0, 47.0, 20.1 and 100.0%) and Thrupur (97.2, 91.3, 97.8, 0.0 and 100 %) districts of Tamil Nadu. Andhra (48.2% soil pH, normal, EC, normal, OC, less than normal, 41.7 kg/ha available phosphorus and high available potassium were recorded from Kolar), 100.0, 99.1, 74.6 and 100.0 % soils of Chittoor district of Andhra while Tumkur district of Andhra Pradesh showed soil pH ranging from 8.6 (2.1% soils), normal EC (in 100.0 % soils) and less than normal OC (in 65.0 % soils) (Table 8.3.1). Appropriate fertilizer/manure recommendations with suitable management practices for maintaining soil health of mulberry gardens and reclamation measures for problematic soils have provided to the stakeholders as support services to the sericulture industry and to its beneficiaries/ promoters.

Table 8.3.1 Soil fertility ranges of mulberry gardens in various states of south India

Region	No. of samples	Hydrochloric acid soluble			
		Electrical conductivity (micromhos/cm)	Organic carbon (%)	Available Phosphorus (kg/ha)	Available Potassium (kg/ha)
Tumkur (KAR)	0.69 – 8.39	0.03 – 0.82	0.27 – 1.08	6.4 – 69.8	79 – 1968
Kolar (KAR)	2.13 – 8.73	0.02 – 2.11	0.06 – 1.19	0.8 – 226.8	46 – 2274
Hassan (KAR)	4.66 – 8.17	0.07 – 0.49	0.44 – 0.46	16.4 – 181.6	178 – 1444
Mysore (KAR)	7.06 – 8.24	0.19 – 2.72	0.06 – 0.80	8.8 – 36.2	208 – 762
Bangalore Rural (KAR)	6.07 – 7.72	0.04 – 0.59	0.11 – 1.20	7.6 – 122.6	124 – 961
Ramanagaram (KAR)	6.19 – 8.40	0.02 – 1.43	0.06 – 1.20	3.0 – 91.2	80 – 1668
Thrupur (TN)	7.44 – 8.09	0.11 – 1.00	0.06 – 0.80	8.8 – 20.7	94 – 1162
Coimbatore (TN)	6.06 – 8.07	0.02 – 0.66	0.07 – 1.26	2.7 – 10.2	68 – 1216
Thoothukudi (TN)	6.58 – 8.05	0.03 – 0.37	0.06 – 1.20	9.7 – 50.5	94 – 1216
Dindigul (TN)	7.10 – 8.31	0.02 – 0.74	0.11 – 0.39	0.5 – 19.5	94 – 1216
Wayanad (KER)	4.50 – 8.10	0.03 – 0.16	0.44 – 1.40	1.0 – 14.5	108 – 1.181
Nirmal Divisional (AP)	5.64 – 7.29	0.02 – 0.11	0.28 – 0.75	–	–
Tribal sub complex	1998	Recommendations given to individual farmer			

III. HOST PLANT PROTECTION

III.1 MPT 2000: Long term effect of mulching cropping systems on soil biology and productivity (July 2007 to June 14)

DMR: Mysore: K. Muralidhar Naik (PI), Prashanth Kumar, P. M. S. S. Sharma (upto Jan 2014), K. Indumathi, Hafiz (June 2012), S. Shri and M. Rekha.

PJTSAU: M. T. Amaregouda, M. B. Madalageri, M. R. Dyamannavar, P. Jagadeesh, M. P. Pandu, T. Magdi Venkatalakshmi, P. Vanitharanee, S. Hasan Baig and Ravi Gundi.

Objectives:

- Study on the role of soil microflora and macro fauna towards sustainable mulberry production.
- To study the beneficial antagonistic microbes associated with soil health in different cropping systems.
- To investigate the factors responsible for the soil microorganisms in sub-tropical zone.

Microbes are major components of biosphere and the composition of the differ greatly from soil to soil and place to place, as a result disease habit microbe interactions (ie. qualitative and quantitative microbial activities are the key factors for productivity and sustainability of soil health for maintenance of production. Some of these interactions involve beneficial exchange of nutrients and are encouraged to enhance the productivity of the crop. Intensive with disease causing pathogenic microbes can result in crop damage and yield loss. But organic matter plays an important role in mobilization and survival of these microbes. Soil organic matter accelerates the growth of beneficial microorganisms which act as inhibitors against the pathogenic microbes. The study helps to know the long term effect of various cultivation practices on microbial population dynamics, their interaction with beneficial and pathogenic microbes, nutrient status of mulberry cropping and other cultural practices which farmers practicing over the years. For this soil samples were collected from identified mulberry gardens in 5 districts viz., Karnataka, Andhra Pradesh and Tamil Nadu. A total of 240 soil samples were collected during rainy, winter and summer seasons. An average of 150.67 x 10^3 CFU/g soil of microbes was isolated from these soil samples. Fungi, bacteria and actinomycetes were recorded as 44.0×10^3, 94.33×10^3 and 12.33×10^3 respectively. They were grouped as beneficial (52.6×10^3), harmful (34.33×10^3) & opportunistic (63.33×10^3). Further, soil samples were analysed for physical and chemical properties which revealed that soil colour varied from light red to light black and texture from sandy loamy to sandy clay loam. Among the experimental sites 60 % of mulberry planting and rearing are above critical limit (> 1.2) and 40% of them have OC below critical limit (< 0.5%). Due to higher pH and less organic content, most of the nutrients are not available to the plants. Hence, there is a chance of entrapment of root diseases. Under nutrient deficiency conditions plants pathogenic species become more serious. Diseased plants may also be susceptible to attack by secondary pathogens or pathogens may infect through wounds.

III.2 PBL KISS: Development of database for mulberry diseases (August 2011 to July 2014)

P. B. Prabhakar Kumar (PI), V. Jagannath, D. C. Sharma and A. M. Babu

Objectives:

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

Diseases are one of the limiting factors for successful mulberry cultivation. These diseases impair quality and quantity of leaf produced. The occurrence of these diseases may vary from season to season and place to place based on the climatic factors. Extensive studies were conducted in India on various aspects of mulberry diseases during the last few decades, which included isolation, identification of disease causing pathogens, diagnosis and intensity of diseases in various agro-climatic conditions, etiology,

epidemiology, management and resistance response of mulberry genotypes. However, this information is scattered. To congregate all information in one place is the main object of this study. Further there is no web based forecasting system for occurrence of disease so that proper management strategies is given to develop a database published literature on various aspects of mulberry diseases so data were collected from various sources such as Journals, books and web sites. Text mounted daily seven literatures, six disease literatures, decided write up of six diseases and 100 mites on various aspects of mulberry diseases were loaded in the web page.

11.3 IBSN 0003: Co-Pave Trial of Hematoxol – a plant based formulation for management of root rot disease of mulberry (October 2013 to September 2014)

CPCRI: Mulberry Dr. B. Sharma (PI), Pratheesh Kumar, P. M. and V. Nivitha Kutti

KVK(s): Dr. R. Sasikumaraja, S. Raja Kumar and Mr. B. Chowdaiah

Objectives:

- To validate the efficacy of hematoxol – a plant based formulation through on farm trials.

Root rot disease caused by the nematode *Meloidogyne incognita* incited a severe incidence in a various thrusting mulberry cultivation in all sericulture areas in India, which reduces the leaf picking to 20%. Since it damages the root system, the plant translocation in various soil zone deficiency. A plant based ecofriendly formulation Hematoxol was developed for the management of root knot disease. It confirmed effective to reduce root knot severity and to convert root gall in decadence and some farmers perform of Hematoxol. To validate the effectiveness of Hematoxol in other states on farm trial has been taken up at Malleboo in Andhra Pradesh, Hanabasappa in Karnataka and Salem in Tamil Nadu. Ten farmers each were selected from 3 states and supplied 2 kg of Hematoxol. The disease severity was recorded before application of Hematoxol, revealed disease ranged from moderate to severe. To commercialize the effectiveness of the product 1^st^ dose of Hematoxol was imposed during the month of January. Data on reduction in disease severity 30 days after application of Hematoxol was recorded. Based on the severity of disease, application dosage is fixed.

11. MOLECULAR CROP IMPROVEMENT

11.1 KT 0440: Development of robust bi-motive hybrids of silkworm, *Bombyx mori* L. tolerant to high temperature environment of the tropics through DNA marker assisted selection (January 2011 to December 2014)

S. Geethma Reddy (PI), D.C. Ashwath, Ravi Kumar and M. Chandrakanth (CSR)

Objectives:

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

To select breeding precursor material for development of thermo tolerant breed, 37 silkworm breeds were screened with marker identified for thermo tolerance (JA, F123 and JPL/08). Out of 37, two breeds (JPL/08 and APH/10) were selected as donor parents based on presence of marker and four breeds (JA, CSR27, CSR2 hybrid and CSR6, CSR28 (Combat)) were selected as recurrent parents. These selected parents were crossed and four F~1~ crosses were prepared (CSR27 x APH/10 and JPL/08 x APH/10, CSR6 x JPL/08 and CSR28 x JPL/08) and F~1~s were crossed with respective recurrent parents and raised four back cross (BC) lines. Presently here are in BC~3~ generation. In each generation (BC~1~-BC~3~), DNA was isolated from five (5) progeny of each line (20 in individual moths) from each first and DNA was screened with SSR markers. The progeny showing presence of marker (2 heterozygous alleles) was selected for next generation rearing (Fig.11.1-11.4). Further in each generation, they were also screened with high temperature conditions to confirm the phenotypic expression (Fig. 11.5). This process was repeated in each generation.

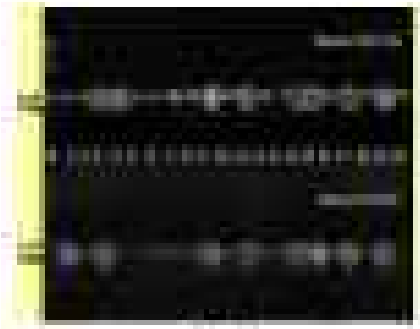


Fig. 11.1

Fig. 11.2

Fig. 11.3

Fig. 11.4

Figs. 11.1 – 11.4: Amplification of SSR markers (LR-125, LR-2029) in Black rosy-lips (A) (Fig. 11.1), MC (Fig. 11.2), BG (Fig. 11.3) and PK (Fig. 11.4) in BC generation (A indicates marker, 1-20 are BC progeny individuals tested. Lanes counted left under the indicated gaps of marker are blank probably due insufficient recognizable loading.

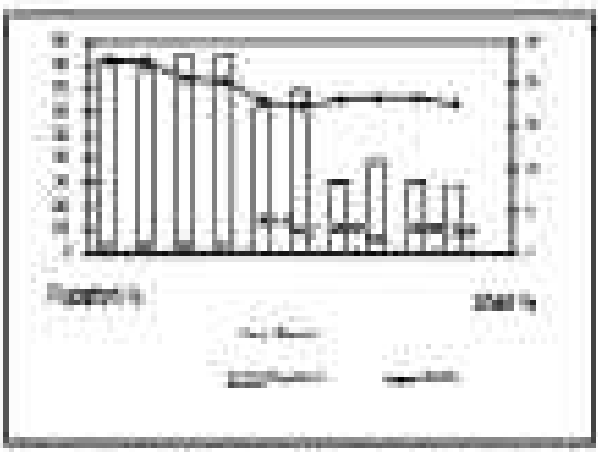


Fig. 11.5: Ripening performance of BC lines and parents under high temperature conditions (Mid-Feb) in Mohanpur (Nadia) during 2013-14 (BC lines 1-141 are BC lines, MR-1 and BH-2 are tested parents and CO-42, CO-86, CO-92 are resistant parents)

11.5 **SSR NSR:** Evaluation of three early maturing Indica hybrids for commercial exploitation (August 2010 to September 2014)

A. Haseena Begum (PI), A. Kar (Tech.) and Kar (Tech.)

Objective : • To identify suitable three early maturing Indica hybrids for commercial exploitation.

The selected three / new cross hybrids viz., FCI x CSRC, FCI x CSRT, TES x CSRC and FCI x CSR 07 were tested and evaluated in the laboratory. The Duration ranged from 99.0 to 106.0%, Ganda weight ranged from 2.007 to 2.090, shell percentage ranged from 33.0 to 33.5, sdu kernel ranged from 71.5 to 72.4, Standard boogie ranged from 1.501 to 1.700 in and medium by around 55.0 quintal. The selected three new crosses FCI/CSRC, FCI x CSRC and FCI x CSR 07 were evaluated along with control single and double hybrids at three locations and found that these hybrids are better than single hybrid TCSRC x CSR 01 and on par with double hybrid, FCI x PCI 2 (Table 11.1 & 11.2)

Table 11.1: Yielding performance of selected three-way cross hybrids

Sl. No.	Three way cross hybrids	Days to 50% flowering	Plant height (cm)	Ear height (cm)	Green cob yield (kg/ha)	100 grain weight (g)	Shelling out-turn (%)	Grain yield (kg/ha)
At the laboratory								
1	FCI x CSRC	100	96.5	54.70	22258	0.457	83.5	7450
2	FCI x CSR 07	99	95.5	55.45	22501	0.445	82.2	7350
3	PCI x CSRC	100	96.8	55.66	22564	0.464	82.4	7450
4	PCI x CSR 07	100	96.0	55.80	22518	0.455	82.1	7350
5	FCI x PCI 2	100	96.9	55.47	22569	0.450	82.4	7450
6	CSRC x CSRHQ	100	96.8	77.66	14468	0.448	70.9	5100
	SEm ±	2.0	0.8	1.2	0.007	0.010	0.6	0.6
On station trials at 4 locations								
1	FCI x CSRC	101	99.1	71.4	14.67	0.451	81.3	5950
2	FCI x CSR 07	100	94.7	71.8	14.61	0.454	81.4	5950
3	FCI x PCI 2	100	97.4	69.8	14.71	0.448	81.2	5950
4	CSRC x CSRHQ	101	93.6	70.6	14.64	0.453	81.7	5950
	CD at 5%	2.2	1.5	0.03	0.011	1.6	1.6	1.6

Table 11.2: Yielding performance of selected three way cross hybrids

Sl. No.	Three way cross hybrids	Days to 50% flowering	Plant height (cm)	Ear height (cm)	Green cob yield (kg/ha)	100 grain weight (g)	Shelling out-turn (%)	Grain yield (kg/ha)
In the laboratory								
1	FCI x CSRC	99	100	103	9.40	82	82	7450
2	FCI x CSR 07	99	101	106	9.00	86	82	7350
3	PCI x CSRC	97	100	107	7.30	82	82	7450
4	PCI x CSR 07	98	102	105	7.50	85	82	7350
5	FCI x PCI 2	99	104	104	7.00	88	82	7450
6	CSRC x CSRHQ	99	99	103	6.00	54	70	5100
	CD at 5%	NS	2.0	NS	NS	NS	NS	NS
On station trials at 4 locations								
1	FCI x CSRC	99	101	104	9.0	84	82	7450
2	FCI x CSR 07	97	97	103	9.0	84	82	7350
3	FCI x PCI 2	99	105	104	9.1	84	82	7450
4	CSRC x CSRHQ	99	99	104	9.0	54	70	5100
	CD at 5%	NS	1.9	NS	NS	NS	NS	NS

NS – Non-significant

11.3 [illegible] Maintenance of Sindhi breeder's stock of germplasm (Continuous)

E. Ratnakaramma (PI) and G. Suneela

Objective : • To systematically maintain newly evolved breeders stock of Sindhi cattle and germplasm for the original characters, to support the genetic resource requirements of adjacent breeders.

A maintenance mating of breeders stock of 25 Sindhi germplasm breeder 30 involved bulls of NDRI, Germplasm 11 breeds of CIRB(T) Mysore which were used as research material in the on going breeding programs of Crossbred and Sun breeds to support CIRB(T), Mysore for single ovulation AI programme (Sec.I, Sec.II, CIRB, III and CIRB IV) were carried out.

11.4 [illegible] Sindhi cattle breeding for development of crossbreeds with better genetic potential (Continuous)

11.4.1 Breeding for development of crossbred breeds with higher productivity under semi intensive conditions of Nilgiris and studies breeding to know genetic variation and stability

E. Ratnakaramma (PI) and P. Suneela

Objectives: • To evolve new crossbred breeds for higher productivity under semi intensive conditions of Nilgiris.

• To assess the relative economic positions of Nilgiris for Sindhi breeding in the long run.

[illegible] bull mothers (SBN-4, SBN-7, SBN-17, SBN-44, SBN-47, SBN-59, SBN-300, SBN-304, Sec I, S-7, S-10) and 4 germplasm breeds (SLW-6, SBN-6, S-12, S-17) were identified based on their performance from the germplasm stock, these mothers at CIRB, Hosur as research material. The following eight breeding plans were effected.

#	Combination	Breeding Plans
1	SBN-17 x SBN-4	[illegible]
2	SBN-44 x SBN-7	[illegible]
3	[illegible] x SBN-44	[illegible]
4	[illegible] x SBN-44	[illegible]
5	[illegible] x S-17	[illegible]
6	[illegible] x S-10	[illegible]
7	[illegible] x S-10	[illegible]
8	S-17 x SLW-6	[illegible]

The F1, F 2, F 3 and F 1/2 generation mating of the eight breeding plans were completed. The targeted quantitative traits were achieved successfully.

The experiment is in final stage of recording milks and hybrid evaluation. A total of 39 calves were produced between the eight fixed sires and the five hybrid sire was completed. (Table 11.4)

Table 11.4 Performance of Mini pneumatic picking line

Variety	Combination	Treatments	Time taken (h)	S.C. wt (g)	S.C. wt. (g)	S.C. %
MCU5	T1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	T2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	T3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
DCH32	T1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	T2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	T3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MCU5 x	T1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	T2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	T3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MCU5 x	T1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	T2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	T3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MCU5 x	T1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	T2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	T3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MCU5 x	T1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	T2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	T3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

11.4 [illegible]

[illegible]

Objectives: • [illegible]

At the [illegible] and [illegible] in a site (i.e. May – June 2013, August – September 2013, November – December 2013, and February – March 2014) by following [illegible]. The biology views of four variety for the yield [illegible] value by weight, single cotton weight, single boll weight and cotton shell percentage is presented in Table 11.4.

Table 11.4: Performance of mutline (mean, Mean of 4 trials)

Mutant	Population size (TS)	Seedset yield/5 plant (g)	1000 seed wt (g)	100 seed wt (g)	Shell percentage (%)
DSM2	1610 ± 132	18.70 ± 2.7	1.31 ± 0.14	0.420 ± 0.02	32.08 ± 0.4
DSM4	1643 ± 224	17.1 ± 1.28	1.307 ± 0.13	0.49 ± 0.03	32.4 ± 0.3
DSM5	1420 ± 132	17.22 ± 0.51	1.31 ± 0.08	0.39 ± 0.01	31.8 ± 0.7
DSM20	1472 ± 108	16.15 ± 1.32	1.350 ± 0.11	0.355 ± 0.07	31.2 ± 0.8
DSM27	1610 ± 110	16.22 ± 1.05	1.331 ± 0.14	0.402 ± 0.02	32.4 ± 0.7
DSM 16	1641 ± 160	16.75 ± 1.68	1.760 ± 0.13	0.350 ± 0.003	31.8 ± 0.6
DSM17	1742 ± 0.	16.85 ± 1.27	1.603 ± 0.12	0.420 ± 0.03	32.1 ± 0.5
DSM30	1620 ± 184	16.85 ± 1.76	1.381 ± 0.16	0.416 ± 0.01	32.5 ± 0.6
DSM31	1668 ± 60	16.78 ± 1.58	1.354 ± 0.11	0.362 ± 0.03	32.4 ± 0.3
DSM32	1420 ± 70	17.0 ± 1.0	1.308 ± 0.12	0.420 ± 0.02	32.7 ± 0.5
DSM33	1574 ± 171	18.1 ± 1.6	1.758 ± 0.15	0.388 ± 0.02	32.3 ± 0.8
Dm1	1620 ± 178	19.50 ± 1.68	2.360 ± 0.14	0.480 ± 0.04	32.7 ± 0.7
PM2	1600 ± 81	16.70 ± 1.49	1.777 ± 0.11	0.381 ± 0.03	32.5 ± 0.8

11.6 Job (new) development of groundnut a polyvoltine breed of the relevant drawing more tolerant to high temperature and drought

V. Jayamala (PI), Ramakrishna and G. Ramakrishnaiah

Objectives:
- To develop groundnut breeds tolerant to high temperature and Drought
- To identify productive polyvoltine x bivoltine hybrids, which are tolerant to high temperature and drought.

Twelve stress tolerant lines were screened for high temperature at F3, Drought at F3 and 9 stress tolerant lines F4 were raised under normal rearing condition. Screening of breeds under high temperature and drought was repeated at F4 and F5 generations respectively. The testing of 12 stress tolerant lines at F7 & F8 generation completed under normal rearing conditions. One way ANOVA was carried out and the significant tolerant stress tolerant lines are in F8 generation (Table 11.5)

Table 11.5 Performance of tolerant lines under normal rearing

S.	Lines	Survival (%)	5 th. wt (g)	5 th. wt. (g)	Shell %
1	HB1	96.00	1.414	0.440	78.14
2	HB2	91.60	1.438	0.444	76.16
3	HB3	93.73	1.388	0.500	20.00
4	HB4	96.33	1.247	0.540	15.00
5	HB5	90.26	1.318	0.511	16.77
6	HB6	82.71	1.387	0.533	16.99
7	HB7	91.60	1.421	0.564	80.52
8	HB8	94.51	1.187	0.536	79.72

11.7 HIB 0901: Improvement of breed characteristics of LH through multinucleated approach (June 2012 to December 2016)

S. R. Ashwath (PI), Ma Reddy, Gyanendra, S. M. Moolhi, C. L. Rajpoot, P. Sudhakara Rao, N. Gurung, S. Hussainani, Ju J. Agarwal and A. Chandrashekar

(ICAR, Rohtak, SRBSC Chennai, TN-DOF, Assam)

Objectives:

- To isolate and fix improved lines of LH carrying breed characters with allelic substitution of non-Mendelian, traits resulting into uniform chosen single-cross seeds.
- To supply F1 CMs to generate seed crosses at CSWRI, Avikar under the project AMA-SRB

Improvement of LH multicellular breed was undertaken simultaneously at the Institute, RRSS, Rohtak, SRBSC Chennai and RC, BCP, Hisar. During the period 4 cycles of breeding has been completed in all the units, the improvement has been achieved with respect of its garments like variation in shape size, segregation in breed markings, variation in comb colour, legs and shanks. However, it was found that the occurrence of broodiness and fibromatosis still persists at Hisar, Chennai and Hessaru, while at Rohtak from 0 to 5 birds the selected ones free from fibromatosis and broodiness. The mean performance of all cycles conducted at the respective locations are shown in Table 11.6.

Table 11.6: Relative performance of LH breed in different locations (mean of 4 cycles)

Location	Plant ability	Laying duration (days)	Peak flow (%)	Chicken weight (g)	Egg weight (g)	Shell (%)	Fibro-sitis (%)	Hetero-flow (%)
Rohtak	Male	327.5	91.75	1.487	5.240	10.66	1.74	0.44
Rohtak	Fem	295.00	90.48	1.348	5.275	20.00	–	–
Chennai	Male	314.00	90.78	1.400	5.350	11.56	1.12	0.11
Hessaru	Fem	284.00	90.38	1.330	5.270	17.38	1.23	1.15

It has been planned to continue the breeding for two more cycles, the improved lines will be evaluated and the best lines will be maintained for further multiplication.

11.8 IBM 0902: Maintenance of breeds developed through single marker assisted selection, multi-nucleus, MPV inheritance and reproductive related studies (January 2012 to January 2016)

S. P. Mandal (PI), Devendra, M. Muralidharan Pillai and V. N. Sachan (upto July 2013)

Objectives:

- Maintenance of lethal gene lines conforming to their original characters
- Maintenance of the homozygosity of the lines as created through emasculation marker assisted selection
- Maintenance of MPV standard localities and poly-cross stocks
- Maintenance of morphological marker phenotypes in mutant stocks

Thirty-four productive breeds were maintained conforming to their original breed character for 8 generations. The rearing and breeding performance of some of the important breeds are presented in Table 11.7.

Table 11.7 Physical and fibre performance of extra-fine testcrosses in the laboratory

Genotype / Mutant	Micronaire value	2.5 gm/tex	UHML (mm)	UI (%)	Elongation (%)	Tenacity (g/tex)	Fibre maturity ratio	Fibre fineness (mtex)

Further, four trials of multiple semi-synthetic inter-specific maintenance crosses completed. Diverse maintainers viz. CISR2-41, CISR4-41, CISR 98-41, CISR10-41, CISR20-41, HB4CISR-41, IH-41, CISR10-41, CISR20-41, SRF4-41, JK7-41, MRC-41, CISR98-41, CISR98-41, RHRH-41, CISR98-41, CISR98-41, CISR20-41, CISR10-41, CISR20-41, CISR20-41. The trials on mean fibre/cotton yield recorded three crosses namely cultivars 98-90 and 98-88, exception with cultivars 98-92 & 91-70, crosses viz. cultivars 1-2218 & 1-1830 g, ginout viz. cultivars 0-2218 & 0-2218 kg and ginout % cultivars 16-7% & 32-4%, all the trial values are in concurrently with the control check values.

A total of six trials of multi-cotton semi-synthetic inter-specific maintenance crossings completed. Diverse maintainers viz. H4-41, H4GL-41, S- H4GB -41, 4H-41, 4H-41, 4H-41, 4H-41, 4H-41, 4H-41, 4H-41, 4H-41, 4H-41, 4H-41, 4H-41, & 4H-41, are trials average data analysed three seasons cultivars 98-94 and 98-94, population-wise cultivars 97-27 & 97-40, crossing viz. cultivars 0-722 & 1-174g, ginout viz. cultivars 0-207 & 0-282g and ginout % cultivars 12-1% & 17-1%. All the trial values are in conformity with the benchmark values.

Twenty hybrids developed through simplex-marker assisted selections, 8 cry and cry-like and 12 MPV. Advanced breeds & 70 mutant stocks were shared and maintained conforming to their typical characteristics under 2 crops during Kharif and Rabi Dec-20 2. Homozygosity for the simplex genes was confirmed by simplex assay. In the crosses developed using simplex marker, Bgg, spiral, and multi-chromosomes were observed and maintained in the mutant stocks. The yielding performance of cry and cry-like cotton breeds developed through simplex marker is shown in the Table 11.8 and Table 11.9 respectively.

