

Central Sericultural Research and Training Institute, Mysuru, Karnataka

HIGHLIGHTS OF CONCLUDED RESEARCH PROJECTS

i) MULBERRY BREEDING AND GENETICS

Sl No.	Project code	Project title	Objective	Investigators	Project period	Project Cost	Objective Achieved	Outcome of the Research Project	How the outcome is utilized
1	PIB-3334	Primary yield evaluation of mulberry genotypes under irrigated condition	To identify superior genotypes with significant increase in yield and quality under irrigated conditions to include in final yield trial.	R. Balakrishna K. Kesavacharulu M. K. P. Urs	2003-2007	24.71	Achieved as per milestones	The genotype K-2 x Kosen developed at CSR&TI, Mysore has been multiplied and taken up plantation as intercrop in coconut plantation with two farmers at Angamali, Kerala. Recorded information on leaf yield, incidence of diseases and bioassay. The same variety has been supplied to farmers at Ramanagara, Channapatna and Mysore as intercrop with coconut plantation.	Field study was conducted with the genotype K-2 x Kosen at farmers level and introduced th e same among the farmers of Ramanagara, Channapatna and Mysore
2	PIB-3336	Development of an efficient model for screening and preliminary selection of potential genotypes at the shortest possible time	To identify an efficient model for screening and preliminary selection of potential genotypes.	Rekha, M K. Kesavacharulu	2003-2007	2.22	Achieved as per milestones	Identified the number of harvests required (7-8) to identify the potentiality of the genotypes at PYE level.	The findings will be utilized by the breeders for identification of mulberry genotypes to save time and resources.
3	PIB-3333	Final yield	• To identify superior	T. Mogili	2003-2007	24.58	Achieved as per	Two genotypes recorded a	The two isolated

		evaluation and development of agronomic package for promising mulberry genotypes under irrigated condition	genotypes of mulberry with significant increase in yield and quality for irrigated condition. <ul style="list-style-type: none"> To develop suitable cultivation package for the identified genotypes. 	S. B. Dandin, R. Balakrishna,			milestones	marginal increase of 2.4 and 3.7% in leaf yield over V-1 and were on par with V-1 in respect of bioassay.	genotypes are being utilized in different breeding programmes.
4	PIB-3334	Primary yield evaluation of mulberry genotypes under irrigated conditions.	To identify superior genotypes with significant increase in yield quality under irrigated conditions to include in final yield evaluation trials.	Balakrishna, R., Kesavacharulu, K. and M. K. P. Urs.	2003 - 2007	24.71	Achieved as per milestones	Two genotypes, Genotype 7 and 13, which recorded significantly higher leaf yield with yield improvement of 18.5 – 25.2 % over S-36 and 11.8 – 18.1 % over V- 1, respectively, were identified.	The identified genotypes No. 7 and 13 were subjected to further testing under FYE trial.
5	PIB-3336	Fast track breeding: Development of an efficient model for screening and preliminary selection of potential genotypes at the shortest possible time through repeatability analysis.	<ul style="list-style-type: none"> To develop a model for early detection of potential genotypes during early screening and selection process by determining the optimum number of harvests required based on repeatability estimates. To test the efficiency of the model developed and to recommend the model for proper breeding management. 	Rekha, M. and Kesavacharulu, K.	2003 - 2007	17.55	Achieved as per milestones	Only 7 – 8 harvests data is sufficient to know the true potential of a genotype at the PYE level, as against 15 harvests data over three years.	The findings of the project is utilized in mulberry evaluation programmes to save time and resources.
6	PIB 3411	Field evaluation of transgenic mulberry for abiotic stress tolerance (DBT funded).	Characterization of agronomical and physiological traits in selected transgenics Evaluation of selected transgenics under greenhouse and field conditions for abiotic stress	R. Balakrishna, M. K. Raghunath V. B. Mathur	Jan.2007 to Dec. 2010.	Rs. 18.95	Achieved as per milestones	Transgenic [K2] lines were multiplied at a rate of 11-29 plants/ line to get a total number of 233 plants. The pot experiment results showed that three lines [ST-17, ST-34 and ST-46] survived even after 60 days	Since the leaf yield under moisture stress condition was too low the Research Advisory Committee of the Institute resolved that, prospective

			tolerance However, due to delay in construction of green house and subsequent transfer of plants the programme was revised to take up only multiplication of the lines.					without watering and ST 46 exhibited sprouting on watering.	mulberry transgenic lines for drought tolerance may be used in future breeding programme towards the production drought tolerant mulberry varieties
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AGRONOMY

7	PPA 3403	Evaluation and promotion of vermicompost technology for the efficient nutrient supplement for the quality leaf and cocoon productivity at farmers' field (CDP assistance of CSB)	<p>1. To study the nutritional status and biological properties of vermicompost prepared out of different feedstock.</p> <p>2.To study the impact of vermicompost on the fertility status of the soil (Physical, chemical and biological properties)</p>	Srikantaswamy K, Dasappa and Munirathnam Reddy	3 years (2007-2010)	10 Lakhs		<p>Nutritional profile of vermicompost was assessed for the different feed stock, which showed varying level of macro (N:1.3-2.3%, P:0.30-0.63%, K:0.33-1.2%) and Micronutrients (Cu:23-393 ppm, Fe:580-9670 ppm, Mn:250-405ppm,Zn:33.1-174 ppm)</p> <p>Vermicompost application has revealed significant increase in the contents of soil organic carbon, EC, total NPK, micro nutrients (Cu, Mn, Fe, Zn) and microbial load substantially and decline in the pH compared with initial status. Soil organic carbon content in soil play key role in marinating soil quality, as it is evident from the statistical analysis. Increase in soil organic carbon with</p>	<p>Bioconversion technology needs to be explored for the enhancement of composting using waste shoots/renewable energy. Varying level of Soil organic carbon recorded at different farmer's field suggest that adequate organic amendments need to be applied for manage-ment of SOC as it is a soil quality indicator for sustenance of crop production.</p> <p>Further studies can be intensified to understand the soil organic carbon</p>
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								<p>the application of vermicompost shown bulk density was significantly reduced with increasing porosity, water holding capacity and the cocoon yield by showing high coefficient determination (r^2) value.</p> <p>The microbial population was significantly increased with respect to actinomycetes(50-55%), bacteria(60-65%), azotobacter(45-52%), PSMs (40-51%) and Fungi (50-55%) with increasing SOC after the application of vermicompost. Besides improving the soil quality, the incidence of tukra was reduced (65.8%) in Vermicompost applied plots. No other foliar diseases were recorded.</p> <p>Economic feasibility of the technology was studied and the cost benefit ratio was worked out to be 1:1.75.</p>	content and soil biodiversity in relation to different cropping systems for the sustenance of crop production.
8	PPA 3337	Economic sustainability of coconut-mulberry	To develop a suitable package of mulberry cultivation as inter-crop with coconut plantation.	Das P. K. Balakrishna R and Vedyavyasa K	4 years (June-2003 to May -2007)	2.16		Significantly higher leaf yield was obtained from the variety K2 x Kosen over K2 variety under both the	The results of the study encouraged the possibility of introducing mulberry

		intercropping system.						fertilizer doses of 300:120:120 kg NPK/ ha/yr and 250:100:100 kg NPK/ha/yr. The yield (number) of coconuts per plant per year increased significantly. On an average 74 number of coconuts were yielded per plant per year in the intercropped area, as compared to 58 nuts per plant in the mono crop area.	as an intercrop in the regular coconut plantations.
9	PPA 3327	Studies on the different organic sources of nutrients in mulberry cultivation. E01 : Effect of different organic sources of nutrients on the growth, leaf yield and quality of mulberry.	To study the effect of different organic resources on growth, yield and quality of mulberry under irrigated condition.	Babu C. M, Gunasekhar V and Vedavyasa, K.	4 years (Mar 2005 - May 2009)	4.37		A cost effective and eco friendly technology package was developed for substitution of costly chemical fertilizers through different organic and biological sources of nutrients for sustained mulberry production.	By supplementing the required quantity of nutrients for mulberry growth and yield through different organic sources indicated the possibility of sustained production of mulberry besides maintaining the soil health. Popularising the technology in farmers field.
10	PPA3368	Studies on the utilization of Sericultural wastes for large scale production of compost and vermicompost. Name of the	To develop the process for large scale production of compost/vermicompost utilizing mulberry shoot wastes.	Dasappa, T. Thippeswamy Munirathnum Reddy	2.5 years (Apr 2006- Aug. 2008)	2.31		An effective technology was developed to produced compost out of mulberry shoot crushed material. 58 MT of compost (Out of 90 MT crushed material) was produced and used in mulberry garden section	A participatory mode was initiated at the farmers level for the promotion and popularization of vermicomposting technology for the effective use in

		experiment No.1: Large scale production of compost and vermicompost using mulberry shoot wastes generated from rearing houses.							mulberry gardens for quality leaf production.
11	PPA- 3326	Development of package of practices for the mulberry varieties suitable under low input condition.	To evolve a suitable agronomical package of cultivation with a suitable mulberry genotype identified for growing under low input condition	Katiyar,R.S.; Jayaram,H; and M.K.P. Urs	June - 2003 to June - 2007.	3.54		<p>The analysed data for 4 years (20 crops) revealed a significant difference in the leaf yield due to the effect of irrigation levels at 36 mm CPE (Optimal) it was 33.79 MT/ha/yr as compared to the irrigation level at 54 mm CPE (Sub-optimal) i.e., 27.09 MT / ha/yr.</p> <p>The effect of low input conditions on leaf yield in different fertilizer doses was as follows: F1 (150:60:60 NPK/kg/ha- Inorganic only) - 33.19 MT/ha/yr, F2 (75: 30: 30 NPK/kg/ha - Inorganic plus organic) - 31.76 MT/ha/yr, F3 (75: 30: 30NPK/kg/ha- Inorganic) - 28.75 MT/ha/yr & F4(38:15:15NPK/kg/ha- Inorganic plus organic) - 28.07 MT/ha/yr.</p> <p>The leaf yield under variety</p>	The technology will be taken up as OFT.

