OUTPUT OF THE RESEARCH PROJECTS CONCLUDED DURING THE LAST FIVE YEARS (2014-2019)

1. Central Sericultural Research & Training Institute, Mysore

Sl. No.	Project Code	Project Title	Project period	Output of the Project
1	PPA 3549	Evaluation of modified spacing with special reference to planting geometry for sustainable mulberry leaf production	Jan, 2016 – Dec, 2017	Thirty farmers adopting different wider spacing (90 cm x 90 cm; (150 +90 cm) x 60 cm; 180 cm x 60 cm; 240 cm x 60 cm; 270 cm x 60cm) in three districts of Karnataka (Ramanagara, Kolar, Chikkaballapura) were identified for estimating the leaf productivity and amiability to mechanization. Data on five crops was collected and maximum mulberry leaf yield was recorded with spacing of (150+90)cm x 60cm (13174.83 kg/ha/crop) and minimum with 270 cm x 60 cm.
2	PIB 3370	Development of superior mulberry varieties by exploitation of hybrid vigour based molecular diversity of promising parental lines.	Jul, 2006 – Mar, 2015	Identified 4 promising hybrids viz., genotype 4, 6, 10 and 12 which out yielded the check V-1 by 11.56 to 19.60% under irrigated conditions with recommended fertilizer inputs.
3	--	All-India Co-ordinated Experiment on Mulberry (AICEM) - Phase-III	Jul, 2011 – Dec, 2015	The variety G4 was authorized for commercial cultivation. It has a leaf yield potentiality of 55 to 60 MT/ Ha/ Year.
4	PIB 3457	Development of disease resistant and productive mulberry genotypes with special reference to root rot and root knot diseases suitable for seri-zones of south India.	Jan, 2012 – Dec,2017	Shortlisted 43 productive hybrids (with leaf yield of 760 – 1171 g/plant) besides 22 hybrids showing resistance to both root rot and root knot diseases and 7 disease resistant productive hybrids for further evaluation.
5	PRP 3530	Development of a broad spectrum formulation for effective management of mulberry root rot disease.	Jan, 2015 – Dec, 2016	Rot-fix an eco-friendly formulation containing 89.5% natural organic material, 8% organic chemicals and 2.5% inorganic chemicals with 70-76% was developed to control root rot disease in the field. It was commercialized through NRDC after obtaining patent.
6	PRP 3535	Popularization of Nemahari – A bionematicide for	Mar, 2015 – Feb, 2017	A total of 4243 kg Nemahari was distributed among 162 selected sericulture farmers of three states

		management of root knot disease in mulberry		treating 132 acre of mulberry land. Nemahari controlled 49-87% root knot with an increase of 12-24% leaf yield in comparison with that of controlled plants. Nemahari has been commercialized through NRDC. Literature/handouts on the technology have also been prepared in five languages and distributed among the farmers.
7	PRE 3486	Development of Database for mulberry diseases	Aug, 2012- Jul, 2014	Developed a data base pertaining to various aspects of mulberry diseases. Developed disease diagnostic system, disease distribution map of important mulberry diseases and disease calendars.
8	AIB 3456	Development of productive polyvoltine breeds of silkworm *Bombyx mori L.* tolerant to high temperature and BmNPV.	Oct, 2011 – Sep, 2016	Five new polyvoltine lines viz., L1, L3, HB1, HB4 and HB6 were developed through selection adopting high temperature and *Bm*NPV as stress. Two new crossbreeds viz., L3 × S8 and HB4 × S8 developped from the above lines were found significantly superior to the popular crossbreed (PM × CSR2) in respect of cocoon productivity and quality.
9	AIB 3498	Popularization of authorized silkworm hybrids among the farmers of South India.	Nov, 2012 – Oct, 2014	Bivoltine Hybrids: Evaluation with 5,17,350 dfls of the bivoltine hybrid, CSR16 x CSR17 at the farmers field of Karnataka, Andhra Pradesh and Tamil Nadu revealed that CSR16 x CSR17 recorded cocoon yield of 64.30 kg / 100 dfls as compared to 61.18 kg/100 dfls in CSR2 xCSR4. Multi x Bi hybrids: 1,13,650 dfls of MH1 x CSR2 reared in Karnataka at farmers level revealed that MH1XCSR2 yields 61.52 kg / 100 DFLs cocoon as against 61.00 kg/100 DFLs in PM x CSR2 (Control). Though the performance of MH1 x CSR2 at farmer's level was good, the reeling performance was not good. Hence KSSRDI was requested to look into the matter.
10	AIB 3488	Pre-authorisation field trials of L14 x CSR2: A polyvoltine X bivoltine	Apr, 2012 – Mar, 2015	L14 x CSR2 was tested in the field and found to have the yield potentiality of 65 Kg/100 DFLs. But

		hybrid with superior fibre quality.		due to unequal emergence, trimoulters and diapauses, the hybrid was not found suitable for commercial utilization. Hence taken for further improvement.
11	AIB 3476	Development of Productive NPV tolerant BV Breeds / hybrids carrying BmNOX marker assisted selection.	Apr, 2012 – Mar, 2015	Through *Bm*NOX (NADPH Oxido-reductase) protein marker assisted selection, 10 NPV tolerant lines were developed. Testing of single & double hybrid combinations resulted in selection of single hybrid (21 x 35) & double hybrid (21 x 118) x (62 x 87) for OFT & field evaluation.
12	AIT 3445	Development of robust bivoltine hybrids of silkworm, *Bombyx mori L,* tolerant to high temperature environment of the tropics through DNA marker assisted selection	Jan. 2011 - Dec. 2015	Two SSR (LFL0329, LFL1123) markers linked with thermo tolerance in silkworm were identified. Four oval thermo tolerant breeds (TT1, TT2, TT3,TT4) and Four dumbbell thermo tolerant breeds (TT5,TT6,TT7,TT8) were developed employing the above SSR marker for selection. These breeds exhibited 70-84% survival and 18 to 20% shell at 36ºC (5th Instar 2nd day to spinning @ 6hrs daily). Two thermo tolerant single hybrids (TT2 x TT6 & TT2 x TT) developed from above lines has the cocoon yield of 60-65 kg/100 dfls; shell % of 21-22%, reelability of 85-88%, raw silk % of 15-16% and renditta of 6.0-6.5. Further, two thermo tolerant double hybrids [(TT21 x TT67) & (TT23 x TT67)] were developed have the cocoon yield of 60-65 kg/100 dfls; shell % of 22-23%, reelability of 88-90%, raw silk % of 15-17% and renditta of 5.5-6.5.
13	AIB 3506	Studies on Thermo Tolerance, Heat Shock Protein Synthesis during Thermal Shock and Inbreeding in Silkworm, Bombyx mori L (DST-SERB funded)	Jan. 2014 – Dec. 2015	By exposing CSR2, SK4C Nistari & Pure Mysore 5th instar 3rd day larvae to 36, 38, 40 & 42 ºC continuously till death / spinning, 38ºC was found to be ideal for conducing experiments on thermo tolerance in silkworm. Biochemical analysis identified two stress proteins (70kDa, 20kDa), which were later found to be immune-related protein CDIL (58.85kDa) and tRNA ligase (32.65kDa).

14	AIB 3528	Evaluation of G11 x G19: A new bivoltine double hybrid silkworm for sub-optimal conditions.	Jan. 2015 -Dec. 2016	Tested 5.0 lakh DFLs of G11 & G19 at the farmers field in Karnataka, Andhra Pradesh, Maharashtra and Tamil Nadu. The average cocoon yield was 68.0 kg/100 dfls in non-captive area over the benchmark values of 50-60kg/100 dfls. Based on the performance, the Hybrid Authorisation Committee (HAC) authorized the hybrid for commercial use.
15	AIB 3536	Development of new bivoltine silkworm hybrids for commercial exploitation.	Mar, 2015 –Feb, 2017	Utilizing bivoltine breeds (oval: CSR2, CSR17, CSR27, CSR50, CSR52, S8, GEN1, 2C, NB1, D2 and EC1; dumbbell: CSR4, CSR6, CSR16, CSR26, CSR51, CSR53, 4D, 4S, SK6, SK7, DUN17, DUN18, BCon1, BCon4 and Pam117), foundation Crosses (oval x oval / dumbbell x dumbbell), Single Hybrids (oval x dumbbell) and Double Hybrids (oval x oval) x (dumbbell x dumbbell) were prepared and evaluated. Out of the shortlisted and evaluated combinations, Single hybrids: SHR1 (D2xSK6) & SHP2 (CSR17 x CSR26); double hybrids: DHR4 CSR27x2C)x(Dun18xCSR16) & DHP5 (S8xD2)x(CSR16xCSR51) were found promising for robustness and productivity, respectively.
16	AIP 3478	Studies on mulberry leaf nutrition on intermediary metabolism of silkworm *B. mori L*	Apr, 2012 - Oct, 2015	Correlation coefficient of leaf nutrients with cocoon production revealed that crude protein content of leaf has significant positive correlation with cocoon production and similarly total carbohydrates has significant positive correlation with cocoon production. Further, the mulberry varieties, V1 with high protein (26.7%) and carbohydrates (17.6%) improved cocoon characters.
17	ARP 3477	Therapeutic control of Microsporidiosis in the silkworm through characterization of Methionine Amino Peptidase enzyme genes (MetAP2) in *Nosema bombycis*	Apr, 2012 – Mar, 2015	Met AP2 gene in *Nosema bombycis* was sequenced and found similar to *Nosema cerenae*. Fumagillin was found effective in suppressing *Nosema bombycis* infection.