Table 11.8: Performance of Cry1 breeds developed through simplex marker assisted selections

Sl. No.	Breeds	Pedigree	MPV 7 DAS larvae		SLC (#)	S.L. (#)	MPVs
			By No.	By wt. (kg)	(g)	(g)	
1							
2							
3							
4							
5							
6							
7							
8							
9							

Table 11.5. Performance of Zymo net inserts developed through amylase marker selection

Sl. No.	Strain	Biomass (g/L)	Total reducing sugars		SSC (%)	ACL (%)	DPPH
			(g/L)	(% of Fg)	(g)	(g)	
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							

11.6 (AD 3479) Development of an assertive MPV tolerant Zymobacter biosynthetic strain using ZymDCV marker assisted selection (April 2010 to December 2014)

S. R. Agrawal (PI) and Virendra Kumar

Objectives:

- To develop productive MPV tolerant zymotive strains using ZymDCV as a marker.
- To identify MPV tolerant single / double mutants through laboratory evaluation and in-house trialling.

ZymDCV (*Acetyl Diphosphate Decarboxylase*) protein marker assisted selection was continued by using the MPV tolerant adaptive variants, namely, Hybrid, P6 evaluated with high ZymDCV recoveries were selected as donor parents (DPs) and productive mutation strains, namely, CO72, CO84, CO92, CO102 and CO827, which are successors to MPV tolerant as recurrent parents (RPs). Operative size samples were collected on the 2nd day of inoculation from the six progeny individually and screened by SDS-PAGE. The vial fractionates with high ZymDCV expression were pooled and subjected to their respective RPs. During the similar screening of SDS progeny was completed after which the progeny were selfed to raise the BC1S1, S2 and S3 generations. Homozygosity of high ZymDCV expression was confirmed in the selfed progeny through protein profiling. Using the selected BC1S3 lines, syrups of 1% each of single mutants, dual P-S and quadruple-MPV tolerant mutant by fermentation evaluations.

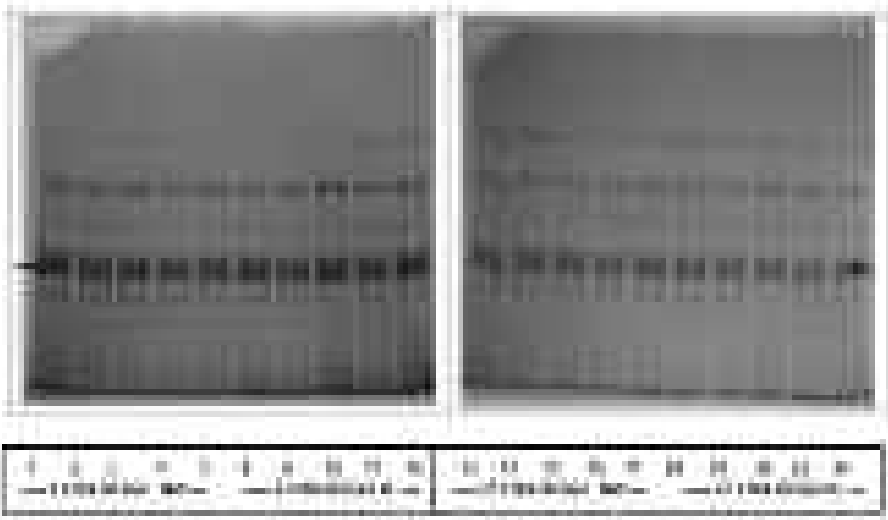


Fig. 11.6. SDS-PAGE profile of BC1S3 selfed progeny. Arrows indicate homozygous selfed of 2C1 10a ZymDCV protein

11. SILKWORM CROP PRODUCTION

11.1 RPM 02.01: Large scale bi-bivoltine and evaluation of new silkworm breeds/hybrids of silkworm (Bombyx mori L., developed at CSRTI, Mysore (Continuous)

P. C. Sandhya (PI)

Objectives:
- To evaluate new silkworm breeds/hybrids and study their large scale performance including economic viability with the existing breeds/hybrids.

Rearing performance of CSR4 (PPPP)

Dfl's total of silkworm seeds (eggs) of CSR4 breed were conducted. Totally 4,00,000 Dfls of P1 breed cocoons (501.0 kg) of CSR4 breed were generated. Recorded survival from ERR (3 Nos. 9500 and av. ERR (3 Nos. 9,500 kg, for CSR4 breed. Recorded an average cocoon of 1.450g, av. shell weight of 0.300g, and av. SHI% of 19.42% for CSR4 breed. The rearing performance is presented in the Table 11.1.

Table 11.1: Rearing performance of CSR4 pure breed

Crop No	No. of Dfls	Mean. Wt	Hatching %	Moulting Date	No. of larvae brushed	Larval Duration (Days)	Cost Rs
1	500	447	95.40	21.5.13	50,000	23.0	650
2	500	457	96.20	10.7.13	1,10,000	24.0	954
3	500	450	94.60	28.8.13	95,000	23.0	952
4	500	448	97.20	2.10.13	1,00,000	23.0	714
5	500	457	96.20	23.11.13	45,000	24.0	650
6	500	448	97.20	11.12.13	45,000	23.0	714
Total (Av)	4000	45	96.23	-	4,00,000	23.0	746

Crop No	Actual yield		Yield/10,000 larvae brushed		SCC wt (g)	S.C. wt (g)	SHI%	Yield/100 Dfls (kg)
			By No.	By Wt.				
1	57.47	32.00	6.87	11.50	1.67	0.314	18.72	11.50
2	95.00	51.00	9.50	5.00	1.863	0.281	15.14	25.50
3	88.00	194.0	9.26	14.19	1.961	0.311	15.82	41.00
4	85.90	123.0	8.61	12.19	1.809	0.280	15.24	12.00
5	95.00	46.00	9.15	9.00	1.97	0.332	16.24	23.00
6	90.00	64.00	8.90	11.00	1.954	0.307	15.82	64.00
Total / Av	6,00,000	83.0	8.05	10.00	1.828	0.308	15.00	46.00

During the year, a total of 3,70,540 P1 seed (common eggs) of CSR4 breed were supplied to CSTRI, RSRS, Thiruvallur and Ramanagaram.

Post-cocoon Evaluation Unit

11.2 RM 02.01: Evaluation of post cocoon parameters of cocoon generated from CSRTI, Mysore and its regional units (Continuous)

S. G. Ramakrishna (PI), Hari Babu (Sr) and K. Umakumar (Sr)

Objectives:
- To evaluate the various characteristics and post cocoon parameters of pure breeds, their multivoltine, multivoltine and breeds/ hybrid cocoons received from all the sections and farms of the institute.
- To compare and evaluate the rearing performance of various breeds/hybrid cocoons at different seasons from various sections in CSRTI and regional units.

A total 7.25 lots of cocoons were test tested for post cocoon parameters and evaluated the data. The data of rearing performance of each lot has been communicated to the concerned. The number of cocoon lots tested received during the period was given in table 11.2.

Table 12.2 Number of cocoon lots from different stations

Source	No. of lots testing
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
Total	[illegible]

A total of 700 kg. of cocoons received from different sources for reel testing and mass rearing were stifled, conditioned, cooked and reeled producing 20 kg. of raw silk.

12.2 [illegible] under the Reeling package for the [illegible] cocoons (January 2014 to March 2014)

Karthigayan (PI), T. C. Ravikumar(Co-PI), and K. P. Sridhar(Co-PI)

Objectives:
- To validate the reeling package for reeling of [illegible] cocoons raised in Tamil Nadu.
- To demonstrate the reeling package to commercial reelers

As per the plan of work, cocoon markets and reeling units of Ramanagaram were surveyed to identify the commercial reeling units especially modern units for accreditation and the testing of the reeling package developed by the institute for [illegible] hybrid.

13. SILKWORM GROUP PHENOMICS

13.1 MTP [MT]: Transgenic control of Microsporidiosis in the silkworm through characterization of Methionine Amino Peptidase enzyme genes (MetAP2) in Nosema bombycis (April 2012 to March 2014)

K. R. Ramkumar Nagaraja (PI) and S. M. Ramesh (CPRI, Bangalore)

Objectives:
- Identification of microsporidian genes controlling MetAP2 enzyme using PCR techniques through specific primers from Nosema bombycis
- The cloning and characterization of MetAP2 of microsporidia.
- Development of a process producing microsporidian using certain chemical compounds in the silkworm

The Nosema bombycis spores were multiplied by inoculating the susceptible silkworm breed, which were collected and purified using standard protocol. The purified spores were disrupted using acid washed silicon glass beads. Proteinase K was added to the disrupted spores and the solution was incubated for 1 hr at 56°C. DNA was then prepared by phenol/chloroform extraction followed by ethanol precipitation. Purified N. bombycis DNA was resuspended in TE buffer and used for PCR reaction. The amplified product were cloned and sequenced. Using the BLAST tool of NCBI database, the sequence was compared and related sequences were retrieved. Phylogenetic analysis MetAP2 gene of N. bombycis was carried out through Clustal W programme, which revealed that the gene sequence is similar to that of Nosema ceranae of honey bee (Fig. 13.1).

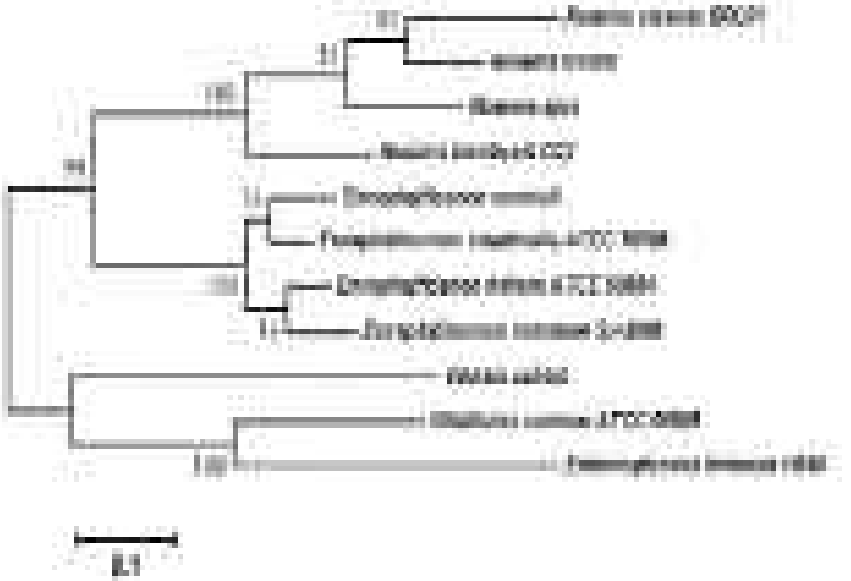


Fig 2.1.1. Phylogenetic relationships of multilocus sequence analysis of *Bacillus* species, *Enterococcus* species and other gram positive cocci

11.2. AP3 cluster : identification of factors responsible for cotton boll shedding due to chewing sucking pest complex and its impact on cotton productivity (July 2012 to December 2014)

M. Balasubramaniyan (PI) and A. R. Hanamanthagouda (CIRCOT, Mumbai, in collaboration with Bidyapeeth, KCMS Kurukshetra, R. Nalini, PRO Coimbatore, S.Palanivel, KCMS Salem, T. Thirumurugan, PRO Dindigul, P. Jeyakumaran, PRO Virudhunagar, B. Kabi Reddy, PRO Kadiri and S. T. Singh, PRO Akola, B. Basavaraja Reddy, PRO Gadag and M. Venkateswara Rao, PRO Guntur)

Objectives:

1. To identify relevant disease culprits in the major cotton growing districts of Tamil Nadu, Karnataka, Andhra Pradesh and Tamil Nadu
2. To estimate the extent of crop loss due to the relevant diseases in the field

Periodic surveys on the relevant diseases incidence were conducted from April 2013 to March 2014 in the selected areas of the three states (Table 12.1). In Karnataka, the survey results in 3 districts (Belgaum, Gulbarga, Koppal, Haveri and Haveripur) indicated 0.62 to 1.24% Grasseria, 1.43 to 2.86% Tachinids and 0 to 1.27% miscellaneous damage.

The survey results in the 3 districts of Tamil Nadu (Salem, Erode and Thoppur) indicated 0.00 to 1.41% grasseria, 0.47 to 2.11% Tachinids and no incidence of miscellaneous during the period. In Andhra Pradesh the survey results in the 4 districts (Nandyalapur, Guntur, Ranga Reddy and Warangal) indicated 0.00 to 1.40% Grasseria, 0.44 to 1.34% Tachinids and 0.00 to 0.44% miscellaneous damage was observed. There was no distinct incidence in the surveyed areas during the period.

Table 13.1 (Seasonal Variation during 2013-14)

Month	Maximum	Minimum	Mean Relative Humidity	Rainfall	Mean Wind Velocity
			KARNATAKA		
Apr. 2013	1.20	1.42	0.28	0.00	12.46
May 2013	1.42	2.51	0.30	0.00	8.72
Jun. 2013	0.78	1.99	0.38	0.00	13.16
Jul. 2013	1.76	2.49	0.49	0.00	15.83
Aug. 2013	1.32	2.17	0.55	0.00	10.42
Sep. 2013	1.31	2.01	0.50	0.00	11.19
Oct. 2013	1.22	2.65	0.50	0.00	10.61
Nov. 2013	0.73	1.48	0.55	0.00	13.00
Dec. 2013	0.76	1.91	1.27	0.00	11.24
Jan. 2014	0.96	2.21	0.29	0.00	11.47
Feb. 2014	0.92	2.05	0.37	0.00	13.44
Mar. 2014	0.76	2.46	0.44	0.00	16.11
Average	1.09	2.00	0.42	0.00	11.44
			TAMIL NADU		
Apr. 2013	0.35	0.41	0.00	0.00	16.83
May 2013	1.07	2.66	0.00	0.00	42.07
Jun. 2013	0.22	0.83	0.55	0.00	16.33
Jul. 2013	0.65	1.07	0.00	0.00	14.16
Aug. 2013	0.49	0.61	0.00	0.00	10.33
Sep. 2013	0.77	0.00	0.00	0.00	10.67
Oct. 2013	0.77	0.71	0.00	0.00	11.64
Nov. 2013	0.60	1.46	0.00	0.00	16.89
Dec. 2013	0.29	0.78	0.00	0.00	12.04
Jan. 2014	0.62	0.68	0.00	0.00	11.11
Feb. 2014	0.60	0.74	0.00	0.00	14.08
Mar. 2014	0.50	0.55	0.00	0.00	15.25
Average	0.62	0.89	0.00	0.00	16.06
			ANDHRA PRADESH		
Apr. 2013	1.40	1.25	0.00	0.00	17.11
May 2013	0.75	1.47	0.00	0.00	16.97
June 2013	1.26	0.46	0.00	0.00	11.33
Jul. 2013	1.30	1.04	0.44	0.00	13.00
Aug. 2013	1.47	1.22	0.00	0.00	13.40
Sept. 2013	1.46	1.16	0.00	0.00	11.64
Oct. 2013	1.20	1.21	0.00	0.00	14.13
Nov. 2013	1.60	0.69	0.00	0.00	10.97
Dec. 2013	0.68	0.87	0.00	0.00	10.87
Jan. 2014	0.74	0.00	0.00	0.00	17.70
Feb. 2014	0.75	0.42	0.14	0.00	14.13
Mar. 2014	1.14	0.41	0.00	0.00	10.68
Average	1.07	0.89	0.11	0.00	14.00

15.1 MFT 2014: Maintenance of mother culture for production of recommended bio-control agents and field release of recommended bio-control agents at mass culture facility in 6 ORATA samples (Continuous)

Vinod Kumar (PI), J. B. Narendra Kumar, Gali Jalaja Lahary, K. A. Gabi, Aug 01 to

Objectives:
- To maintain mother culture of pure bio-control and host insect stock.
- To maintain mother culture of parasitoid and predators of millipede pests and their insects.
- To release bio-control agents in ORATA samples for control of millipede pest and aphid.
- To make available bio-control agents supply to stake holders.

Mother cultures of five parasitoids namely *Anagyrus dymus*, *Acerophagus aethiopicus*, *Tetrastichus* sp., *Trichogramma* sp. and *Chelonus* sp., two predators of mealy bug *Cryptolaemus montrouzieri* & *Scymnus coccivora* and one egg parasitoid of sugarcane pest i.e., *Trichogramma chilonis* besides host culture of mealybug, pink mealy bug & *Corcyra cephalonica* were maintained throughout the year. During the period under report, in total of 1,240 parasites of mealybug *A. dymus*, *C. Sp.*700 *Scymnus* beetles (475 males and 225 female) were produced. 16.8 crosses (16.8 table adults) of *A. dymus*, 2,300 predator beetles (1.1 male) and 200 female were released in COHA campus, which resulted in keeping pest incidence below 4% in addition, a total of 1,460 parasites consisting of 1,1,820+ were released in the selected village of Chikkahonnali (Honnapadara field research TOT programme). A total of 220 adults of mealybug *A. dymus*, 14,000 *Scymnus* beetles (25 males) were also generating an income of Rs. 42,240.

15.2 ARM 2013: Bioeconomics of soil fly management strategies in an adopted village of Shimoga district (April 2013 to May 2014)

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

Objective:
- To bring down soil fly infestation less 2% in the adopted village.

As IPM package (release of entomopathogenic nematode, *Heterorhabditis indica* @ 2 juveniles/cm2 OM in, placement of soil trap & sucking/spraying of safflowers fibre in order to kill the soil insect available in it) was demonstrated by covering all the participants (about 120) in an adopted village (i.e., Chikkahonnali village (Honnagadaha Taluk). A total of 1460 adults of *A. dymus* were released by releasing 18,000 OHA in 60 crops. Further, the placement of soil traps (refer 3 outside the sowing borders plus also 6 trap 25 LAA soil fibre. The implementation of IPM package reduced the soil fly incidence from 17.7% (pre-trend incidence) to 2.72%.

15.3 MFT 2013: Forewarning and forecasting of mulberry pests (Continuous)

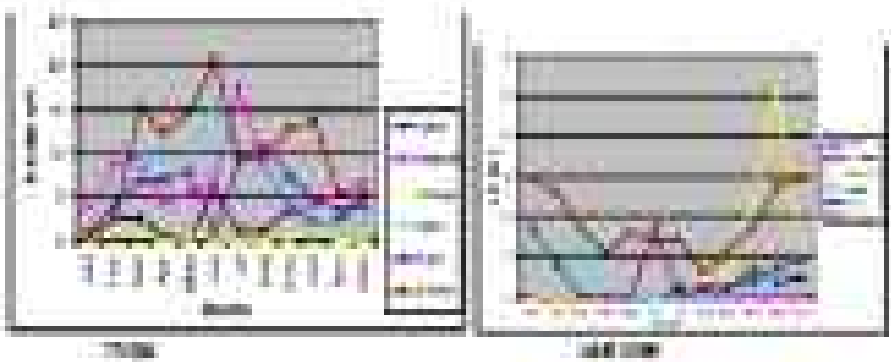
Mani Jawahar Dhanraj A. V. (PI), J. B. Narendra Kumar, D. Mallikarjuna, Kavya Nandan, K. Kalaimanan, S. Sangeetharaja, A.S.A. Dawood, M. V. Rao and Santhosh Baby

Objective:
- To monitor the incidence of major mulberry pest in Karnataka, Tamil Nadu and Andhra Pradesh and issue forecasting to stake holders.

Fortnightly survey on occurrence of pests in mulberry gardens & silkworm rearings at COHLF campus were conducted and collected data from 7 related units i.e., RSRS Chintamani(age), RSC Hindupur, RSRS Anantapur, RSC Dharmapuri, RSRS Salem, RSC Kollegal and RSC Somanahalli. Average incidence of major pests like pink mealy bug, mites and leaf roller at various centres are as follows.

Average mites incidence was highest in RSC Somanahalli (5.55%) followed by RSC Dharmapuri (2.5%). In all other centres it was below 2%. Thrips incidence was highest in RSC Dharmapuri (3.25%) followed by RSC Somanahalli (1.1 1%), RSC Hindupur (1.00 %), RSRS Salem (0.25%) and RSC Kollegal (0.01%). At COHLF, Mysore and RSRS Chintamangalore were below 0% Leaf roller incidence was highest in RSC Somanahalli (1.57%), in all other 7 centres, it was below 0%. Incidence of other pests like whitefly, aphids, mealy bug, beetle and grass hopper as well as incidence of cyst was below 2% in all the centres (Fig. 15.2).

A total of 21 variety demonstrations were taken by four districts of Andhra Pradesh viz., Guntur, Nandyal, Srikakulam, Kadapa and Nalgonda through 20 Pickup of CIRI, which included 4 demonstrations on Bunny (mid color cotton), papaya mealybug and Black Rot as undertaken CIRCOT varieties and one each in Indian silk on Mary Jane noodles and hand weave paper (Lead color).



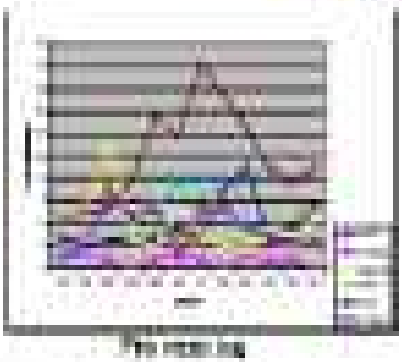


Fig 13.2: Sustenance crops grown in different agro-climatic zones of south India

14. IMPACT FOR EXTENSION

14.1 PROJECT: Horticulture varieties and technology transfer – a bio-up approach (April 2013 to October 2014)

Dr. S. Ravikumar (PI), Dr. Sudhakar Rao and Dr. C. Rajkumar

Objectives:

- Out up assessment among horticulture farmers on improved varieties during and following cultivation technologies.
- Promote horticulture based self employment among rural horticulture women for sustaining income.
- Create awareness about the available resources through different government departments/institutions for effective utilization and increased output.
- To improve the index of income and income of the farmers in horticulture.

Identified Mandal crops under respective taluk, Mahaboob Nagar District for the study. A total of 4 horticulture practicing farmers were selected for the formation of farmers groups. Formed farmer group conducted benchmark survey and initiated technology demonstrations. During cropping period conducted many group discussion on how technologies on different crops and two technology demonstration on control and management of mealybug disease and usage of bio-formulations for quality cocoon production. A total of twenty horticulturist farmers attended the demonstration.

16.2 AMS 3403: Pre-action/production field trials of L-14 x S-812 (Apr. 2013 to Mar. 2014)

Executive Authority: B. M. Khadi, A. Sukumaran[1], Amitava Rakshit[2]

Project Coordinator: S. Vennila

Investigators: Chaitanya, V. Lakshmanan, P. S. Jogi, T. Thiyageeswaran, J. P. Ramkrishnappa, D. Purushotham, D. S. Suryawanshi, P. C. Sandha, S. A. Kalkarni, S. A. Undirwade, S. R. Nagargoje, M. Rajamanickammanavar, K. Chandrasekharan, Y. G. Pankajakshan[3], K. P. Shivakumar, S. Kanagaraj, C. Lakshmanan, S. L. Rajkumar[4], Chitkeswar[5], Dr. Satyanarayanreddy[6], R. Hariharajulu[7], Sukhadeo H. Kale, S. M. Shivankumar[8]

[1]National Oilseeds and Vegetable Oils Development Directorate, [2]Central Soil Salinity Research Institute, Karnataka, [3]Regional Horticultural Research Station (KAU), Kozhikode, [4]KVK, Salem, [5]KVK, Amaravati, [6]KVK, Chamarajanagara

Objective: a. Large scale pre-multiplication evaluation of new cotton hybrid L-14 x CSHG 1/99 with respect to cotton yield and quality in comparison with PH x DHH

During the year two titles of L-14 were under conduct with total quantity of 1250 kits each received on average DHH 0.200 larvae for the 6500 and no weight 16.00 kg with single cocoon weight of 1.30 gm and shell percentage of 19.32, reeled into length of 4.3 kms a total quantity of 432.262 Cl. seed cocoons to 54000, 60*6 Hamadagram size, blackboxed packages by production of F1 hybrid (L-14 x CSHG 1/99) for silkworm dfferentiation trials of (L-14 x DHH) programme

A total of 1.10 lakh L-14 seed cocoons pierced at CSR&TI Mysore and CSRS seed cocoons stations were received from 40000 silkworm pupae/moth to a tune to produce 28000 of L-14 x CSHG 1/99. The dfls were supplied to the field under pre-multiplication field trials. The month wise dfls production are presented in the Table -(4.)

It is inferred from the table that the pupage performance of L-14 x CSHG 1/99 is consistent and satisfactory with reference to egg yield per kg. of cocoons. The information during the period was also. Further the production in target basis is taken up by HSSO dfls w.e.f. June 2013.

Table (4.) - Details of L-14 x CSHG 1/99 production for the year 2013-14

Month	Cocoons kg wt.	Pupation %	No. of dfls	No. of eggs/kg	wastage/loss	eggs yield per kg.
April	12500	91.68	4680	823	6.11	5681
April	27100	91.68	9350	823	1.1	8532
May	42000	79.91	9700	1780	1.49	8144
June	20000	90.91	8750	1734	5.00	8048
Total/Av	101600	88.05	28480	1157	3.93	8246

During a period a total of 15475 dfls of L-14 x CSHG 1/99 BG Hamsas of 600/600 Cs of Karnataka, Andhra Pradesh, Tamil Nadu and Maharashtra were distributed and recorded an average cocoon yield of 1.3 kg/100 dfls. A total of 53,600 dfls of PH x DHH distributed with 100 Hamsas and recorded an average cocoon yield 55.00/100 dfls.

Table 14.2: Training performance of CIAE-CIRCOT at Bhimavaram field

#	Name of the centre	No. of farmers	Cost of cultivation/ Acre (Rs.)	Yield (Kg/ Acre)	Profit (Rs./ Acre)
1	Kanchikacherla	278	34779	34.74	39027
2	Andhra Pradesh	231	32000	40.77	51139
3	Vanavolu	196	28102	30.44	51179
4	Vishwasanthi & IAF	6	1800	44.27	16630
5	Tripuraneni	28	4000	34.79	28000
6	Chirala	34	1200	40.88	39176
	Total/ Average	823	104479	40.08	37648

14. AGRICULTURE ENGINEERING

The impact of mechanization on various aspects of cotton cultivation is discussed. The impact of mechanization on productivity of the workers can be enhanced as detailed in Table 14.1. The mechanization will help in reducing the expenditure on various stages as detailed in Table 14.2.