								<p>RC1&RC2 was 32.40 MT/ha/yr, followed by 26.62MT/ha/yr in case of K2 variety.</p> <p>The study suggested that under suboptimal conditions variety RC 2 responded significantly higher compared to RC1 & K2. Hence RC 2 can be adopted at field condition.</p>	
12	Externally funded project	Setting up of model organic farm (Sponsored by National Centre for Organic Farming, Min. of Agriculture, GOI, New Delhi)	To physically demonstrate the actual practice of organic farming in the field including production of all the required inputs with in the farm and least depending on external inputs.	Dasappa, T. ; Thippesamy, K. and Vedavyasa, K.	3 years (May2006 - April 2009)	1.99		<p>A total of 15 crops were harvested from each (treated T1 and control T0) treatment. The 3 years pooled leaf yield data recorded under T1 were 51841, 51250 and 52922 kg/ha/yr, Where as T0 recorded 52210, 50551 and 51346 kg/ha/yr respectively.No significant difference was observed among the treatments.</p> <p>Data on physical, chemical and biological properties of soil revealed significant increase in the soil fertility in the organic treatments.</p> <p>The comparative economics worked out in different treatments revealed that the lowest cost of production (Rs.1.39/kg</p>	The technology will be taken as on farm trials (OFT) at RSRSSs.

								mulberry leaf) observed in the organic treatment T1, where as in control the cost of production was Rs.1.53 kg/ leaf.	
13	PPA-3267	Sustenance of mulberry leaf yield and quality through integrated technology package .	To sustain and improve the productivity and quality of mulberry by the introduction of cost effective integrated technology package.	Tippeswamy, T; Das, P.K.Das ; Subbaswamy, M. P ; Chandrakanth K.S. and Mathur,B.V..	5 Years (April 2002 - April 2007)	1.32	An integrated technology package was developed for management practices on the growth, leaf yield and leaf quality of mulberry under irrigated conditions.	A total of 50 crops were harvested in 5 yrs. from two blocks of 2 acre each. Data indicated a significant variation in the leaf yield between ITP (11,076 Kg/ha/crop) and the control (10,850 Kg/ha/crop), which received full dose of fertilizers.	Popularising the technology in farmers field.
14	PPA – 3272	Fortification of sericompost and it's effect on mulberry production. Experiment No. 1 : Effect of fortification on the quality of Seri compost.	To improve the plant nutrient and microbial status of the compost and to use as enriched compost for better maintenance of soil health and mulberry quality.	Das, P.K. ; Bhogesha, K.; Vedavyasa, K. and Choudury, N.B.	3 Years (2005 - 2007)	1.00		Fortification of compost and vermi compost found further improvements in mulberry leaf production and quality.	A method of use of fortified compost for the production of quality mulberry is evolved. Fortification of compost and vermi compost technology has been popularized and is being used by the sericulture farmers.
		Experiment No.2: Studies on the efficacy of fortified Seri compost on leaf yield and quality of mulberry.	To study the impact of enriched composts on mulberry yield and quality.	Bhogesha K.; Das, P.K. ; Vedavyasa, K. and Choudury, N.B.	3 Years (2005 - 2008)			Fortification of compost and vermi compost found further improvements in mulberry leaf production and quality.	It was found that the enrichment of compost and vermi compost further improve the quality of mulberry leaf produced. Fortification of compost and

vermi compost technology has been popularized and is being used by the sericulture farmers.

SOIL SCIENCE AND CHEMISTRY

15	PPS3160	Sustenance of soil fertility and yield of mulberry	<p>a. To monitor the changes taking place in the physical, chemical and biological properties of the soil as a result of continuous manuring and cropping from the point view of crop productivity and soil health</p> <p>b. To monitor the effect of continuous cropping and fertilization on micro nutrient status in mulberry garden and crop productivity.</p>	K. Vedavyasa M. Muniratnam Reddy, Sibiyan Sen M.R.Subbaswamy , Vijay Kumari	April 2000 to March 2012	3.455	Achieved the objectives by monitoring the changes taking place in the physical, chemical and biological properties of the soil as a result of continuous manuring and cropping and its effect on micro nutrient status in mulberry garden	<p>Highest mulberry leaf yield recorded in T7(higher fertilizer level) compared to control and other treatments.</p> <ul style="list-style-type: none"> • There is 4 to 7% reduction in yield in T4 (less 50%N & Biofertilizer) & T5(less 50%N and P, biofertilizer, VAM) compared to T2 (Normal dose) <p>However, in these treatments, there is significant improvement in physical & biological properties. The nutrient content in the leaf is on par with other treatments.</p> <ul style="list-style-type: none"> • pH of all the fertilized plots were 	<p>The out come will be utilized in two ways. To obtain higher leaf yield and to maintain soil health chemical fertilizer dose of 350:140:100 kg (NPK/ha/yr) and 25MT of FYM/compost is required. Hence, this is recommended.</p> <ul style="list-style-type: none"> •For optimum leaf yield & sustainable soil health fertilizer dose of 150:60:90kg of NPK/ha/yr with 20MT FYM
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								<p>recored less pH compared to initial value, however the Treatment which received higher nitrogenous fertilizers recorded lowest.</p> <ul style="list-style-type: none"> • High level of potassium in soil was observed in treatments which received potassium at 120 kg/ha/yr. • In soil all the micro nutrient decreased in control compared to other treatment, T1 which received only recommended level fertilizer also recored lower content of Zinc compared to other treatment. 	/ha/yr, biofertilizer and VAM will be recommended
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MULBERRY PHYSIOLOGY

16	PIP-3296	Physiological and anatomical characteristics of mulberry in relation to soil moisture stress tolerance (Intersectional	To understand the morphological, physiological and anatomical traits of mulberry varieties that contribute to their drought tolerance, and also the plasticity of those traits	J.Kodandaramaiah K. Jhansi Lakshmi M.G.Sabitha	Feb 2004 - March 2007	Rs.0.67 lakhs	-	1. High chlorophyll stability index, cell membrane stability and fluorescence stability are the intrinsic tolerance parameters associated with high yielding genotypes under soil moisture stress in	The physiological parameters identified for drought resistance will be utilized as selection parameters for screening the
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		collaborative project)	under varying stress conditions.					mulberry. 2. Micro-morphological studies indicated that decrease in stomatal population and increase in the % of palisade mesophyll among the leaf characters and decrease in the thickness of bark and increase in the xylem vessel elements among the root characters were found to be associated with drought tolerance in mulberry. 3. Drought resistant genotypes were associated with increase in xylem vessels or decrease in bark thickness during soil moisture stress.	germplasm/progeny for evolving drought resistance genotypes.
17	PIP-3357	Studies on chlorotic disorders in mulberry under field conditions (Inter sectional collaborative project)	1.To evaluate the soil nutrient status of mulberry gardens under varied field conditions. 2.To evaluate macro and micro nutrient compositions of mulberry varieties under different field conditions. 3.To understand the chlorotic/necrotic symptoms of mulberry in relation to specific elemental deficiency/toxicity/sufficiency, and to assess these imbalances in relation to leaf quality parameters. 4.To recommend specific region- wise nutrient package for improving mulberry	J.Kodandaramaiah (Upto May, 2008) M.G.Sabitha Mala V. Rajan. Munirathnam.Reddy M.R.Subbaswamy	April 2006- June 2009	Rs 2.015 Lakhs	-	1. Chlorotic disorders in mulberry indicated that chlorosis is mainly due to higher soil pH associated with mineral nutrient imbalances. 2. Studies revealed that chlorotic mulberry leaves contained lower chlorophyll pigments, soluble sugars and protein contents indicating poor leaf quality. 3. Based on the analysis of the soil and leaf samples in mulberry	Poshan – A Multinutrient formulation was developed for correcting the nutrient deficiencies at field level. The product has been commercialized to 1. M/s RAINBO AGRO VET SERI TECHNOLOGIES PVT LTD. KADAPA.

			productivity and quality. 5. To integrate the leaf nutrient status with physio-biochemical characters of mulberry that have important bearing on the leaf quality.					gardens of the three states (Karnataka, Andhra Pradesh and Tamil Nadu). A colour chart was prepared for easy identification of degree of nitrogen deficiency. 4. To correct the deficiencies based on the degree of chlorosis A multinutrient formulation "Poshan" was developed	2. M/s. SERICON TECHNOLOGIES BANGALORE	
18	PRP – 3402	Identification of physiological and biochemical markers associated with root rot resistance in mulberry.	1.To identify the physiological and biochemical markers associated with root rot resistance in mulberry. 2.To evaluate disease severity in different mulberry genotypes and identify the tolerant and susceptible ones.	Mala V. Rajan J. Kodandaramaiah (upto May,2008) M.G.Sabitha N.B.Chowdary	Jan 2007- Mar. 2010	Rs, 1.33 Lakhs		1. Three parameters viz, leaf temperature, phenol content and total carbohydrates have been identified as physiological and biochemical indicators for screening of mulberry genotypes for root rot resistance. 2. 5 tolerant (Hungarian, Himachal local, Ber.20, Almora local & local male) and 5 susceptible (Ber.C776, S30, Sujapur 5, V1& S54 mulberry genotypes have been identified in the project,	The identified genotypes will be utilized as parents for root rot resistance-breeding programme.	
MOLECULAR BIOLOGY LABORATORY – 1										
19	DBT-9511	DBT sponsored research project – "Mulberry genome characterization: DNA profiling for ascertaining genetic diversity and	To develop mulberry specific micro- satellite markers To develop a framework molecular linkage map using microsatellite DNA markers (that would be developed in-house under the project) as well as,	Dr. S. B. Dandin (Coordinator) Dr. V. Girish Naik (PI from 25.10.2004 and CI up to 24.10.2004), Dr. A. Sarkar (PI up to	January 2004 – March 2007 (3 ¼ years)	Rs. 32.99 lakhs (actual)	All the envisaged objectives were fully achieved.	A total of 150 randomly selected progeny of the cross Mysore Local x V-1 formed mapping population for the construction of mulberry linkage map. A total of 369 polymorphic molecular markers identified from DNA profiling	Identification DNA marker for rooting ability in mulberry and development of SCAR marker for use in Marker Assisted Breeding in mulberry.	