18	--	Validation and refinement of Serifit, an inorganic compound for effective sanitation	Apr. 2015 -Nov. 2015	0.2% solution of Serifit, a new chlorine based disinfectant was found to be effective against pathogens of silkworm. It is an effective disinfectant for silkworm rearing house, appliances and surface disinfection of silkworm eggs.
19	APR-3550	Validation trials of automated disinfection of silkworm rearing house.	Jan,2016 – Mar, 2017	Validated the technology at TVDC, CSRTI-Mysuru, REC-Bidaraguppe, RSRS- Kodathi & RSRS-Salem and recommended for adoption by the farmers.
20	ARP 3519	Silkworm Disease Monitoring of Seed and Commercial Crop Rearing of South Indian States	Oct, 2014 – Mar, 2018	Developed web based programme for uploading the disease incidence. Basic Seed Farms (BSFs) in A.P., KA and T.N and selected clusters in A.P., KA, Kerala, MH, T.N. and Telengana were covered.
21	ARP 3597	Standardization and Validation of LAMP (Loop mediated isothermal amplification reaction) technique for the detection of Nosema bombycis infection in silkworm	Oct, 2016 – Sept, 2017	Standardized, validated and fine tuned the new LAMP technology for identification of Pebrine, which is . cost effective and less time consuming.
22	PIG 3502	Sustaining mulberry yields: Identification of QTLs conferring resistance to root rot disease by Linkage Disequilibrium mapping and trait introgression (Phase I) – (DBT funded)	Jun, 2013 – Jun, 2015	Out of the 211 germplasm accessions evaluated for root rot disease resistance, twenty accessions were found to be resistant (with <25% root rot), fifty one accessions were moderately resistant (26-50% root rot) and forty one accessions were susceptible (51-75% root rot). The remaining 99 accessions were with >75% root rot and considered as highly susceptible. The least root rot (9.85%) was observed in *M. cathayana* (Hybrid), whereas 71 accessions developed 100% root rot infection. Mulberry specific microsatellite markers (130 nos.) were screened for marker amplification and 25 were found to be polymorphic. Further, 60 mulberry specific SSR primers were designed based on sequences archived (MulSatDB; http://btismysore.in/mulsatdb/) and another twenty five polymorphic

				markers were also synthesized. 96 diverse germplasm accessions were genotyped using 20 SSR markers.
23	PIB 3507	Development of Distinctness, Uniformity and Stability (DUS) descriptors for Mulberry (*Morus spp.)* and their Validation (PPV & FRA funded)	Apr, 2013 – Mar, 2016	DUS test guidelines for mulberry was prepared with 35 charecters and submitted to PPV & FRA, New Delhi and it was approved and gazette notified. It was also published in the Plant variety Journal of India for more circulation.
24	PPE 3455	Habitats studies-Impact of crop diversity on conservation and performance of parasitoids and predators in mulberry crop system.	Sept. 2011 - Aug. 2014	Crop diversity in the vicinity of mulberry has significant impact on the multiplication & subsequent recovery of augmented predatory beetles. Mulberry gardens surrounded by mixed crop species with cowpea, castor, maize, sorghum, red gram, cotton, horse gram etc., showed maximum recovery of predatory beetles (488%) and minimum was recorded in gardens surrounded by tomato (280%).
25	ARE 3526	Investigations on Semiochemicals of the silkworm uzi fly *Exoristabombycis*. (In collabora-tion with NBAIR, Bng)	Jan, 2015 – Dec, 2016	Tricosene was found effective in attracting uzi flies and Tricosane & Pentacosan were identified as minor attractants. 5mg tricosene per dispenser was effective in trapping the adult uzi flies in the laboratory experiments. Trials with different traps revealed that water pan trap was able to trap adult uzi flies better than sticky or Mc Phail traps in the field.
26	PRE 3527	Survey & Surveillance of major pests & their natural enemies in mulberry eco-system.	Jan, 2015 – Dec, 2016	Highest mealybug incidence was recorded at RSRS-Salem (12.7%) followed by areas of REC-Srivilliputtur (5.77%) & REC-Madivala (5.41%), RSRS-Anantapur (4.64%) and lowest (2.69%) at REC-Kanakapura (1.48%). Leaf roller incidence was highest at RSRS-Anantapur area (5.65%) followed by CSRTI (4.93%), REC-Madivala (3.8%) and lowest at REC-Srivilliputtur (1.36%). Thrips incidence was highest at RSRS Salem (11.25/leaf) followed by REC-Srivilliputtur (7.04/leaf) and lowest at CSRTI (1.6/leaf). No new pests/

				natural enemies were recorded during the period.
27	PRE 3546	Identification, characterization, synthesis and field evaluation of sex pheromone of the mulberry leaf roller, *Diaphaniapulverulentalis* (Lepidoptera : Pyralidae) (In collaboration with NBAIR-Bangalore)	Jan, 2016 – Dec, 2017	Isolated, Identified and synthesized the sex pheromone of the mulberry leaf roller for trapping the males. Three pheromone compounds namely Z-11 hexadecenal, Octadecane and Z-e-7, 11-hexadecenal acetate was isolated and successfully synthesised to develop traps for the leaf roller.
28	APR 3529	Design and development of silkworm rearing house models for hot & dry and hot & humid areas of peninsular India.	Jan, 2015 – Dec, 2016	Studied the existing designs of silkworm rearing houses in non-traditional areas and the prevailing atmospheric conditions. It was hypothesized that the abstract humidity and temperature do not have any bearing on the optimal growth of silkworms. The enthalpy of air is much more important and the rearing houses should be equipped with the heating and cooling devices to maintain optimal enthalpy.
29	MOE 3523	Study on drought management practices in mulberry Sericulture.	Jan, 2015 - Dec, 2016	The adoption gaps were identified through the diagnsotic study (six clusters with 300 farmers) on drought management practices. A book on drought management practices was brought-out for farmers in English, Tamil, Kannada and Telugu. The impct study conducted revealed improved adoption levels (25-30%) in drought management practices by the farmers.
30	MOE 3525	A study on the impact of pest & disease management practices in sericulture among the farmers under CPP in South India.	Jan, 2015 – Dec, 2016	The data collected from 17 selected clusters revealed that adoption of technology in the control of pests and diseases in mulberry and silkworm through IPM and IDM practices was efficient. The impact of the packages on incidence of mulberry pests and diseases, silkworm diseases was very high. The constraints identified include lack of availability of IPM inputs, high cost of inputs, lack of awareness about IPM/IDM, especially in Maharashtra. Training & timely supply of bio-control agents