Table 14.1: Improvement in workers efficiency through appropriate mechanization

#	Activity/Work	Workers output		Ratio of worker's output through mechanization
		Manual (A)	With machine (B)	(B/A)
1.	Land preparation	2.5 ha/ day	20 ha/ day	8 times
2.	Hole/ dibbling preparation	100 holes/ man-h	1 000 holes/ man-h	2 times
3.	Ploughing/ earthing	250 kg/ day	1250 kg/ day	5 times
4.	Inter culture operations	1.25 ha/ day	10 ha/ day	8 times
5.	Leaf chopping	20 kg/ h	200 kg/ h	10 times
6.	Pesticide sprayers picking	30 litres/ day	300 litre	10 times
7.	Cotton harvesting	10 kg/ h	60 kg/ h	6 times
8.	Cotton dehusking	8 kg/ h	40 kg/ h	10 times
9.	Tray seedling	200 trays/ h	800 trays/ h	4 times

Table 14.2: Savings in various activities achieved through mechanization

#	Activity/work	Cost of operation (Rs.)		Total savings through mechanization
		Manual (A)	Machine (B)	(A-B)/A x 100
1	Land preparation per ha	1000	750	25 %
2	Cutting preparation per 1000	80	12	85 %
3	Intercultural operations per ha	4000	1400	65 %
4	Chemical application (per ha)	400	100	75 %
5	Weed harvest (per MT)	500	125	75 %
6	Fleeting boats distribution per 200 litre	320	128	60 %
7	Leaf chopping per day for 4000 litre	4000	200	95 %
8	Pheromone packing (per 100 litre)	1000	200	80 %
9	Cocoon harvesting (per 100 litre)	600	150	75 %
10	Cocoon dehusking per 100 litre	400	100	75 %
11	Tray seedling (per 1000 trays)	200	40	80 %

The mechanization can help in lowering the profitability of silk cocoon production as shown in Figure 14.1. It depicts the annual net earnings or profits from silk cocoon production per acre to different category on farmers based on extent of living of the workers. Here, it can be observed that the farmers who have sufficient family labour to do various works and do not hire any workers and make huge profit of Rs. 1,24,000/acre/year. Normally, the farmers having moderate plantations upto 2 acres can be kept in this category. The profits reduce with increase in extent living of people, a farmer with 20% work force as family members and rest outside work manpower will have net earnings of Rs. 1 /as mentioned/year. The farmers having moderate plantations above 2 acres and upto 5 acres come in this category. In Figure 14.1, there is a

ners. Interesting thing to note, that the farmers, who do not have any family labour and fully dependent on hired workers, can earn profit of around Rs. 34,000/acre/year. The big farmers having moderate plantations above 5 acres are in this category. Most of these farmers are educated, employed and engaged in many works. They have sufficient finances to hire labours and invest in production like rearing house, equipments and machines, transportation, communication, etc. This is a big strength of sericulture and for this reason only many young youths are attracted by sericulture. This is a good sign for rural sericulture industry in the coming years.

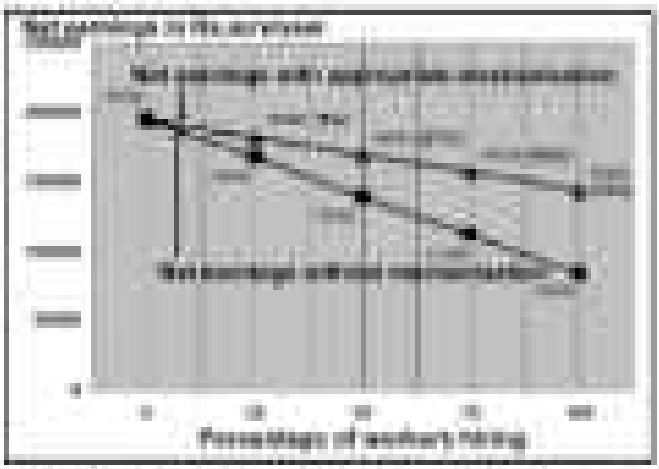


Fig. 14.1: Impact of extent of workers hiring on net earnings in mulberry silk cocoon production

Using the yield and cost models, a cocoon cutting machine and a plastic mountage rearing table machines were developed and supplied.

6. PROGRESS, EFFECTS, FUTURE RESEARCH STUDIES, ACHIEVEMENTS

Title: Evaluation of elite mulberry varieties under semi-arid agro climatic conditions (August 2013 to March 2018)

PI: Chandrashekhar (PI), B. A. Kumaresh Babu and Dr. Sabyasachi Roy

Objectives:
- To evaluate elite mulberry varieties under semi-arid agro climatic conditions and to assess the growth and yield potential of elite mulberry varieties under semi-arid region of northern Karnataka.

Five elite mulberry varieties viz. S1, K2, K6, Tekkalu, V-1 & Anantha were evaluated under semi-arid agro-climatic conditions. Their growth data of the leaf varieties were collected for one crop, which recorded highest yield of 38.4 kg in S1 compared to 31.2 kg in V-1 and 18.4 kg in Anantha. Average data of two cross leaf production and leaf yield attributes of different mulberry varieties is given below.

Table 14.1: Leaf yield data of elite mulberry varieties (mean of four crops)

Varieties	No. of shoots/ plant	Total shoot weight (kg)	No. of leaves/ shoot	Fully Flesh wt. of shoot (g)	Shoot wt. of leaf (g)	Leaf/ shoot ratio	Leaf moisture (%)	Leaf moisture retention capacity (%)	No./ ha (L)	Leaf yield/ plot (kg)
S1	5.62	216.00	27.0	38.40	25.60	66.67	75.10	58.01	21.79	38.47
K2	5.20	187.20	21.0	31.20	19.50	62.50	75.00	56.00	20.26	31.21
K6	5.01	180.36	21.00	30.00	18.80	62.67	68.01	52.00	19.5	30.00
V1	4.50	108	21.00	23.00	15.00	65.22	71.00	54.00	16.20	24.00
A	4.10	98.40	18.00	18.00	12.00	66.67	70.00	50.00	15.00	18.00
T	5.00	180.00	21.0	30.00	18.00	60.00	80.00	60.00	20.00	30.00

VII. PROJECTS FUNDED BY EXTERNAL FUNDING AGENCIES AND COLLABORATIVE PROJECTS

(a) DBT Projects:

7. 1 RNAi based: Isolating mulberry plants identification of RNAi conferring resistance to root rot disease by Linkage Disequilibrium mapping and trait introgression (Phase II (June 2011 to 2013)—Funded by DBT

S. Anbu Rani (PI), D. D. Sharma, V. Vasudha Rani, Ramanagaram, JRF, R. Vinod, JRF

Objectives:

- Assessment response of mulberry germplasm to major causal fungus of root rot disease in pot grown plants
- Molecular characterization of germplasm accessions and finally identify the contrasting resistant and susceptible.
- Develop mapping populations by crossing of contrasts in mulberry.

A total of 32 germplasm accessions were collected from the gene bank of CSGRC, maintained at 33 accessions including four elective varieties and V-1 in the conserved nursery for raising seedlings. Among them, 17 were established in pots for root rot inoculation screening. A total of 36 fungal isolates from root rot infected mulberry genotypes were collected from the states of Andhra Pradesh, Tamil Nadu and Karnataka. Cultural and morphological characteristics of 19 fungal isolates were recorded. Twelve fungal isolates of Macrophomina phaseolina were more multigenic for pathogenicity testing. Sixteen numbers of V-1 seedlings were raised in the pots for pathogenicity test of fungal isolates. A total of 11 primer pairs (six microsatellite markers, nine custom synthesized for characterization of mulberry germplasm. Out of the nine, the PCR amplification of six primers was standardized.

7. 2 Establishment of Sub-Distributed Centres (Sub-DCC) under biotechnology information system network programme (BTIS Net) of Department of Biotechnology, Govt. of India

Coordinators: B. R. Bhadana, R. Swamy and S. K. Ashwath

Objectives:

- Maintain information repository of silkworm and mulberry germplasm resources.
- Develop and maintain database of silkworm and mulberry genomic resources.
- Conduct training and workshops to create awareness in the area of bioinformatics.
- Solve problems in analysis and dissemination work.
- Create database through website and provide online support for user community and bioinformatics resources.

Eight databases viz., Mulberry GRIT, mulberry genome database, Silk b-mtD, database of SNV sequences for important eight genes in mulberry, SSR-PIC database on mulberry plants and database and database on silkworm pests and diseases were updated and maintained. A two day workshop on Bioinformatics and its applications was held in which 25 scientists from CSRTI, Mysuru and Regional stations participated. The workshop deliberated on basic genetics, silkworm and mulberry biotechnology, integration of proteomics and genomics, bioinformatics tools and techniques, IT applications, internet applications using open source software, biological databases, structural biology, 3D structure of protein visualization and drug designing.

(E) PPV & FBA-TSM&DD

E.1 PME 0207: Development of Multivoltine, bothvoltly and Bivoltly (CSR) silkworm hybrids for multivoltine silkrearing and their evaluation under tropical and subtropical zones

B. G. Sharma, Director, V. Girish Kalti (PI), Suresh Dora, S. Chakravarty, T. Thimmareddy, Sandhyarani, SRP

Objectives:
- Survival and viability assessment for multivoltine
- Identify productiveness and specific heterogenous recombinant/crossover carriers, and its plurality
- To characterize the extent of variability
- Develop checklist for the descriptors of multivoltine to add on to NBAIR- Silkworm Germplasm Database for DUS

The descriptor (46 characters - including morphological, reproductive, economical and growth parameters) have been initially shortlisted and 18 multivoltine varieties were identified for evaluation of descriptors. Data recording of 23 morphological characters were completed for validation of DUS test. Short listed morphological characters descriptors will be used to demonstrate the distinctiveness, uniformity and stability.

(G) WMO FUNDED

E.1 PPP 0209: Development of sericulture culture model for income augmentation (June 2012 to December 2013) – in collaboration and funded by WMO, Chennai

B. G. Sharma, Project Co-ordinator (CSRTI, Mysore), B. Sharma, Project Co-ordinator (CSRTI, Kalimpong), K. Ambikapathy (PI) and S. Jain (CO-PI, Kalimpong), Mohammad Ashraf (Field Assist, Kalimpong)

Objectives:
- To work out the economic income generating out of sericulture and its economical relation to multivoltine silkworm production.
- To assess the soil fertility status of the soil from tea plot and comparison.
- To find out the cross infectivity studies, if any, from multivoltine to tea plant and vice versa.

Flemingia being a leguminous plant can retain and survive in long dry spells and has the capacity to fix the atmospheric nitrogen. Root nodulation can take place very freely with native rhizobial soil types in WMF Nadavi. Considering the advantages associated with the perennial nature of shrub, attempt has been made to grow Flemingia as an intercrop with multivoltine at TSRDS, Chamarajanagara. The experimental plot initially at 60cm x 45cm with existing multivoltine mulberry crop plantation in wider spacing (2 m x 2). Three months old Flemingia seedlings were transplanted in between multivoltine tree plantation with spacing of 1 m x 1 m. Regular cultural operations like weeding, manuring and irrigation twice in three days were carried out by the farmer's supervision. Around 450 seedlings were transplanted per hectare of for its growth and biomass production after eight months of transplantation. The survival percentage was recorded around 85 %. The biomass production per plant ranged from 0.400 kg to 0.600 kg including around 4 leaves with the shoot length of 80 cm – 110 cm. It was observed that high temperature (>35°C) followed by dry weather during the growth period coupled with high soil pH (> 8.0) resulted in poor growth of the plants. Leaf based culture media mediated at times also proved apt inoculant on the tea host plants facilitating colonization for its production. It was found that Flemingia being a leguminous plant owned soil enrichment resulting in reductive effort from 25 to 50 % and is beneficial for mulberry growth.

Under irrigated conditions at farmers plot, permissible land preparation was carried out (+) spacings were closed and transplanted in wider spacing (TCP spacing). Plantation is under establishment. Flemingia space bars also grown in prominent spacings in case the seedlings are around 15% survivability was noticed in the nursery.

(C) JCA PROJECTS

8. 1 Popularization of rotary mooring for quality cocoon production (April 2013 Continuing)

A. Ramakrishnan (PI), K. R. Krishna (Chemist), Ms. Mitra Devaprasad, JCA Project

Objective:

- To Popularize rotary mooring in order to overcome energy, monetary losses for quality cocoon production

An extensive survey was conducted along with JCA upon the Extn.Viswapoint in AP, KA and TN and collected the feed back from the sericulturists for non adoption of rotary mountage technology for quality cocoon production. To substantiate the technology the farmers were advised to follow some non cocoon method for collection of 30% of the mature larvae to reduce the mountage during spinning time and go for mounting of 80% mounting on rotary mountages and the remaining on chandrike. With this method at least 70% quality cocoons are produced and in turn economic gain. In Karnataka, Andhra Pradesh and TN five clusters each were selected and provided with 50 rotary mountages and 500 kg of cum-net which can accommodate 100 dfls and a pair of pushed cocoon machineries. In populated this method demonstration programmes were conducted at K. Kothakoti, K.R. Pete, Kunda, T.N. Janta, Peddapura cluster (Karnataka), TPS Puram, Pillari cluster (TN), Chinnam Gollu and Tekulapalli villages in V. Kota and Pileru cluster (AP), community mounting halls where mulberries are organized at subcentres. V. Kota in Andhra Pradesh for conveying from to rotary mounting halls. Rotary mountage quality control committee meeting with manufacturers and the farmers was conducted at CSB, Bangalore.

VIII. CENTRAL OFFICE PROJECTS & PROGRAMMES (NATIONAL)

1. All India Co-ordinated Experiment on Multivoltine Evaluation Phase III

Duration:	June 2011 to June 2014
Zones Co-ordinator:	K. R. Krishna
Investigators:	T. Thangavelu, M. A. Kothari, Rele and JPS, Rajasekar, L. S. Ganesh Dixit, S. S. Choudhary (upto 31.08.2013) and Mallikarjuna
Objectives:	• To test multivoltine combos in different agro-climatic zones of India for assessing the region specific yields.

Test combos in southern zone

State	Test combos
Karnataka	CSR19, Uttara Karnataka State Sericulture Research & Development Institute, Bangalore, Research Extension Centre, Madanapalle
Tamil Nadu	Research Extension Centre, Kothagiri Tamil Nadu Agriculture University, Coimbatore
Andhra Pradesh	Regional Sericultural Research Station, Anantapur Research Extension Centre, Mulanbagal, Research Extension Centre, Piddagandla, Andhra Pradesh State Sericulture Research & Development Institute, Warangal

The experimental plots were established in all the four test centres in the southern zone with three test varieties (PM*SK4, CSR2, Suvarna-2) and four check varieties (Mysore and V1). After final pre-monsoon crop during June 2013, three cross hills were received.

Last mile activities of front runners and choices in NSDS hub centres of southern zone

Activity	Last mile activities								
	Dharwad, Karnataka			Guntur, Andhra Pradesh			Jalna, Maharashtra		
	Group I	Group II	Group III	Group I	Group II	Group III	Group I	Group II	Group III
Q. 2008	7500	15000	22500	7500	15000	22500	7500	15000	22500
[illegible]	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2009-10	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2010-11	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2011-12	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2012-13	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2013-14	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2014-15	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2015-16	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2016-17	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2017-18	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2018-19	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2019-20	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2020-21	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2021-22	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2022-23	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2023-24	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2024-25	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2025-26	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2026-27	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2027-28	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2028-29	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2029-30	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2030-31	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2031-32	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2032-33	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2033-34	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2034-35	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2035-36	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2036-37	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2037-38	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2038-39	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2039-40	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2040-41	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2041-42	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2042-43	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2043-44	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2044-45	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2045-46	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2046-47	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2047-48	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2048-49	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2049-50	6000	12000	18000	6000	12000	18000	6000	12000	18000
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Q. 2051-52	6000	12000	18000	6000	12000	18000	6000	12000	18000
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Q. 2056-57	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2057-58	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2058-59	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2059-60	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2060-61	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2061-62	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2062-63	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2063-64	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2064-65	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2065-66	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2066-67	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2067-68	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2068-69	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2069-70	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2070-71	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2071-72	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2072-73	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2073-74	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2074-75	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2075-76	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2076-77	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2077-78	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2078-79	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2079-80	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2080-81	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2081-82	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2082-83	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2083-84	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2084-85	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2085-86	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2086-87	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2087-88	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2088-89	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2089-90	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2090-91	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2091-92	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2092-93	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2093-94	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2094-95	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2095-96	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2096-97	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2097-98	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2098-99	6000	12000	18000	6000	12000	18000	6000	12000	18000
Q. 2099-00	6000	12000	18000	6000	12000	18000	6000	12000	18000

*Crop 1 & 2 could not be harvested in Mahajan and Dadhadi due to severe drought

1. NB 2002: Popularization of authorized Bikaneri cotton hybrids among the farmers of South India

Duration:	November 2012 to October 2014
Project Co-coordinator:	**Dr. R. Bhatnagar**
Investigators:	The Director, CIRCOT, Mumbai (Lead Coordinator) The Director, NSDS, Bangalore; The Director, CCRH, Bangalore The Director, APSDSS,Hindupur; The Director, NSDS, Thrippathoor, Bangalore Commissioners/Directors of Agriculture, Karnataka, Andhra Pradesh, Tamil Nadu and Maharashtra
Objective:	• To popularize the authorized hybrids for commercial exploitation.

The parental lifts (Bikaneri hybrids, CSH 16 and CSHH 1) were supplied by CIRCOT, Mumbai to farmers for raising of seed crop and subsequent generation of hybrid seed. A total quantity of 3,70,000 lifts of CSH 16 & CSH 1 were tested at different locations of Karnataka, Andhra Pradesh, Tamil Nadu and Maharashtra and recorded an average cotton yield of 66.7 kg / 100 lifts. The state wise data up to now final a total of 84,750 lifts were distributed to 150 farmers in Karnataka and the hybrid recorded an average cotton yield of 63.25 kg / 100 lifts. In Andhra Pradesh, a total quantity of 2, 00,000 lifts were distributed to 400 farmers and the hybrid recorded an average cotton yield of 68.75 kg / 100 lifts. In Tamil Nadu, a total quantity of 66,750 lifts were distributed to 130 farmers and the hybrid recorded an average cotton yield of 67.50 kg / 100 lifts. In Maharashtra, a total quantity of 70,500 lifts were distributed to 20 farmers and the hybrid recorded an average cotton yield of 61.25 kg / 100 lifts. The hybrid provided the silk quality of 24 to 26 grade.

Field performance of CSH 16 & CSHH 1

Sl. No.	State	No. of lifts	No. of farmers	Actual yield (kg)	Yield / 100 lifts	Cocoon weight (g)	Shell weight (g)	Shell %	Fiber (kg / lifts)
1	Karnataka	84750	150	1,00,000.00	66.66	1.50	0.32	20.5	0.75
2	Andhra Pradesh	200000	400	3,00,000.00	68.75	1.52	0.33	20.8	0.80
3	Tamilnadu	66750	130	2,00,000.00	67.50	1.50	0.30	21.1	0.75
4	Maharashtra	7050	20	4,000.00	61.25	1.45	0.31	20.1	-
	Total/Average	358550	1500	10,00,000.00	66.66	1.50	0.32	20.6	0.77
	[illegible]	358550	1500	10,00,000.00	66.66	1.50	0.32	20.6	0.77

*Cocoon Crop data

III. ON STATION TRIALS CONDUCTED BY RSRSs

1. RSR's coastal Karnataka

a. Evaluation of the resource conducted varieties RC3 and RC5 at the seed and coordinated of RSR's, Kodlipet

Shoot crops growth and yield data were recorded and the leaves were utilized for rearing. The cocoon based yield data of 4 crops were sent to CSRTI, Mysore. The results indicated that there is no significant difference in the leaf yield among the three varieties RC1, RC5 & Kajli. However, the growth parameters like height of the plants, number of plants, branches and leaf moisture percentage recorded a significant variation among the three varieties.

b. Control of root rot disease in different mulberry varieties by Neemax application

Plantation with five mulberry varieties viz., V1 - S36, K2 & RFS 135 in paired row system is being maintained with appropriate cultural operations. Observation for the incidence of root rot disease was recorded in three crops and leaf was utilized for silk rearing. Neemax was applied to all the plants for all crops. It was observed that out of four varieties, the variety V1 is more susceptible (20%) and variety RFS135 (8%) is more resistant to root rot disease. The Neemax is very effective and the incidence of root rot disease was reduced more than 50% of the previous year i.e. 2%.

c. Demonstrations of technologies

Demonstration plots were maintained on integrated nutrient management package (INM) and silk reeler mini reeling (50+50+150 x 50/50+150) for large scale farming community and surrounding and some surrounding villages maintained appropriately for the demonstration of the technologies for the farmers visiting the station. A total of 2240 farmers/ students/ officials who visited the station during the period were benefited on the advantages of these technologies.

d. Three crop cocoons

3 three-way cross double hybrids were evaluated during June-July, August and October-November. The NB4 hybrid, FC4 x C2R17 was superior in terms of MS (%), weight (N.F. kg) and cocoon weight (1.74 g), filament length (672.4 m) and ratio (68.5 %) (Tab. 1), which compared to NB4D2 (1.46 kg, 1.71 g, 781.3 m and 18.3 %) in case of control, FC1 x FC2 succeeded.

e. Bivoltine hybrids

One trial of bivoltine hybrids (61 x D 9 and 81 x 82, CH1, CH2) along with control hybrids (FC1 x FC2, C2R6 x C2R08, C2R8 x C2R2, C2R27 and C2R2 x C2R4) were evaluated. The double hybrid, 81 x D19, recorded the highest SHC cocoon (MSC), SHW and 1,774 kg), which compared to (FC1 and 1.5 respectively in the control hybrid.

f. Bivoltine Double hybrids

One trial of double hybrids viz., CC x D1, D1 x D2, (D3D2 x D3B50) x (D3D1 x D3B30), (2n+) DH 2, Double hybrid (Kolimandala) and D3D2 x D3B4 as control hybrids received from D3D2, Coonoor were evaluated. Highest SHC No. of 3600, SHW of 47.2 kg, cocoon weight of 1,745 g was found in D3 x D3 which compared to 7800, 17.5 kg, 1,8778 g respectively in the control.

a. Multi-location trials

One hybrid improved cooking yield, KDH 4 (CO(H) 4 x CO(H) 5) and 1 hybrid CO(H) were evaluated during the month of Oct. - Nov. 2013 along with control hybrid ATM 3 x CO(H) 4. The hybrid KDH 4 was found to be superior in terms of highest green leaf yield (6600 kg/ha), green fodder yield (17777 kg/ha), dried fodder weight (5,276 g), dried leaf yield (1634), flowered weight (11.4 t/ha) and dry stalk yield (7.6 t/ha), while in the control hybrid, ATM 3 x CO(H) 4, the values were 5600, 1633 kg/ha, 1656 g, 5,000 g, 10.1 t/ha, 7.6 t/ha and 13.3 t/ha respectively.

2. Milk & Dairy Development Activities

a. Evaluation of HG1 and HG2 genotypes under water stress conditions

Germplasm of HG1 and HG2 was taken up with two farmers during the period under report. One farmer harvested two crops and another farmer harvested one crop. Average of three crops leaf yield data indicated that, the variety HG1 yielded 3781 (14.89% improvement) kg/acre/cut and HG2 gave 3313 (4.11% improvement) kg/acre/cut where as check variety- CO 5 gave 1 ton kg/acre/cut. Cuttings of HG1 and HG2 supplied to KVK, Kanadukathan and Government Cattle Farm, Thalaivasal, Dist, Tamil Nadu for distribution to farmers. Seedlings are raised in nursery beds at TCRC, Dharmapuram for distribution to farmers.

b. Integrated nutrient management package for multiple cut situation

The TCRC was implemented with 15 farmers having 1+1 multiple cut garden in URDT soil having water irrigated condition. Inputs were supplied @ 3 kg Azotobacter, one kg PSB and one liter Rhizobium per acre for each crop and one time supply 4 kg green manure seeds and 200 kg neem oil cake during first period under report only. Green leaf yield data was recorded from both trial and control plot covering ten farmers field. Pooled data indicated that the trial plot shown higher leaf yield of 9 kg/cut/plot over the control plot (approximately with an leaf yield improvement of 6.1%. The average cotton yield was recorded as 21.4 kg/100 plant which with an improvement of 10.1 % over control plot.

c. Testing of new three way cross double hybrids

Two no. Station Trials (CBT) were conducted with PC1 x CBR and PC3 x CBR F hybrids PC1 x PC3 and CBR x CBR as control. The data indicated that the three way cross hybrid PC1 X CBR and PC3 x CBR F1 had shown higher BMR by number (9000 and 8467) and by weight (14777 and 14,773 kg). In comparison to control hybrid PC1 x PC3 and CBR2 x CBR1. Similarly the two hybrids had shown comparatively higher cobs/m sq, shell wt, and shelling % than the control hybrids.

d. Demonstration of efficacy of soil fly controlled biocontrol formulation for control of soil fly

Regular mass production of H. thymus on locally sipped was undertaken at TCRC and commercially completed were released in field during rearing period. The data were collected before and after release to assess the percentage of reduction of infestation. During 2013-2014 a total of 7200 no. (100 packets) H. thymus were released on locally sipped and 7200 H. are supplied to FT farmers under TCRC. The total infestation of soil fly was 14.1% and it was reduced to 6.27% after release of H. thymus. Economics was worked out based on the feed back data collected from farmers and it was found that a net profit of Rs.1,000.00 was obtained in 100 ha.

e. Demonstration of efficacy of entry and beetle for control of black weevil bug

Mass production of S. cocciphora through culture of mealy bug in pumpkin was initiated at TCRC. 12 boxes of lady bird beetles (S. cocciphora / C. montrouzieri) were released in 15 farmers

garden and in RSH2 farm. The initial infestation recorded was 23.67% before release of bio control agents which had reduced to 5.83% after release of lady bird beetles. Economics was worked out based on the feedback data collected from farmers and it was found that a net profit of Rs.114.00 was obtained per acre with the cost benefit ratio was 1:1.81

3. Krishi Vigyan Kendra, Hassan Annexe

New shoottip three-way cross hybrids, FC3 x SSR IT and FC1 x DSR2 were tested along with the controls, FC1 x FC2 and DSR2 x DSR4. The hybrid, FC1 x DSR2 showed the highest CBR No. (CBR at 10 hpi, cocoon weight (1.302 g) and shell weight (0.427 g), when compared to SSR, IT (1 hpi, 1.1838 g, 0.41 g), respectively in FC1 x FC2. The shell/cocoon ratio did not vary significantly. Multiple trait shoottip x deaftop hybrids, (FC1 x SSR_IT) x (C_FC2_FC1 and DSR2 x DSR4) were tested. FC1 x SSR showed the highest CBR No. (CBR) and weight (45.1 dg) when compared to the control.