		<p>construction of framework linkage map” (in collaboration with CCMB, Hyderabad).</p>	<p>markers like RAPDs, AFLPs, and ISSRs.</p> <p>To develop some specific mapping populations of mulberry of traits of economic importance in sericulture (the CSRTI will work on this aspect).</p> <p>To develop a web-enabled database of DNA polymorphisms, DNA markers, mapping populations etc.</p> <p>Creation of a DNA polymorphism database for selected elite mulberry varieties and two wild species viz., <i>M. laevigata</i> and <i>M. serrata</i>, for their management, conservation and utilization.</p>	24.10.2004)				<p>by 171 RAPD and 9 ISSR primers between two parental lines (Mysore Local and V-1) were finally considered for marker segregation pattern among 150 progeny. Among the segregating female specific DNA markers, 102 followed a typical test cross (1:1) and 18 followed a monohybrid (3:1) ratio. Similarly, among the male specific markers, 120 followed test cross and other 12 followed monohybrid ratio. <i>Chi square</i> test was performed to test the null hypothesis of 1:1 and 3:1 segregation of all the markers scored. The marker loci not indicating any segregation distortion from the expected 1:1 ratio were further utilized for map construction and there by eliminating any spurious linkages. All the markers were conveniently coded and mapped on chromosomes using software MapMaker ver. 3.0. A total of 21 linkage groups of Mysore Local (♀ parent) and 20 of V-1 (♂ parent) were established. At minimum logarithm of the odds (LOD) score threshold of 3.0, the male map covered a distance of 1531.1 cM with an average distance of 12.76 cM and a maximum map distance of 278.4 cM between two marker loci. The female map covered a distance of 1630.3 cM with an average distance of 16.0 cM and a maximum distance of 191.3 cM between the two linked markers.</p> <p>Composite interval mapping (CIM) performed using WinQTL cartographer on all the three season data sets of following determination of empirical LOD threshold (LOD \geq 2.5). In 2004, the QTLs for No. of branches(NBR) and total shoot length (TSL) were mapped on LG2. The major QTLs</p>	<p>Development of web enabled “Mulberry Gnome Database” for use mulberry geneticists and breeders.</p> <p>Development of Molecular IDs’ of important and promising mulberry varieties and germplasm for registration and protection of Plant Breeder Rights (PBR).</p> <p>Construction of framework linkage map of mulberry using RAPD and ISSR markers for use mulberry genetics and breeding.</p> <p>Quantitative trait loci (QTLs) controlling yield and yield contributing characters (total No. of shoots, inter-nodal distance, average leaf area etc..) were identified for use in MAS.</p>
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								<p>(dry leaf weight of the longest shoot - DLWL and fresh leaf weight of the longest shoot - FLWL) with highest R² value (19 and 14% respectively) and length of the longest shoot - LLS (R² = 10%) were located on linkage group LG3 and LG13 respectively. Two QTLs (average leaf area - ALA and total shoot weight - TSW) on LG3 and one QTL (moisture content % - MC%) position on LG13 were identified based on the second data recording in April 2005. Further, QTLs (ALA and TSL) on LG3, MC% on LG8 and LLS on LG17 were mapped based on the phenotypic analysis in October 2006.</p> <p>Molecular IDs' of improved and promising mulberry varieties of India was generated using DNA markers for protection of Plant Breeders Rights' and germplasm registration.</p> <p>Genetic diversity and interrelationship among large number of germplasm (about 200 Nos.) was assessed using different marker (RAPD/ISSR/SSR) systems.</p> <p>A RAPD putative marker (OPA-20₉₀₀) associated with rooting ability in mulberry was sequenced and characterized. The marker was successfully converted into SCAR for use in marker assisted breeding.</p> <p>Genetic characterization of large collections (72 Nos.) of two wild mulberry species of India was undertaken using molecular markers. The study indicated that Andaman collections of <i>M. laevigata</i> represented a unique gene pool. The study also recommended the utilization of wild species for broadening of the genetic base of cultivated mulberry</p>
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								<p>and introgression of novel genes (saline tolerance and termite resistance). A graphical user interface (GUI) based mulberry genome database - MulGenomeDb was developed using DNA and phenotypic marker-centric data which facilitate the systematic storage, visualization, analysis and can be accessed through network. The web system catalogues data and information on Polymerase Chain Reaction based markers (RandomAmplified Polymorphic DNA, Inter Simple Sequence Repeats, Simple Sequence Repeats <i>etc.</i>) of the genome of large number of mulberry germplasm collections and mapping populations in the form of DNA fingerprints/profiles, detailed primer- wisemarker scores, similarity/dissimilarity matrices, molecular marker based genetic clusters and phylogenetic trees, marker segregation pattern of progenies, important phenotypes etc. This web application is built on Linux, Apache, MySQL, and PHP (LAMP) technology with user friendly interface, appropriate hyperlinks and help</p>
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20	DBT-9517	<p>DBT sponsored research project – “Identification of QTLs for water use efficiency and root traits to improve moisture stress tolerance in mulberry (<i>Morus alba</i> L.) through marker assisted selection’ (in collaboration with Dept. of Crop Physiology , UAS, Bangalore).</p>	<p>To evaluate the core germplasm and cultivated species for variability in WUE and root traits based on $\Delta 13C$ and $\square 18O$.</p> <p>To identify contrasts and develop mapping population for WUE and root characteristics.</p> <p>Development of stress specific markers by cloning stress genes.</p> <p>Construction of linkage map and association of QTL for WUE, transpiration rate and root traits.</p> <p>Introgression of QTLs to develop better genotypes.</p>	<p>Dr. S. B. Dandin (PI)</p> <p>Dr. A. Sarkar (CI up to 24.10.2004)</p> <p>Dr. V. Girish Naik (CI)</p> <p>Dr. J. Kodandaramaiah (CI)</p>	<p>April 2004 - September 2009 (5 ½ years)</p>	<p>Rs. 17.26 lakhs (actual)</p>	<p>All the envisaged objectives were fully achieved.</p>	<p>Mapping population for water use efficiency and root trait (moisture stress tolerance) and alkalinity stress tolerance was developed and established in the field.</p> <p>Framework genetic linkage maps of Himachal Local, MS-3, Dudhia White and UP were constructed using molecular markers.</p> <p>QTL analysis using trait specific (WUE and root) mapping populations was undertaken. On Himachal Local (\square) map, QTLs were identified in the chromosomal regions controlling average shoot length (LG7, LOD 4.0), length of the longest shoot (LG7, LOD$>$ 4.0). On MS-3 (male parent) map, QTLs for average leaf area and inter- nodal distance were located in LG3 with LOD value $>$ 4.0.</p> <p>Analysis of root trait mapping population identified QTLs on LG9 of Dudhia White controlling leaf yield (LOD 3.4) and longest root length on LG5 (LOD 3.2).</p> <p>WUE and root trait were introgressed and two populations were developed. Five promising mulberry introgressed lines were identified based on $\Delta 13C$, total shoot biomass and morphological grading for evaluation under primary yield trial</p>	<p>Number of mapping resources for WUE and root traits was developed for further investigation and use in genetic studies.</p> <p>Parent specific molecular marker based linkage maps were constructed for WUE and root traits. QTLs for important component traits were identified for use in MAB. The maps can be used for further marker saturation and identification of tightly linked marker with the loci of interest. Five promising introgressed lines will be evaluated for moisture stress tolerance under PYT and FYT before recommending the variety for cultivation in the farmer’s field.</p>
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21	DBT-9528	DBT sponsored research project – “Identification of DNA markers associated with diseases and pest resistance in mulberry (Morus spp)” (under Network Program).	<p>Screening of short listed mulberry germplasm for mealy bug (Tukra) resistance.</p> <p>Identification of diverse set of contrasting genotypes for tukra resistance.</p> <p>Extensive multilocus DNA profiling of contrasting sets of genotypes for all the three traits (nematode, tukra and powdery mildew resistance) by RAPD and ISSR and, identification of putative markers linked to the traits of interest.</p>	<p>Dr. S. B. Dandin (PI) Dr. V. Girish Naik (CI) Dr. Satya Prasad (CI)</p>	<p>January 2005 - September 2008 (3 ¾ years)</p>	<p>Rs. 16.00 lakhs</p>	<p>All the envisaged objectives were fully achieved.</p>	<p>About 150 mulberry germplasm having contrasting response to tukra, powdery mildew and root knot nematode resistance were assembled from different sources at CSRTI, Mysore and established under ARBD design and pots for pest screening.</p> <p>Screening for mealy bug resistance over three trials identified resistance and suscep[tible</p> <p>Morphological along with RAPD marker analysis indicated the presence of duplicates germplasm in the collection.</p> <p>Based on the screening results at three participating centers sets contrasting germplasm for the respective diseases and pest were identified and short-listed.</p> <p>Identification of DNA markers for major diseases of mulberry (viz., powdery mildew, mealy bug and root knot nematode) has been undertaken in the DBT Network Project involving major sericulture Institutes. The DNA markers associated with powdery mildew and mealy bug resistance have been identified. The marker for powdery mildew resistance is being utilized in MAS at CSRTI, Berhampore in collaboration with CCMB, Hyderabad.</p>	<p>Contrasting germplasm for powdery mildew resistance, root knot nematode and mealy bug resistance were identified for use in mapping studies as well as for conventional breeding for crop improvement.</p> <p>Putative DNA markers associated with powdery mildew and mealy bug resistance were identified.</p> <p>As a result of the study, MAS based approach is being followed at CSRTI, Berhampore in collaboration with CCMB, Hyderabad.</p>
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22	Pilot Study (no code allotted)	Development of micro-satellite (SSR) markers from EST library for genotyping.	Identification of di, tri, tetra, penta and hexa repeat motifs in mulberry ESTs by data mining. Development of genetic SSR markers and validation in a diverse set of mulberry germplasm.	Dr. V. Girish Naik (PI)	June 2010 - May 2011 (1 year)	--	All the envisaged objectives were fully achieved	Out of the total of 1818 ESTs available in the NCBI database, all the sequences were analyzed for di, tri tetra, penta and hexa repeat motifs using SSR tools. A total of 150 EST sequences showed SSR repeat motifs. The primers (F/R) were designed using the flanking regions of 101 ESTs containing repeat motifs. Among the 101 EST-SSR primers designed <i>in silico</i> , 7 primers were tested and showed marker amplification in test genotypes.	The SSR markers designed in the study is being currently utilized in genotyping of mulberry germplasm under ongoing DBT project – “DNA marker aided analysis of mulberry gene bank towards a core assembly for sustainable conservation and enhanced utilization in cropimprovement”.
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Tissue culture Laboratory