				and other critical inputs would improve the rate of adoption.
31	PPF 3500	Development of seri-lac culture model for income augmentation. (Collaborative project with IINRG, Ranchi) RSRS C. NAGAR.	Jun, 2012 – Dec, 2016	Lac host plants with 8' x 8' spacing were maintained in between the mulberry trees. Average of three crops' lac production indicated about 150 kg of lac harvested/ac/yr resulted in an additional income of Rs. 46,750/-. Dual culture of silk and lac revealed higher returns of Rs.1,56,840/ac/yr over mulberry as a solo crop (Rs. 1,10,090/-). C:B ratio was higher in Seri-Lac Culture Model (1:2.06) over mulberry as a solo crop (1:1.74.) Crop residue management after harvesting lac used as surface mulch indicated significant improvement in soil fertility.
32	PPA 3551	Determination of Yield potential of newly developed bivotine hybrids under Tree type mulberry plantation with protective irrigation.	Jan, 2016 – Dec, 2016	The study taken up with silkworm hybrids CSR16 x CSR17, CSR50 x CSR51, FC3 x FC4 and G11 x G19 with tree mulberry cultivation and protective irrigation' revealed significant improvement in the productive parameters in comparison with the traditional 'bush mulberry plantation with normal irrigation' and also with 'bush mulberry plantation with protective irrigation'. Performance of the two single hybrids CSR16 x CSR17, CSR50 x CSR51 revealed that, these hybrids can be utilized even in moisture constraint areas with tree mulberry cultivation with protective irrigation and as an alternative to CSR2 x CSR4. Performance of the two double hybrids FC3 x FC4 [(CSR50 x CSR52) x (CSR51 x CSR53)] and G11xG19 also revealed that, these hybrids can be utilized for wider adaptability in field with tree mulberry plantation with protective irrigation using affordable micro irrigation technology in moisture constraint regions.
33	PRE 3512	Studies on pest status and eco-friendly management of thrips (*Pseudodendrothrips mori)* (Thysanoptera:	Apr, 2014 – Mar, 2016	Survey method for thrips on mulberry has been standardized. Survey result indicated that Tamil Nadu recorded higher incidence of thrips (11-30 thrips/ leaf) as

		Thripidae) on mulberry in Tamil Nadu and Karnataka (In collaboration with NBAII, Bengaluru)		compared to Karnataka (1-10 thrips / leaf). Karl Pearson correlation coefficient was determined for correlating the thrips population with weather parameters. The correlation (three sets of pooled data) between climatic parameters and thrips abundance was found to be significant and negatively correlated with rainfall. Thrips population was not influenced by the weather parameters in Kolar; negatively significant with rainfall in Salem and significant positive correlation with minimum temperature in Erode. Four species of predatory thrips *Franklinothripsvespiformis, Mymarothripsgaruda, Aduncothripsasiaticus, Scolothrips asura*; three species of anthocorids viz., *Oriusmaxidentex, Oriusdravidiensis, Montandoniolaindica*; and one species of predatory Trombidiforme mites have been recorded as probable natural enemies for the management of mulberry thrips. Laboratory studies on predatory potential of *C. zastrowisillemi, B. pallescens and F. vespiformis* on mulberry thrips indicated that *C. zastrowisillemi* could able to feed more than 800 thrips nymphs within 8-10 days period.
34	MOE 3562	Socio Economic Impact of CPP in bivoltine serifarmers in Tamilnadu	Feb, 2016 – Jan, 2018	Technology adoption level ranged from 75 to 92% with a cocoon productivity improvement from 69.7kg (2012-13) to 78kg/100 dfls (2016-17) in Tamil Nadu. The Dfls Brushing increased from 38.34 lakhs (2013-14) to 73.68 lakhs (2016-17). The critical technologies / practices were adapted to higher levels (80-100%) for achieving the improved productivity. Raw silk production improved from 603 MT (2012-13) to 1627MT (2016-17). Half of the respondents were in old (50.00%) age category and nearly half of them were also high

				(48.75%) income group. The net returns from one acre of mulberry ranged from Rs.0.997 lakhs to Rs. 1.575, whereas the cost of production of per Kg cocoons ranged from Rs.245-275/- Constraints in non-adoption of technologies were recorded and analyzed. The contributory factors for improved production, productivity and socio-economic improvement include good returns from sericulture; disinfection / hygiene measures; CRCs; suitable rearing houses and adequate rearing facilities; adoption of latest technologies; effective crop moinitoring by the CSB & DOS staff and farming communities.
35	MOE 3564	Impact of CPP on Sericulture development in North Karnataka.	Mar, 2016-Sept, 2017	Impact of CPP in North Karnataka (2012-2017) resulted in the shift from CB to Bivoltine. CB brushings came down by 87% and BV brushings increased by 276%. Average cocoon yield (kg/100 dfls) increased by 22% and total silk production increased by 50%. The technology adoption increased from 23.2% to 63.4%. The asset position increased by 23.62% (discounted), liability position came down by 6.3%. Sericulture income has increased by 47.2% due to higher production, productivity and market prices. Social status improvement (15.86%) was observed with the sericulture farmers. The non-neutral technological efficiency increased by 15.27%. Nutral technological efficiency was noticed upto 22.35% mainly due to higher labour use efficiency and use of FYM.
36	MOE 3565	Studies on yield gaps in silkworm cocoon production in the states of Andhra Pradesh and Telangana.	Oct, 2015 – Mar, 2018	Most of the respondents were in the age group of 30 - 40 years, educated and small farmers with few years of experience in sericulture farming. Fellow farmers (45.30 % in Telangana; 49.5 % in Andhra Pradesh) were major source of information on improved sericultural

				technologies in the CPP. It was observed that the yield gap I was lower than the yield gap II in case of mulberry leaf production and silkworm cocoon productivity. Before cluster approach in Telangana, the yield gap recorded was 29.84% in case of mulberry leaf production and 40.06% in cocoon production. After CPP, the yield gaps were reduced to 12.90% & 9.38% respectively. With regard to Andhra Pradesh 26.05% yield gap was recorded in case of mulberry leaf production and 35.24% in case of cocoon production. After CPP, the yield gap was reduced to 11.21% & 12.48%, respectively with regard to mulberry leaf and cocoon production.

2. Central Sericultural Research & Training Institute, Berhampore

#	Project Code	Project Title	Project period	Outcome of the project
37	PIB-3424	Development of low temperature stress tolerant Mulberry Genotypes for sub-tropical plains.	Jan, 2009 to Dec, 2015	Thirty-six parents comprising 10 males and 26 females were selected on the basis of annual and winter season leaf yield, sprouting duration, leaf yield rate, nitrate reductase activity and no. of chloroplasts in guard cells. Developed hybrid populations between the three groups of parents on the basis of Electrical conductivity (EC). 1st set 58 combinations (41,356 No's), 2nd set 128 combinations (76,841 No's) and 3rd set from CSR&TI, Pampore OP seeds of 33 early sprouting varieties (25,682 No's). Identified fifteen progenies with early sprouting, EC, Nitrate Reductase Activity (NRA), leaf yield etc., during winter seasons under Progeny Row Trial. Further, seven genotypes i.e., C-29,C-33, C-45, C-108, C-212, C-225 and C-384 recorded higher growth, biochemical parameters, moulting test and leaf yield over the check S-1635 through Primary Yield Trial.
38	PIB 3479	Development of high yielding mulberry varieties using physiological growth parameters as markers for selection.	Oct, 2012 to Sep, 2016	Developed 1024 hybrid seedlings from six female and eleven male parents with better physiological traits and leaf yield. Identified 24 seedlings with significantly higher leaf yield ranging from 2.104 to 2.561 kg / plant / y as compared to check S-1635 (1.620 kg / plant / y) under PRT.
39	PIB 3515	Evaluation of newly developed triploid mulberry varieties under irrigated condition.	Jun, 2014 to Mar, 2017	Fifteen triploid seedlings along with a check variety (S-1635) were evaluated for leaf yield, biochemical and disease & pest incidence under PYT. Selected seven triploids with leaf yield ranged from 369 to 445 g/plant/crop (>15%) and biochemical values significantly higher than check S-1635 (319 g/plant/crop) for FYT.
40	PIB 3481	Evaluation of mulberry varieties suitable for low input soil.	Jan, 2013 to Dec, 2017	Seven genotypes developed for low input condition were evaluated for leaf productivity, stability and silkworm palatability under low NPK input under FYT cum MLT. Five genotypes recorded significant high leaf yield potential over check S-1635 to the extent of 1.2 to 13.1% under half