4. RSRS Kalale, Tamilnadu

a. Testing of New Tensi Bivoltine Cross Bivoltine Hybrids

Three trials completed with new three way cross bivoltine hybrids viz., FC1 x DSR2, FC2 x DSR1T along with DSR2 x DSR4 and FC1 x FC2 as Control hybrids. Results of the trials indicated that FC1 x DSR2 has performed better with respect of CBR no. (90%), CBR wt. (1.45 dgs), DCR (-1.42%), DSHW (23 followed by FC1 x DSR1T. Regarding the rearing parameters, FC1 x DSR2 was superior for vegetality (96.34%), ART (11.45 days), MSPC (10.42 [illegible]) and FC1 x DSR1T was superior for Mortality (3.6 %) and MSP (79.1 No.) compared to control hybrids.

b. Testing of Improved Cross Breeds

Two trials completed with two improved cross breeds viz., L14 x DSR2, NB18 x DSR4 along with L14 x DSR2 and FB1 x DSR2 as control hybrids. L14 x DSR2 (Control) was superior for CBR No. (92.12), GPC (NI (1.45dgs), DCR (-1.42%), DSHW – 23 days and SFI (92.1%) followed by NB18 x DSR4 (). Third trial testing data indicated that L14 x DSR2 was superior with ART (11.83 Days), MSPC (92.2 No. deaths (2.45), Mortality (3.36) and MSP (1.8 Kgs) followed by NB18 x DSR4 ().

c. Testing of Bivoltine hybrids developed by NSRI, Component

a) Pilot trial completed with two bivoltine double hybrids developed by (DSR2, Crossbred viz., CH1, CH2 and CH3 along with FC1 x FC2 as control. Results of the trial indicated that the rearing performance of CH1 was superior for CBR (No. basis), ERR (%), (18.52kgs) and SCCV (1.4kgs) followed by SH2 comparable control.

b) Pilot trial completed with two bivoltine single hybrid (C2 x CH 3) and double hybrid (CH x C2) x (C1 x CH1) developed by DSR2, Crossbred along with DSR2 x DSR4 and FC1 x FC2 as control hybrids.

d. Testing of new bivoltine breeds developed through marker assisted selection by NSRI, Bangalore

One trial completed with three bivoltine breeds developed through marker assisted selection by scientific Staff/scientist of NSRI, Bangalore. Among the three breeds, SHASHIKALA has performed better with favourable (21 (- SHWR No. (SSR), SHWR Wt. (1.87dgs), SCCV (1.2kgs), ERR (0.2kgs) and SR (2.32%) followed by NVSR.

3. SERICULTURE EXTENSION

S.S. Hiriyur, Sandhya Tewary, S.B. Hegsagara, B. Ramachandra, S.S. Godkhindi, Mahima Santhosh and A.B. Dutta

I. Cluster Promotion Programme (CPP)

The Cluster Promotion Programme (CPP) is implemented in Southern zone viz., Karnataka, Andhra Pradesh, Tamil Nadu, Kerala, Maharashtra and Madhya Pradesh from 1st April 2013 to 139 clusters. The clusters in Southern zone are categorized into 95 mother clusters and 44 satellite clusters. The Director, CSRTI, Mysore is the south zone coordinator.

In the cluster promotion approach, a cluster of villages and families in close vicinity are selected and adopted so as to have synergistic effect of the improved technologies introduced under the programme and the programmes are managed by the farmers themselves and extension workers jointly with the active participation of local stakeholders. The main objective of establishing these clusters is to produce 4000 MT of graded Raw silk by the end of XII plan. The projected raw silk output for 2013-14 was 1400 MT for southern states including Madhya Pradesh.

During the year, south zone clusters have achieved the target in raw silk production. The cumulative raw silk produced is 1405.61 MT against the target of 1400.00 MT. The Tamil Nadu and Andhra Pradesh states have achieved CHC pockets target in DFLs distribution in CHC. A total of 15,411 lakh DFLs were distributed to the farmers of the clusters against the target of 15,000 lakh with an achievement of 102.74%. In the clusters 8029.040 MT of cocoons were produced with an average yield of 68.1 kg for 100 DFLs. In these clusters 1234 farmers had newly planted 1855.5 (1) acres.

Progress report of CPP of southern zone for the year 2013-14

State	Clusters	No. of farmers	Area under mulberry (acres)	Cocoon production (MT)	Raw silk production (MT)	Bivoltine hybrid (%)	Improvement		Remarks
	Target / Existing	Existing / planned	Existing / planned	Existing / planned	Existing	Existing	No. of farmers	Area (ha)	Remarks
Karnataka	1500	8000	1500	2000.0	800	100	500	1000	0.0
Andhra Pradesh	500	1500	1500	1500.0	600	100	500	500	0.0
Tamil Nadu	1000	4000	1000	1500.0	600	100	1000	1000	0.0
Kerala	500	1000	1000	1500.0	600	100	1000	1000	0.0
Maharashtra	500	1000	1000	1500.0	600	100	1000	1000	0.0
Total	3500	15500	6000	8000.0	3200	500	4000	4000	0.0

II. Visitors Services

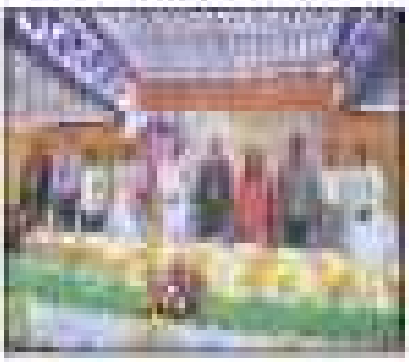
The institute is one of the tourist attraction places in Mysore, especially for the students of sericulture sciences, farmers from sericulture background and foreign visitors. During the period, the visitors have co-ordinated the visit of 2445 farmers, 2200 students, and 140 others including foreigners to the institute covering different sections and interacted with scientists and they have utilized the visit for information.

Month	Farmers	Students & Others	Others/Foreigners
April 2013	32	150	-
May 2013	150	-	-
June 2013	50	-	-
July 2013	117	27	10
August 2013	450	98	-
September 2013	150	414	17
October 2013	122	120	17
November 2013	1120	421	
December 2013	450	600	17
January 2014	150	340	-
February 2014	120	50	-
March 2014	400	110	-
Total	3445	2330	101

8. Mass Media Programmes

Agriculture Farmers Workshop

Central Sericultural Research and Training Institute (CSRTI), Central Silk Board, Mysore jointly with Department of Agriculture, Government of Karnataka organized one day workshop on "Agriculture for sustainable livelihood for the farmers on 22nd January, 2014 at its Campus to enlighten them on the recent technological developments made for benefits of agriculture industry. Chairman, Member Secretary and Board Members of CSB graced the Agriculture Farmers Workshop at CSRTI, Mysuru.



A large number of farmers (about [illegible]) representing all the 30 districts of Karnataka state, besides hundreds of CSB officials, sericulture entrepreneurs, representatives from NGO participated in the workshop. A host of dignitaries including Shri. N.S. Bhasavanthi, Honble Chairman, Central Silk Board, Bangalore; Padmabhushana Prof. N. Balasubramanya, Former Vice Chancellor, UAS, Dharwad and President, Former Vice Chancellors Forum, Hon. Smt. Asha Roy, I.A.S., Member Secretary, CSB, Bangalore; Shri M.C. Lingaraj Babu, Board Member, CSB, Bangalore; Shri M.P. Lakshmipathi, Board Member, CSB, Bangalore; Shri R.K. Jayasimha Reddy, Board Member, CSB, Bangalore; Shri B.S. Ramakrishnappa, Board Member, CSB, Bangalore; Shri Ramadas, JDS, DOS Karnataka; Shri N.G. Shanthamurthy, DDS, DOS; Dr. K.K. Reddy, Dr. M.N. Ramakrishnappa, Dr. K.R. Vijaya Prakash, the Directors, CSB; Mr. [illegible] Sangle, Assistant Director and Dr. H.S. Basavaraja, Dy. Scientist-E, CSRTI were present at the event.

As a part of workshop, a sericulture exhibition and on-spot demonstration of new technologies were organized for the benefit of visiting farmers. The new technologies/ products/ equipments/ machineries developed by the institute were showcased. Other sericulture research institutes i.e., CSTRI, Mysuru and APSRTI also participated in workshop and exhibited their technologies.

On the same occasion many new technologies/products developed by the institute were released for the popularization among sericulture farmers. The main technologies released were:

1. Sericulture Technology: Hornless cocoon
2. Proceedings of seven national seminars of CSRTI, Mysuru - set I
3. Commemorative Stamp
4. Multivoltine Silkworm Hybrid (Chamaraja)
5. Multivoltine Silkworm Hybrid (Jayachamaraja)
6. Multivoltine Silkworm Hybrid (Mysore Gold)
7. Sericulture Technology: Pictorials in English
8. Sericulture Technology: Pictorials in Kannada

Feed back collected from the participants of Farmers Meet

a. Profile of the participants: Majority of the farmers who attended the Farmers Meet were male (81.42%), aged between 41-50 years (30.71%) and belonged to middle age group (41-60 years). Other age group (above 60 years) formed 27.86% and belonged to young age group (below 40 years). About 77.86% were educated from primary to high school level while only 12.86% were illiterates and 9.43 % graduates. The knowledge level was medium in 65% and high in 30% of the farmers. Among the participants, 51.71% belonged to general category, while 32.57 % were from SC/ST category. Majority of the sericulture farmers (one third) belong to the middle age group of 41-50 years (33.86%). Further about 28.43% of the sericulture farmers were carrying out silkworm rearing in separate rearing house, while as 57.86% rear in dwelling cum rearing houses. About 70% of farmers were making

(b) Co-efficient ratio: 37.89% mean 200:200Rs / cms. The average land holding was 3.40 acre under rainfed and 2.14 under irrigated. The average number of crops per year cultivated with an average annual income of Rs.1.54 lakhs/year.

c. Impact : It was found that there was a considerable increase in knowledge levels of farmers attending chawki rearing in respect of technologies like disinfection of rearing house, use of bed disinfectants, nursery chawki rearing, soil testing, timely application of fertilizers etc. Further, on spot technology demonstrations and exhibition of the consumer/public issue also elevated the farmers knowledge levels. Consequently for the chawki rearing centres got good cocoon % of the farmers, as compared to 7 years since and this is mainly upon most use average.

ii. Models of cocoon sale CRC, on chawki cocoon

The main aim of model chawki rearing center is to associate chawki-rearing concept through private entrepreneurs to promote cocoon sericulture in India. It is also utilized as training school for training interested farmers particularly egg handling, bed cleaning, bed spacing, temperature and humidity maintenance etc. During the period, a total of 62000 dfls brushed in 22 batches and distributed the chawki worms to adopted farmers. The farmers recorded an average yield of 67.71 kg/100 dfls with an average cocoon sale price per kg. An average return per dfls recorded was Rs.240/-. The total revenue generation recorded was of Rs.3,01,440/- through sale of chawki worms. Besides, a total of 287 farmers were trained in chawki rearing technology at the model center.

Chawki rearing details of cocoon farmers

Months	No. of batches	Qty. of eggs/g	Pupation (kg) %	No. of farmers involved	Value (Rs.)	No. of farmers trained	Yield (kg)	Revenue generation (Rs.)
April 2013	1	500	86.00	12	6500	11	345	17,250
May 2013	2	1000	91.00	18	14400	21	744	37200
June 2013	2	1200	91.00	18	15600	12	810	40500
July 2013	3	1000	92.00	20	15200	19	759	37950
August 2013	2	600	89.00	12	7500	11	360	17400
September 2013	1	700	90.00	10	8400	10	510	25500
October 2013	1	400	90.00	07	7200	08	288	14400
November 2013	1	900	92.00	08	7500	09	342	17100
December 2013	1	1000	89.00	10	7500	09	333	16650
January 2014	1	800	90.00	10	7200	08	297	14850
February 2014	2	600	90.00	12	6720	10	271	13550
March 14	2	600	90.00	15	6720	21	264	20350
Total/Avg.	22	62000	91.00	168	97721	287	330	301400

iii. Awareness on Role of CRCs in sericulture sub production

Central Sericultural Research and Training Institute, Mysore organized a Workshop on Role of CRCs in sericulture sub production on 13th December 2013 at CSRTI, Mysore. The main objective of this workshop was to provide a platform to the owners of Chawki Rearing Centres to discuss and exchange their views, problems and constraints for supply of quality chawki worms and to interact with the scientists of the institute, seed producers and the DOS officials.

Mr. Nitin Ray, I.A.S., Director Secretary, Central Silk Board, Bangalore, representative of Department of Sericulture, Karnataka and Tamil Nadu Dr. D.B. Bhimba Shenoy, CSRTI, Mysore and Dr. B.N. Anjala Devaiah, Mysore, Bangalore, the owners of Chawki Rearing Centres, Dealer Development Facilitators of Central Silk Board along with cocoon officials from Karnataka, Andhra Pradesh and Tamil Nadu were present for the workshop.

A technical booklet on "Commercial Chawki Rearing –Practicing Idea Practices" was released during the occasion by CDO and Member Secretary, CSB, Bangalore. On the same occasion scientific presentations on scientific topics was organized for the benefit of CRC owners.

Post lunch session started with group discussions among coffee growers, coffee and cafe representatives accompanied by interactive session. Totally 6 groups were constituted, first three groups were from Karnataka, 4th & 5th groups from Tamil Nadu and 6th group was from Kerala respectively.

All the groups discussed on the 10 points of agenda of workshop and gave their recommendations. These various recommendations were presented in valedictory session for further necessary action.

8. Supply of seed seedlings and saplings of improved maturity varieties

Sl.No.	Name of centre	Nursery area (ha)
1	RRC Hirehalli	0.20
2	RRC Sakleshpur	0.20
3	RRC Virajpet	0.20
4	RSS Chikkamagaluru	0.10
5	RSS Pandikudi	0.14
6	RSS Devarshola	0.20
7	RRC Chikkamagaluru	0.20
8	RRC Kalpetta	0.20
9	RSS Kodaikanal	0.10
10	RSS Kodaguhalli	0.10
	Total	1.84

9. Performance of CAR trainees in the command area of Krishi

Sl.	Name of centre	No. of trainees	No. of offs trained	Average income (per coffee unit)
1	RRC Hirehalli	110	11000	50.00
2	RRC Chikkamagaluru	144	21600	74.74
3	RRC Sakleshpur	600	60000	33.00
4	RRC Virajpet	900	225000	66.74
5	RSS Pandikudi	221	22100	50.00
6	RSS Devarshola	647	116460	63.74
7	RRC Chikkamagaluru	140	33600	67.00
8	RRC Kalpetta	500	100000	50.00
9	RSS Kodaikanal	41	12300	60.00
10	RSS Kodaguhalli	201	60603	43.74
	Total/Avg.	4149	915363	54.00

8. Income generation at R&D by test tested units (Rs. in lakhs)

Name of Units	Total Income (Gross)	Total Income	Total Foreign exchange earnings	Total Foreign	Direct	Total
[illegible]	-	[illegible]	-	-	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

III. HUMAN RESOURCE DEVELOPMENT

S. D. Sharma, Ravindranath, S. B. Patil, S. Lakshmanan, L. M. Sudha, R. S. Gupta, Vivek Kumar, A. S. Juyal, and A. Singha

a. Management Development Programmes (MDP)

Sl. No.	Name of the course	Duration	Number of persons trained
1	[illegible]	10 days	24
2	Mobilization in Horticulture	4 days	13
3	Disease Management	4 days	13
4	Nematode Control	4 days	16
	Total		134

b. Technology Up-gradation Programmes (TUP) for scientists

Sl. No.	Name of the course	Duration	Number of persons trained
1	[illegible]	5 days	167
2	Computer software training for scientists	10 days	21
3	Mobbing Formulation	5 days	13
4	Integrated pest and disease management for [illegible]	5 days	22
	Total		223

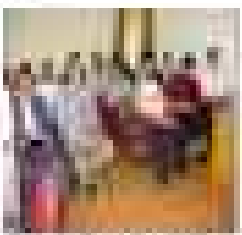
c. Training under integrated skill development scheme (ISDS)

Sl. No.	Name of the course	Duration	Persons trained
1	[illegible]	10 days	37
2	Mobbing Formulation	10 days	19
3	Cashew Nut Products	10 days	40
4	Quality Seed [illegible]	10 days	52
	Total [illegible]		148
5	MANAGE, Hyderabad	10 days	100
6	NAIP, [illegible]	10 days	60
7	NAIP, Pune	10 days	100
8	NAIP, Kolkata	10 days	70
	Total		330

d. Intercultural Training Programmes

Sl. No.	Name of the course	Duration (days)	Number trained
1	Plant biotechnology, tissue culture and plantation management for officials from Bangladesh	10	21
2	[illegible]	10	21
	Total		42

Trainees from Bangladesh



Trainees from Afghanistan

4. Programmes conducted

The training centres [illegible] organizations, universities, departments of agriculture, etc., to train their staff in improved agricultural technologies from time to time. Accordingly, the additional programmes were planned and [illegible] were implemented during [illegible] programmes.

Sl. No.	Name of the course	Duration (days)	Sponsoring agency	No. of persons trained
1	[illegible]	3	[illegible]	15
2	[illegible]	6	[illegible]	18
3	[illegible]	10	[illegible]	17
4	[illegible]	5	[illegible]	20
			[illegible]	
			[illegible]	
5	[illegible]	4	[illegible]	22
6	[illegible]	3	[illegible]	150
7	[illegible]	3	[illegible]	12
8	[illegible]	7	[illegible]	28
9	[illegible]	5	[illegible]	15
10	[illegible]	4	[illegible]	3
11	[illegible]	3	[illegible]	1
12	[illegible]	10	[illegible]	18
13	[illegible]	4	[illegible]	45
14	[illegible]	3	[illegible]	12
15	[illegible]	30	[illegible]	2
16	[illegible]	5	[illegible]	30
17	[illegible]	30	[illegible]	10
18	[illegible]	30	[illegible]	5
19	[illegible]	3	[illegible]	15
		Total		[illegible]

I. Training of stakeholders at R&D and vendor units

Sl. No.	Name of the course	Number of persons trained
RSRS, Kodam & vendor units		
1	Disinfection and disease management	[illegible]
2	Mulberry crop protection	[illegible]
3	Integrated nutrient management in mulberry	[illegible]
4	Silkworm crop protection	[illegible]
5	Soil fertility management	[illegible]
6	Training under ISDS	[illegible]
	Total	[illegible]
RSRS, Thalavadipura & vendor units		
7	Disinfection and disease management	[illegible]
8	Mulberry crop protection	[illegible]
9	Organic farming	[illegible]
10	Silkworm crop protection	[illegible]
11	Training under ISDS	[illegible]
	Total	[illegible]
RSRS, Kowdapur & vendor units		
12	Disinfection and disease management	[illegible]
13	Mulberry crop protection	[illegible]
14	Organic farming	[illegible]
15	Silkworm crop protection	[illegible]
16	Soil fertility management	[illegible]
17	Training under ISDS	[illegible]
	Total	[illegible]
RSRS, Kodathi & vendor units		
18	Disinfection and disease management	[illegible]
19	Mulberry cultivation and disease management	[illegible]
20	Integrated nutrient management in mulberry	[illegible]
21	Soil fertility management	[illegible]
22	IPM of silkworm and mulberry pests	[illegible]
23	Training under ISDS	[illegible]
	Total	[illegible]
Units directly administered by CSRTI, Mysore		
24	Disinfection and disease management	[illegible]
25	Mulberry cultivation and disease management	[illegible]
26	Integrated nutrient management in mulberry	[illegible]
27	Disinfection and disease management	[illegible]
	Total	[illegible]
	Grand Total	[illegible]

g. Feedback training to bivoltine silkworm rearings:

To support all the above activities, bivoltine silkworm rearings were organized in 5 districts. A total of 500 lots were reared with an average hatching silkworm of 92.74, single cocoon weight of 1.2nd, single shell weight of 0.4nd and shell percentage of 21.81. The average cocoon yield obtained was 64.41 kg / 100 dfls with an average rate of Rs. 215.26 per kg realized in the assigned cocoon market.

Mandal	No. of dfls	Hatch. %	Cocoon weight (g)	Shell weight (g)	Shell (%)	Yield/ 100 dfls	Rate/ kg (Rs.)
[illegible]	100	90.00	1.800	0.340	22.20	71.74	194.00
[illegible]	100	89.00	1.400	0.307	22.00	78.00	180.00
[illegible]	100	95.00	2.000	0.410	21.00	84.00	230.00
[illegible]	100	93.00	2.100	0.370	22.00	81.04	220.00
[illegible]	100	91.00	1.900	0.390	20.00	72.27	200.00
[illegible]	100	89.00	1.800	0.370	20.00	82.11	207.00
[illegible]	100	88.00	1.700	0.340	19.00	84.00	200.00
[illegible]	100	94.00	1.900	0.400	21.00	90.00	200.00
Total/Avg.	800	90.00	1.800	0.400	21.00	64.41	215.26

Race reared: Double Hybrid

h. Revenue Generation

A sum of Rs. 1037110.00 was generated by training centers from the sale of cocoons, cocoon fee, accommodation charges, etc.

III. PROGRAMMES BEING IMPLEMENTED IN COORDINATION WITH DOI OF DIFFERENT STATES (AT A GLANCE)

Sl. No.	Name of the Project/ Programme	Duration	States benefited/ covered	See Page No.
1.	Pre-sericultural trial trials of [illegible] CSRTI, Mysore and Bivoltine hybrids of Karnataka Domestic and [illegible] field conditions	Apr. 2013 to Mar. 2014	Karnataka, Andhra Pradesh, Tamil Nadu, Maharashtra and Madhya Pradesh	5
2.	Mobile Sericultural Extension Laboratory (Mobile Project)	Aug. 2011 to Dec. 2013	Karnataka, Andhra Pradesh, Tamil Nadu	79
3.	Popularization of bivoltine silkworm hybrids among the farmers of south India	Nov. 2012 to Oct. 2013	Karnataka, Andhra Pradesh, Tamil Nadu, Maharashtra and Madhya Pradesh	81
4.	Disease Prevention Programme	April 2013 to March 2014	Karnataka, Andhra Pradesh, Tamil Nadu, Kerala and the Union Territory of Puducherry	84
5.	Technology demonstrations – Integrated silkworm rearing and management, harvesting & cocoon marketing, Mulberry pest [illegible], Effects of Pesticides and Insecticides, Silkworm rearing in Mulberry	Continuous	Karnataka, Andhra Pradesh, Tamil Nadu, Maharashtra and Madhya Pradesh	88

(iii) [illegible]

[illegible] [illegible] [illegible] [

8. हिन्दी दिवस आयोजन पुरस्कार योजना का कार्यान्वयन: पंजाब एवं हरियाणा उच्चतम न्यायालय हिंदी में आदेश, अधिसूचनाएँ तथा अभिलेखों का हिन्दी में मूल रूप में प्रयोग बढ़ाने की दृष्टिसे प्रयत्न के लिए विशेष रोकड़ राशि की स्वतंत्रतापूर्वक वित्तीय प्रत्यायोजन योजना लागू की गई है जिसके अनुसार जिलाधीश तथा जिला न्यायाधीश को 1 जनवरी से 31 दिसंबर तक की अवधि के दौरान हुए रोकड़ के उपयोग के उपयोग के लिए स्वतंत्रता दी गई है। इस योजना के अनुसार जिलाधीश तथा जिला न्यायाधीश को प्रत्येक वित्तीय वर्ष में 10,000/- रुपये तक की राशि के भुगतान करने की शक्ति प्रदान की गई है।

9. सेवानिवृत्ति होने से पूर्व कर्मचारी का अवकाश: यदि वह कर्मचारी सेवा निवृत्ति से पहले छह माह की अवधि में सेवा निवृत्त होने वाला है तो 30 दिन, लेकिन यदि आवश्यक समझा जाए तो 60 दिन की अवधि के लिए।

10. हिन्दी पुस्तकालयाध्यक्षों का सम्मेलन: सम्मेलन की आवश्यकता होने पर सम्मेलन विशेष हिन्दी में आयोजित किए जा सकते हैं। सम्मेलन की मुख्य गतिविधियां पुस्तकालय कर्मचारियों के 2 दिवसीय प्रशिक्षण शिविर का आयोजन।

11. सम्मेलन नियम 10(4) के अनुसार आयोजित सम्मेलनों का अधिकृतिक विवरण प्रस्तुत करना है। हिन्दी में कार्यालयीन कामकाज के संबंध में संविधान 30 की धारा 8 के अनुसार कार्यालयों को न्यायालय द्वारा जारी किया गया है। इस सम्मेलन के अनुसार 10% अधिकारी कर्मचारियों को अधिकृतिक आदेश जारी किए जाएंगे।

12. हिन्दी प्रतियोगिताओं का आयोजन: सम्मेलन में नियम 10 और 11 के अनुसार हिन्दी प्रतियोगिताओं का आयोजन किया जाएगा। 1. प्रतियोगिता 1: सर्वश्रेष्ठ कार्यालय, 2. सर्वश्रेष्ठ कार्यालय में हिन्दी प्रतियोगिता के विजेताओं को पुरस्कार, 3. प्रतियोगिता 2: सर्वश्रेष्ठ कार्यालय में हिन्दी प्रतियोगिता के विजेताओं को पुरस्कार, 4. प्रतियोगिता 3: सर्वश्रेष्ठ कार्यालय में हिन्दी प्रतियोगिता के विजेताओं को पुरस्कार।

13. हिन्दी प्रतियोगिताओं का आयोजन किया जाए। हिन्दी प्रतियोगिता के नियमों को प्रकाशित, हिन्दी, मुद्रित एवं अन्य पुस्तकों प्रकाशित करने का निर्णय लिया।

14. सेवानिवृत्त न्यायाधीशों का सम्मेलन: पंजाब, हरियाणा, उच्चतम न्यायालय, चंडीगढ़ में सेवानिवृत्त न्यायाधीशों का सम्मेलन किया जाएगा। सम्मेलन में उनके अनुभवों को साझा करने के लिए एक मंच प्रदान करना है। सम्मेलन में उनके अनुभवों को साझा करने के लिए एक मंच प्रदान करना है। सम्मेलन में उनके अनुभवों को साझा करने के लिए एक मंच प्रदान करना है।

15. सेवानिवृत्त न्यायाधीशों का सम्मेलन: पंजाब, हरियाणा, उच्चतम न्यायालय, चंडीगढ़ में सेवानिवृत्त न्यायाधीशों का सम्मेलन किया जाएगा। सम्मेलन में उनके अनुभवों को साझा करने के लिए एक मंच प्रदान करना है। सम्मेलन में उनके अनुभवों को साझा करने के लिए एक मंच प्रदान करना है।

16. सम्मेलन में उनके अनुभवों को साझा करने के लिए एक मंच प्रदान करना है। सम्मेलन में उनके अनुभवों को साझा करने के लिए एक मंच प्रदान करना है।

17. सम्मेलन में उनके अनुभवों को साझा करने के लिए एक मंच प्रदान करना है। सम्मेलन में उनके अनुभवों को साझा करने के लिए एक मंच प्रदान करना है।

18. सम्मेलन में उनके अनुभवों को साझा करने के लिए एक मंच प्रदान करना है। सम्मेलन में उनके अनुभवों को साझा करने के लिए एक मंच प्रदान करना है।

III. ACTIVITIES REGARDING OFFICIAL LANGUAGE IMPLEMENTATION

During 2013-14 Official Language policy has been implemented with all Central level circular, Research and Training Institute, Hqrs are. Compliance of section 3 (3) of the Official Languages Act has been ensured. The progress of implementation of Hindi was reviewed from time to time by conducting meetings of the Official Language Implementation Committee.