23	PIT 3190	<i>In vitro</i> technique in mulberry breeding. Expt: <i>In vitro</i> screening of promising mulberry genotypes for tolerance to alkalinity and drought stress.	To screen the promising genotypes for tolerance to alkalinity and drought stresses and short list before being actually tried in the respective locations.	S.Ravindran and M.K.Raghunath	April 2001 to 2007.	3.25	Achieved as per the milestones.	Selected promising genotypes were screened and identified for alkalinity and drought stress conditions.	The identified tolerant genotypes can be included in the breeding programme for further selection and evaluation as abiotic stress tolerance.
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24	PIT 3444	Development of mulberry transgenics over expressing transcription factors associated with drought and epicuticular wax biosynthesis to increase stress tolerance and leaf quality (In collaboration with Dept. of crop physiology, UAS, GKVK, Bangalore: DBT funded).	Standardization of protocol for transformation of promising mulberry genotypes by Agrobacterium mediated gene transfer.	N.Nataraja Karaba* (PI), P.Chandrashekar Reddy (CI)* and M.K.Raghunath (CI). *Department of Crop Physiology, UAS, Bangalore-560065.	Nov. 2007- March. 2012. [CSR&TI, component started from Oct. 2009].	3.0	Achieved as per the mile stones.	A complete protocol for obtaining regeneration from leaf explant tissues of V-1 and S-34 genotypes for a transgenic culture was standardized. This is a first report in mulberry for achieving transgenics through leaf explant cultures.	The protocol is useful for developing the drought tolerant genotypes within less time and space compared to conventional breeding method.
25	PIT 3369	Invitro techniques in mulberry breeding	To screen promising genotypes for tolerance to alkalinity and drought stress	S. Ravindran M. K. Ragnunath	Nov. 2005 Oct. 2007	33.15	Achieved as per the mile stones.	Four genotypes tolerant to alkaline stress were identified. Two genotypes were found tolerant to moisture stress.	The identified tolerant genotypes can be included in the breeding programme for further selection and evaluation as abiotic stress

MULBERRY PATHOLOGY

26	PRP- 3329	Impact of microbially enriched compost on suppression of soilborne diseases of mulberry (in collaboration with Agronomy)	<p>To know the impact of various types of composts enriched with useful/ antagonistic microbes on sprouting and survivability of stem cuttings of mulberry during nursery plantation as well as suppression of nursery diseases.</p> <p>To know the effect of composts enriched with useful/antagonistic microbes on suppression of root knot disease of mulberry.</p> <p>To know the effect of composts enriched with useful/antagonistic microbes on suppression of root rot disease of mulberry.</p>	D. D. Sharma, Mala V. Rajan, V. Nishitha Naik, N. B. Chowdary & P. K. Das (Agronomy)	Jan, 2005 - June 2007	0.50 Lakh	Achieved	<p>Studies were conducted in mulberry to find out the effect of compost prepared by seri residue (SR; silkworm litter + rearing waste) enriched with Rock phosphate (RP), Phosphate solubilizing bacteria (PSB), <i>Azotobacter</i> (Az), <i>Trichoderma harzianum</i> (Th) and <i>T. pseudokoningii</i> (Tp) on suppression of nursery, root knot and root rot diseases.</p> <p>In nursery, maximum sprouting (91.8 %) & survival of cuttings (89.8%) were recorded in seri residue (SR) enriched with RP+Az+PSB+Th+Tp+ neem oil cake (NOC), on par with that of the recommended method (Nursery Guard + Indofil M-45; sprouting 92.6 % & survivability 90.0%). Similarly, the maximum root knot control (no. of egg masses) of 80.7 % was recorded in SR+RP+Az+PSB+ Th+Tp+NOC. The reduction of disease severity was on par with that of the presently recommended method (Bionema + neem oil cake; 84.5 %). The same treatment was found to be effective in controlling root rot disease also to 74.3 % on par with that of the recommended method (Raksha + Indofil M-45; 77.6 %).</p> <p>Recommendations: Application of seri residue enriched with Rock phosphate + Phosphate solubilizing bacteria + <i>Azotobacter</i> + <i>Trichoderma harzianum</i> + <i>T. pseudokoningii</i> mixed with neem</p>	As and when required, farmers are using a package involving seri residue compost enriched with useful and antagonistic microbes along with neem oil cake for control of root diseases in mulberry and curtailing FYM up to 10 MT/ha besides improving the soil health
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								oil cake (2:1) @ 2 kg/m ² / plot for control of nursery diseases. For control of root knot and root rot diseases, the mixture should be applied @ 250 g/plant (3 times/year at an interval of 4 months) followed by irrigation.	
27	PRP- 3274	Screening and identification of efficient lignolytic/cellulolytic microbes for effective decomposition of seri residue	To collect, isolate and identify the efficient lignolytic/cellulolytic microbes and testing their pathogenicity on mulberry. To develop a bio-product from the identified microbes for effective decomposition of seri residue, especially left over mulberry shoots.	V. Nishitha Naik (PI) D. D. Sharma (CoI) N. B. Chowdary (CoI)	October 2006 -September 2010	1.32 lakhs	Achieved	75 microbes (fungi and bacteria) were isolated from various sources (paper pulp, bagasse, dead and decaying wood). They were tested for lignolytic and cellulolytic activity. Genera like <i>Pleurotus</i> , <i>Phanerochaete</i> , <i>Lentimus</i> , <i>Agaricus</i> & <i>Calocybe</i> showed both lignolytic and cellulolytic activity. These microbes were found non pathogenic to mulberry. They were further screened for three enzymes associated with lignin degradation such as laccase, lignin peroxidase & Manganese peroxidase. Two isolates, <i>Pleurotus florida</i> and <i>P. ostreatus</i> showed positive reaction for all the three enzymes and selected for decomposition of mulberry shoots. 11 treatments in different combinations were imposed under anaerobic condition for hastening the decomposition of mulberry shoot. Treatment-9: Mulberry shoot + Single Super Phosphate + Lime powder + Sugarcane bagasse + <i>Pleurotus florida</i> was found effective in decomposing the mulberry shoot up to 92% within in 150 days. Chemical analysis of the decomposed mulberry shoot showed pH: 7.2; EC: <1, OC: 1.61 - 3.06%; N: 0.20 - 0.29 %; P: 0.11 - 0.22% and K: 0.18 - 0.32. It	Supplied the <i>P. florida</i> cultures to needy farmers.

								helps in hygienic disposal of seri-residue and increasing organic content (3.06%) in the soil.	
28	PRP- 3436	Development of integrated package for management of soilborne pathogens	To develop an integrated, cost effective method for management of soilborne pathogens including nematodes from contaminated soils to raise healthy new mulberry plantation.	D. D. Sharma and Pratheesh Kumar, P. M.	October, 2009 – March, 2011	1.0 Lakh	Achieved	<p>Severely infested plot with soil borne pathogens causing nursery, root rot and root knot was selected for developing the IDM package for management of soilborne pathogens including nematodes from contaminated soils to raise healthy new mulberry plantation.</p> <p>Different treatments in various combinations such as deep digging, soil solarization, application of neem oil cake and growing of Dhaincha crop were imposed. Pathogen population was assessed at 15-20 days interval after the treatment.</p> <p>After 80 days, complete suppression of pathogen population was recorded in treatments T-3 where deep digging (30 cm) along with application of neem oil cake (@ 800 kg/ha after 45 days) and raising of Dhaincha (@ 20 kg seeds/ ha after 6 days) were made. To validate the test results, fresh cuttings were planted in the same treated plots. All plants were survived in treatments T-3 and free from soilborne nematodes and fungal pathogens. In this treatment, the plant height and leaf yield were increased up to 32.0 and 35.0 %, respectively over the check.</p>	It is a need-based technology. As and when farmers are taking the new mulberry plantation they are using the same technology.