				and 3.4 to 26.6% under full dose of NPK.
41	AICEM III	All India Coordinated Experimental Trial for mulberry-Phase-III	Aug, 2011 to Dec, 2016	Three genotypes were tested under one irrigated (at CSRTI, Berhampore) and six rainfed test centers. In addition to above, the genotypes tested under subtropical hills of RSRS, Kalimpong including Tr-23. C-2038 recorded a mean seasonal leaf yield of 10756 kg/crop and an annual yield potential of 53781 kg /ha/yr. Rearing performances with bivoltine silkworm hybrid (SK-hybrid at AMF; B.con1 x B.con4 in all other test centers) indicated C-2038 fed silkworm showed maximum cocoon yield.
42	PPS 3504	Study of root rot disease of mulberry in the Gangetic plains of West Bengal and development of its control measures.	April, 2014 to March, 2017	A combination of Carbendazim 12%+ Mancozeb 63% @ 0.2% was recommended to cure root rot in West Bengal.
43	CSS-2107	Forewarning of mulberry diseases of eastern and North Eastern India.	April, 2012 to March, 2017	Broadended the mulberry disease data base of Eastern and North Eastern India. Existing models were fine tuned and models developed when severity of disease is > ETL (Economic Threshold Level). Region specific forewarning models were developed for the management of mulberry diseases.
44	PIP 3469	Screening of early sprouters and late senescence mulberry variety with better leaf yield and quality under low temperature condition.	Nov, 2011 to Oct, 2014	149 mulberry accessions (25 exotic, 51 indigenous, 38 C-lines and 35 S lines) were screened. Accessions C-1540 and C-1726 recorded maximum leaf yield 4507 Kg/ ha/ crop & 4215 Kg/ ha/crop respectively with moderate quality.
45	PPS 3452	Terrestrial carbon sequestration for sustained high productivity of quality mulberry.	Jul, 2011 to Jun, 2015	Mulberry growing under moderate tillage with grass cover registered the highest leaf productivity of 38.72 t ha^{-1} $year^{-1}$. However, mulberry growing under the existing farming practice (intensive tillage) recorded leaf productivity of 38.16 t ha^{-1} $year^{-1}$. In terms of CSP also, mulberry growing under moderate tillage with grass cover, registered the highest value of 6.90 t ha^{-1} $year^{-1}$ followed by that of mulberry growing under existing farming practice (intensive tillage) with the value of 6.54 t ha^{-1} $year^{-1}$. Soil organic carbon stock (SOCS) as

				estimated after completion of the field experimentation is 40.16 Mg ha^{-1} under moderate tillage with grass cover and the same is significantly higher than existing farming practice (intensive tillage) registering the value of 35.25 Mg ha^{-1}.
46	PIN 3587	Anil Pappachan Improvement of leaf quality and productivity through external application of seaweed extracts in mulberry.	Jul, 2011 to Jun, 2015	Economic analysis revealed that application of *Ascophyllum nodosum* extract @ 0.5 ml /L at 21 and 28 DAP was most suitable for increasing leaf yield in mulberry with a cost benefit ratio of 1:1.67.
47	PPF 3532	Assessment, Development and Management of area under mulberry in major sericulture districts of West Bengal.	Feb, 2015 to Jan, 2017	It is observed that satellite images and GPS are very useful in generating high resolution spatial information at village level which can be put in a single window web portal. Results of hyper spectral data analysis led to the possibility of using these data for ascertaining leaf protein and moisture content of the large-scale mulberry canopy. Information like mulberry variety, different govt. schemes, marketing places etc., can be obtained from the MIS at one place. The study showed that high resolution multispectral images (less than 1m resolution) will be very useful for identification of individual farmer's field in future.
48	PPS 3559	Testing of carbon capturing potential of mulberry in different locations.	April, 15 to March, 18	The order of annual carbon capturing (t ha^{-1}) at Kalimpong (0.36) > Jorhat (0.31) > Koraput (0.21) > Ranchi (0.15) Results of the study found that the altered farming practice "moderate tillage with grass cover" promises to enhance carbon capturing potential of mulberry substantially on long term basis through continuous improvement of soil organic ambience.
49	PPA 3499	Evaluation of field Apr., 2013 to Mar., 2018) level performance of Vishala mulberry variety in different locations under irrigated conditions in West Bengal.	March, 13, Feb,18	Vishala mulberry variety exhibited 10.98% higher leaf yield potentiality than check S1635 in irrigated condition of W.B. Both the varieties are good in respect of palatability, silkworm growth, cocoon yield and other economic parameter. No significant differences were observed in respect leaf quality.

50	AIB 3480	Development of silkworm *Bombyx mori L.* Breeds from a gene pool with higher genetic plasticity	Sept, 12 to Aug, 16	The following lines were developed: - **Bivoltine** Six way cross *i.e.,* (B.Con.4 x CSR-2) x (Dun-21 x KPG-A) x (RSJ-14 x APS-45)- raised as converged gene pool for high Shell weight and two lines were isolated as: 1.Plain (*p*) Larvae, Faint Constricted, White © colour Cocoon 2.Marked (+p) Larvae, Faint Constricted, White © colour Cocoon **Multivoltine** Six Way cross *i.e.,* (Nistari +*p*) x Cambodge) x (M.Con.4 x PM) x (MH1 x Sarupat) – raised as converged gene pool for horizontal tolerance (survival) and Three lines were isolated as: 1. Plain (*p*) Larvae, Yellow ©, Oval shape Cocoon 2. Plain (*p*) Larvae, White ©, Oval shape Cocoon 3. Plain (*p*) Larvae, Light Greenish(*Gr*) Oval shape Cocoon
51	AIB 3466	Development of region specific bivoltine breeds suitable for highly fluctuating and seasonally variable climatic conditions of Eastern and North-Eastern India.	Aug, 11 to Dec, 16	Five new oval bivoltine breeds and five new dumbbell breeds were developed through systematic evaluation at six different locations involved in the project viz, CSRTI, Berhampore, RSRS, Kalimpong, RSRS, Jorhat, RSRS, Koraput, REC, Bhandara and REC, Shillong.
52	AIB 3496	Development of high temperature and high humidity tolerant bivoltine breeds of silkworm (*Bombyx mori* L.).	Jul, 12 to Jun, 15	Screening of silkworm breeds under high temperature (35±1°C) and humidity (85±5%), 10 breeds were short listed as breeding resources based on overall performance with special emphasis on pupation rate.
53	AIB 3531	Authorization Trials of Silkworm Hybrids in Eastern and North-Eastern India.	Aug, 14 to Jul, 15	Based on the overall performance at farmer's field, during favourable seasons (Agrahayani, Falguni and Baishaki), the cross breed M6DPC x (SK6 x SK7) was recommended in West Bengal and Jharkand states. With regard to bivoltine hybrids, it is recommended to rear B.Con.1 x B.Con.4 in West Bengal, Jharkand & North Eastern states.
54	AIB 3491	Post Authorization trials of silkworm hybrids in Eastern & North-Eastern India.	Sept., 12 to Dec., 14	It was recommended during favourable seasons i.e. Agrahayani, Falguni and Baishaki, to rear the multi x bi hybrids, M.Con.1 x B.Con.4 and M.Con.4 x B.Con.4 and during unfavourable seasons i.e. Shravani, Jaistha, Bhaduri

				and Aswina, rearing of multivoltine hybrids, Nistari x M.Con.4 and M.Con.1 x M.Con.4 in West Bengal and Jharkhand states. With regard to bivoltine hybrids, it was recommended to rear Gen3 x Gen2 in West Bengal and Jharkand and FC1 x FC2 in North Eastern states.
55	AIB 3547	Development of high temperature and high humidity tolerant bivoltine breeds of silkworm (*Bombyx mori* L.)	July, 15 to June, 17	Two thermo-tolerant hybrids *viz.*, **HTH-3 x HTH-6** and **HTH-4 x HTH-9** have been identified as tolerant to high temperature (35º C) and high humidity (>90%).
56	AIB 3545	Authorization Trial of silkworm hybrids in Eastern and North-Eastern India	Aug, 2015 Mar, 2018	The silkworm hybrids, M6DPC x (SK6 x SK7) & B.Con.1 x B.Con.4 were authorized by HAC for commercial rearing.
57	AIB-3514	Development of multivoltine based congenic /NIL breed of silkworm (*Bombyx mori* L.) through introgression of "*Id*" character and its' use.	Aug, 2014 to July, 2017	The following five "Id'' carrier breeds were developed. M.Con.4^{Id}(Pseudo pigmented Diapause Inhibitor Yellow Oval shaped cocoon) similar to M.Con.4 M.Con.4^{Id}(Non pseudo Diapause Inhibitor Yellow Oval shaped cocoon) similar to M.Con.4 M.Con.4^{Id} (Pseudo Pigmented Butter Colour Cocoon B.Con.4^{Id} Pseudo Pigmented Butter Colour Cocoon. BHB^{Id}Pseudo Pigmented White Colour Oval & Dumbbell.
58	AIB 3501	Development of multivoltine breeds of silkworm (*Bombyx mori* L.) with high shell percentage and high neatnes of silk filament.	July, 2013 to June, 2016	The following seven multivoltine lines with high SR% (more than 17%) and high neatness (more than 85 points) were developed : 1. M1 – Parents: M.Con.1x MH1, Cocoon colour: White 2. M2 – Parents:M.Con.4 x MH1, Cocoon colour: Yellow 3. M3 – Parents:Nistari x MH1, Cocoon colour: Yellow 4. M6 – Parents:M6DPE x MH1, Cocoon colour: Yellow 5. M7 – Parents:MH1 x BHB, Cocoon colour: White 6. M4 – Parents:Gen3 x M.Con.4, Cocoon colour: Yellow and 7.M5 – Parents:SK6x7 x M.Con.4, Cocoon colour: Yellow Besides, best two Multi x Multi and two