Organization of Hindi workshop, Hindi day, Hindi fortnight, publication of articles in Hindi, publication of Hindi magazine have been done and Hindi typing/drafting incentive scheme has been implemented.

During the year i.e. in December 2013 the Institute received citation under Official Language rolling shield scheme of 2013 for the excellent performance made in implementation of the Official Language during the year 2012-13. Action taken on 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 cleared in bilingual.

2. Compliance of Rule 11 : All types of forms, letter heads, Name slips, Visiting cards, Envelopes, Identity cards, etc are in bilingual. Every efforts are being made to ensure the same.

3. Hindi Correspondence : During the year the percentage of letters sent in Hindi in different regions were more than the prescribed targets i.e. 82.5%, 83.7% and 84.7% letters were sent in Hindi in Central Govt. Offices of A, B and C regions respectively and 99.4% and 99.8% letters in Hindi in state Govt. Offices and boardcasts of A & B regions.

4. Organization 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 2013-14. Official Language Implementation Committee meetings were organized on 17.06.2013, 05.09.2013, 21.12.2013 and 11.03.2014 and follow up action was taken on the decisions of the meeting.

5. Organization of Hindi Workshops : Hindi workshop was organized 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 30 officers and 22 staff have been trained in Hindi workshops organized on 20.06.2013, 26.09.2013, 20.12.2013 and 14.03.2014 essentially for technical and administrative officials, officers and scientists.

6. Implementation of noting/drafting incentive scheme : To encourage the officers and staff of the Institute and its subordinate offices to do their work originally in Hindi, CSIR's Revised noting-drafting incentive scheme was implemented, in which cash awards are given for writing noting/draft words in Hindi. During the year Hindi awards were given to 4 officers on the celebratory function of Official Language fortnight held on 14.09.2013. Apart from this 11 officials of subordinate offices were also awarded prizes under this scheme.

7. Use of Hindi in Scientific field : During the year some of the scientific research papers and articles originally in Hindi and also they were published in Reshami Dhara, half yearly magazine in Hindi brought out by CSMCRI, Bhavnagar.

8. Publication of Hindi books/booklets : Annual report of the institute and the training calendar were published in bilingual. Two issues of Reshami Dhara (Half yearly house journal) of the institute were also published.

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

10. Organization of Hindi competitions : Official Language Workshop was organized from 16.09.2013 to 18.09.2013 during which 10 different Hindi competitions viz. 1. Typing 2. Dictation, 3. Memory test, 4. Group discussion, 5. Elocution, 6. Noting drafting and administrative glossary, 7. Technical glossary, 8. Songs, Kumar does the actions speak? and 10. Antyakshari competitions were organized. The prizes 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, scientific progress report and evaluation report work related to meetings circular are provided on computers. Unicode system is activated in all computers which facilitates to do work in Hindi, English and other Indian language.

12. Awards : During the year 1st to September 2013 the Institute was awarded with a citation under the Official Language Shield scheme of DOLR for the excellent performance made in the implementation of official language policy of the union for the year 2011-12.

Apart from the OLSS, Veraval, a subordinate office of the Institute was awarded first prize under the Working Shield scheme of the Town Official Language Implementation Committee (OIC) Veraval for excellent performance made in Official Language Policy during 2012-13.

13. Five Chiefs were prepared in Hindi showing details of the achievements made in implementation of Official Language Policy and activities of the implementation of the Official Language.

XIV. ADMINISTRATIVE REPORT

Central Inland Fisheries Research & Training Institute, Barrackpore and its Regional units

Regional Inland Fisheries Research Station (RIFRS)

1. [illegible]
2. [illegible]
3. [illegible]
4. [illegible]

Research Extension Centres (REC)

1. [illegible]
2. [illegible]
3. [illegible]
4. [illegible]
5. [illegible]
6. [illegible]
7. [illegible]
8. [illegible]
9. [illegible]
10. [illegible]
11. [illegible]
12. [illegible]
13. [illegible]
14. [illegible]
15. [illegible]
16. [illegible]
17. [illegible]
18. [illegible]

Sub-units of Freshwater Extension Centre (FEC-SU)

1. [illegible]
2. [illegible]
3. [illegible]
4. [illegible]
5. [illegible]
6. [illegible]
7. [illegible]
8. [illegible]
9. [illegible]
10. [illegible]
11. [illegible]
12. [illegible]
13. [illegible]
14. [illegible]
15. [illegible]
16. [illegible]
17. [illegible]
18. [illegible]
19. [illegible]
20. [illegible]
21. [illegible]
22. [illegible]
23. [illegible]
24. [illegible]
25. [illegible]
26. [illegible]
27. [illegible]
28. [illegible]

Coastal Aquaculture Centre (CAC) : 1 Kakdwip

Coastal Development Centre (CDC) : 1 Petuaghat, 2 Tiljala

[illegible] : 1 Howrah

Sahibabad Siluroid Breeding Station : 1 Sahibabad

[illegible]

N°	Nom	N°	Nom	N°	Nom	N°	Nom
	[illegible]	50	[illegible]	99	[illegible]	148	[illegible]
1	[illegible]	51	[illegible]	100	[illegible]	149	[illegible]
2	[illegible]	52	[illegible]	101	[illegible]	150	[illegible]
3	[illegible]	53	[illegible]	102	[illegible]	151	[illegible]
4	[illegible]	54	[illegible]	103	[illegible]	152	[illegible]
5	[illegible]	55	[illegible]	104	[illegible]	153	[illegible]
6	[illegible]	56	[illegible]	105	[illegible]	154	[illegible]
7	[illegible]	57	[illegible]	106	[illegible]	155	[illegible]
8	[illegible]	58	[illegible]	107	[illegible]	156	[illegible]
9	[illegible]	59	[illegible]	108	[illegible]	157	[illegible]
10	[illegible]	60	[illegible]	109	[illegible]	158	[illegible]
11	[illegible]	61	[illegible]	110	[illegible]		
12	[illegible]	62	[illegible]	111	[illegible]		[illegible]
13	[illegible]	63	[illegible]	112	[illegible]	159	[illegible]
14	[illegible]	64	[illegible]	113	[illegible]	160	[illegible]
15	[illegible]	65	[illegible]	114	[illegible]	161	[illegible]
16	[illegible]	66	[illegible]	115	[illegible]	162	[illegible]
17	[illegible]					163	[illegible]
18	[illegible]		[illegible]		[illegible]	164	[illegible]
19	[illegible]	67	[illegible]	116	[illegible]		
20	[illegible]	68	[illegible]	117	[illegible]		[illegible]
21	[illegible]	69	[illegible]		[illegible]	165	[illegible]
22	[illegible]	70	[illegible]		[illegible]	166	[illegible]
23	[illegible]	71	[illegible]	118	[illegible]	167	[illegible]
24	[illegible]	72	[illegible]	119	[illegible]	168	[illegible]
25	[illegible]	73	[illegible]	120	[illegible]	169	[illegible]
26	[illegible]	74	[illegible]	121	[illegible]	170	[illegible]
27	[illegible]	75	[illegible]	122	[illegible]	171	[illegible]
28	[illegible]	76	[illegible]	123	[illegible]	172	[illegible]
29	[illegible]	77	[illegible]	124	[illegible]	173	[illegible]
30	[illegible]	78	[illegible]	125	[illegible]	174	[illegible]
31	[illegible]	79	[illegible]	126	[illegible]	175	[illegible]
32	[illegible]	80	[illegible]	127	[illegible]	176	[illegible]
33	[illegible]	81	[illegible]	128	[illegible]	177	[illegible]
34	[illegible]	82	[illegible]	129	[illegible]	178	[illegible]
35	[illegible]	83	[illegible]	130	[illegible]	179	[illegible]
36	[illegible]	84	[illegible]	131	[illegible]	180	[illegible]
37	[illegible]	85	[illegible]	132	[illegible]	181	[illegible]
38	[illegible]	86	[illegible]	133	[illegible]	182	[illegible]
39	[illegible]	87	[illegible]	134	[illegible]	183	[illegible]
40	[illegible]	88	[illegible]	135	[illegible]	184	[illegible]
41	[illegible]	89	[illegible]	136	[illegible]	185	[illegible]
42	[illegible]	90	[illegible]	137	[illegible]	186	[illegible]
43	[illegible]	91	[illegible]	138	[illegible]	187	[illegible]
44	[illegible]	92	[illegible]	139	[illegible]	188	[illegible]
45	[illegible]	93	[illegible]	140	[illegible]	189	[illegible]
46	[illegible]	94	[illegible]	141	[illegible]	190	[illegible]
47	[illegible]	95	[illegible]	142	[illegible]	191	[illegible]
48	[illegible]	96	[illegible]	143	[illegible]	192	[illegible]
49	[illegible]	97	[illegible]	144	[illegible]	193	[illegible]
		98	[illegible]	145	[illegible]	194	[illegible]
				146	[illegible]		
				147	[illegible]		

RETIREMENT/RESIGNATION/DEATH 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 Institute are sincerely acknowledged.

Name	Designation	Date
I. Retired		
1. Dr. P. C. Jaggi	Scientist E	April, 2013
2. Dr. M. K. Bhandari	Scientist D	April, 2013
3. Dr. Rajesh Rao	STA	April, 2013
4. Sh. Nagendra	Asst. Technician	May, 2013
5. Sh. Ashpama	AO (F&A)	May, 2013
6. Sh. R. K. Bhandari	TA	May, 2013
7. Sh. M. Mehmood	STA	June, 2013
8. Dr. R. Deepthima	Scientist E	June, 2013
9. [illegible]	[illegible]	June, 2013
10. Sh. P. Prakash	Attender	August, 2013
11. Dr. Vicky Pindi	Scientist E	October, 2013
12. Sh. Christopher James	Staff Car Driver	November, 2013
13. Sh. R. K. Pande	Asst. Director	December, 2013
14. Sh. Agnishekhar Jha	Scientist E	December, 2013
15. Dr. D. D. Shukla	Scientist E	January, 2014
16. Sh. K. J. Kesarma	Supdt. (Admn)	March, 2014
17. Sh. R. K. [illegible]	STA (ES)	March, 2014
18. Sh. A. C. Nandha	TA	March, 2014
19. Sh. S. K. Raina	TA	March, 2014
20. Sh. Mahajan	TA	March, 2014
II. Resigned		
1. Sh. A. A. Bisht	DD (F&A)	June, 2013
2. Sh. R. Laxminivas	AO (Stat)	August, 2013
3. Sh. Sonu Sandhu	Asst. Technician	September, 2013
4. Sh. K. D. Jayant Shinde	Asst. Technician	December, 2013
5. Sh. S. K. Nagpure Rao	TA	October, 2013

One colleague passed away during the year and his contribution to the growth and development of the Institute is gratefully acknowledged.

1. Sh. T. V. Venkateshappa	TA	December, 2013

Budget (Rs. in lakhs)

Sl. No.	Particulars	Revised Allocation for 2013-14	Expenditure 2013-14
1.	Non-Plan	1868.23	1868.23
2.	Plan (Rev.)	854.78	854.78
3.	Plan (Cap.)	91.00	191.00
	Total	1914.01	1914.01

R.A.S.S. ADMINISTRATIVE PERSONNEL OF ICRISAT AND IT'S HEADED UNITS

L.R.A.S Reddy
A. ICRISAT, Patancheru
Dr. S. B. Kharbas (DIRECTOR)

Planning, monitoring, co-ordination & evaluation

Dr. S. B. Kharbas, Sr.P.S

Dr. Umesh Kumar, Sr.C.C

Dr.(Ms.) S. Vanitharani, Sr.P.S

Shri M. Rama Rao, S.O. (Stat)

Millets Crop Improvement (Sorghum Breeding)

Dr. N. Nagarea Reddy, Sr.P.S

Dr. L. Krishnaiah, Sr.C.C

Dr. Virendra Kumar, Sr.C.C

Dr. (Ms.) Narendra Reddy, Sr.P.S

Dr. S. Ramesh, Sr.C.C

Dr. K. S. Gowda, Sr.P.S

Dr. Rajvanshi, Sr.P.S

Dr. S. Mallikarjuna Gowda, Sr.C.C

Millets Crop Production (Pearl Millet & Finger Millet Breeding)

Dr. S. Gurumurthy, Sr.C.C

Dr. S. Bhagya, Sr.P.S

Shri T. Ravishankar, Sr.P.S

Dr. P. S. Reddy, Sr.C.C

Dr. S. N. Nwanze, Sr.C.C

Millets Crop Protection (Millets Pathology, Pearl Millet)

Dr. M. Balasubramanian, Sr.P.S

Dr. Vinod Kumar, Sr.P.S

Shri A. V. Rao, Assistant, Sr.C.C

Dr. J. S. Narasima Kumar, Sr.C.C

Shri A. R. Nanjappa Nayak, Sr.C.C

Pearl Millet Evolution

Millets Molecular Biology & Tissue Culture, Mutagenesis Physiology, Agronomy

Dr. T. Thiyagarajan, Sr.C.C

Dr. M. K. Pathanjali Iyer, Sr.C.C

Shri H. Rajeshwar, Sr.C.C

Dr. M. S. Sidhu, Sr.C.C

Dr. V. Girish Patil, Sr.C.C

Dr. Ganesh Kote, Sr.C.C

Pearl Millet Production (Farm Management, Weeds)

Dr. Deosaran, Sr.P.S

Dr. V. Balasubramanian, Sr.P.S

Shri M. T. Vidhyasagar, Sr.C.C

Dr. J. P. Ramakrishnaiah, Sr.C.C

Dr. Dharam Vir, Sr.C.C

Shri Vinod Kumar Pandey, Sr.P.S

Pearl Millet Production (Statistical Methodology)

Dr. V. Nirmala Rani, Sr.P.S

Dr. P. S. Pradeepa Kumar, Sr.C.C

Millets Utilization

Dr. S. D. Vimitha, Sr.C.C

Dr. Geeta Thomas, Sr.P.S

Shri S. M. Nagaraja, Sr.C.C

Dr. K. Jayaprada, Sr.C.C

Shri A. S. Surve, Sr.P.S

Dr. S. C. Dembre, Sr.P.S

Smt. Vasanta Reddy, Sr.C.C

Pearl Millet evaluation and pearling

Dr. P. S. Rameshwaran, Sr.P.S

Shri Hanagya, Sr.C.C

Shri K. P. Janardhan, Sr.C.C

Training Division

Dr. S. D. Sharma, Sr.P.S

Dr. V. N. Sastry, Sr.C.C

Dr. S. Ramakrishna, Sr.C.C

Dr. S. N. Patkar, Sr.C.C

Dr. P. S. Kelkar, Sr.P.S

Publicity & Publications

Dr. Rakesh V. Vatsa, Sr.C.C

Agricultural Engineering Division

Dr. Satish Verma, Sr.Agl.Engineer

Dr. Hanan Bin Jaha, J.E.

[illegible]

[illegible]
Dr. K. L. Rajitha, SO-D
Dr. Upasakan, SO-D
Dr. P. K. Anitha, SO-D
Dr. P. Gokhale, SO-C
Mr. K. Shivashankar, Sr.T.O
Dr. H. Sudhakar Rao, Sr.I-C
Smt. K. L. Padmavathi, Sr.I-C
Mr. S.K. Hanumantharayappa, Sr.I-C
[illegible]
Dr. M. Nanje Gowda, SO-D
[illegible]
Dr. V. Lakshmanan, Sr.S.O
[illegible]
Dr. P. N. Suresh Kumar, SO-C
[illegible]
Dr. M. R. Sreelakshmi, Sr.S.O
[illegible]
Dr. M. T. Antarkhaag, SO-C
Smt. A. Sreedevi, Sr.T.O
[illegible]
Dr. Vasanthi, Sr.T.O
[illegible]
Dr. M. K. Raghavan, Sr.C.O
[illegible]
Dr. Hanagodimath, Sr.S.O
[illegible]
Dr. Ramakrishna Hattigatti, SO-C
[illegible]
Dr. Vijayalaxmi, T.A
[illegible]
Dr. B. N. Chandrappa, T.A
[illegible]
Dr. Arafa Ahmed Gandhi, T.A
[illegible]
Dr. Shreekanth Shedole, Asstt. T.O
[illegible]
Dr. S. M. Ravikumar, T.A
[illegible]
Dr. S. Prakash, T.A
[illegible]
Dr. M. Nataraja, SO-C
Dr. K. Dhanalakshmi, Sr.S.O
Dr. K. Harini, SO-C
[illegible]
Dr. K. S. Muralidhara Gupta, Sr.I-C
[illegible]
Dr. Chikkanna, Sr.T.O
Smt. D. Radhamani, Sr.T.O
Dr. S. Radhakrishnan, SO-C
Dr. R. Harakumar, SO-C
Smt. C. N. Mary Rose, Sr.I-C
Dr. J. Ramkumar, SO-C
Dr. S. Mahila Hans, Sr.T.O
[illegible]
Dr. S. Balasaraswathi, Sr.S.O
Dr. S. Madhavan, Sr.I-C
[illegible]
Dr. A. Shivakumar Swamy, SO-C
Dr. T. Gopalakrishnan, SO-C
[illegible]
Dr. T. Thirunavukkarasu, SO-C
Dr. A. Nasir, Sr.T.O
Dr. M. Dharma Reddy, SO-C
[illegible]
Smt. S. Muthukumary, SO-C
Dr. P. Sathyanarayana, SO-C
Dr. K. Chandrasekaran, Sr.T.O
Dr. G. H. Ballal, SO-C
Smt. R. Venkatalaxmi, Sr.I-C
[illegible]
Smt. K. Gangal, Sr.T.O
Smt. N. Dhanuja, Sr.I-C
[illegible]
Smt. P. V. Sivakumary, Sr.I-C
[illegible]
Dr. S. K. Gobinath, Sr.T.O
[illegible]
Dr. (Smt.) A. Lalithamba, SO-C
[illegible]
Dr. V. Kumaraswamy, SO-C
[illegible]
Dr. Sharanagouda Patil, Sr.T.O
[illegible]
Dr. Ramachandra Reddy, SO-C
Dr. N. Gopalakrishna, SO-D
Dr. M. Raghunath, Sr.I-C
Dr. H. A. Shamrao Salvi, SO-C

RRC (B), Jamnagar
Dr. P. S. Reddy, Sc-E
RRC, Allahabad
Dr. P. Venkateswarlu, Sc-E
RRC, Bharatpur
Dr. A. Nagabhushanam, Sc-D
RRC (B), Pantnagar
Dr. A. Majumdar, Sc-C
Dr. A. Immaculate, Sc-E
RRC, Rohtak(Sub)
Dr. M. Venkateshwarlu, Sc-D
RRC, Rewa
Dr. M. Venkateswara Rao, Sc-E
RRC (B), Dibrugarh
Dr. T. V. S. Krishna Rao, Sc-C
RRC, Mandalgarh
Dr. R. Ravi Reddy, Sc-E
RRC, V. Kota
Dr. T. Singh, Sc-D
CRC, Patiala(Sub)
Dr. S. V. Prasad, Sc-E
CRC, Kolaghat
Dr. M. P. Reddy, Sc-D
RRC (B), Rohtak
Dr. Shivraj, Sc-D
RRC, Vishakhapatnam
Dr. A. Vijaya Kumar, Sc-C
RRC (B), Mangalore
Dr. B. V. Sangamesh Rao, Sc-C

RRC, Ujjain
Dr. M. S. Chandrakar, Sc-D
ICAR, Shillong
Dr. R. Sanjeet, Sc-E
Shri. P. Rajkumar, Sc-C
PI & IC, Hisar
Dr. (Ms.) Kalpana, Sc-D
Dr. K. K. Chandrakumar, Sc-E
RRC (B), Motihari
Dr. A. K. Mallick, Sc-D
RRC, Gir, Bhandariya
Dr. H. Jayaram, Sc-E
RRC, Porbandar
Dr. A. J. Vanmali, Sc-D
RRC, Mahanadi
Dr. Prem Prakash, Sc-D
RRC (B), Kurnaghat
Dr. Babu Singh, Sc-C
RRC, Kawardha
Dr. R. S. Sisodiya, Sc-C
RRC, Vishakhapatnam
Dr. K. K. Bhatt, Sc-C
RRC (B), Jaffna
Dr. Kailash Nath Rajak, Sc-C
RRC (B), Chennakesavi
Dr. A. P. Bapat, Sc-C
RRC, Bahraich(Sub)
Dr. Prakash Gokhale, Sc-C

II. ADMINISTRATIVE PERSONNEL

Dr. A. Kandeepan, JD (P)
Dr. R. Jeyabalan, CD (A&A)
Dr. S. Ayyappan, CD (CC)
Dr. I. Mahfuzul, CD (I)
Dr. B. P. Mishra, CD
Dr. Yogendra Mohan, JD (I&A)
Shri. V. Jai Shankar, JD (CC)
Dr. S. S. Patra, JD (Pub)
Shri. Brijendra, JD (A&A)
Dr. Mohan, JD (A&A)

STAFF POSITION AS ON 31.03.2014

Category	Sanctioned	Filled	Vacant
Director	1	1	0
RMP	171	133	38
Technical	196	161	35
Administrative	116	102	14
Supporting	97	83	14
Total	581	480	101

XV. RESEARCH ADVISORY COMMITTEE

Chairman:
Prof. V. Ramgopal Rao
Vice Chancellor
University of Agricultural Sciences
GKVK, Bangalore-560 065

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

Dr. R. B. Prasad
Professor & Head,
Centre for Agricultural and Rural Development
Acharya N.G. Ranga Agricultural University
Hyderabad-500 030, Andhra Pradesh

Dr. Reddy,
Prof. & Head, Plant Pathology
Dept. of Plant Pathology
University of Agricultural Sciences
GKVK, Bangalore- 560 065

Dr. K.T. Ramesh,
Former Director (Research)
MPKV, Rahuri-Pincode
(At / Post), Block,
Thuppadahalli, Bangalore- 560 049

Commissioner of Horticulture
Govt. of Tamil Nadu, Post Box No. 53
Kasturba Complex, Anna Salai,
Chennai 600 013, Tamil Nadu

Director of Horticulture
Govt. of Maharashtra,
Krishi Aayukta Building,
No.2, Apt Bldg, Old Land, 1st Floor,
Nagpur-440 010, Maharashtra

The Commissioner
Directorate of Horticulture
Govt. of Madhya Pradesh,
Lower basement, Satpura Bhawan
Bhopal-462 002

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

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

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

Dr. S. Vellaiyan,
Former Principal Scientist &
Head, Maize & Millet
No. A-106, Nagarjuna Residency
7 Block, Bandlaguda Nagar
Bangalore- 560 086

Dr. R. J. Rabindra
Dean, College of Post Graduate Studies
Central Agricultural University
Imphal, Barapani - 793 103
Manipur

Commissioner for Horticulture Dept. &
Director of Horticulture, Govt. of Karnataka
#1 Floor, M. S. Building,
Dr. B. R. Ambedkar Veedhi
Bangalore - 560 001, Karnataka

Commissioner of Horticulture
Govt. of Andhra Pradesh
Room No. 12, Pramanik Bagh
Aziznagar,
Hyderabad – 500 072, Andhra Pradesh

The Commissioner
Commissionerate of Rural Development
Govt. Complex-B, 10th Floor, A.S.
Pohulamma Nagar-500 063, Hyderabad

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

The Director
National Bureau Soil Biodiversity
Central Silk Board, 1st Floor, CSB Complex
BTM Layout, Madiwala,
Bangalore-560 068

The Director
Central Tasar Research & Training Institute
CSB Campus, Santoshpur Road,
Santoshpur Post, Kotsila,
Bangalore-560 068

The Director
Karnataka State Agricultural Research & Development Institute
Trichaphalapura, Bangalore - 560 067

The Director
Karnataka State Agricultural Research & Development Institute
Trichaphalapura, Srirangapura - 562 002

Shri. Ramakrishna
Dr. Shri. Bhimanagouda
Mudgal Bandi, A.P. Patil Rd.,
Mandya District

Dr. S. Senthilvelu (Delhi)
Dr. S. Ajay (Delhi)
Lakshmipuri P.O.,
Nellore-524 004,
Chittoor Dist., Andhra Pradesh

Dr. N.R. Ramakrishnan,
Dr. S.K. Nallamuthu,
No. 29/A, Muthulakshmi Street,
Anandapuram Village P.O. 626 307
Virudhunagar Taluk, Virudhunagar Dist.
Tamil Nadu

Andhra

Officer Incharge,
Regional Agricultural Research Station
Central Silk Board,
Ministry of Textiles, Govt. of India,
P.O. No.20, Peddapuram, Srikakulam (Dt.) 533 437
Andhra Pradesh

Officer Incharge,
Regional Agricultural Research Station
Central Silk Board,
Ministry of Textiles, Govt. of India,
Near Fakirbai Station, Hanamkonda,
Chaitanyapuri P.O. 506 001, Karimnagar

The Deputy Secretary (R&C),
Regional Office of Central Silk Board,
Ministry of Textiles, Govt. of India,
No. 12, Hillal Chambers, Hanmakonda Road,
Kazipet-506 001, Warangal Dt.

The Deputy Director (Tech.),
Regional Office of Central Silk Board,
Ministry of Textiles, Govt. of India,
No.28/22, V.S. Dalal Road,
Madurai Nagar, Alagarkoil,
Chennai-600 093, Tamil Nadu

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

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

Shri. R. Jayaram
Dr. Shri. S. Rajmohan,
#8, Survey No.117, Doddamallu Kunta,
Bukkapatnam Taluk,
Ramanagara District-571 501, Karnataka

Dr. S. Kumaresan
Dr. Dr. Sampath Kumar
Old Area,
Kolar-563 101,
Karnataka State, Andhra Pradesh

Dr. N. Rajkumar,
Dr. S. Vijayakumar,
Station, Kothandaraman P.O.,
Periya Obulapuram,
Salem - 636 010,
Tamil Nadu

Officer Incharge,
Regional Sericultural Research Station
Central Silk Board,
Ministry of Textiles, Govt. of India,
Dharmaram Post,
Karnataka, Bangalore-560 105

Officer Incharge,
Regional Sericultural Research Station
Central Silk Board,
Ministry of Textiles, Govt. of India,
Hanamkonda, Kazipet Post,
Warangal (Dt.), Andhra Pradesh, 506 003, Telangana

The Deputy Secretary (R&C),
Regional Office of Central Silk Board,
Ministry of Textiles, Govt. of India, Prayankar Nagar, Road No.12, Jubilee Hills,
Hyderabad-500 034, Andhra Pradesh

Dr. S. Sharma, Director
Chairman-Convener,
Central Sericultural Research & Training Institute,
Srirampura, Manandavadi Road,
Mysuru-570 008, Karnataka

XIII. REGIONAL RESEARCH ADVISORY COMMITTEE II

ZONE ANANTAPUR

Chairman:
Dr. B. Sudhakara Rao, Director of Research, ANGRAU, Hyderabad

Dr. P. Punnaiah,
Deputy Director of Extension,
ANGRAU, Hyderabad

Prof. D. Bharathi,
Professor, Dept. of Horticulture,
SPMV, TIRUPATI

Dr. B. Ravindranath Reddy,
Principal Scientist & Head, Dry Land Agriculture,
Agricultural Research Station,
Ananthapur,
ANANTHAPUR - 515 001

Deputy Secretary (T&C),
Regional Office,
Central Silk Board, BANGALORE

Sri P. Subbaiah Reddy,
Agriculturist,
Madakasira Mandal,
ANANTHAPUR District

Sri Y.N. Satyanarayana Raju, Scientist - B,
Member-Convener,
RSRS, ANANTHAPUR

Sri Hanji Ayyappa,
R/o Dilla, (M),
ANANTAPUR, Orange District

Dr. S. K. Kalpana Reddy,
Programme Coordinator,
KVK, TADIPATRI

Sri N. Chandrasekhar,
Additional Director of Sericulture, Department of
Sericulture, Govt. of A.P.
HYDERABAD.