									Recommendations: For taking up the new plantations of mulberry, the following IDM package can be used. Deep digging/ ploughing the plot up to 30 cm, where the new plantation will be taken up. 30 days after deep digging or ploughing, apply neem oil cake @ 800 kg/ha. 6 days after neem oil cake application, raise Dhaincha crop by sowing the seeds @ 20 kg /ha. 40 days after mulch the Dhaincha crop in soil before flowering. The new plantation can be taken up thereafter.
Silkworm Breeding Lab -1									
29	AIB-3265	Test verification of newly developed silkworm breeds and their hybrids	To test verify the overall performance of newly developed silkworm hybrids right from parental seed cocoon raising to commercial hybrid rearing art farmers level	A. Naseema Begum P.G. Joge K.C. Mahalingappa S.N.Pallvi	Oct, 2002- Mar, 2007	7.08	Achieved	Lakhs of dfls of double hybrid (CSR6 x CSR26) x (CSR2xCSR27) were field-tested and recorded cocoon yield of 65.0 kg /100 dfls. Besides a total of 25970 dfls of GEN 3 x GEN 2 and 16200 dfls of CSR16 x CSR17 were field tested and recoded cocoon yield of 62.6 and 64.5 kg/100 dfls respectively	The double hybrid (CSR6 x CSR26) x (CSR2xCSR27) was popular in the field and the hybrids CSR16x CSR17 and GEN 3xGEN2 are included under popularization of hybrids programme.
30	AIB-3294	Maintenance of bivoltine silkworm races	Maintained productive (10) , robust (12) , thin denier (2) and sex-limited bivoltine breeds(4) conforming to the original breed characteristics.	H.K.Basavaraja P.G..Joge N. Mal Reddy N. Suresh Kumar G.V. Kalpana B.Nanje Gowda	Dec, 2003 -Dec, 2008	16.4	Achieved	Maintenance of bivoltine silkworm breeds Viz., CSR2, CSR3, CSR4, CSR5, CSR6, CSR12, CSR16, CSR17, CSR18, CSR19, CSR26, CSR27, CSR46, CSR47, CSR48,	Pure breeds will be utilized for commercial hybrid preparation

								CSR50, CSR51, CSR52, CSR53, CSR2 (SL), CSR4 (SL), CSR202 (SL), CSR8 (SL), JPN7, etc., conforming to their breed characteristics	
31	MOE-3463	Popularization of productive bivoltine double hybrid “Krishnaraja” with the farmers of Karnataka	Popularization of productive bivoltine double hybrid “Krishnaraja” with the farmers.	Miss Sowmya S (JRF) A. Naseema Begum S. Nirmal Kumar	Dec 2010 – Nov 2012	10.39	Achieved as per milestone	A total of 3500 dfls of double hybrids were distributed to 10 farmers of Srirangapatna and average cocoon yield recorded was 62.4 kg as against 55.2 kg /100 dfls in CSR2xCSR4. Procured disinfectants bleaching powder, vijetha, lime and equipments viz., Gattor sprayer and wet and dry thermometer for supply to farmers. Cocoons were collected from the farmers for test reeling.	The hybrids will be sent to NSSO for commercial hybrid preparation
Silkworm Breeding Laboratory-2									
32	AIB-3275	Evaluation of new multi x bi and multi x multi hybrids and studies on reproductive behavior in new multivoltine breeds	Studies on the reproductive behavior in new multivoltine breeds in relation to photo period for successful exploitation of the breed potential Field trial of new multi x multi and multi x bi hybrids in different agro-climatic	B.K. Kariappa D.P. Prakash Murthy V.N. Sudha K. Umadevi O.K. Gopinath S.B. Nagaraj	60 Months (October 2002 to October 2007)	1,39,000	Proposed objectives were achieved fully	Two promising multi x bivoltine hybrids viz., BL67 x CSR101 and ND7 x CSR2 were identified and field tested Recommended for pupal sexing in ND7 to minimize selfing during preparation of hybrid	ND7 x CSR2 is under authorization. Pupal sexing is being practice during hybrid seed production with new polyvoltines

			conditions						
33	AIB-3410	Application of Parthenogenesis Engineering in the development of superior breeds/hybrids of mulberry silkworm <i>Bombyx mori</i> L	<p>Identification of silkworm breeds/hybrids with high parthenogenesis ability</p> <p>Development of homozygous silkworm breeds with parthenogenesis origin</p> <p>Development of homozygous silkworm breeds with androgenic origin</p> <p>To know genotype variability of the silkworm breeds developed through DNA finger printing</p> <p>Assessment of extent of practical advantages of parthenogenesis and androgenesis such as viability, hybrid vigor, combining ability and phenotypic variability</p>	Ravindra Singh	36 Months (August 2005 to July 2008)	8,15,159	Proposed objectives were achieved fully	<p>Identified two promising multivoltine breeds (AGL3 and AGL5) and two multivoltine x bivoltine hybrids (AGL3 x CSR2 and AGL5 x CSR2)</p> <p>Identified two promising bivoltine breeds (DNB1 and DNB6) and four bivoltine hybrids (DNB1 x CSR2, DNB6 x CSR2, DNB1 x CSR4 & DNB7 x CSR2)</p>	The two promising multivoltine breeds are being maintained conforming to their original characteristics for using them as breeding resource material
34	AIB-3372	Improvement of silk quality in polyvoltine races of the the silkworm <i>Bombox mori</i> L	<p>Improvement of fiber quality in polyvoltine breeds/hybrids</p> <p>Identification of hybrids for commercial exploitation</p>	P.R.M. Rao Ravindra Singh V. Premalatha Sangappa K.P. Shivakumar	60 Months (June 2006 to May 2011)	4,50,000	Proposed objectives were achieved fully	Identified a new hybrid L14 x CSR2 with improved fiber quality (2A to 3A grade silk)	The new hybrid is being tested under large scale in the field under pre-authorization programme
SILKWORM GENETICS LABORATORY									
35	AIG 3316	Evolution and evaluation of	1. Improvement of survival potential of the productive	S.K.Ashwath, K.K. Sharmila,	May 2004 To	72.776	Survival potential has been impro-ved	Six oval lines of CSR2,viz., 2P,2N,2C, 2D,2S,2M &five	The short-listed single hybrid

		productive silkworm breeds with high survival using povoltine donors employing amylase marker assisted selection	bivoltine breeds using polyvoltine donors employing isozyme marker assisted selection. 2. Evaluation of hybrids of evolved lines for identification of promising hybrids for on farm trials and large scale field testing	H.K. Basavaraja	Mar.2008		in 6 lines of CSR2 & 5 lines of CSR4. Single hybrid, GEN1 x 4C and double hybrid G3 x G8 have been short-listed.	dumb-bell lines of CSR4, viz., 4P, 4C, 4D,4S,4M have been developed. Using these lines 36 single hybrid & 25 double hybrids were evaluated at lab. Single hybrid GEN1 x 4C & double hybrid G3 x G8 with highest mean index value were short-listed & evaluated under in-house testing at TVDC which showed the superiority of the hybrids in terms of higher survival & better yield traits.	GEN1x4C and double hybrid G3xG8 evaluated under OFT at RSRS during 2009-11, which showed the superiority of the hybrids in terms of higher survival & better yield traits.
36	AIG3438	Evaluation and on- farm trials of single and double hybrids with high amylase activity and temperature tolerance.	1. Test the efficacy of amy-lase activity as an additional parameter for selection of hybrids. 2. To assess the thermotolerance of newly evolved bivoltine breeds, single hybrid & double hybrids developed by amylase selec-tion & identification of ther-motolerant hybrids. 3. Field evalua-tion of short listed hybrids with amylase activity & ther-motolerance through on farm trials	S.K. Ashwath (PI) K.K. Sharmila (CI) K.C.Mahalingappa(CI) V.N. Sudha (CI)	Aug.2008 Jun.2012	3.50	Efficacy of amylase activity was tested as selection criteria for hybrid evaluation. Single & double hybrids with highest amylase activity & thermo-tolerance were short-listed & evaluated under OST at RSRS as well as with farmers.	One single hybrid 2C x 4S out of 11 single hybrids and among 42 double hybrids one double hybrid G11 x G19 was identified based on highest amylase activity and thermotolerance. OST trials at RSRS Chamaranaganar, the single hybrid 2Cx4S indicated 28% improve-ment of survival and 71,18 and 16% impro-vement of survival in G11x G19 at Chamara-janagar Ananthapur & Salem respectively. Field testing of 2870 dfls both the hybrids with 11 farmers have shown yields of 67-68 kg/100 dfls.	OST trials at Chamaranaganar & Ananthapur and limited field trials have shown the possibility of commercial exploitation of the identified single and double hybrids under sub-optimal conditions.

Molecular Biology Laboratory- II

37	No.9509	c-DNA cloning and expression of the anti-viral gene in <i>Bombyx mori</i> L. (Funded by DBT)	To clone, characterize & express the anti-viral gene.	Virendra Kumar Ashwath S.K. Nataraju B	Dec.2003 To Jun.2007	27.8 lakhs	The antiviral protein has been cloned, sequenced and expressed.	An anti-viral protein of 28 kDa was detected in the digestive juice of BmNPV tolerant silkworm strain, Nis-tari which was isolated and purified. This protein significantly inhibited the multiplication of BmNPV in BmN cell lines. Further, Identification of a 26.5 kDa protein named BmNOX in the gut fluid of Nistari has been	The protein marker is being used in the ongoing project as a marker for developing NPV tolerant silkworm breeds.
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								documented, which possessed antiviral activity against BmNPV in vitro. The full-length gene encoding BmNOX has been characterized & the levels of expression of this gene in select tissues of silkworm larvae has been studied.	
38	AIT3292	DNA fingerprinting of indigenous & evolved silkworm <i>Bombyx mori</i> races	To establish molecular IDs for silkworm races.	Sreekumar S Ashwath S.K. Virendra Kumar Chitra S	Apr.2004 To Sep.2007	17.22 lakhs	Fingerprinting has been completed for 15 silkworm breeds.	DNA fingerprinting was carried out for 36 silkworm breeds using 32 sets of microsatellite primers. Molecular IDs using microsatellite markers have been clearly established for 15 short-listed silkworm breeds comprising of 5 indigenous breeds, 1 evolved polyvoltine breed & 9 evolved bivoltine breeds. Using RAPDs, a total of 56 breed specific RAPD bands were detected for 32 silkworm breeds. Further, 2 RAPD markers were found to be specific for PM SL and six markers for CSR2 SL breeds.	Breed specific DNA markers have been detected which can be used as molecular ID for systematic maintenance of silkworm strains and breeder's rights can be protected.
39		Identification of DNA markers to develop as SCAR marker using RAPD and ISSR markers for high survival & BmNPV resistance in silk worm. (Exploratory study)	To develop SCAR markers for survival & NPV resistance	Virendra Kumar	Oct..2007 To Sep.2009		One RAPD marker associated with NPV tolerance identified.	23 popular multi- & bivoltine races were screened with 22 RAPD & ISSR primers. A total of 379 PCR products were generated out of which 41 were polymorphic. One RAPD marker of 650 bp amplified by OPA18 primer was detected in NPV tolerant breeds like Nistari, Sarupat, Daizo, BL67, ND5 & ND7. Genetic distance was estimated & dendrogram generated by UPGMA based on the DNA profiles clearly showed clear groupings of multi-voltines, bivoltines, evolved, oval & dumb-bell breeds.	The information generated on genetic distance is useful for identification of heterotic parents for raising hybrid combinations.
40	No.9537	Identification EST-cDNA	To detect DNA markers associated with cocoon	Sreekumar S Ashwath S.K. Bhanuprakash Raj.	Jan.2008 To	28.4 lakhs	Est-SNP markers linked	The genomic DNA of parents showing contrasting features for cocoon and post-cocoon	The SNP marker based selection can be used in silkworm