				Multi x Bi hybrids are also identified. These are Multi x Multi Hybrid 1. M7 x M.Con.4- SR%-18.60, Neatness-84 points & ERR(Wt)- 14.81 2. M1 x M9A- SR%-18.37, Neatness-84 points & ERR(Wt)- 16.47 Multi x Bi hybrid 1. M2 x (B.Con.4 x 1) - SR%-19.55, Neatness-80 points & ERR(Wt)- 15.78 2. M1 x (SK6xSK7)- SR%-19.67, Neatness-85 points & ERR(Wt)- 15.97
59	PIB 3521	Assessment of promising powdery mildew (PM) resistant mulberry lines for perspective commercial use	Jan, 2015 to Dec, 2017	Leaf biomass of 3 PM resistant F1 genotypes showed 6% to 29% more potential over ruling cultivar S1635 (44t/ha/yr). About 53 to 83% less PM disease severity (range: 3.9-10.8 DSI) over better susceptible parent S-1 (DSI: 23.1). Two SSR markers (*MM68* and *MM128*) with the allele of ~182bp and ~190bp showed strong association with phenotypic PM resistance over three generation.
60	DBT funded	Development of DNA marker based genetic linkage map of mulberry and QTL analysis for agronomically important Plant traits. [Collaborative with CCMB, Hyderabad]	March, 2011 to Sept, 2014	Identified three high yielding lines and after through evaluation recommended for field application. Development of ~225 mulberry specific SSRs and partially saturated linkage map of commercial mulberry by CCMB. Identification of major QTLs for some important agronomic/disease resistant traits for MAS based utility breeding in mulberry.
61	ARP 3516	Studies on symbiotics (combination of Probiotic and Prebiotic) induction for control of common diseases of silkworm, *Bombyx mori* L.	Oct, 2014 to Sep, 2016	The tested symbiotics couldn't produce any beneficial effects with respect to rearing and reeling parameters and disease control in silkworm.
62	ARP 3522	Isolation, cloning and characterization of antibacterial protein(s) from silkworm, *Bombyx mori* L. (A collaborative project with SBRL)	May, 2015 to June, 2018	Apolipophorin III gene was successfully cloned and expressed in Pichia pastoris expression system. Recombinant lipoprotein of ~20kDa and ~33kDa is showing good antibacterial activity against pathogenic bacteria as determined by zone of inhibition assay.

63	PRE 3508	Studies on standardization of mass multiplication and field efficacy of *Scymnuspallidicolli* (Mulsant) for eco-friendly management of Tukra.	Apr, 2014 to Mar, 2016	Mass multiplication of the predator *Scymnuspallidicolli* was standardized. The life cycle of the predator under ambient conditions was completed in 27-29 days.
64	PPE 3517	Population interaction of pest and natural enemies in mulberry ecosystem	Aug, 2014 to July, 2017	Population of thrips observed more than Economic Threshold Level (ETL) when the max., temp was about 38˚C. Increased RH and rainfall, observed the less population of thrips. When the min. RH increased (>50%), the *white fly* population was significantly high. Adult whitefly population decreased due to heavy rainfall. The highest incidence of mealy bug was observed during June when maximum temp. was>38˚C and min. temp., was around 23˚C. Heavy rainfall decreased mealy bug population as it washes away the eggs, adults and other stages of mealy bug. Naturally available parasitoids like *Encarsia* spp. Are capable to control the mealy bug by consuming the nutrient from host body which led to mortality of the mealy bug nymphs. The abiotic factors like max. temp. of 29˚C (Aug.) and 30˚C (Sept.), max. humidity of 99% (Aug.) and 97% (Sept.) helped in population buildup of root mealy bug in Kalimpong.
65	PRE 3533	Incidence of whitefly in Mulberry germplasm accessions.	Mar, 2015 to Feb, 2018	Out of 154 mulberry germplasm accessions, 10 accessions found to be relatively resistant to whitefly.
66	APS 3497	Studies on the environmental effect on P1 rearing, its' grainage performance followed by commercial rearing of silkworm, *Bombyx mori* L., during unfavourable seasons of West Bengal.	May, 2013 to Apr., 2015	Environmental factors such as, temperature and relative humidity influence on silkworm seed crop rearing, reproductive potential and on subsequent commercial grainage performance. Information generated can be utilized in solving the grainage problems during unfavourable crop seasons in West Bengal.
67	AIP 3472	Standardization and determination of temperature tolerance potentiality in different developmental stages	Sept., 2011 to Aug., 2014	Amongst the three bivoltine breeds, B.Con.4 and among the three multivoltine, M.Con.4 registered as thermo-tolerant along with the traditional breed Nistari (with low production

		of silkworm, *Bombyx mori* L.		potentiality). NB4D2 was found to be the most susceptible amongst the bivoltines. Sarupat was found severely affected with thermal stress > 32 ºC.
68	AIE 3454	Evaluation of elite bivoltine silkworm germplasm under different agro climatic conditions: All India Silkworm Germplasm Evaluation Programme Phase-II project of CSGRC, Hosur	Sept, 11 to Aug, 14	Silkworm accessions BBE-268 (60), BBI-348 (57.8) and BBI-338 (56.9) with higher evaluation index can be used as potential parents for silkworm crop improvement.
69	PRE 3511	Studies on predatory efficacy of coccinellid predator, *Scymnusposticalis* Sicard for management of white fly on mulberry.	Apr, 2014 to Mar, 2016	Mass culture of the mealy bug (secondary host) on potato sprouts and pumpkin was done. Life cycle of the predator was completed in 23-31 days. The life cycle of the predator on mealy bug was longer (upto 48 days with less fecundity). The predator could not be multiplied on mealy bug in large scale due to lack of mass multiplication of host. Hence, the field efficacy studies taken up for mass multiplication was failed and result was inconsistent.
70	APS 3539	Characterization of mulberry growing soils for nutrient management in selected Seri-villages of Golaghat district of Assam. (Colla borative with NBSS&LUP, ICAR, Jorhat)	April, 2015 to March, 2017	Recommended 0.1 % foliar sprays of boron along with recommended dose of fertilizer (RDF) for micronutrient Boron deficit mulberry growing soil. Recommended NPK (150:50:50) per ha for medium fertility soil. Recommended 25 % extra of RDF for low fertile soil and 15% less of RDF for high fertile soil.
71	MTS-3599	Study on Mulberry Sericulture Production in West Bengal: A Statistical Approach.	Nov, 2016 to April, 2018	Cost and returns of sericulture are benefitted for small farmers compare to marginal farmers. It is revealed that scale of economies works better when size of rearing increases. Economic efficiency of 70% was observed from study farms. It showed that 30% farms are inefficient. This inefficiency can be managed through the efforts on suitable mechanization development and a proper resource use pattern in labor usage, feed, silkworm hybrids usage, etc The outcome of study has been utilized as reference for developmental project in sericulture by Govt. of West Bengal.
72	MOT	Skill Gap Analysis and	Nov,20	Recommended key roles of extension

	3601	Capacity Building of Sericulture Extension Workers and Farmers in Traditional and Non-Traditional States	16 to April, 2018	workers in sericulture development. Prepared Skill Charts of different sericulture activities for farmers of Eastern India. Skill Gaps for both farmers and extension workers were identified. Manual for training of sericulture farmers in Eastern India prepared.
73	AIT 3557	Multi locational trial on Transgenic BmNPV resistant silkworm strains to establish their efficacy and generate data for their regulatory approval.	Jan, 2016 to Aug, 2017	Non-significant difference was observed upto 5th cycle of comparative rearing of Transgenic [N (T) x (SK6 x SK7)] and Non-Transgenic hybrid [N x (SK6 x SK7)].