ZONE, KALIMPONG

Chairman:
Dr. S. K. Krishnamoorthy,
Prof & Head, Dept. of Entomology,
TNAU, Coimbatore.

Dr. N. Nagarajan,
Prof Head, Dept. Of Plant Pathology,
TNAU, Coimbatore

Dr. Harikumar Thandore,
Prof & Head, Dept. Of Agricultural Extension &
Sociology,
TNAU, Coimbatore.

Dr. K. Ramamoorthi
Professor,
TNAU, Coimbatore

Sri. P. Venugopal
Deputy Director,
DOS, Salem

Dr. D. Kirubagaran,
Deputy Secretary (Tech),
FIC, CSB, Chennai

Sri. R. Ramakrishnan,
Farmer Member,
Uthamapalayam

Dr. C. R. Ramesh,
Farmer Member - I,
Chennai-Agent

Dr. Chikkanna Gowda B
Member Convener
RSRS, Salem, Tamil Nadu

FARM PRODUCTION AND REPORTS MANAGEMENT

Chairman
Dr. K. Ramamurthy
Principal Scientist (Farm Machinery and Agril. Engineering) (PME)
IARI, Pusa

Dr. K. S. Nanjappa,
Professor (Horticulture), UAS, Bangalore

Dr. H. B. Shivaram, Associate Professor, Department of Agronomy, UAS, Bangalore

Dr. M. G. Nadagouda,
Prof., Department of Agril. Extn., UAS, Bangalore

Dr. V. R. Prabhakar, Joint Director
DOR, Directorate, Bangalore

Dr. B. K. Dandara,
Technical Officer, Kempegowda Farm, Bangalore

Dr. D. R. Jagadish, Ho.Sc.(Sil) Retd. / Hi. Group Supervisor, Chamarajanagar Farm, Chamarajanagar District

Joint Director of Horticulture
Bangalore Division, Department of Horticulture
No. 16, Kasturba Cross, Shivajinagar, Bangalore

Dr. R. L. Rajanna, Assistant Director
RORS, Hosahalli - 03.07.2013

Dr. Madhusudana, B. Nandihalli, Director (Research)
RORS, Chamarajanagar - 03.12.2013

Details of Services meeting held during the year

#	Meeting	Date
1	Research Council (RC)	29th - 31st May 2013 23rd - 25th November 2013
2	Research Advisory Committee (RAC)	16th - 18th July 2013 28th February 2014
3	Regional Research Advisory Committee (RRAC)	06.07.2013 at Hirehalli 09.07.2013 at Gulbarga 05.12.2013 at Chamarajanagar 04.12.2013 at Bellary, Tamil Nadu

STAFF TRAINING ATTENDED

Institute/Venue	Subject
Central Sericultural Research & Training Institute, Mysore	Training on Human Resource Development for Technical Officers, participant: K. Sangeetha
Central Sericultural Research & Training Institute, Mysore	Training programme on Extension Management Approaches for promotion of sericulture industry, National Institute of Agricultural Extension Management, Hyderabad, July 31, 2013 to August 6, participant: Devappa, K. Sangeetha
Department of Science and Technology, Govt. of India, New Delhi, 25th October, 2013, Department of Science and Technology, New Delhi	Climate Change and Carbon Mitigation, 21.10.2013 to 25.10.2013, Participant: G. R. Sasidhar, A. P. Ananda
Central Sericultural Research & Training Institute, Mysore	Extension Management Approaches for Promotion of Sericulture Industry, 29.07.2013 to 31.08.2013, Participant: D. S. Somashekar
Central Sericultural Research & Training Institute, Mysore	ISO training on implementation of quality system as per ISO 9001:2008, 16.4.2014, Participants: Satish Kumar, Hulluraj, R. S. Kantha Murthy, B. Dayananda Swamy, Ashwath, B. K., Somesha Doddi Shetty, Virendra Kumar, Hiral Kumar, Ramakrishnan Reddy, S. Mahesh, H. Lakshmana, B., Jadeja, N. M., Shamsha, K. K., Harsha Hegde, V., Ravi Shankar Gowda, K. V., Narendra Kumar, J. R., Prathesh Kumar, P. M., Bhagya, P., Shivananda, Manikya Reddy, S., Radhakrishnaiah, T. G., Parameshappa, C., Jamma, P. C., Jadeja, N. Kulkarni, Ganesh Dada, S., Hiremurthy Yadav, K. Jadeja, M. M., Mahesha, Adiga Hareesh, Dhanraj, D. Yogananda Murthy, V., Jayashree, Jai, R., Jadhav, and Ashok.

XVIII. PARTICIPATION OF SCIENTISTS IN SYMPOSIA/SEMINARS/WORKSHOPS/ CONFERENCES

International

S	Symposia and Seminars/ Workshops/Conferences
1.	6th ANCOM International Conference Meeting "Heat Chemistry and Quality" Telephone: 0039 049 8211 Padova Italy (27.01.2014 to 31.01.2014) Participants: D. Manthey Kavitha
2.	5th International Conference on "Water & Water borne diseases" at Kenyatta University, Nairobi, Kenya (04.02.2014 to 06.02.2014) Participants: Vinod Kumar
3.	International Conference on Food technology, Impact on nutrition and health (ICFN-2014), New Delhi (22.02.2014 to 24.02.2014) Participants: S. Rajeshwar
4.	International conference on life sciences, biomaterials and biotechnology, Kerala (28.02.2014 to 01.03.2014) Participants: Chandana, S. and Ramakrishna, C. Raj Kumar

Overseas Visit

Dr. Ramesh Chandra, Indian Ambassador, Romania from 2011 to June, 2013 as one of the six member delegation consisting of Romania from India, headed by Secretary, Ministry of Textiles, Govt. of India to attend India - Romania Joint Working Group Meeting (JWG) on Textiles. Romanian side apprise Indian counterpart the textile industry profile of Romania, investment for synthetic manufacturing, investment in cotton, new and innovative products and secrets of Indian companies in Romanian market. The other main agenda included India-Romania Textile sector trade, collaboration in Research and Development between the Central Silk Board and Romanian institutes, collaboration in skill development and compliance setting up of Textiles Trade offices and in garment in Bucharest. A concept note of collaboration between India and Romania in the field of R & D in sericulture was presented and discussed.

National

S	Symposia and Seminars/ Workshops/Conferences
1.	Impact Assessment of schemes and projects of central and state governments, at CFTI, Mysore (16.08.2013 to 21.08.2013) Participants: Ramesh Chandra, S. Rajeshwar, Vineet Kumar, A. S. Gupta
2.	Validation on Mauritius silk weaving at Kollegal cluster, organized by CSTRI, Bangalore & CSRTI, Mysuru at silk exchange, Kollegal (29.08.2013) Participants: T. G. Prabhakaramurthy, Ramakrishna, C. P. Shivkumar
3.	Hindi workshop organized at CSRTI, Mysore (05.09.2013) Participants: J. M. Mahendra Kumar, V. Dhileepkumar, S. K. Dhanraju, S. Manika Naik, P.C. Shantha, J. P. Thirumalchandrappa, G. Parameshkumar, S. B. Vidyavati, Bhavani Shri, Shashi Gupta, Vinod Kumar Yadav
4.	National Conference on Global and Indian status of Biodiversity in India with special reference to Himalaya (24.10.2013 to 26.10.2013) Participants: V. Dhileepkumar, S. Ramakrishna
5.	National conference on recent advances in modern biology and contribution for human enhancement and rural development at KUVEMPU, Thalaghattapura, Bangalore (24.10.2013 to 26.10.2013) Participants: R. M. Krishna, Sathish Verma, J. M. Mahendra Kumar, S. M. Chandy, V. Dhileepkumar, S. Manika Naik, Thippeswamy T. S. S. Dhanraju Gaurendra, S. Rajkumar, G. V. Nalgaye, J. Mahendra, S. Ramesh Babu
6.	Workshop organized by CSIR Mandates (16.11.2013) Participant: Rajeshwar
7.	Workshop on Bioinformatics and its application components in Bioinformatics Centre, CSRTI, Mysore (30.11.2013 to 05.12.2013) Participants: T. G. Prabhakaramurthy, B.V. Nalgaye, A. Shakira Shaikh, S. Ramesh Babu,
8.	National symposium on "Recent advances in conventional breeds" (NSRB), Mysuru (27.11.2013 to 29.11.2013) Participants: B. B. Bindroo, K. Sreelakshmi

9 XXII Conference of ISSE, Bangalore (4-6.12.2013) (6.12.2013)
Participants: A. M. Saha
10 Multi Science at New Delhi (28.11.2013 to 29.11.2013)
Participants: Kavita Trivedy
11 Role of CROs in maritime site investigation at CSIRT, Kolkata (11.12.2013)
Participants: B. K. Vaidya, S. K. Nagraj, B. Sangeetha, A. C. Dutta, M. S. Sekhar, A. Lakshmi Kanthi, S. Sankaranarayanan, S. S. Sharma, C. Rajamohana and P. Bhagya
12 20th All India Sociology conference (20th Mysore (27.12.2013 to 29.12.2013)
Participants: M. S. Sekhar
13 Planning Meet at United Research Station (URS), Visakhapatnam (11.12.2013)
Participant: Society
14 National symposium on innovations in science and technology for inclusive development, Kolkata (January 2013) (27.12.2013 to 29.12.2013)
Participants: Mary Josephine A. V., N. Sangeetha
15 National seminar on 'Environment and social issues', Periyar University, Salem (27.01.2014 to 28.01.2014)
Participants: S. Rajkumar
16 Birth place Planner's Workshop at CSIRT, Mysore (29.01.2014)
Participants: B. K. Vaidya, S. D. Mapare, S. Sangeetha, A. C. Dutta, R. S. Gedam, A. Krishna Chaitanya, Sreekumar Vasu
17 National conference on Infrastructure for livelihood security, IIAS Bangalore, Karnataka (29.01.2014 to 31.01.2014)
Participants: S. Sangeetha, P.S. Ramakrishnan, K.S.Gopala Krishna, B. V. Mapara, M. Venkata Subbaiah, A. Venugopal, S. Rajkumar, B. R. Ramesh, R. Sukumar
18 101st Indian Science Congress Association (ISCA) at University of Jammu, Jammu (India) (03.01.2014 to 07.01.2014)
Participant: Vinod Kumar Yadav
19 National conference of Biodiversity and ecological sustainability, Puri (Orissa) (19.02.2014 to 19.02.2014)
Participants: A.R. Babu, J. Justin Kumar
20 ICITA national conference on Science & Technology, JIS college, Kolkata (Orissa) (21.02.2014 to 22.02.2014)
Participants: S. Sangeetha
21 Sensitization Planning workshop for systematic livelihood at CSIRT, Mysore, (27.02.2014)
Participants: M. S. Sekhar Raja and S. Vasanth Kumar
22 National Conference on "Recent Trends in Biosciences – Challenges and Future Prospects organized by the Dept. of Biotechnology, Vels Thyrar College of Science and Technology, Vadi Kollan, Kerala in association with Kerala State Council for Science, Technology & Environment, Thiruvananthapuram, Kerala (14.03.2014 to 15.03.2014)
Participant: S. Rajkumar
23 Hand washing Awareness at CSIRT, Mysore (14.03.2014)
Participants: Debasish, K. S. Pitchi Raja, Lakshmi V. Kiran, S. Sangeetha, G. V. Sandhya, M. Lakshmikanth Reddy, Satyanarayana, D. S. Sundaramoorthi, Geetha Reddy, P. Bhagya, Mahipalsinh, P. M. Praveen Kumar, Mary Josephine Sherly
24 Scientists meet at Central office, Central Silk Board, Bangalore (21.03.2014)
Participants: Ashok Kumar Jhanwar, B. K. Vaidya, Kamala Thapa, A. Hazarika Gogoi, S. Thoudamsing, S. K. Avasthi, M. Mukunthula Gowtham, Virendra Kumar, S. S. Nagaraj, V. Ramakrishna, Debasish, K. S. Rajkumar, Vineet Kumar, N. Sangeetha, C. Raja Shekar, Somasundaram, Vipul Kumar, B. T. Srinivasa, M. S. Pitchi Raja, Sri. M. Muralidharan Reddy, S. Giri Reddy, Kailash V. Kiran, M. S. Sekhar, K. S. Shankar, S. Hazarika Gogoi, A.K. Garg (Chief), J. S. Narendra Kumar, P.G. Praveen Kumar, R. Bhagya, Mahipalsinh, Geetha, S. Sreedhar, T. C. Ramakrishna, Sanjeeva, D. S.
25 Scientists meet at Central office, Central Silk Board, Bangalore (22.3.2014)
Participants: C. Parameswaran, S. N. Yadav, N. S. Nahak, S. Purushotham, A. P. Dhakarma, P. S. Sarma, , A. R. Nakulkar, Rajeev, Satish R. Kulkarni, A. Hazarika Gogoi, Vasanth Gowda, S. Sridhar Rao

III. WEEKLY SEMINARS CONDUCTED AT CSIR-CFTRI, MYSORE

Sl. No.	Name of the Speaker(s)	Topic of the Seminar	Date
1	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]
12	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]
14	[illegible]	[illegible]	[illegible]
15	[illegible]	[illegible]	[illegible]
16	[illegible]	[illegible]	[illegible]
17	[illegible]	[illegible]	[illegible]
18	[illegible]	[illegible]	[illegible]
19	[illegible]	[illegible]	[illegible]
20	[illegible]	[illegible]	[illegible]
21	[illegible]	[illegible]	[illegible]
22	[illegible]	[illegible]	[illegible]
23	[illegible]	[illegible]	[illegible]
24	[illegible]	[illegible]	[illegible]
25	[illegible]	[illegible]	[illegible]
26	[illegible]	[illegible]	[illegible]
27	[illegible]	[illegible]	[illegible]
28	[illegible]	[illegible]	[illegible]
29	[illegible]	[illegible]	[illegible]
30	[illegible]	[illegible]	[illegible]
31	[illegible]	[illegible]	[illegible]
32	[illegible]	[illegible]	[illegible]
33	[illegible]	[illegible]	[illegible]
34	[illegible]	[illegible]	[illegible]
35	[illegible]	[illegible]	[illegible]
36	[illegible]	[illegible]	[illegible]
37	[illegible]	[illegible]	[illegible]
38	[illegible]	[illegible]	[illegible]
39	[illegible]	[illegible]	[illegible]
40	[illegible]	[illegible]	[illegible]
41	[illegible]	[illegible]	[illegible]

XII. [illegible] REMEDIES

Analysis of materials received from various entities was undertaken and generated revenue of Rs. [illegible]

S. No.	Particulars	Number of samples	Revenue Amount (Rs.)
1	Soil	1700	1,21,000.00
2	Soil - [illegible] (Hydrated, Hydrated with Supplement, Analysis), (Vehicle Soil, Analysis Analysis)	88	1,18,800.00
3	Fertilizer	30	11250.00
4	Water (Soil, Effluent Water Analysis)	40	8000.00
5	Leaf	220	4,950.00
6	Sand (Dry)	20	900.00
7	Cotton	10	450.00
	Revenue Generated	Total	3,67,350.00

XIII. REVENUE GENERATION

1. Details of other miscellaneous receipts of CSIRTI (Revenue in [illegible])

S. No.	Heads	Amount for the year [illegible] (Rs.)	Percentage
1	Sale/Permissions	[illegible]	[illegible]
2	Rent - Others	[illegible]	[illegible]
3	Sale - Bore application	[illegible]	[illegible]
4	Sale - Food Grains	[illegible]	[illegible]
5	Consultancy by Scientists	[illegible]	[illegible]
6	Course Fee	[illegible]	[illegible]
7	Interest earned	[illegible]	[illegible]
8	Income from Subscription Sales	[illegible]	[illegible]
9	Other Misc. receipts	[illegible]	[illegible]
	Total	[illegible]	[illegible]

2. Details of receipts credited to revolving fund - Farm development fund pertaining to CSIRTI, Mhow [illegible] (Rs.)

S. No.	Heads	Balance for the year [illegible] (Rs.)	Percentage
1	Sale of [illegible]	[illegible]	[illegible]
2	Sale - Bio Inputs	[illegible]	[illegible]
3	Sale - Fertilizers [illegible]	[illegible]	[illegible]
4	Sale of Farm Produce	[illegible]	[illegible]
5	Sale - Bio Agri Products	[illegible]	[illegible]
6	Farming charges (Farmers)	[illegible]	[illegible]
7	Sale - Fertilizers (Animal)	[illegible]	[illegible]
	Total	[illegible]	[illegible]

II. Details of receipts credited under farming fund account

Sl. No.	Heads	Amount for the year 13-14 upto March, 2014 (Rs.)	Percentage
1	Licence Fee	[illegible]	[illegible]
2	Project Fee	[illegible]	[illegible]
	Total	[illegible]	[illegible]

III. Details of receipts credited under Agriculture Diversifying Commercial farming account

Sl. No.	Heads	Amount for the year 13-14 upto March, 2014 (Rs.)	Percentage
1	Revolving Fund	[illegible]	—
	Total	[illegible]	[illegible]

IV. Details of receipts credited under Rural deposit

Sl. No.	Heads	Amount for the year 13-14 upto March, 2014 (Rs.)	Percentage
1	Training Subsidy Fund	[illegible]	[illegible]
2	Farm Development Fund	[illegible]	[illegible]
	Total	[illegible]	[illegible]
Grand Total Revenue generated (+)		[illegible]	[illegible]
Total Grants received upto March, 2014 from Govt.		[illegible]	—

XIII. TECHNOLOGIES UNDER THE PROCESS OF INVENTING AND COMMERCIALISATION

#	Technology/Products	Line of Activity	Present status
1	A machine for harvesting soybeans separate from plants, cleaning & moisturizing	[illegible]	[illegible]
		[illegible]	[illegible]
2	Automatic Irrigation	[illegible]	[illegible]
		[illegible]	[illegible]
3	Organic waste cleaning machine	[illegible]	[illegible]
		[illegible]	[illegible]
4	Biosensor	[illegible]	[illegible]
5	Production for restoration of liquid wheat in medium for urine without by-products	[illegible]	[illegible]
6	Hi-tech capsule for treating young age children's memory (Chaitanya shakthi)	[illegible]	[illegible]
		[illegible]	[illegible]
7	Water pricing system for management of watering plants in nurseries	[illegible]	[illegible]
8	A process for cultivating [illegible]	[illegible]	[illegible]

[illegible] ROYALTY RECEIVED

[illegible] sale and royalty received from NCDC Operations pertaining to various products mentioned and commercialized for the calendar [illegible] as communicated to Godrej office is as follows:

Sl.No.	Particulars	Previous (Rs.)	Royalty (Rs.)
1	[illegible]	[illegible]	[illegible]

[illegible] RIGHT TO INFORMATION ACT 2005 (RTI)

Name of CPIO: [illegible] Director, [illegible], Kolkata

Sl. No.	Date received	Date of correspondence and letter No. and date		
1	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	[illegible]	[illegible]
12	[illegible]	[illegible]	[illegible]	[illegible]

XIX: LIST OF DIGNITARIES WHO VISITED THE INSTITUTE

#	Name of Visitor(s) Organization	Address	Date of Visit
1	Dr. Kim Jong Bin	Korean Research Institute of Bioscience & Biotechnology, Daejeon, Korea	15.05.2013
2	Dr. P. Thakur	Director of Horticulture, Govt. of Sikkim	13.06.2013
3	Dr. M. Ramakrishnan	Jagat Foods Pvt. Ltd., Chennai	14.06.2013
4	Dr. C.K. Ramesh	Jagat Foods Pvt. Ltd., Chennai	15.06.2013
5	Mr. Shiji Tsuruga Ji	JICA Expert, Japan	17.06.2013
6	Ms. Kaori Kawaguchi	JICA Expert, Japan	21.06.2013
7	Prof. Jayakumar Kamachi Mudali	Homi Bhabha National Institute, Kalpakkam	19.06.2013
8	Dr. Shanmugam Dharma	Chairman, CSIR Laboratories	21.06.2013
9	Dr. S.K. Gupta	Director of Technology, Department of	27.06.2013
10	Padmakumar Prof. Subbalakshmi Sir	NCC Director, CSIR, Bangalore	28.06.2013
11	Dr. Radhakrishnan	Medical and Research College, Law Course, Mysore	03.07.2013
12	Dr. Pradeep Kumar	Ministry of Environment & Forests, Government of India, Regional Office	08.07.2013
13	Dr. K.S. Rama Swamy	CSIR Director, Bangalore	09.08.2013
14	Dr. A.P. Laxminarayana	CSIR Board Members, Bangalore	09.08.2013
15	Dr. Laxmana Rao	CSIR Board Members, Bangalore	09.08.2013
16	Dr. R.A. Reddy	CSIR Board Members, Bangalore	09.08.2013
17	Dr. R.S. Ramakrishna	CSIR Board Members, Bangalore	09.08.2013
18	Mr. Ankit Roy, IAS	Mysore Secretary, CSIR, Bangalore	12.08.2013
19	Dr. P. Sudhakumar	Director, Finance, CSIR, Bangalore	08.09.2013
20	Dr. A.S. Nisar Ahmed	CSIR Chairman, Bangalore	08.09.2013
21	Mr. Ankit Roy, IAS	Mysore Secretary, CSIR, Bangalore	03.07.2013
22	Padmakumar Prof. Subbalakshmi Sir	NCC, Director, CSIR, Bangalore	28.07.2013
23	Dr. B.K. Lakra	Dr. Scientist, CSIRTE, Kolkata	08.08.2013
24	Dr. B.K. Ramachandra	Dr. Director, CSIRT, Bangalore	28.07.2013
25	Dr. Ajay Shankar, IAS	Mysore Secretary, Government of Karnataka, Chief Minister's Secretariat, Bangalore	12.08.2013
26	Dr. A.G. Jadhav	Dept. of Zoology, Shivaji University, Kolhapur, Maharashtra	05.09.2013
27	Dr. B.A. Patwardhan	Dept. of Zoology, Shivaji University, Kolhapur, Maharashtra	05.09.2013

[illegible] METEOROLOGICAL DATA

Meteorological data for the [illegible]

[illegible] CRRI, Hyderabad

Month	Temperature (°C)			Humidity (%)			Rainfall (mm)
	Maximum	Minimum	Average	Maximum	Minimum	Average	
January	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
February	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
March	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
April	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
June	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
July	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
August	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
September	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
October	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
November	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
December	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rain: High	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]
Rain: Low	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]
						Total Rainfall	[illegible]
						No. of rainy days	[illegible]

[illegible] IIHR, Bangalore

Month	Temperature (°C)			Humidity (%)			Rainfall (mm)
	Maximum	Minimum	Average	Maximum	Minimum	Average	
January	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
February	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
March	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
April	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
June	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
July	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
August	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
September	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
October	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
November	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
December	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rain: High	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Rain: Low	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
						Total Rainfall	[illegible]
						No. of rainy days	[illegible]

[illegible]

[illegible]	Temperature (°C)			Humidity (%)			Rainfall (mm)
	Maximum	Minimum	Average	Maximum	Minimum	Average	
January	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
February	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
March	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
April	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
June	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
July	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
August	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
September	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
October	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
November	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
December	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total / Highest	[illegible]	[illegible]	-	[illegible]	[illegible]	-	-
Rainy days	[illegible]	[illegible]		[illegible]	[illegible]		

[illegible]	[illegible]
No. of rainy days	[illegible]

[illegible]

[illegible]	Temperature (°C)			Humidity (%)			Rainfall (mm)
	Maximum	Minimum	Average	Maximum	Minimum	Average	
January	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
February	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
March	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
April	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
June	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
July	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
August	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
September	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
October	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
November	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
December	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total / Highest	[illegible]	[illegible]	-	[illegible]	[illegible]	-	-
Rainy days	[illegible]	[illegible]		[illegible]	[illegible]		

[illegible]	[illegible]
No. of rainy days	[illegible]

[illegible]

[illegible]	Temperature (°C)			Humidity (%)			Rainfall (mm)
	Maximum	Minimum	Average	Maximum	Minimum	Average	
January	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
February	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
March	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
April	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
May	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
June	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
July	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
August	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
September	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
October	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
November	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
December	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total / Highest	[illegible]	[illegible]	-	[illegible]	[illegible]	-	-
Rainy days	[illegible]	[illegible]		[illegible]	[illegible]		

[illegible]	[illegible]
No. of rainy days	[illegible]

XXVII. RESEARCH PUBLICATIONS

Research papers	A. International Journal	07
	B. National Journals	04
Popular articles		02
Books		02
Book/Technical bulletin		03
Newspaper/Media work		01
Extension material/brochure/pamphlet		02
Papers/Abstract presented in seminar/conference/ workshop	A. International	02
	B. National	01
Invited talks		03

INTERNATIONAL JOURNALS

Arredondo Bustamante, Alejandro Ventura Aliaty, Rubalcaba Gamboa, M. P., Murthy, B. N. S., Singh, Vaijyanti and Ramachandran Nimmi (2013). Drug hazards associated with mulberry (Morus spp.) in Mysore, India. Entomología Mexicana, 12(2):950-957.

Arunkumar Singh and Mirunalini, M. T. (2014) Reported effect of plant based extract as a promotor of self moulting in the silkworm Bombyx mori L. Science Parade 7(1): 102-105.

Balasubramanian, M., Chandrashekharaiah, S., Sharma, D. D., Mallikarjuna Nayaka, A. R. and Bhavana, B. R. (2013) Disinfection and hygiene technology using Neem and Aritzan for the management of silkworm diseases. International Journal of Plant, Animal and Environmental Sciences, 3(1):187-196.

Chandrakanth, M., Murthy, B. N. S., Kavitha, P., Saravanan, Ashwath, B. S., Kumar, V. and Bhavna, B. R. (2014) Evaluation of genetic diversity in silkworm (Bombyx mori L.) strains using microsatellite markers. International Journal of Biotechnology and Molecular Biology Research, 5(2):14-24.

Devaraj, S. R., Dr. Satyanarayana Rao, Thippeswamy, T. and Bhavna, B. R. (2013) Variability of morphological traits in relation to age of mulberry (Morus spp.) plants. Lancaster Research Journal of Agriculture and Life Science, 1(1):7-11.