		mar-kers linked to genes controlling cocoon & post- cocoon traits in mulberry silkworm, <i>Bombyx mori</i> . (Funded by DBT)	& post-cocoon traits in silkworm		Dec.2010		to cocoon wt., filament length & denier have been identified.	traits, viz., PM, CSR2, their F1s and bulks of F2/BC progeny were screened with 240 primer pairs of single nucleotide polymorphic markers (SNPs) located in the ESTs.Out of the 240 primers, 48 revealed distinct polymorphism between the parents. Bulked segregant analysis with the 48 polymorphic primers revealed PCR products of primer No.40124 of the 4 th Linkage Group (LG), No. No.09082 of LG 9 and No.12059 of LG 12 are closely linked to cocoon weight, filament length and denier, respectively.	breeding for improving cocoon and post-cocoon traits
41	AIT 3419	Identification of RAPD-SCAR markers linked to amylase gene using near isogenic lines of mulberry silkworm.	To develop RAPD-SCAR marker for amylase genes	Sreekumar S Ashwath S.K.	Jan.2008 To Dec.2010	15.5 lakhs	6 RAPD markers linked to digestive amylase gene has been identified. SCAR marker developed	Screening with 27 sets of RAPDs has shown linkage of six primers of OPA01, OPA06, OPA09, OPA15, OPAH03 and OPAH05 to Amy d ^{iv} and d ^v alleles. PCR products specific to amylase gene was sequenced and RAPD-SCAR marker of 2.6 kb specific to both 4 and 5 band amylase genes has been developed.	The results can pave the way for cloning and further characterization of chromosome segments flanking the amylase genes to identify genes conferring higher survival.
42	AIG 3440	Identification of cDNA markers linked to genes controlling non-susceptibility to BmNPV in the mulberry silkworm <i>Bombyx mori</i> . (Indo-Japanese joint pro-	Identification of DNA markers associated with NPV resistance.	Sreekumar S Ashwath S.K.	Jun.2009 To May 2011	7.13 lakhs	3 SNP markers and one RAPD marker linked to NPV tolerance were detected.	The NPV tolerant parents (Tx and 5N), susceptible parent (CSR2), their F1s, F2s & BC progeny were inoculated with NPV & genomic DNA from the tolerant & susceptible progeny were extracted and purified. The mortality data of the F1, F2 & BC progeny clearly indicate the possibility of a dominant gene controlling non- susceptibility to BmNPV. DNA samples were amplified with	The identified DNA markers can be used by breeders for developing BmNPV tolerant bivoltine breeds.

		ject Funded by DST-JSPS						SNP primers of 28 linkage groups which revealed 14 SNP primers showing distinct poly- morphism between parents. SNP primers of three linkage groups (8,9 & 23) showed association with NPV tolerance. Screening with RAPD primers showed linkage of 0.4 kb product of OPY11 primer with NPV tolerance in Tx crosses.	
Silkworm Physiology									
43	AIP-3297	Maintenance of bivoltine and multivoltine semi-synthetic diet silkworm strains for original breed characters.	To maintain artificial diet breeds developed under the project AIP- 3139 as breeders stock for original breed characters.	Kanika Trivedy M.Ramesh & S.Nirmal Kumar	2004-2009	33.87	Achieved	Bivoltine and multivoltine breeds developed in earlier project (1999 –2004) are continued to maintain for their original breed characters. Diet chawki rearing procedure has been standardized. A silkworm feed and a process for preparation thereof (Patent no. 218430, dated 3.02.99) granted on 1st April 2008 (Filed IPR no. 133/Mas/99 dated 3.2.99). 5 research papers published.	Diet Breeds were maintained to their original characters. Universal diet formulation patent filed and granted.
44	AIP-3371	Formulation of viable semi-synthetic diets for young instar vanya silkworms viz., <i>Antheraea Assamensis</i> helper (Muga)	To formulate semi-synthetic diet for Eri, Muga and Tasar silkworms.	Kanika Trivedy, Anukul Barah, Himangshu Barman S.Nirmal Kumar, D.S.Somaprakash,	Jun. 2006-Mar. 2011	4.843 (CSRTI MYS.)	Achieved	Developed viable semi-synthetic diet for Eri, Muga and Tasar and the technology for rearing vanya silkworms on the semi-synthetic diet upto II instar. By adopting artificial diet	Patents filed for Eri, Muga and Tasar diets. Tasar diet formulation patent is

		and <i>Samia Ricini</i> Donovan (Eri) and standardization of commercial young instar diet rearing technology.						young instar rearing, the loss of worms in young instar due to changing climatic condition and predator attack could be minimized so that cocoon yield per unit number of eggs be increased.	granted. As a follow-up popularization of semi-synthetic diet rearing for Vanya silk was studied.
SILKWORM PATHOLOGY									
45	PEBS - JICA	Strengthening of Extension System for Bivoltine Sericulture in India	Demonstration and popularization of silkworm diseases management technology in the three southern sericultural states.	B. Nataraju, M. Balavenkata-subbaiah S. D. Sharma P. Sudhakara Rao K. Chandrasekharan	2002 -07	-	Achieved as per mile stone	An integrated silkworm disease control technology was demonstrated at farmers level under bivoltine rearing programme and popularized in the field.	Popularized the integrated silkworm disease control technology in the sericultural areas of South India.
46	ARP 3304	Studies on the improvement of tolerance of promising silkworm breeds to BmIFV	<ul style="list-style-type: none"> To study the susceptibility status of the popular and productive silkworm breeds against BmIFV and identification of potent donor parents. To increase the tolerance in potential breeds To study the inheritance pattern of BmIFV tolerance in identified donor silkworm breeds 	T. Selvakumar, P. Sudhakar Rao S.D. Sharma	Jan. 2004 – June 2007	8.53	Achieved as per mile stone	Identified and short listed tolerant silkworm breeds against BmIFV and increased the tolerance level and studied their inheritance pattern.	The findings were utilized in the development of BmIFV tolerant silkworm breeds (5N and 96C).
47	DBT 9527	Identification of DNA marker(s) linked to baculovirus	To identify DNA marker(s) for baculovirus resistance in silkworm	B. Nataraju	2005-08	14.77	Achieved as per mile stone	One most tolerant multivoltine (CSR 19) and bivoltine (CSR 10) breeds and one most susceptible multivoltine	The findings were utilized in the disease resistant/ tolerant silkworm breeding program.

		resistance (In collaboration with APSSRDI, SBRL and KSSRDI)						(CSRM 8) and bivoltine (CSRB 11) breeds to BmNPV were identified	
48	DBT 9529	Field trial of botanical based eco-friendly products for management of silkworm diseases at farmers level		B. Nataraju, M.Balavenkata-subbaiah S. D. Sharma K. Chandrasekharan	2005-07	13.00	Achieved as per mile stone	Two eco-friendly bed disinfectant formulations and two plant-based formulations were tested at farmers level.	Commer- cialized Ankush to 4 companies and Amruth to 2 companies for production and supply to farmers. The products are popular and widely used through out India.
49	AIG 3439	Identification of DNA markers linked to infectious flacherie virus (IFV) resistance in silkworm <i>Bombyx mori</i> L. (Collaboration with Mol. Biology)	<ul style="list-style-type: none"> • Identification of DNA markers associated with IFV resistance in silkworm. • Conversion of identified markers to SCAR markers • Validation of new markers for their linkage to the resistance. 	Virendrakumar P. Sudhakara Rao K. Chandrasekharan	2008-2011	12.90	Achieved as per mile stone	One tolerant (5N) and one susceptible (CSR2) breeds were identified and 57 RAPD and 13 ISSR primers were screened out of which 21 RAPD and 3 ISSR primers showed distinct polymorphism	The markers will be used for screening the germ-plasm for IFV tolerance in ther breeding programs.
PEST MANAGEMENT LAB									
50	DST Project 9512	Development of woman entrepreneurs for mass production of bio control	To develop women entrepreneurs for production of <i>N. thymus</i> parasitoid and to popularize their use in the field.	M.A.Shekhar S.H.Divya	Jan, 2004 to Jan, 2007	6.5	Successfully trained women entrepreneurs in mass production of <i>N. thymus</i>	Training imparted to 25 women farmers and motivated them to establish mass production units of bio control agents.	One mass production unit at Bommandoddi was established for supply of bio-control agents.