3. Central Sericultural Research& Training Institute, Pampore

#	Project Code	Project Title	Project Period	Output of the Research project
74	PPS- 3474	Survey, isolation, identification and characterization of native AM fungi and endophytic bacteria in the mulberry rhizosphere of Kashmir region.	2012-2015 Jan, 2016	The study concluded that AM fungal species was *Glomus macrocarpum*across in the valley and can be utilized as native bio fertilizer for growth and productivity of mulberry for temperate region.
75	PPS-3490	Sustainability of soil health under temperate mulberry ecosystem	2012-2015 Dec, 2015	The studies revealed that by adopting the INM approaches 25% of chemical fertilizers (NPK) can be curtailed without affecting the growth and productivity of mulberry. It also increases the soil OC content by 0.77%, which is beneficial for the sustainability of soil health.
76	MOT-3460	Women Empowerment in North India through Sericultural Technologies	2011-2014 Jan, 2015	As a result of technology intervention, the farmers could able to get improvement in cocoon production by 16 to 30% and average income was also increased from Rs.3225/- to Rs.8482/-.
77	AIB - 3475	Evolution of *Bm*NPV tolerant bivoltine breeds of silkworm *Bombyx mori* L.	2011-2015 Jan, 2016	Nine bivoltine silkworm breeds contain four oval (Line-1, Line-4, Line-7 & DR-9) and five dumbbell (Line-6, Line-12, Line-16, Line-18 & DR-8) were isolated.
78	AIE -3454	Evaluation of elite bivoltine silkworm	2011-2014 Nov, 2014	Data generated from the rearing of allied bivoltine silkworm

		germplasm under different agroclimatic conditions: All India silkworm germplasm evaluation programme.(AISGEP)		germplasm was submitted to CSGRC, Hosur, Tamil Nadu for further analysis.
79	AIB-3510	Improvement of Silkworm *Bombyx mori* L. for sustainable Bivoltine Silkworm Cocoon Crop In North West India.	2014-2018 Aug, 2018	Five new silkworm lines viz. Line-1, Line.7, Line-8, Line-13, and Line-14 were evolved with shell percentage in the range of 19.50 to 21.0% and pupation rate up to 93%.
80	PPE-3485	Exploration of Natural Enemies for Management of Insect Pests and Diseases of Mulberry	2012-2014 Mar, 2015	Recorded eight hymenopteran parasites of leaf webber and five powdery mildew feeding Coccinellids from Kashmir and two species of *Trichoderma roseum* &*T. parceramosum* Bisset against leaf spot. Among all parasites, the most predominating and hyperactive parasite was *Chelonus carbonator* (Braconidae) with 3.1 to 14.5 % parasitism on *Glyphodespyloalis* Walker during the study period. Among all powdery mildew feeding Coccinellids, the most predominating and active feeder was *Halziatschitscherini* Semenor. The antagonistic effects of *T. roseum* and *T. parceramosum* on the pathogen growth inhibition of leaf spot revealed a significant decrease over the control. *T. roseum* showed about 70% antagonistic activity against leaf spot.
81	PRP-3572	Management of root rot disease of mulberry in kashmir	2016-2018	Root rot was observed as a serious disease of mulberry with varied incidence in various systems, locations and varities across kashmir valley. Navinya and carbendazim can effectively be utilized for the development of integrated disease management package for management of root rot disease in mulberry in Kashmir valley.
82	ARP-3573	Severity, extent of crop loss and management of	2016-2018	The highest incidence (%) of Grasserie and extent of crop

		Grasserie of *Bombyx mori* L. thorugh advocated bed dis infectants in Kashmir.		loss were observed at South Kashmir followed by Central and North Kashmir. The increase in cocoon production over control was 2.63 % using Ankush (Bed Disinfecatnt). The cocoon yield / 100 dfls and various economic parameters *viz*. pupation rate (%), SCW, SSW, and SR (%) were found superior as compared to Rakshak, Resham Jyothi and Vijetha (control).
83	PIB-3579	Identification of cold tolerant genes for improvement of mulberry genotypes.	June 2016 Sept., 2018	11 cold tolerant genes were identified.
84	MOE-3574	Yield gap analysis of cocoon productivity under conditions fo North West India	April, 2016-March, 2018	The constraints were analysed in the study based on pooled response of adopted and non adopted rearers for cocoon yield gaps during Spring and Autumn crop for four experimental sites in North West India. The main reasons for the yield gap are lack of technical know how, poor hygiene maintenance during rearing, lack of skilled labpur, dependency on Govt. lack of separate rearing space, shortage of mulberry leaf and non supply of chawki worms etc.
85	PIP 3543	Induction of water stress tolerance in mulberry under rain-fed condition by application of triazole compound paclobutrazol.	2014 - 2016	Use of 25mg/lt paclobutrazol per mulberry tree (10 year old plant requires 3 lt solution) would mitigate the water stress condition in rainfed areas. It would effectively improve the leaf yield and quality under rainfed /water stress conditions.

4. Central Sericultural Germplasm Resources Centre (CSGRC), Hosur,Tamilnadu

#	Project Code	Project title	Project Period	Outcome of the Project
86	AIE-3454	Evaluation of elite bivoltine silkworm germplasm under different agro climatic conditions: All India Silkworm Germplasm Evaluation Programme Phase-II	Aug,12-Feb,15	For spring season, the Bivoltine accns BBI-0348 followed by BBE-329, BBI-290, BBE-266 and BBE-216 were identified as better performers. For autumn season, the Bivoltine accns BBE-266, BBI-348, BBI-338, and BBE-268 were identified as better performers. The Bivoltine accns BBI-348, BBE-329 BBE-266, BBE-216 and BBI-338 identified for wider adaptability in different agro climatic conditions and seasons.
87	AIE-3434 (Phase-1)	Collection, Introduction, Characterization, Preliminary Evaluation, Conservation & Supply of Silkworm Genetic Resources.	April, 2009 to March, 2012	All the 73 Multivoltine, 350 Bivoltine and 20 Mutant accessions were characterized, evaluated and conserved following the standard protocols for germplasm conservation. Supplied 64 Bivoltine and 71 Multivoltine accessions to 17 Institutions in 66 spells for research purposes. Obtained national accession numbers for 443 SWGRs from NBAII, Bangalore. Registered two accessions, MH-1 and SLWU & eight accessions from KSSRDI, Bangalore. One Multivoltine and 11 Bivoltine accessions were collected.
88	PIG-3482	Collection, introduction, characteri-zation, evaluation, conservation and supply of mulberry genetic resources.	April, 2012-Mar,2015	23 mulberry accessions from KSSRDI, Thalagattapura, 15 from Goa and Pondicherry were collected. 65 mulberry germplasm accessions were characterized for different descriptors on morphology, reproductive biology, leaf anatomy and evaluated for growth and yield in the field gene bank. 6 accessions MI-0891, MI-0870, MI-0867, MI-0901, MI-0896 and MI-0898 which have higher

				values in more than 5 desirable characters were utilized for further evaluation in the hot spots and included in the breeding programmes for stress tolerance. 696 indigenous and 222 exotic acc. were supplied to 16 indenters and collected feed backinformation. 5 accessions with leaf yield > 3kg / plant in MI-0943, MI-0939, MI-0940, MI-0928, MI-0941 and total biomass more than 8kg/plant in MI-0943, MI-0939, MI-0938, MI-0940, MI-0928 were identified under ex situ field gene bank. 6 accessions - MI-0940, MI-0872, MI-0939, MI-0938, MI-0936, MI-0927 per-formed better for 5 traits. 1269 mulberry accessions are being conser-ved in the ex situ field gene bank. Agave plant extract effectively used for termite control of the plants in ex situ field gene bank.
89	AIG-3483 (Phase-2)	Collection, characterization, preliminary evaluation, conservation and supply of silkworm genetic resources.	April, 2012-March, 2015	23 new silkworm breeds (8 MV and 15 BV) were procured from 5 Institutes viz. CSRTI, Berhampore (6), CSRTI, Pampore (4), APSSRDI, Hindupur (8), CSRTI, Mysore (4) and SSTL, Kodathi (1). After two quarantine rearings and ensuring disease freeness, these accessions were added to the gene bank. National accession numbers were obtained from NBAIR, Bengaluru for these additions. 81 multivoltine germplasm accessions 365 BV and 20 mutants were confirmatorily characterized for different descriptors and updated in the SGIS. All the 81 multivoltine germplasm accessions 365 Bivoltine and 20 mutants were evaluated for 12 important