Dharmesh, Premalatha, V., Rajavenkatasubbaiah, M., Chandrashekharaiah, C., Ravish Kumar, S. and Ashwath, B. S. (2013) Ash analysing resource materials for the assessment of thermo-stable metals of silkworm, Bombyx mori L., reared in high temperature. International Journal of Plant, Animal and Environmental Sciences, 3(4): 98-101.

Gandhi, S. S. (2014) Women, agriculture and empowerment. Journal of Rural and Agricultural Economics 2:1-2.

Gangadhara, Krishnaiah N. M., Chandra, K. R. and Naik, V. N. (2013) Silkgrabber Sampling: a software to estimate cocoon yield from RAPD marker data with application to mulberry. Plant 1(3):51-61.

Himantharaj, M. T. and Mirunalini Singh (2013) Effect of feeding mulberry and castor mulberry leaves on some growth parameters in the silkworm Bombyx mori L. Science Parade 7 (1): 67-70.

Himantharaj, M. T. and Chandra, K. (2013) The physiology biology of spinning, cocoonase of silk protein in silkworm Bombyx mori L. and its application. Science Parade 4 (1):64-67.

Kalyanaraman, Padmalakshmi, T. C., Dhanalakshmi, R. P. and Sumathirajan, T. N. (2013) Comparative performance of multiple sort based silk reeling processing in the spinning technology. 3(3): 1128-1131.

Krishnan, R. R., Naik, V. G., Ramesh, S. R. and Qadri, S. M. H. (2013) Microsatellite marker analysis in relation to the evolution and spread of cultivated mulberry in the Indian subcontinent. Plant Genetic Resources, 12(1): 104-108.

Krishnan, R., Dandin, R., Kumar, N. R., Bindroo, B. B. and Ito, Y. S. 2014. DivDiv (Divflex): versatile method for dividing plant entries in development of core collections. Crop science, 54(1):1-9.

Lakshmanan, V. and Suresh Kumar, R. 2013. A cross-concentration mutation study of silk yield traits of genetic resources of the mulberry silkworm, Bombyx mori L. International Journal on applied bio-engineering (online), 6(1):33-43.

Meenna Begum, V., Nallayana Gowda, N., Rudraswamy, T. C., Sivakumar, P. P. and Shenoy, S. R. (2013). Studies on cocoon filament data for effects of three silk cross hybrid breeds of the silkworm, Bombyx mori L. International Journal of Research in Biological Sciences, 3(2): 77-79.

Saini, S. M. V., Nagesha Begum, A. and Reddy, S. and Kumar, S. (2013). Studies on evaluation and selection of bivoltine cross hybrids between hybrids of Bombyx mori L. for commercial exploitation. International Journal of Research in Biological Sciences, 3(2):77-79.

Naik, V. R., Sujatha, M. G., Chandan, K. G., Sakri, S. M. K. and Gowda, S. B. (2013). Physiological and biochemical markers associated with cold tolerance in mulberry, Morus indica L. Mysore J. Agric. Sci., 47(4):699-706.

Nandha Naik, L., Prithviraj Kumar, P. M., Sharma, D. D., Sivaprasad Naik, B. R. and Sakri, S. M. K. (2013). Production of compost from mulberry shrubs using Lignin-cellulolytic fungi and its impact on growth and yield of mulberry. Sericologia, 53(1):39-47.

Rajkumar, U., Chikkanna, and Ambrish, S. S. (2014). Host and medicinal values in " silkworm" and its host plant " mulberry" exploring new horizons. International Journal of Food and Nutritional Sciences, 3(1):1-6.

Ravikumar, J., Sujatha, G., Vasanthi, L., Sathiyan, N., Ramakrishnan, J., Balakrishna, K. and Sakri, S. M. K. (2013). Bioefficacy of entomopathogenic plant extracts against mites, Polyphagotarsonemus latus (Banks) on mulberry. Acta Biologica Indica, 1(2):113-119.

Sathiyan, N. (2013). Effectiveness of three botanicals enzyme extracts, viscal (Hydrological stabilizer), Jeegiya (wetting agent) and Polyethylene (Herbicide) against pappus mealybug, Phenacoccus manihoti infesting mulberry in Tamil Nadu. Journal of Biopesticides, 6(1):71-75.

Sathiyan, N. (2013). Field performance of three exotic parasitoids against papaya mealybug, Phenacoccus manihoti Matile-Ferrero and Brachymeria lasus (Walker), infesting cassava in Tamil Nadu. Journal of Biological Control, 27(2):93-97.

Sharma, S. D., Naik, L. N., Chandan, K. G. and Sakri, S. M. K. (2013). Effectiveness of compost prepared from leaf residue enriched with beneficial and antagonistic microbes as management of root rot disease in mulberry. Sericologia, 53(2):117-124.

Sharma, S. D., Nallaswamaswamy, M., Balraj, A. S., Vishal Kumar, S. and Ambrish, S. S. (2013). Impact of a few microbiocides/ chemicals on textural and biometric parameters of the silkworm, Bombyx mori L. International Journal of Plant, Animal and Environmental Sciences, 4:152-157.

Subramanian, S., Sathiyan, N. and Sakri, S. M. K. (2013). Rearing technology of an alternate plant to combat tomato leaf curl virus under protected and field plant conditions in Tamil Nadu. International Journal of Life Sciences Biotechnology & Pharma Research, 2(2):32-41.

Suresh, M., Ashwath, S. K. and Nagabhushan, V. K. (2013). Theoretical - modelling and scaling studies of silkworm rearbirth incubator. Journal of Photonics Bioimaging, 2(1):2:2-24.

Vinod Kumar (2013). Role of biocontrol agents in the pest management in mulberry (Morus spp.) cultivation. South Asian Journal of Marine and Agricultural Science, 1:64-70.

NATIONAL JOURNALS

Ambika P. H., Amalia, S. B. and Ravindran (2013) Effect of sewage water on the germination and seedling growth of some pulses. Brem Bendig, 43-45:457-461.

Ambika P. H., Amalia, S. B. and Ravindran (2013) Effect of sewage water on microbial population and diversity in the rhizosphere soil of different Malvaceous crops. Indian Botan Reporter 23:203-208.

Bhattacharjee, A. C., Reddy, M. P., Hajabdulmatheena, A., Pamarthipudur, P., Vasudevan, P. and Sinha, S. (2013) Effect of vermicompost, oil extraction wastes on soil bacterial count and dehydrogenase activity and soil respiration. Advances in Plant Sciences, 26(1): 77-80.

Bhosle, B. B., Bathkal, R., Kasabalu, L. and Kakal, M. K. (2013) Competitive weed flora of mulberry under irrigated conditions in Southern Karnataka. Indian Journal of Sericulture, 52(2):89-90.

Hiremath, M. T. and Hiregoudar, S. S. (2013) Tubular test—A new method to evaluating the quality of mulberry leaves. Indian Journal of Sericulture, 52(1): 79-81.

Kumaresan, P., Hiregoudar, S. T., Balakumar, S. R. and Geeta, S. M. H. (2013) Status and pattern of equipment and machinery utilization in sericulture in south India. Indian Journal of Sericulture, 52(2): 149-153.

Kumaraswamy, T. S. and Singhvi, N. R. (2013) Effect of graphite improved agriculture practices on the productivity of sunflower (Helianthus annuus L.) hybrid. Agriculture Update, 8(3):469-471.

Mahendra, J. and Rajkumar, R. V. (2013) Bioecological studies on the host range, pupation activity and host mediated pattern of different colony adaptive strains of Corcyra cephalonica L. Advances in Life Sciences, 2(1):12-15.

Mahmood, M. and Ravindran (2013) Impact of certain plant extracts against mulberry leaf roller Diaphania pulverulentalis. Uttar Pradesh Journal of Zoology, 33(2):141-145.

Mallikarjuna, M. and Kadirvelkumar, K. K. (2013) Selection of new mulberry genotypes for moderate shoot conditioning yield level analysis. Karnataka Journal of Agricultural Sciences, 26 (1): 107-109.

Manjula Reddy, G., Chandrakanth, K., Ashwath, B. K., Virendra Kumar and Krishna, K. M. (2013) Genetic diversity analysis using RAPD marker in some silkworm breeds of Bombyx mori L. Annals of Biological Research, 4 (2): 52-55.

Mary Josephine, A. A. and Krishna, M. M. (2013) Cicadas (Hemiptera: Cicadidae), an emerging pest on mulberry in Kerala and Karnataka. Insect Environment, 19(3): 91-92.

Mishra, S., Nath, V. S., Sukumar, K., Pinto, M. T., Dhanavanthri, N. S. and Dandin, S. B. (2013) Genetic analysis of parental genotypes for breeding of cocoon yield efficiency and cocoon traits in mulberry. Indian Journal of Genetics and Plant Breeding, 73(2): 204-210.

Nath, V. S., Doddabasanthi, N., Pinto, M. T., Mishra, S., Sivaprasad and Dandin, S. B. H. (2013) Assessment of genetic diversity among mulberry (Morus) accessions from south India using phenotypic and RAPD markers. Indian Journal of Sericulture, 52(1): 34-43.

Nandeshwar Rajaka, A. R. and Sharma, S. S. (2013) Relevance of vertical transmission of nuclear polyhedrosis virus in popular multivoltine and crossbreed breeds of silkworm, Bombyx mori L. Journal of Entomology and Zoology Studies, 2(1):72-75.

Nandeshwar Rajaka, A. R. and Sharma, S. S. (2014) Evidence of fifth haemocyte count (THC) in popular multivoltine and multivoltine breeds of mulberry silkworm Bombyx mori L. during the progressive infection of nuclear polyhedrosis virus (BmNPV). Journal of Entomology and Zoology Studies, 2(1):76-79.

Narendra Kumar, J. B.; Dhruva, D. R.; Srinivasa, B. T. and Shekhar, M. A. (2013) New antifungal formulations against Sclerotium rolfsii Sacc. for management of Anthracnose disease in Arecanut. Indian Phytopathology, 66(2): 139-143.

Narendra Kumar, J. B.; Dhruva, D. R.; Srinivasa, B. T.; Shekhar, M. A. and Gowri, S. H. H. (2014) Epidemiology and management of Anthracnose disease of Arecanut (Areca catechu L.) - A review. Journal of Pesticide Science and Technology, 1(1&2): 33-37.

Narendra Kumar, J. B.; Jayanthi, K.; Manikanth, N. and Gowri, S. H. H. (2014) Pesticide persistence in tropical plants and pest management practices in horticulture under tropical climate of Karnataka. Indian Journal of Horticulture, 71(2): 161-167.

Nataraja Kallappa, A.; Mahadevaiah, C.; Vishnuvardhan Kumar, S. and Gowri, S. H. H. (2013) Utilization of near isogenic cereals of Sharbati dwarfing gene (Rht-1) as male component for production of cytoplasmic male sterile hybrids. Journal of Horticulture Technology, 1(1&2):43-48.

Nataraja Kallappa, A.; Mahadevaiah, C.; Vishnuvardhan Kumar, S. and Gowri, S. H. H. (2014) Biochemical analysis of the kernels of the popular Sharbati dwarfed wheats and Sharbati isogenic lines. Indian Journal of Animal Research, 48(2): 172-178.

Pinto, M. S.; Patil, V. S.; Gowri, S. H. H. (2014) Genetic variability studies in Nutrient using microsatellite markers. Journal of Horticulture Technology, 1(1): 39-43.

Prathapan Kumar, P. N.; Kotha, V.; Sharma, D. D.; Rekha, G.; Thirupathaiah, T. and Krishna, B. S. (2014) Effect of microbial dusting on seed germination and seedling growth of nursery and their antagonistic Rhizosphere beneficial. Indian Journal of Horticulture, 71(2):164-167.

Rajeshwarrao, T. G.; Rekha, G. S.; Sankaran, Sreekumar, S. P. and Kumar, G. (2014) Studies on impact of timeliness of cocoon cooling on rearing performance and quality of raw silk. Indian Journal of Horticulture, 1(1):71-74.

Sakthivel, N. (2014) Comparative efficacy of botanicals and chemicals against two major sucking pests of tapioca. Indian Journal of Horticulture, 71(2): 178-181.

Sakthivel, N. and Gowri, S. H. H. (2013) Effect of fortification of mulberry leaves with zinc on economic traits of silkworm. Indian Journal of Horticulture, 1(2): 39-42.

Sharma, D. D.; Krishna Naik, T.; Deepika Yadav, B. R.; Kalia, V. K. and Gowri, S. H. H. (2014) Effect of enriched compost for management of root knot disease in mulberry. Indian Journal of Horticulture, 71(2):164-169.

Sharma, D. D.; Prathapan Kumar, P. N.; Krishna Naik, T.; Thirupathaiah, T. and S. S. Sharma (2013) Application of soil borne pathogens in contaminated soils for making disease free nursery plantation. Indian Journal of Horticulture, 1(2): 33-37.

Singh, R.; Raghavendra Rao, S.; Ramakrishna, Y. and Sharma, S. S. (2014) An overview of sericulture research trends developed at CSRTI, Mysore during the last five decades. Asian Entomology & Zoology, 9(1): 59-74.

Singha, H. S.; Kathayana, R. L. and Dhruva, M. K. (2013) Study of summer preservation pupa in Diamond silkworm at immature nymphal stage. Journal of Experimental Zoology India, 16:1549-1554.

Soumyadeep, T.D.; Gowrisa, P.L.; Sudhakara Rao, P. and Nataraju, B. (2013) Determination of virulence in the selected pupitine silkworm isolate through Semi-in- vivo bioassay and non bioassay inoculum. Asian Journal of Animal Research, 7(1): 59-61.

Soumyadeep, T. D.; Sudhakara Rao, P. and Nataraju, B. (2013) Interference in solation involving silkworm isolate resistant to nuclear polyhedrosis virus (BmNPV). Asian Pacific Journal of Zoology, 2(2):91-97.

Deshmukh, S., Shelake, R. D., Ashwathi, D. K., Ganesh Kumar, K. and Sinha, A. K. (2012) Evolution of Weed Control Practice in the Literature, abstracts Hindi • All Countries. Journal of Agricultural Technology, 8(1): 9-27.

Kumbhar, M., Ashwathi, D. K., Chandrasekhar, N. and Ramakrishnan, L. K. (2014). Insect identification in polyethylene sheeting trap to conserve diversity. Abstracts Hindi. BIOSCIENCES, 2(2):564-582.

Vishwanna Chandra, Vidyasagar, M. S. and Ashwathi, D. K. (2013) Differential expression of cuticular lipids in Spodoptera litura (Fabricius) (Noctuidae:Lepidoptera). BIOSCIENCES, 4(2):221-231.

Vishwanna Chandra, Vidyasagar, M. S. and Ashwathi, D. K. (2013) Evaluation and identification of potential biocontrol agents of Spodoptera litura (Fabricius) (Noctuidae:Lepidoptera). Journal of Entomology & Zoology Studies, 1(6):73-81.

POPULAR ARTICLES

Kalyan, R. L., Singhal, N. R. and Kushwaha, R. V. (2013) Bhindavi (Abelmoschus manihot) Abhidi, Adhik labhdayak Dayakon mein Abhivriddhan hetu (3 abhiyaan). Bhartiya Krishi, 7(162):13-14.

Kashyapkumar, B. and Chandrasekhar, K. R. (2014) Hajaramoni samasyaon mein kapaas prabandhan. Krishi Vikas, 1(2):54-57.

Kashyapkumar, B. and Balasubramanian, G. (2012) Kapaas mein Pesticide. Pesticide, 1:30-31.

Mogal, T., Prasad, S. V. and Giri, Balasubramanian Rao (2014) Organic manures from agricultural waste. Arogyasri, 4(3):6-10.

Narendra Kumar, J. R., Mary Josephine, A. V., Shelke, M. K., Nalawade and Mishra, B. B. (2013) Abelmoschus manihot (L.) Medik. - Bhartiya Krishi Vaigyanik Anusandhan Parishad, Indian Journal of Plant Genetic Resources, 26(3):317-320.

Nandha, Ram, V. (2013) Pesticide residue analysis in vegetables: Need, problems and remedies. Pesticide Research Journal, 25(2):114-116.

Singh, R., Vinod Kumar, S. S. Singh and T. K. Sharma (2012) Soil Solution in Tropics : Processes. Indian Farming, 62(4):10-12.

Singhal, N. R., Kushwaha, R.V. and Nakhale, V. Vikas (2013) Bachchoyukt Ke Vaigyanik Utpadan. Krishi Vikas, 1(2):54-57.

Yadav, P. K., Kalyan, R. L. and Dayasagar (2013) Bhindavi (Abelmoschus manihot) Ki Jaivik Kheti. Krishi Vikas, 1(2):54-57.

BOOK

Bhardwaj, S. K. and Kalkhoran, J. Vinod, (ed) (2014) Advancements in Indian Agriculture - Proceedings of the National Conference, CIRCOT, Mumbai, 29-30 January 2014. (Modern pattern pollination: Technological innovations). Editors and co-editors.

Shelke, M. K., Hiranya, D. G. and Gawli, S. M. in "Women, Agriculture and Livelihood: Case of Sericulture in Ramtekari" a chapter in book "Governance of Commons and livelihood security" published by Allied National Agricultural Research Institute, March 2014, pp. 164-178.

BOOKLET/TECHNICAL BULLETINS

Eco-friendly management of aphids, Bemisia tabaci and Helicoverpa armigera in cotton. CIRCOT Technical Bulletin No. 17, January 2014.

Integrated pest management of leaf curl in CIRCOT Technical Bulletin No. 18, January 2014.

Integrated pest management of mealy bug (Phenacoccus solenopsis) in cotton. CIRCOT Technical Bulletin No. 19, January 2014.

Mallika Kaimal, S., Chitleema and G. S. Dhaimal. Forecasting of Aphid incidence on mustard in Tarai Region. http://www.ccsniya.ac.in/sites/default/files/Forecasting%20of%20Aphid.pdf

Mallika Kaimal, S., Chitleema and P. S. Dhaimal. Forecasting pod-borer, A. obliqua and pod fly incidence on mustard in Tarai region. http://www.ccsniya.ac.in/sites/default/files/Forecasting%20of%20Aphid.pdf

NEWSPAPER & MAGAZINES

Chakraborty, N. K. and Mukherjee, A. K. (2013) Causes for poor ranking of Indian cottage. The Hindu, May 20th, 2013.

Chowdary, K. R. and Sri. Satyanarayana Raju (2013) Saving the mulberry ecosystem. Down Earth, The (Hindi), October 15th 2013.

Daniel, A. S. S., Suryanarayanan, T. and Bhanu, P. S. (2013) Novel alternation by RPC Saravanakumar. Hindu (JAN.) 2013 (1) 43.

Daniel, A. S. S., Suryanarayanan, T. and Vijayakumar, G. (2013) Field day programme by RPC Saravanakumar. Hindu (Dec.) 2013 (1) 45.

Daniel, A. S. S., Suryanarayanan, T. and Vijayakumar, G. (2014) Technology demo programme by RPC Saravanakumar. Hindu (Feb.) 2014 (1) 48.

Hemanthkumar, M. T. and Udayakumar, K. S. (2013) enlightenment programme. Hindu (Jan. 5) 2013.

Krishnaraj, R. (2013) One Lakh sapuri on Tukra disease was published as a news item in Hindu's, January 27th 2014.

Krishnaraj, R. (2013) Enlightenment programme organized at Kadalur area. Hindu (Jan. 5) 2013.

Kushwaha, K. L. (2013) Farmers Training Programme at Amravati. Hindu (Jan.) 2013.

Kushwaha, R. L. (2013) Field day at Hindupur, TN (Dec.) 2013, Hindu (Jan.) 2013 (1) 43.

Kushwaha, R. L. and Kumaresh, G. L. (2013) Farmers Training Programme at Krishnagiri, Hindu (Jan.) 2013 (1) 43.

Kushwaha, R. L. and Kumaresh, G. L. (2013) Field day at Amba field Tukda, Krishnagiri. Hindu (Dec.) 2013 (1).

Kushwaha, R. V. and Kumaresh, G. L. (2013) Training programme at Periyakulam, Hindu (Jan.) 2013 (1).

Reddy, M. P. and Sri. Satyanarayana Raju (2013) Cocoon Discussion at Vemulawada. Nagarkurnool Hindu, Hindu (Jan.) 2013 (1).

Reddy, M. P. and Sri. Satyanarayana Raju (2013) Cocoon Discussion at Hindupur. Hindu (Jan.) 2013 (1).

Reddy, M. P. and Sri. Satyanarayana Raju (2013) Cocoon Discussion at Dharmavaram. Hindu (Dec.) 2013 (1).

Reddy, M. P. and Sri. Satyanarayana Raju (2013) Awareness programme at Bellampalli, Hindustan Intermediate, Hindu (Dec.) 2013 (1).

Reddy, M. P. and Sri. Satyanarayana Raju (2013) Cocoon Discussion at Vemulawada. Nagarkurnool Hindu, Hindu (Jan.) 2013 (1).

Mary Vasantha, A. V. and Gunasekharan, M. P. (2013) Report on Field day. Hindu (Jan.) 2013 (1).

Sasikiran, N. (2013) Silkworm : Yield increasement. Kisan Bharat, January p.57.

Sankhavi, N. and Dikkinavar (2013) Diseases and insects in modern dairy cattle. Science & Technology Agriculture. The Hindu, 14th November. pp 10, p 11.

Shantikumar, N. and Balakrishnan, R. (2013) Eco friendly measure to control cassava mealybug. Science & Technology Agriculture. The Hindu, April 18th. pp 2, p 16.

Vidyasankaranna Raju D.N. and Shivakumar, N. R. (2013) Managing small but diverse in machinery. The Hindu, July 16th, 2013.

Vidyasankaranna Raju, D.N. (2013) A Report on agriculture Technical workshop on promotion of Mushroom and production conducted by KVKBS, Hiremallapur at Bangalore(R), Indian Edn. 4(3): 56

Vidyasankaranna Raju, D.N., Prakash, N. S. and Chikkalki (2014) A Report on Jangleshwari programme at Hanchinal village conducted by DPC, Association of KVKBS, Anantapur and DDS Anantapur. Indian Edn. 4:3-10,11

Vidyasankaranna Raju, D.N., Raghupathi, N., Sudarshanbabu and Chikkalki (2013) A Report on sangleshwari programme at Kottapalli village conducted by KVKBS, Anantapur and DDS Anantapur. Indian Edn. 4:[45] pp.44

Vidyasankaranna Raju, D.N., and Shankara Babu, N. A. (2013) A Report on agriculture farmers study tour programme conducted by KVKBS, Anantapur at Nagpur(MP). Indian Edn. 4:[5] 28

Vidyasankaranna Raju, D.N., and Gowrish Reddy, N. (2013) A Report on agriculture farmers training at Hirehalal village conducted by KVKBS,Anantapur and DDS. Indian Edn. 4:[5] 44.

Vidyasankaranna Raju, D.N., Reddy, P. D. and Gowri, (2013) A Report on agriculture farmers sangleshwari programmes conducted by KVKBS, Anantapur at Hatoli and by Hiremallapur, Kottapalli at Hiremallapuradoddi. Indian Edn. 4:[5] 37.

Vidyasankaranna Raju, D.N., Sharma, S. D., Rammohan, and Mahadevaiah, N. (2013) A Report on Training programme conducted at KVK, Jeedipalli by CSWRI, Avikanagar and KVKBS, Anantapur on July 31st – 5th 2013, Indian Edn. 4:[5] 44.

Vidyasankaranna Raju D.N. and Vidyalaxmi, B. (2013) A Report on field day conducted at Hanchinamaradi on Cv. K-2043 by Smt. at Dist. Indian Edn. 4:1-4,11.

Shivakumar, N. (2013) Pest day at Pavagada. Indian Edn. 3:1(2):1-11.

Shivakumar, N. (2013) Field day organized at T. N. Mutta village in Pavagada Taluk. Indian Edn. 4:11-12,16

Shivakumar, N. (2013) Farmers field experience(C). Doddur Mallur. Indian Edn. 3:1(2):35.

Shivakumar, N. (2013) Training programme organized at Gollahalli, Kasaluru Hobli, Dodda Ballapur Taluk. Indian Edn. 3(1):1-10,11.

Shivakumar, N. (2013) Pest day conducted at Lingadahalli, Pavagada Taluk. Indian Edn. 4:2-3,42.

Shivakumar, N. (2013) Group Discussion held at Kottakallu, Pavagada Taluk. Indian Edn. 4:1(2):39-42.

Shivakumar, N. (2013) Pest day organized at Chikkabanahalli. Indian Edn. 4:1-2,11.

Shivakumar, N. (2013) Training programmes conducted at different centres. Indian Edn. 4:1-4,11-14.

Sureshmanjunath, M. N. (2013) Report on Sheep rearing in Vijayapura. Rythmitram Edn on September 21st 2013.

Sureshmanjunath, M. N., Nandeesha, K. L. and Shankara, B. N. (2013) A demonstration on chaffcutter operation organized at Hirebidanur. Indian Edn. 4(6):7-12,13-14

Sureshmanjunath, M. N. (2013) A demonstration on breeding, rearing and application of Azolla at Thotlaguppe, Bandalapura Taluk. Indian Edn. 4(6):7-12.

Umadevi, K. and Hiremath, M. T. 2013. Floriculture and Extension. Indian Cir. 3: 6 8 1-14.

CIPHET, LUDHIANA, ANNUAL RESEARCH REPORT FOR 2013-14

Abdullah, S. A., Sharma, R. K., Sethi, V. N. Prasanna Kumari, and Verma, S. K. 2014. AEW-1 AEW-1 new oil palm hybrid for sub-optimal conditions.

Sharma, D. S., Prasanna Kumari, K. and Mal Reddy (2014). New Sharma different model, hybrid – [illegible] – Sharma's model. A Sharma variety for light egg laying and one variety are in production.

Chandan, N. S. (2013). Refractive index scale adjusted astronomical scientific refractometer (Telugu).

Chandan N S. (2014). Refractometer for astronomy in immediate (Telugu).

Chandan, N. S., Sri. Satyanarayana Raju and Ananda, S. S. (2013). Scientific investigation – Samajika Anupamam Organic agriculture – a comprehensive understanding (Telugu).

Deepika, Yadav, V. S. and Thippeswamy, T. (2014). Recognition reporting for successful nursery soil.

Deepika, Yadav, V. S. and Thippeswamy, T. (2014). Connecting and Commonwealth through rounding of agricultural institute.

Deepika, Yadav, V. S. and Thippeswamy, T. (2014). Personnel Recruiting Service (PRS- RECRUIT) Definition for nursery soil production.

Kali Reddy, S. (2013). [illegible] [illegible] [illegible] [illegible] [illegible] (Telugu).

Kali Reddy S. (2013). Nutrients stimulating organic Sanskrit book electronic (Telugu).