		agent and popularization of eco friendly management strategies against Uzi fly <i>Exorista bombysis</i> a serious pest of <i>Bombyx mori</i>					parasitoid of uzi fly.		
51	Nil	Studies on the prospects of Eri culture in Karnataka	To assess the quantity of leaf available for eri silkworm rearing in castor; To find out the effect of defoliation on castor seed yield and quality. To Standardize the eri silkworm rearing using cultivated variety of castor under rain fed conditions of Karnataka	Tomy Philip (P.I) M.A.Shekhar B.K.Kariappa, D.S.Somaprakash	June, 2005 to Sept. 2007	3.64	Package of practices for rearing of Eri silkworms in South Indian condition was developed.	Rearing Technology for Eri silkworm developed.	Rearing technology package being utilized by Eri silkworm rearers.
52	ARE-3353	Evaluation of performance and	To identify zone specific parasitoids which can establish	K.Sathya prasad, M. A. Shekhar Vinod Kumar,	3 years July 2005 to	39.79	Three parasitoids namely	Among the 3 parasitoids, <i>N.thymus</i> was able to establish	Eight mass production units of bio-control

		establishment of natural enemy complex of Uzi Fly <i>Exorista bombycis</i> in different agro climatic sericulture zones.	and be effective against uzi fly To evolve cost effective easy mass production technology for the parasitoids of uzi fly.	D.S. Somaprakash	June 2008		<i>Nesolynx thymus</i> , <i>Exoristobia philippinensis</i> & <i>Trichopria</i> sp. were evaluated in field. Mass production of <i>E.philippinensis</i> was standardized on house fly pupa.	better in all the agro climatic zones of southern India.	agent of uzi fly are established in field to cater the need of sericulturists.
53	PRE-3425	Studies on bio-intensive pest management strategies of Papaya mealy bug, <i>Paracoccus marginatus</i> in mulberry ecosystem.	To monitor the incidence of papaya mealy bug and its natural enemies in mulberry. To develop Classical Biological Control of the pest and its field evaluation.	Dr. M. A. Shekhar Vinod Kumar Balasaraswathi Dr.Rabindra, Director, NBAII & A.N.Shylesha (NBAII, Bangalore) C.A.Mahalingam, TNAU, Coimbatore	2 Years Aug. 2009 to July 2011		Monitored pest incidence in T.Nadu, Karnataka, Kerala and developed Classical Biological Control through inoculative release of exotic parasitoid, <i>Acerophagus papayae</i> .	Of the 3 exotic parasitoids namely, <i>Anagyrus loecki</i> , <i>Acerophagus papayae</i> and <i>Pseudleptomastix mexicana</i> , <i>A. papayae</i> was found most effective and its inoculative release was able to reduce pest incidence from >95% to <5% within 3-4 months of release without application of any insecticides.	Parasitoids are being supplied at free of cost to farmers/ sericulturists for management of papaya mealybug by NBAIR/ CSRTI and its nested units.

Sericulture Extension Economics and Management Division

54	MOE - 3355	Impact of evaluation of commercial CRC model in Karnataka, Anahdr Pradesh, Tamil nadu and Maharashtra	To evaluate economic performance of the established commercial chawki rearing centres in IVLP and non-IVLP cluster areas, to study the impact of CRCs on cocoon production and to analyse constraints in efficient functioning of CRCs.	T.S. Mahadeva Murthy, Hiriyanna, H.M. Munikrishnappa and R.G. Geethadevi	Jan 2006 to Dec 2008	2.84 lakhs	Objectives were achieved.	The study indicated the there is an improvement in the cocoon yield ranges from 8-10 kg/100 dfls and the percentage improvement was 19.97% in Bivoltine hybrids and 14.59% in case of Multivoltine hybrids. There was an increase in mulberry area, no.of farmers, and brushing capacity in the vicinity of CRCs. There was an increased trend in brushing of dfls every year and net income was more among CRC owners.	
55	MOE - 3416	A study on economics of sericulture and other competitive agricultural crops in non-traditional areas of Southern India and Maharashtra	To working out cost and return from sericulture and other competitive agricultural crops at the selected sample farm households of non-traditional areas.	S. Lakshmanan, H.M. Munikrishnappa, W.Damodar Naidu, P.V. Soudamani, B.T. Srinivas, T. Shivasubramanian and Ramprakash	Apr. 2008 to Mar. 2010	1.5 lakh	Objectives were achieved.	The cost and benefit ratio in sericulture for Karnataka, Andhra Pradesh, Tamil Nadu, Kerala and Maharashtra were 1:1.55, 1:1.54, 1:1.63, 1:1.51 and 1:1.41. The cost of cocoon production per kg was the highest in Kerala (Rs. 111.48) and the	

								<p>lowest was in Tamil Nadu (Rs. 98.60).</p> <p>The cost and benefit ratio for other agricultural crops were: Kerala Banana (1:1.53), Coconut (1:2.57) and Paddy (1:1.12)</p> <p>i) Tamil Nadu Banana (1:1.68), Sugarcane (1: 1.46) and Paddy (1: 1.19) Karnataka Onion (1:2.27) and Maize (1:1.99) Andhra Pradesh Paddy (1:1.14) and Maize (1:1.75) Maharashtra. Wheat (1:1.18) and sugar cane (1:1.59)</p> <p>The important constraints faced by the sample farmers were non-availability of hired-labour in silkworm rearing, increasing cost of inputs and higher labour wages.</p>	
56	MOE-	Transfer of	To study the level of	S.M.H. Qadri,	Apr. 2007	2.0	Objectives were	Six Farmers Field	

	3414	technology through Farmers's Field School - A case study	adoption and capacity building after intervention of FFS and its impact. To standardize FFS methodology to disseminate sericulture technologies.	R.K. Subramaniam B. Mallikarjuna N. Shivashankar B.T. Srinivas Damodar Rao M.V.S. Srinivasa Rao T. Mogili R. Vijayakumar J. Ravikumar N.G. Selvaraj	to Mar. 2009	lakh	achieved.	<p>Schools with two each in Karnataka, Tamil Nadu and Andhra Pradesh were established. A series of 21 learning sessions organized on the basis of constraints faced in adoption of technologies through course materials prepared with participatory approach. Supply of equipments were made.</p> <p>Lead farmers and fellow farmers adopted soil testing, application of correct dose of fertilizers, pruning and thinning of mulberry. They gained knowledge on composting, vermicomposting, drip irrigation but require subsidy to adopt it. They have acquired knowledge on control measures for root diseases and pests of mulberry. They have also adopted disinfection, incubation, black boxing, chawki rearing,</p>	
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								shoot rearing and crop protection measures. In respect to rearing new bivoltine hybrids, gained knowledge on mountages, advantage of separate rearing houses, but adoption is partial due to financial constraints.	
57	MOE-3415 (DBT Funded)	Popularization of chawki rearing centre model developed by CSRTI, Mysore in identified clusters of Karnataka, AP and TN - A support mechanism of bivoltine sericulture ((MOE-3415) (DBT Funded)	<p>1.To establish chawki rearing centres in phase wise by providing the in identified cluster areas for the benefit of sericulturists.</p> <p>2. To impart training to the identified entrepreneurs and their assistance on chawki garden and chawki rearing management.</p> <p>3.Implementation of the CRC model brushings through regular guidance and monitoring brushings.</p> <p>4.To evaluate the performance, impact and constraints in management aspects of the CRC model established.</p>	H.M. Munikrishnappa and A.S. Suma	April 2008 to March 2011	17.33 lakhs	Objectives were achieved.	<p>Objective 1: A total of 12 CRCs were established in phase wise by provided the necessary equipments, 5 in Karnataka, 2 in Andhra Pradesh and 5 in Tamil nadu in co-ordination with the officers of RECs and DOS.</p> <p>Objective 2: Organized one week duration certificate training programme on commercial CRC maintenance and management in A total of 6 CRC owners & 15 their assistants were trained in 12 different batches at CSRTI, Mysore.</p> <p>Objective 3: Start up materials required for</p>	

								<p>brushing was supplied. Arranged demonstration of brushing programme at CRCs. Initiated the chawki brushing as per the CSRTI model. Regular technical guidance was provided</p> <p>Objective 4: During favorable seasons a total 29.00 lakh dfls of bivoltine hybrids were brushed, 5937 farmers benefited & the average cocoon yield was 62.92kg/100dfls. Contributed for estimated production of 1825.30 M.T bivoltine hybrid cocoons and 260.75 M.T. of raw silk.</p> <p>There is an impact of increase in yield income and increase in asset acquired position of beneficiary farmers over bench mark and Similarly there is also an increase in income level of CRCs owners</p> <p>Non availability of</p>
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								labour, Non availability of quality silkworm seed & Delay in payment of chawki charges are the major constraints expressed by the CRCs owners.	
58	MOE-3416	A study on Economics of Sericulture and other competitive agricultural crops in non-traditional areas of southern India and Maharashtra	A study on economics of sericulture and other competitive agricultural crops in Southern India and Maharashtra was initiated with the objective of working out cost and return from sericulture and other competitive agricultural crops and level of recommended technologies followed and constraints faced by farmers at the selected sample farm households of non-traditional areas. The empirical study consists of 300 random samples selected in five states (60 sample for each state) during 2008- 09 (two years period). The data were collected by direct interview method using a pre-tested schedule and the	S. Lakshmanan, H.M. Munikrishnappa, W. Damodar Naidu, P.V. Soudamani, B.T. Srinivas, T. Sivasubramanian and Ramprakash	Apr. 2008 – Mar. 2010		Objectives were achieved.	The study indicated that the average mulberry holding size was the highest in Karnataka (2.78 acre) while the lowest was in Kerala (0.914 acre). Dfls brushing per acre/year was high in Tamil Nadu 9957) while it was low in Maharashtra (410). With regard to cocoon yield (per acre/year) Tamil Nadu showed the highest quantity (632.703 kg) and the lowest was in Maharashtra (233.759 kg). The cocoon yield/100 dfls was the highest in Kerala (71.034 kg) and the lowest was in Maharashtra (57.012 kg). The cost and benefit ratio in	