				economic traits and updated in the SGIS for each generation of conservation crops. Characteri-sation and evaluation data of 81 multivoltine germplasm accessions 365 Bivoltine and 20 mutants were updated in the SGIS. 600 Bivoltine accessions were supplied to 15 indenters in 68 spells and 128 Multivoltine accessions were supplied to 10 indenters in 29 spells for Post Graduation research, evaluation and as breeding resource materials. 466 silkworm genetic resources are being conserved in the gene bank following standard conservation protocols. National accession numbers were obtained for 23 new collections (Total 466) accessions). Top performing multivoltine and bivoltine accessions were identified for multiple traits and also for individual traits. Variability of the Silkworm Genetic Resources conserved was maintained. 466 silkworm genetic resources are being conserved in the gene bank following standard conservation protocols.
90	CYR- 3484	Evaluation of Silkworm Genetic Resources for Post Cocoon Traits.	April, 2012- March, 2015	32 silkworm accessions were evaluated for post cocoon traits. The SGIS databank was updated with the new information. Top performing accessions were identified for all post cocoon traits. 7 Multivoltine accessions were evaluated for denier & filament length consistency during 5 seas-onal trials. 270 silkworm accessions were evaluated for fibroin / sericin content. Reeling waste was utilized to

				make nonwovens by a new eco-friendly method.
91	PIE 3541	Collection, characterization, evaluation, conservation and supply of mulberry genetic resources	April, 2015 to March, 2018	Collected 55 new mulberry germplasm samples from 4 states. Planted 50 temperate mulberry accessions at Manasbal and 319 core accessions at CSR&TI Mysore as safety back up. Characterized 69 accessions for morphological, reproductive & anatomical traits. Updated MGIS23 new collections were added to field gene bank. Conserved 1269 [285 exotic & 1007 indigenous] accessions in field gene bank. Supplied 1125 accessions [303 exotic & 822 indigenous] to 32 indenters for research.
92	AIE 3542	Collection, characterization, evaluation, conservation and supply of silkworm genetic resources.	April, 2015 to March, 2018	Collected 9 new silkworm germplasm (2 MV & 4 BV) samples from CSR&TI Mysore. Collected one wild species of mulberry *viz*. *Bombyx huttoni* through survey of Ziro Valley in Arunachal Pradesh. Confirmatory characterization of 83 Multivoltine, 369 Bivoltine & 23 mutants carried out for different descriptors. Evaluated 83 Multivoltine, 369 Bivoltine & 23 mutants for 12 parameters and conserved. Updated SGIS data bank. Supplied 177 Bivoltine accessions and 274 Multivoltine accessions for research, evaluation & as breeding resource.

5. Seri Biotechnology Research Laboratory (SBRL), Kodathi

#	Project Code	Project Title	Project period	Outcome of the project
93	AIT -3468	Development of RNA interference (RNAi) based nuclear polyhedrosis virus resistance transgenic silk moth. (DBT project Jointly with CDFD, Hyderabad, APSSRDI, Hindupur)	Oct, 2011-Mar, 2017	Transgenic form of the silkworm breed CSR4 and CSR27 races were developed through conventional breeding method.
94	PIG-3465	Isolation and characterization of Microsatellites in mulberry (*Morus* spp.) genome.	Jan, 2011-Dec, 2014	Identified EST-SSR markers from 32 diverse mulberry accessions. 65 SSR markers were validated by testing in 32 accessions. Out of 65 SSR markers, twelve were found to be highly polymorphic.
95	AIG -3473	Molecular characterization of the flacherie causing virus in *Bombyx mori* with specific reference to RdRp (RNA Dependent RNA poly-merase) gene and the regulatory elements in the viral genome.	Jan, 2012-Dec, 2014	A RNA virus, *infectious flacherie virus (IFV)* causing falcherie disease in silkworm *Bombyx mori* was characterized through analysis of RdRp region of the virus. Initially, *Bm*IFV is isolated from field samples of larvae with flacherie disease symptoms. *Bm*IFV was purified and the genomic RNA was isolated. In order to clone the RdRP gene, the primers specific to RdRp gene were designed & used for PCR amplification using cDNA as template. A partial fragment of the viral RdRp gene was cloned and sequenced. The sequence was submitted to NCBI database (accn No. HQ013324.1) A new methodology has been successfully developed to isolate the RNA virus & partial cloning of viral genome Based on the information a new Indo-Swedish collaborative project was proposed on characterization of Iflavirus (a RNA virus) infecting *Antheraea mylitta* and is under progress at

				SBRL.
96	AIT - 3494	Host-parasite interaction: Transcriptome responses to parasitism in the silkworm *Bombyx mori*	Jan, 2013 - July, 2016	The seven host response proteins viz. Hemocytin, Apolipophorin, Humoral lectin, BmToll 11, Relish, Dorsal, Cactus were found activated upon infection by the parasites. Transcriptome responses were analyzed by microarray. Cellular responses of hemocytes were analyzed by Electron microscopy.
97	ARP 3489	Isolation and molecular characterization of major pathogens associated with flacherie disease in *Antheraeamylitta*	Feb, 2014 - Jan, 2016	Identified RNA virus Cytoplasmic polyhedron Virus, IFLA virus pathogens from infected *A. mylitta* larva using molecular markers. Different bacterial *sp* were identified including *Enterobacter spp, Proteus spp, Staphylococcus spp, Enterococcus spp* Identified different pathogens from infected larvae of *A. mylitta* indicate multiple infections. Source of infection and mode of transmission has to be analyzed for early prevention.
98	ARP - 3495	Development of immuno- molecular techniques for early diagnosis of different microsporidians infecting silkworm, *Bombyx mori* L	Feb, 2013- Jan, 2016.	A Polymerase Chain Reaction (PCR) method was developed to detect microsporidian infection at spore load as low as 10-20 spores. The method is suitable for detection of different microsporidian species. Real Time PCR method detecting at femto levels (1 x 10^5) of DNA was also developed.
99	ARP-3513	Molecular characterization of Indian isolate(s) of Densovirus (DV) and viral resistance gene in the host, silkworm *Bombyx mori*	June, 2014 to June, 2016	*Bm*BDV resistant Indian silkworm races being developed through marker assisted selection and these breeds were field tested and found significant increase in qualitative and quantitative traits of silkworm.
100	ARP-3518	Expression profiling of genes associated with resistance to *Beauvariabassiana* in *Bombyx mori* silkworm strains	Oct, 2014 - Sept, 2017	Through semi-quantitative expression analysis for antifungal resistant genes, the multivoltine races Nistari and APDR15 & among the bivoltine races A and J (2)p were found to be tolerant to muscardine disease. The fungal genes can be utilized

				further as potential markers for screening the germplasm to identify the races that are tolerant to muscardine disease and to develop disease resistant/tolerant races.
101	AIT-3544	Validation of Vitellogenin Receptor (VgR) Gene Expression Levels as Molecular Indicator for Fecundity and Fertility in Silkworm Races (*Bombyx mori*)	Aug, 2015 – Dec, 2016	Using quantitative real time PCR, the *m*RNA expression levels of VgR gene among 17 different races of silkworm was estimated. High transcripts levels were observed in BBE0213, BB10255, BBE0293, BB10290, BBE0244, BB1291, BBE0247, and BBI0325 among bivoltine strains and in the multivoltine strain, BMI007. The differential expression levels of *VgR* in silkworm races were found to be correlated with that of fecundity, high *VgR* transcripts leads to high fecundity. The highest expression level was seen in BBE0213 in which the fecundity is reported to be 590 followed by BBI0255 whose fecundity is 572. Validation of the *VgR*gene through this study strongly indicates its use as a functional marker in screening promising silkworm races for the selection of high yielders.
102	AIT-3582	Development of Densovirus resistant productive Bivoltine Silkworm breeds through Marker Assisted Selection.	Sept, 2016-Aug, 2018	49 breeders' stock/productive Bivoltine breeds from CSR&TI, Mysore and CSGRC were screened and identified 30 breeds carry resistant allele for DNV-2. CSR6, CSR26, MASN-6 and MASN-7 breeds were selected for DNV-2 resistance based on *nsd-2* marker. Artificial inoculation validated the marker selection. Hybrids generated by crossing BBE-0266 X CSR6-R and BBE-0266 X CSR-26-R were completely resistant to DNV-2 infection.