Kali Reddy, S. (2013). [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] (Telugu).

Mallikarjuna, S and Sastha, (2014). Pioneer' Assessment Assistant Commencement Graphic Institute (Kannada).

Mallikarjuna, S. (2014). Technical' Assessment program [illegible] [illegible] [illegible] (Kannada).

Mallikarjuna, S. (2014). Assessment analysis and learning [illegible] [illegible] (Kannada).

Mallikarjuna, S. (2014). Assessment Assistant [illegible] [illegible] (Kannada).

Mallikarjuna, S. (2014). Data scientific Assessment Assistant primary level language (Kannada).

Mallikarjuna, S. (2014). Data scientific predominant Assessment Assistant [illegible] [illegible] [illegible] (Kannada).

Mallikarjuna, S. (2014). Data scientific predominant management Assistant [illegible] [illegible] (Kannada).

Mallikarjuna, S. (2014). Data scientific predominant Assessment Assistant [illegible] [illegible] [illegible] (Kannada).

Mal Reddy, Nagarma Begum, A. and Sharma, S. S. (2014). Sunflower double hybrid – Kamalaja – CSH1 x CMS1 2 cross of CMS1 for light egg laying and one variety.

Mal Reddy, Nagarma Begum, A. and Sharma, S. S. (2014). CSH1 x CMS1 Sunflower hybrid.

Meena, R. and Mallikarjuna, S. (2013). Data scientific [illegible] [illegible] – [illegible] (Kannada).

Mandal, R. and Mallikarjuna, G. (2014). Advanced practices for cultivation of Jatropha curcas L. in India. Jatropha, Jatropha-curcas Linn. Biology and Genetics, 1-11.

Mandal, R. and Mallikarjuna, R. (2014). Physical stress: Jatropha curcas L. Jatropha, Jatropha curcas Linn. Biology and Genetics, 1-11.

Mandal, R. and Mallikarjuna, R. (2014). Genome wide analysis of stress responsive genes in Jatropha curcas L. Jatropha, Jatropha curcas Linn. Biology and Genetics, 1-11.

Mallikarjuna Reddy, K., Sujana, K., Bhanu Prakash, K., Madhumurthy, D. V., Sharma, K. K., Ramesh, K., Ramana Rao, M. V., Sharma, S. D., Ramana Rao, V., Ramakrishna, Y. S., Wani, S. P., Pathak, P., Srinivasa Rao, Ch., Gopinath, K. A., Venkateswarlu, B., Singh, A. K., Singh, R. K., Singh, S. D., Singh, H. P., Sahrawat, K. L., Sreedevi, T. K., Rao, K. V., Kalaivanan, D., Rupela, O. P., Thirumeni, S., Yadaiah, P., Srinivas, K., Narsimlu, B., Sudhakar, P., Wani, S. P

Thippeswamy, T., Sia, M. A. P. and Shekhar, S. K. (2013) Cytotoxic activity of Indian snake venoms against human cervical carcinoma cell line.

Thippeswamy, T., Ong, M. A. P., Rajeshwara, K. and Shekhar, S. K. (2014) RCP- A multienzyme complex for low temperature adaptation.

Thippeswamy, T., Lim, M. A. P., Rajeshwara, K. and Shekhar, S. K. (2014) RCP- A multienzyme complex for low temperature adaptation.

Vidhya Lekshmi and Sasidharan, K. (2013) Angiosperms flowers checklist of Kerala, southern Western Ghats, India. Phytotaxa.

OTHER ACADEMIC ACTIVITIES

ATTENDED

International Conference on Biodiversity, Bioeconomy and Biotechnology: Organized by Association for the Advancement of Biodiversity Science and Society for Applied Biotechnology, Bhopal, Karnataka, 29-31st January 2015.

Chikkanna, Bheemareddi, D., Venkatesan, S., Ravikumar, J. and Shekhar, S. K. (2014) Cytotoxic activity of various plant extracts against the cassava mealybug, Phenacoccus manihoti (Williams and Granara de Willink) infesting mulberry, p.44.

Bheemareddi, D., Sadhikhan, N., Hiremath, S. M., Chikkanna and Shekhar, S. K. (2014) Field efficacy of different insecticidal schedules against the cassava mealybug, Phenacoccus manihoti (Williams and Granara de Willink) infesting mulberry and their influence on leaf yield, p.44.

Ravikumar, J., Dandothkandy, P., Chikkanna, Bheemareddi, D. and Shekhar, S. K. (2014) Bioconcentration of sericultural chemicals by Trichodesma indicum, p.47.

Third International Symposium on Sericulture for Tropical/Subtropical Areas held on 11 – 13 September, 2013 at Nanning City, PR China.

Shekhar, S. K., Sangma, A., Krishnan, M. N., Ramesh, G. N., Thippeswamy, T. and Sahi, V. N. (2013) Suitability mulberry yields in terminal conditions: Characterization of germplasm resources for novel traits variations and its utilization in crop improvement.

Proceedings of the "XIth IUCNN International Conference"Building Value Chains for Sericulture" "SERIBOOM" 2013 held at Padua, Italy on April 7th – 12th 2013.

Hazarika, D. G., Das, S. K., Hatibaruah, R., Pait, N. S., Chandrasekaran, K. and Gupta, A. K. (2013) Identification of suitable translation zones for mulberry seed crop distribution in Eastern and North Eastern India, p.46.

Hazarika, D. G., Das, S. K., Kalita, M. M. and Hatibaruah, R. (2013) Breeding of hardy mulberry germplasm and identification of polyvoltine x bivoltine silkworm hybrid suitable for variable climatic conditions of the foothills of India, p.47.

Hazarika, D. G., Chandrasekaran, K., Hatibaruah, R. K., Hatibaruah, R., Dalapati Begum, A. and Das, S. K. H. (2013) Identification of molecular markers (SSR) associated with thermo tolerance in silkworm, Bombyx mori, p.52.

XIII Biopesticides International Conference held at Crop Protection Research Centre, Dept. of Advanced Zoology & Biotechnology, St. Xavier's College, Palayamkottai, TN, India 26th-28th November, 2013.

Hazarika, D., Hatibaruah, I. and Hatibaruah, M. (2013) Efficacy of neem extract and its combination against flacherie disease in mulberry silkworm, Bombyx mori L., p.42.

Mahmoudi, A., Siddiqui, N., Naim, R. and Rajakumar, S. (2013) Effects Monodora tenuifolia between tomb plants, pre mealybug, Maconellicoccus hirsutus and its predator, Hemisarcoptes malus. p.146

Mahmoudi, A., Siddiqui, N., Naim, R. and Rajakumar, S. (2013) Studies on the association of some ants (Hymenoptera: Formicidae) with Maconellicoccus hirsutus (Green) and its influence on predatory mites in Indian ecosystem. p.224

Ravikumar, J., Ramaraju, K., Sasikumar, G., Ramachandran, P., Rajkumarsingh, K., Chitdeshwari, T. and Sivakumar, G. (2013) In vitro evaluation of botanicals against papaya mealybug, Paracoccus marginatus (Williams and Granara de Willink) in Andaman. p.116

Ravikumar, J., Mohan, M., Sasikumar, G., Ramachandran, P., Rajkumarsingh, K., Chitdeshwari, T. and Sivakumar, G. (2013) Studies on spatial variation of cotton mealybug pests and its natural enemies in Tamilnadu ecosystem. p.231

Sasikumar, G., Kalaimagal, A., Ravikumar, J., Ramachandran, P., Chitdeshwari, T. and Sivakumar, G. (2013) Impact of chemical pest management practices on the field populations of parasitic wasp, Aenasius bambawalei and population buildup of papaya mealybug, Paracoccus marginatus in mulberry growing. p.218

Sasikumar, G., Kalaimagal, A., Ramachandran, P., Ravikumar, J., Chitdeshwari, T. and Sivakumar, G. (2013) Field evaluation of some selective biopesticides against mulberry thrips, Pseudodendrothrips mori (Niwa) (Thysanoptera: Thripidae). p.225

Sasikumarraj, P., Sasikumar, G., Ravikumar, J., Chitdeshwari, T. and Sivakumar, G. (2013) Commercial production of biocontrol agents for the control of pests in mulberry and silkworm. p.224

Sasikumarraj, P., Sasikumar, G., Ravikumar, J. and Chitdeshwari, T. (2013) Scope on utilization of residues from mulberry culture for the mulberry sericulture for eco-sustainability. p.227

Workshop of the ESG Scope Working Group on Mass Rearing and Quality Assurance: Emerging Opportunities for the Mass Production & Quality Assurance of Invertebrates, 6-8 November 2013, NBAII, ICAR, Bangalore - 560 024, India

Mahfuz Haider, Q., Chitdeshwari, T., Sasikumar, G., Sasikumar, K., Siddiqui, J., and Qamaruz, Z. (2013) Hibiscus sabdariffa L. 'Mitravenkata' as an alternate host plant for mass rearing of Paracoccus marginatus (Williams and Granara de Willink) (Hemiptera: Pseudococcidae) and their natural predators. p.23-45.

Venkatesan, T., Mahfuz Haider, Q., Jalali, S. K., Sethuraman Reddy, K. and Lalitha, Y. (2013) Rearing and Evaluation of pesticide resistant Populations of Chrysoperla carnea (Stephens) (Neuroptera: Chrysopidae). p.27-32.

10 International Conference on Vector and Vector Borne Diseases held at Maharshi Dayanand University, Rohtak, Haryana, India on 14 – 16 September 2013.

Vinod Kumar, Bhardwaj, M. R. and Narendra Kumar, J. R. (2013) Biological control of Mealy Diptera flies. p.139

International Symposium on "Frontline Discoveries and Innovations in Microbiology and its Interdisciplinary Relevance (FDIMIR-2013) held at Maharshi Dayanand University, Rohtak, Haryana during November 17-19, 2013.

Venkatesha, V. Afreen Abdu, Thippeswamy T. and Mallick, S. R. (2013) Biological control of root rot disease of mulberry caused by Rhizoctonia bataticola (Taub.) Butler by endophytic bacteria. p.45

PATTERNS.

'43rd Indian Science Congress Association (ISCA), held at University of Jammu, Jammu (J&K) From February 3-7, 2014.

Mewara Begum, K.; Md Reddy, N.; Mathur Moorthy, S.; and Bhavsar, B. N. (2012) Multiple cloning hybrid (CDR5) x CDR27) x (CDR5) x CDR27) Development of Alleles, Biology mol. L. – a Queensland Honey Spinner for the semi-arid tropics, p.66.

Yadav, C. R., Dasappa, Thippeswamy, T., Soni, S. and Bhavsar, B. N. (2012) Insect Lepidoptera Insect and Its parameters as wildlife pest Initiative to optimum and yield of mulberry p.78-97.

4th Annual R&D conference on science and technology for societal transformation" dated 15th and 16th December 2012 and published in Research and Need of process.

Siddhapara, Rakesh Begum, K. Patel, S. H. N. and Nirmal Kumar, S. (2012) "FISH to study of sensitive telomere inside and single hybrids among the farmers in Junagadh in India, Insect a report' p.42.

Gujarat Juvenile Industrial Conference on Sericulture Innovations: Actors and Aspects, 28 – 30th January, 2011, CSRTI, Mysore.

Thomas, B. B. (2013) Sericulture extension in the state of Jammu and Kashmir – A SWOT approach, p.172-178.

Ramakant, Bhardwaj, B. B., Anil Dhar, and Khan, M. A. (2013) Mid-culture for livelihood development in Kathua district, Jammu and Kashmir, p.220-223.

Workshop/ seminar on innovations in science and technology for inclusive development in the year 2014 (Departmental studies in Zoology, University of Mysore, Mysore.

Siddhapara, T.G., Jadeja Kumar, Sudhakara Rao, P., and Siddiqui, A. (2011) Estimation of molecular and combining ability in Mulberry (Morus) and their hybrids of Morinda mont L. in MORPH, Innovation and Initiation, p.1-16.

Workshop/ Conference on "Status and Conservation of Biodiversity in India with special reference to Himalaya" held at Centre of Advanced for Development and Department of Environmental Sciences, University of Kashmir, Srinagar from 4-5 October, 2011.

Kotak, B. G., Lee, G. L. F., Rajashekar, K., Thippeswamy, T. and Bhavsar, B. B. (2) (a) Influence of climate change on biodiversity, Evolutionary and conservation strategies for posterity, p.14-44.

Nath, J. G., Krishnan, S. R., Thippeswamy, T., and Dhanraj, S. S. (2012) Role of wild mice relatives in diversification of breeding gene pool of Mulberry – A simulation study with real data, p.21-38.

Lee, M. K. F., Rajashekar, K., Gandhi Rose, S., Thippeswamy, T. and Bhavsar, B. B. (2012) Status, conservation strategies and utilization of biodiversity for environment region specific multiple varieties, p.33.

National Conference on Biodiversity and ecological sustainability-2014, at G.G.S. college, Port, Odisha in collaboration with academy of plant sciences India, Bhubaneswar (O.P).

Jadhi Kumar, J. and Balasubramanian, M. (2014) Remodeling in the subspecies silkworm Bombyx mori L. using genotypes p.47.

National Conference on recent advances in modern Biology & technology for women empowerment and rural development (NCMBTWERD-2012) 24-26th October 2012, SSVPS, Thallaghattapura, Bangalore.

Devasena, Thiloo, K.K. and Thilagavathy, T. (2013) Influence of soil moisture and soil chemical properties on soil microbial co- soil chemical and biological properties and leaf yield of mulberry at farmers level. p.13.

Jayakumar, Palma Venkata, Kalu, K., Ammaiappa, V., Nagaraswamy, C., Umashankar, R., K.J. Vishal Kumar, S. and Mahesh, M. S. (2014) New improved cocoon seeds of silkworm Bombyx mori L., suitable for southern India. p. 450.

Kodali, S. S.; Gill, M. S. K.; Reddy, M.; Thilagavathy, T. and Mahesh, M. S. (2014) Influence of CO2 on spinning behaviour and thickening time in some mulberry germplasm/ accessions after silkworm chawki. p.15.

Chandra Shekar, N. S.; Satpathy, S. V.; Vasudevappa, A. and Mahesh, M. S. (2014) Importance of harvesting and mulching method in mulberry garden maintenance and its impact on leaf quality and cocoon productivity. p.17.

Chandra Shekar, K. R.; Balasubramanya, H. A. and Mahesh, M. S. (2014) Studies on the effect of harvesting seven mulberry varieties in the productive situations based CSRC. p.18.

Ravikala, S. K.; Chandra Shekar, K. R. and Mahesh, M. S. (2014) Impact of systematic bi-annual silkworm breed maintenance on the consistency in the expression of breed characters over generations at FC level. p. 19.

Mahadeva, J.; Satpathy, S. V. and Mahesh, M. S. (2014) Interaction of total reducing carbohydrate and protein in mulberry and multivoltine hybrid silkworm Bombyx mori L. p.20-21.

Mahadevaiah, M. and Sandhyarani (2012) Evaluation of different plant extracts for the management of mealybugs and sooty mould on the mulberry field. p.45.

Moorthy, S. M.; Chandrakanth, B.; Ashwath, S. K.; Kalaiarasu Raguvir, A.; Md Shafiq, M.; Mahesh Kumar, S. and Mahesh, M. S. (2013) Phenotypic population of thermotolerance in silkworm strains of Bombyx mori L. p.54.

Manimaran Kumar, J. R.; Vinod Kumar, Deekshatulu, B. T. and Mahesh, M. S. (2013) Classical biological control of the cassava mealy bug Phenacoccus manihoti in Karnataka. p.46.

Nath, J. G.; Kalaivani, K. R.; Raghu, S. T.Vijayakumar, T. and Mahesh, M. S. (2013) DNA-barcode marker analysis of mealybug genotypes supports the introduced spread of mealybug from China to other Asian, European and African countries. p.44.

Mallikarjuna Gadi, C.; Nagaraveni, M. S.; Shankar, D. G.; Thilagavathy, T. and Mahesh, M. S. (2013) Screening of mulberry root accessions for salinidic and saline stress. p.23.

Nagaraju, S. and Mahesh, M. S. (2013) Women contribution in rural development through Sericulture. p.197.

Nagaraju, S. and Mahesh, M. S. (2013) Sericulture is emerging as a business opportunities and need to fall its economic importance. p.194.

Ramachandrula, V. V.; Sundaramanjam, M. R.; Dakshayanee, S. S.; Sonnadara, J. and Hegadi, B. S. (2013) Village survey on age women - A comments on sericulture p.144.

Ramachandrula, V. V.; Dakshayanee, S. S.; Sundaramanjam, M. R.; Vasanth, P. S. and Hegadi, B. S. (2013) Silk city Kanchipuram - A unique socio-economic case study for sericulture sciences p.134.

Sankaranarayana, M. S.; Ramanjaneyulu, T. V.; Subbaramaiah, M. R.; Sonnadara, J.; Satpathy, P. K. and Hegadi, B. S. (2013) Sericulture as instrument to fund planning economic growth p.134.

Silkworm rearing and sericulture. M. S. (2014) Improved rearing equipment and machines for enhancing the productivity and reducing drudgery for mulberry sericulture. p.144.

Central Vermi And Biotech. 2: 2. (2013) Role of microbiology in mulberry sericulture p:57-102.

Sharma, K. K., Reddy, S. N., Mohan, M. N., Ashwath, S. S., Naseema Begum, A. and Mohan, K. R. (2013) Comparative performance of BMAP x BMAD during pre authorization and post authorization trials p:19.

Sowmyalakshmi, T. N., Jagdish Kumar, J., Sudhakara Rao, P. and Vijayaraj, R. (2013) Comparative virulence of cytoplasm to the identified silkworm breeding through NPV inoculation and temperature induction p:130.

Subbaramaiah, K. R., Ramakrishnaiah, T. V., Ramamurthy, H. R., Shivakumar, C. and Angadi, B. S. (2013) Drought principle: A book for sericulturist p:189

Sudhakara Rao, P., Sowmyalakshmi, T. N. and Jagdish Kumar, J. (2013) Photoperiodic modulation in the silkworm (Bombyx mori L.) race for diapause and non diapause induction p:130.

Thimmaraja Gowda, Kalappa, G. V. and Ashwath, S. S. (2013) Identification of fly parasitoid of mulberry thread silk caterpillar Eriogyna pyretorum, for mass p:83.

Workshop Conference cum Sensitization Cum Unofficial Assembly, January, 20-21, 2014 held at Kollegal of Sericulture, University of Agricultural Sciences, Chikkamagaluru, Karnataka, India

Shanthi, K. P., Dasappa, D. D. and Hobbi Hemanth, M. (2014) Influence of Chawki rearing centre on cocoons and cocoon characters p:131-136.

Shankara Shetkar, K. R., Kalpana, G. V., Mallikarjunan Reddy, M., Venkatesha, K. and Srinivas, M. R. (2014) Role of 'sexing and moulting method on soil fertility and its impact on mulberry leaf quality and cocoon productivity p:1021.

Vijayalaxmi, M. and Hanumanth, S. (2014) Impact of age on the progeny production and progeny morphometric characteristics of Thread foot Inchworm (2008), an endemic pest p:1169

Vidyasagar, G. V., Shankara Shetkar, K. R., Radha Lakshmi, T. C. and Srinivas, K. R. (2014) Evaluation of the compatibility of the autoclaved chawki mulberry leaf and cocoon traits at semi commercial rearing in Malavalli district p:1419.

Madhu Manthesh, M., Basavaraju, M., Rajanna, H. L. and Shankara, K. R. (2014) Chawki promotion programme and its impact on sericulture and socio economic improvement of Bangladesh mulberry farmers p:1577-1581.

Mohan Kumar, M., Rajanna, H. L. and Srinivas, K. R. (2014) Impact of spacing in mulberry plantation on the leaf production and incidence of insect pests in Kolar region. p:11

Rajakumar, G., Chikkanna and Shankara, K. R. (2014) Making sericulture resource rich, debt and subsidence through efficient management of the elderly silkworms and product diversification p:1-10.

Sakthivel, N., Mallikarjuna, N. N., Chikkanna and Gowda, G. Y. H. (2013) Biochemical changes in Jatropha leaves (Pinnacocus manihotoides Hillaire and Brenes ex Pittier) infected Cassava mosaic and its impact on rearing performance of Eri silkworm (Samia cynthia ricini Boisduval) p:1-5-117.

Shenoy, H. and Manjunath, H. R. (2013) Tourism, sericulture and communities village - A conceptual study p:145.

Venkateshaiah, B., Venkatesha Reddy, S. and Sri. Dayananda Raju (2014) Role of chemical in the improvement of cocoon yield emergence in the silkworm, Bombyx mori L. p:2041.

Venkateshaiah, B., Venkatesha Reddy, S. and Sri. Dayananda Raju (2014) Role of sugar content of mate moths in reproductive ability in the silkworm, Bombyx mori L. p:31-32.

Anandaraj, M., Hemavathy Reddy, S. and Sri Balaramana Rao (2014) Role of relative humidity during male moth preparation on male moth efficacy in CSR ureas of the silkworm, *Bombyx mori* L. p.59

Annapoorna, A., Sri Balaramana Rao and Shekar, S. S. (2014) Hebiron: A specific plant based formulation for control of mulberry root rot at farmers level in P hosahalli area of Krishnagiri district, India.

Annapoorna, A., Sri Balaramana Rao and Shekar, S. S. (2014) Pocket: A multivalent formulation for control of mulberry root rot at farmers level in P hosahalli area of Krishnagiri district, India.

Annapoorna, A., Raghupathi, M., Reddy, M. P., Sri Balaramana Rao and Rathore, S. S. (2014) Transfer of technologies through different extension programmes under central sector schemes: An application in P hosahalli area of Krishnagiri district. p.111

Annapoorna, A., Sri Krishna, S., Sri Balaramana Rao and Shekar, S. S. (2014) Impact of Pocket bag Pheromone compositions on mulberry in Kolar area of Karnataka State. p. 4

National seminar on "Recent trends for Sustainable agriculture" held at Sri Padmavathi Mahila Visvavidyalaya, Tirupati (dates not available but after March 2013 and published in December.

Sreenivasulu, Naveena Begum, A., Dalal, S. R. K. and Murali Kumar, S. (2013) Double hybrid, an economic booster to the traditional sericulturists of Kolar district of Karnataka state. p.127

National Seminar on Development and social issues 30 24th January 2014 Organized by Geology Department, Periyar University, Salem.

Rajakumar, S., Chikkanna and Shekar, S. S. (2014) Socio-Economic Empowerment of Rural Women through Sericulture.p24

National symposium on Recent Advances in silkworm Biology (Mulberry, Lac Culture) and sericulture held on 21 to 23 11.2013 at Ranchi, Ranchi, Jharkhand.

Shivakumara, S. and Shekar, S. S. (2013) ICT (Affordable Micro Irrigation Technology) - A novel technique for increasing productivity in drought prone Chamarajanagar district. p.6

Shivakumara, Shekar, S. S., Jain, S. and Kamala Jain (2013) Field evaluation of bio fast acting (1 generation) acaricide by dose of chalcap against *P. ki*.

Shivakumara, S., Shekar, S. S. and Giri, S. (2013) Combined effect "cow manure and bio-NP" management for soil improvement and sustainable mulberry leaf production under rain fed conditions.p.ab.

National workshop on Role of Graded Rearing Centre (GRC) in Bivoltine DFR production held at CSRTI, Mysore on 10 Sep. 2013.

Sekar Venkatachalam, M., Narasimha Reddy, A. K. and Ashoka, S. S. (2013) Disinfection and Hygiene for Grade Rearing commercial Grade Rearing - ensuring farm workers success.

Jayaram, S. and Shekar, S. S. (2013) Economics of Grade Rearing Centres. p.23-32.

Thippeswamy, T., Deepika and Shekar, S. S. (2013) Sericulture and management of mixed farming system. p.14

Proceedings of Sixth Joint Seminar on "Emerging Novel avenues in Sericultural Research", 22nd February 2014 organized by Central Institute of Biotechnology Research, Madurai.

Jalali, Kumar J., Kumar A. S. K. and Mishra, S. (2014) Biotechnological Tools for Silkworm Disease Management, p 23-25.

Proceedings of the 102nd Indian Science Week, National Conference on Biodiversity and ecological sustainability, 15-16th February, 2014, Port Blair.

Babu, A. M., Jalali S, Kumar, Chandra and Bhanu, S. S. (2014) A comparative anatomical study on the development of the tracheal system in Bombyx mori (Linn.) recognizing the role of the moulting hormone with varying dosage tolerance, p. 18

Seminar on arts held on 6th January Conference on Entrepreneurship, Ahmedabad.

Sharma D. C., Chandrashekar, K. R., Nirmal Kumar, S. and Sahil, S. et al. (2013) Adoption of innovative technologies for boost seeding in silkworm seed cocoon banks in the cooperative farmer – A case study.

39th All India Sociology Conference on "Social Inequality, Socio Justice and Empowerment", 27-29th December 2013, organized by Indian Sociological Society, New Delhi and Karnataka State Open University, Mysore, at K.S.O.U Campus, Mysore, India.

Geetha, G.G., Vishnu, S. S. and Bhanu, S. S. (2013) Silkworm Insecta: Activity of Human Dimorphism in Silk Industry, p.1-32.

National Symposium on Innovations in Science and Technology for Inclusive India at Department of Studies in Zoology, Manasagangotri, University of Mysore, Mysore, Jan 5-6, 2014

Thangathai, R. and Hariprasath, S. (2014) "Effect of fluoride ion on the reproductive efficiency and progeny rate in", p.6.

Mary Josepha, A. C. and Bhanu, S. S. and Shridhar, S. S. (2014) Ethological changes in Vanessa cardui L. : Insects affected with radiation, moulting hormone, p.73.

KSTA Regional Conference on Science and Technology for Education and Health care held at JSS college of Arts, Commerce and Science, Mysore between 31st & 2nd Feb 2014.

Thangathai, R. and Hariprasath, S. (2014) "Progeny production efficiency of Tasar silkworm inherent and morphometric characteristics of its progeny as influenced by malathion", p.10-11.

Swamyraju, T. R., Justin Kumar, Nandeesha Nayaka, A. R. and Mary Josepha, A. C. (2014) Effect of Bombyx mori nuclear polyhedrosis virus (BmNPV) infection and radiation on the biochemical parameters of some silkworm tissues, p.47.

National Conference on recent trends in Bio-sciences - Challenges and Future prospects, Bal Bharati College of Science and Technology, Surat, Kottam, Kerala, 10-12 March 2014.

Rajasekaran, R. (2014) Biotechnology in sericulture and silkworm breeding for evaluation of new breeds- Challenges and constraints, p.17.

CSRTI, MYSORE - EXTENSION NETWORK

Basic Seed Farm	(1)
Cluster Dev. Centre	(2)
Cluster Promotion Centre	(1)
Research Extn. Centre	18
Regional Sericulture Research Station	1
SSI of Research Extension Centres	35
Satellite Extension Training Station	11

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