			<p>same were analyzed following simple tabular method.</p>					<p>sericulture for Karnataka, AP, TN, Kerala and Maharashtra were 1 :1.54, 1 : 1.63, 1:1.51 and 1:1.41. The cost of cocoon production per kg was the highest in Kerala (Rs.111.48) and the lowest was in TN (Rs.98.60). The cost and benefit ratio for other agricultural crops such as banana, coconut, paddy in Kerala, banana, sugarcane and paddy in TN, onion and maize in Karnataka. Paddy and maize in AP and wheat and sugar cane in Maharashtra respectively. With regard to knowledge and adoption level by the sample farmers across the study regains of the different states shoot harvesting method was the highest level while green manuring, vermicomposting, bio-fertilizer and weeding method were showed lowest level. In the</p>	
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								case of silkworm rearing, more than 90 per cent of sample farmers had knowledge and adoption level in shoot rearing method, the lowest was in IPM uzifly - control measures. The important constraints faced by the sample farmers were non- availability of hired labour in silkworm rearing, increasing cost of inputs and higher labour wages.	
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Training Division

59	Seri-technology complex for women (DBT)	Seri-technology complex for women (DBT)	S.B. Dandin, R.K. Rajan etc.	Feb 2003 -Sept 2008	87.00	Objectives were achieved.	Achivements : The women of different catagories like small, medium, large and marginal farming families practicing sericulture who intend to venture into sericulture business were trained. During these programme the women were taught how to practice the different technical skills, exposed to demonstrations and
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								allowed to practice technologies by themselves to gain confidence for further adoption. They were allowed to practice each and every skills independently for the reasonable time. A total of 625 women were trained under various training programme during the year.	
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RSRS

60	<i>DBT Project</i>	<i>Field trial of botanical based eco-friendly products for management of silkworm diseases at farmers level (DBT funded project)</i>	<ul style="list-style-type: none"> ◆ Large scale field test verification and demonstration of the efficacy bed disinfectant formulations BD1 & BD2 in prevention of spread of disease in Silkworm rearing. ◆ Large scale field test verification and demonstration of the efficacy of eco-friendly products PL1 & PL2 in suppression of grasserie and flacherie diseases. 	B.Nataraju *, S.M.H.Qadri, G.Punithavathy and T.Selvakumar*	2005-07	<i>DBT</i>	8 demonstrations were undertaken in Salem and Namakkal district covering 57 farmers. Results indicated that the new silkworm body and seat disinfectant BD1 was effective in silkworm disease management. The botanical formulation PL2 + Vijetha was found effective in silkworm disease management during the summer seasons and PL1 + Vijetha was found effective in rainy seasons.	Results indicated that the new silkworm body and seat disinfectant BD1 was effective in silkworm disease management. The botanical formulation PL2 + Vijetha was found effective in silkworm disease management during the summer seasons and PL+ vijetha was found effective in rainy season.	Information generated were utilized for product development.
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61	<i>DST Project</i>	Socio-economic empowerment of tribals through state-of art technologies in sericulture at Karamadai and PN Palayam ranges of Coimbatore District, Tamil Nadu.	To increase in per capita income. Poverty alleviation. Curbing social exploitation. To bring in overall farming development.	S.M.H.Qadri, B.Sundar* and N.Ravi (* DOS, Coimbatore, Tamil Nadu)	2004-2008	<i>DST- ST Project Rs. 10 lacs</i>	<i>and adoption of appropriate new sericul- ture technolo gies. Established one acre V1 at Kolli Hills (DOS Farms) and effort were made to bring in over all improvements in farming activities. 88 benefi- ciaries completed shoot rearing rack at III phase and II Phase. All the III phase beneficiaries were given the netrikas. An average yield of 59.00 kg/100 dfls was obtained by the beneficiaries and farmers adopted the Bivoltine rearing technology under the project.</i>	Over all improvement in adoption of sericulture technologies among the tribal families was achieved.	The project helped to improve socioeconomic status of tribals.
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62	<i>DST Project</i>	<i>Empowerment of sc sericulturists through state-of-art sericulture technologies in Thalanchi at Udumalpet Taluk of Coimbatore District (DST) of Tamil Nadu.</i>	<i>To identify the problems related to technology of the clusters wherein large number of SC people are involved in Sericulture activities. To assess technological requirements and areas To develop tailor made capsule training programme comprising of hands on expertise for sericulture development. To study the impact of training programme on the target population for further streamlining and popularization.</i>	S.M.H.Qadri, I.Devasagayam*, R.Anbazhagan and N.G.Selvaraju* (* DOS, Coimbatore & ** REC, Udumalpet)	2004-2007	<i>DST-SC project Rs.2.50 lacs</i>	<i>This project was taken up with twin objectives of improving the sericultural productivity and socio- economic conditions of sericulturists belonging to SC community through tailor made capsule training programmes comprising of hands on practice.</i>	315 farmers were imparted training in different technologies	<i>Large numbers of SC people were involved in Sericulture activities.</i>
63	<i>CSB Project</i>	<i>(A) Sustainable sericultural development through Integrated Nutrient, Pest & Disease</i>	To develop technology modules for INM, IPM & IFSM for sustainable sericultural development.	S.Jayaraj ¹ , S.B.Dandin ^{2,3} , S.M.H.Qadri ³ , S.Masilamani ³ , N.Dhahira Beevi ³ , and P.Samuthiravelu ⁴ , J.Ravikumar ⁴ ,	2002-2007	<i>CSB project</i>	Daincha as green manure crop was sown @ 12 kg./acre and collected data on weed suppression. Only neem oil 1% and 2% had been sprayed in two	Soil Science Laboratory was established at RSRS, Salem. Triacntanol (Vipul) was sprayed in 2 splits with an interval of 15 days @ 100ml/acre/crop. Neem oil cake was applied @ 60kg./acre/crop along with 75% of	<i>The package developed with the advocated models are being popularized among the farmers through OFT &</i>

		<p>management in South India – “Farmers’ Participatory Mode”. & (b) Collaborative R&D Project on mulberry sericulture based Integrated Farming System Management (IFSM) - Farmers Participatory Mode (Collaborative with SJRF, Chennai).</p>		<p>R.Vijayakumar⁴, T.Thirunavukkarasu⁴, C.A.Mary Flora⁴, N.G.Selvaraju⁴ and Y.Humayun Sherieff⁴ (1 SJRF, Chennai, 2 CSR&TI, Mysore, 3 RSRS, Salem, 4 RECs of RSRS, Salem)</p>			<p>splits at 10 days interval due to low incidence of Tukra Mealy bug and Leaf webber. However, the existence of natural enemies was also observed at weekly interval. Azospirillum @ 1.6 kg./acre/crop mixed with 80 kgs of well powdered FYM was applied followed by copious irrigation.</p>	<p>recommended nitrogenous fertilizer besides full dose of phosphorous and potassic fertilizer. An attempt was made to study the soil macro fauna available with in cubic feet. Data on leaf and cocoon parameters were collected from treatment and control farmers.</p>	<p>Demonstration programmes of RSRS, Salem and its nested units</p>
64	CSB Project	<p>Cluster Promotion Programme (CPP) in Tamil Nadu</p>	<p>To introduce the latest technological innovations through Cluster Promotion Programme in a systematic way to improve production, productivity and quality; to create awareness among other farmers to take-up sericulture; To provide technical and financial assistance to sericulturists to improve sericulture.</p>	<p>Dr.R. Balakrishna and RSRS, Salem and concerned CPP centres scientists.</p>	2008-2012	<p>CSB project in co-ordination with DOS.</p>	<p>Following 6 clusters have been taken up for Promotion of Bivoltine Sericulture in Tamil Nadu Palani in Dindigul District Udumalaipettai in Tiruppur District Gobichettipalayam in Erode District Berigai in Krishnagiri District Uthangarai</p>	<p>During the project period, six clusters of Tamil Nadu have brushed 51,24,120 dfls against the target of 40,27,300 achieving 127.23 % of the target and produced 36,44,832 kg of cocoons against the target of 25,76,215 kg achieving 141.48 % of the target. Similarly 113.05% achievement was recorded in cocoon yield/ 100 dfls by harvesting an average cocoon yield of 71.13 kg/ 100 dfls. Under the project the Tamil Nadu clusters produced</p>	<p>The programme was very successful and paved a way for improvement of Bivoltine sericulture through Cluster approach.</p>

							in n Krishnagiri District Sanarpatty in Dindigul District	560.74 MT of raw silk	
65	PPA-3401	INTERCROPPING IN MULBERRY WITH CEREALS, PULSES AND OIL SEEDS UNDER RAINFED CONDITIONS OF CHAMARAJANAGAR DISTRICT	To identify a suitable and sustainable intercropping system in rain fed mulberry under Chamarajanagara conditions to augment the income generation per unit area of mulberry garden.	P.K.Das R. Gururaj S. B. Magadum C. Dureswamy* and Shivashankar Murthy*. (* K.V.K.Chamarajanagar)	June 2007 Date of completion: Dec 2009	Budget : Rs.10. 32 Lakhs		Intercropping once in a year in S-13 mulberry during rainy season with cow pea, horse gram and specially with groundnut under 3 ' x 3' row system of plantation, V-1 mulberry with paired row system and S-13 mulberry under tree plantation with 6' x 6' or 8'x 8' is recommended. This will augment the farm income besides proper utilization of farmland. While intercropping with cowpea the seed rate should be @ 20 kg / ha, horsegram @ 25 kg / ha and groundnut @ 100 kg / ha following line / row sowing method keeping a distance of 1 feet from line to line / row to row. Chemical fertilizers should be applied for the intercrops at the rate of 30:50:30 NPK kg / ha / year besides application of the recommended dose of fertilizers for mulberry during rainy season. FYM can be applied as per the recommendation of mulberry cultivation under rainfed condition.	The intercropping in rainfed mulberry will be popularized among the sericulturists of Chamarajanagar.