6. **Silkworm Seed Technology Laboratory (SSTL), Kodathi**

#	Project Code	Project Title	Project Period	Outcome of the Projects
103	APS 3470	Development of two years preservation Schedules for bivoltine seed of the Silkworm *Bombyx mori* L.	Oct, 2011 to Sept, 2014	More than one-year (500 days) preservation schedule for the CSR breeds (CSR2, CSR 4, CSR6, CSR 26, CSR 27 & NB4D2) were developed to preserve the eggs without adverse effect on hatching and rearing performance.
104	APS 3471	Development of hibernation schedules for univoltine (Barpat) and bivoltine (SK6 & SK7) eggs of silkworm *Bombyx mori* L.	Oct, 2011 to Sept, 2014	Bivoltine and Univoltine preservation Schedule was developed and it can be carried out up to 300 days. The hatchability and rearing performance of SK6 & SK7 were almost similar in 4, 6, 8 & 10 months preserved eggs.
105	APS 3520	Improvement of Silkworm Seed preservation techniques in *Bombyx mori* L.	Sept, 2014 to Mar, 2017	The race-wise preservation technology was developed to preserve the multivoltine eggs of 9 breeds viz. Chalsa, Balapur, Debra and M12W, L14, APDR 15,MH1, PM and Sarupat up for 30-40 days without affecting yield and cocoon

7. Central Tasar Research & Training Institute (CTR&TI), Ranchi, Jharkhand

#	Project Code	Project Name	Duration	Outcome of th e Research Projects
106	AIB-4694	Improvement of Dabaecorace of *Antheraeamylitta* Drury for higher fecundity	Jan, 2012 – Dec, 2014	Three breeding lines with >230, > 250 and > 270 were isolated/ developed without detrimental effect to male shell weight and female pupal weight. Developed lines were having higher fecundity in comparision with ruling Daba fecundity (200-220). A package of practice for rearing of high fecundity line CTR-14 was also developed out and recommended.

107	APR-4693	Studies on the biology and ecology of Lariaecorace of *Antheraeamylitta* Drury on sal flora.	Feb, 2012 – Jan, 2015	Based on the outcome of the findings on biology and ecology of Lariaecorace of *Antheraeamylitta* D in both *in situ* and *ex situ* conditions, a **package of practices** with the recommendations to discourage summer preservation of laria cocoons, to discourage collection of laria cocoons before completion of rainy season, no human interference in the natural lifecycle of laria to protect natural proliferation and continuation, to conduct brushing during 3rd or 4th week of September for better survivability and conservation of laria in natural ecopockets in the forests of Jharkhand etc. were recommended for the efficient utilization of Sal flora in Jharkhand and also to improve the Laria productivity on Sal.
108	ARP-4691	Induction of tolerance to *Am*CPV (*Antheraeamylitta cytoplasmic polyhedrosis* virus) in commercially exploited tasar eco-races of Daba B.V. and T.V.	Oct, 2010 – Dec, 2014	In both the Daba B.V and T.V, Cocoon weight, Cocoon shell weight and shell ratio recorded lower values in *Am*CPV treated lots than the healthy control in initial generations and obtained almost equal values to healthy control when it reached to the generation G_8. The analysis of variance showed highly significant ($P<0.001$) values in the treatment, generation and treatment x generation for all tested survival, cocoon weight, cocoon shell weight and shell ratio traits. The developed tolerant breeds were recommended for field trials.
109	PPA-4704	Development of package for cultivation of *Lagerstroemia speciosa* for rearing of Tasar	April, 2014 - March, 2016	Standardized the package of cultivation of *Lagerstroemia speciosa* for economic plantation. Two consecutive

		silkworm, *Antheraeamylitta* D.		silkworm rearings can be done on the same plants. Plantation can be utilized after 2/3 years of waiting (gestation) period and can well be developed all over India.
110	AIP-4696	Management of abiotic factors to regulate emergence in diapausing seed cocoons.	April, 2012 – Aug, 2015	Preservation of seed cocoons at low temperature (20^{o}C) delays the emergence for 10-15 days.
111	AIT-4702	Molecular cloning and heterologous expression of *Antheraeamylitta*cocoon ase-DBT funded (Collaborative project with BIT, Mesra, Ranchi)	June, 2013 to June, 2015	It is found that softening of tasar cocoon is possible with an enzyme based eco-friendly cocoon cooking and reeling technology in order to produce organic tasar silk with natural beautiful color.
112	ARP-3489	Isolation and molecular characterization of major pathogens associated with flacherie disease in *Antheraeamylitta* D.(Collaborative project with SBRL, Bangalore)	Oct, 2012 to Sept, 2015	Viral & bacterial pathogens associated with flacherie disease in *A.mylitta* were isolated & identified.
113	AIT-4703	Exploitation of wild silk moth biodiversity in Manipur &their genetic characterize-ation using molecular markers under the Twinning Programme for the NE– DBT Fund	Nov, 2011 – May, 2015	17 species belonging to nine genera were collected from Manipur and identified. Out of those *A. frithi* occurred in large numbers in wild.
114	APR-4701	Studies on Bioecology of *Antheraeafrithii* Moore in Manipur.	Oct, 2012 to Sept, 2015	It is found that *A.frithi*is distributed in the forest of Manipur, mostly abundant at Senapati district. The cocoons and larvae were found especially on *Lithocarpusdealbata*, as compared to other oak tasar food plants. Grainage activities were conducted in e*x-situ* and *in-situ* conditions.
115	PIC-4705	Development of in-situ soil health and nutrient management in tasar growing areas.	April, 2014 - March, 2017	Digging trenches for conservation of *in-situ* rain water with growing of wild leguminous plants as cover crops & green mulching and

				inoculation of PSB is found to be effective in improving the soil health, leaf yield and nutrient content in leaf of *T. tomentosa* at farmers' field.
116	AIB-4707	Bioecology of Raily – An endemic sal based ecorace of *Antheraeamylitta* Drury in Bastar (Chhattisgarh)	April, 2014 – March, 2017	Occurrence of tasar food plants in abundance, suitable climatic conditions for growth and multiplication of wild tasar silkworm and availability of number of stocks of Raily population in the biosphere of Bastar which indicates great potentiality of this ecorace for multiplication in future.
117	AIB-4708	Survey, collection, characterization and conservation of wild ecoracesLaria and Baraf of tasar silkworm *Antheraeamylitta* D available in different parts of Chhattisgarh.	April, 2014 – March, 2017	Eco races Laria and Barf being wild in nature are not amenable for human handling. It exhibits considerable preservation loss followed by poor performance in grainage and rearing of the ecorace under *ex-situ* conditions. However, natural proliferation is observed under in-situ conditions.

8. Central Muga & Eri Research and Training Institute (CMER&TI), Lahdoigarh, Assam

#	Project Code	Project Title	Project duration	Outcome of the project
118	AIP-5851	Development of high yielding Muga silkworm breeds through population improvement.	Feb, 2011 – Dec, 2015	From the segregating generations of the hybrid, CMR1 has been developed with higher survivability of > 50 % and shell weight of > 0.60 g in female and >0.48 g in male. In the 18^{th} generation, the breed showed average cocoon yield of 86 per dfl against 65 cocoons per dfl in the control (33.87% improvement) and similarly, it showed improvement of 14.54% in female cocoon shell weight and 17.78 % improvement in male cocoon shell weight. Backcrossing of the hybrid, another breed CMR2 was also developed which showed higher survivability of > 50 % and higher shell weight of > 0.60 g in female and >0.48 g in male.

				In the 17th generation, the breed showed average cocoon yield of 73 per dfl against 65 cocoons per dfl of the control (12.31% improvement) and similarly, it showed improvement of 10.00 % in both female and male cocoon shell weight.
119	PIE-5853	Collection, characterization, evaluation and conservation of perennial host plants for erisilkworm rearing.	Oct, 2011 - Sept, 2014	Ten Kesseru accessions were identified and characterized for first time which is being maintained in the germplasm bank. Passport data of all accessions were maintained. 35.73% improvement in leaf yield recorded in HF 005 & HF 008 than the benchmark of traditional practice in both kesseru accessions. Based on leaf morphological study, four accessions of *Ailanthus grandisi.e*., AG 001, AG 002, AG 003, AG 004 and five accessions of *A.excelsa i.e.,* AE 001, AE 002, AE 003, AE 004, AE 005 were identified.
120	AIE-5854	Exploration, collection, characterization and cataloguing of wild sericigenous insects available in NE India	Oct, 2011 – Sept, 2014	Twenty nine species of wild silk moths were collected from Manipur, Arunachal Pradesh, Meghalaya, Mizoram, Nagaland and Assam states of North East India. According to recent survey, only three species of Eri are found in North Eastern India *viz*., *Samia ricini*, *Samia canningi* and *Samia kohlii*. Male genitalic features are used to identify the *Antheraea pernyi, A. compta, A. frithii* and *A. proylei*.
121	PRP-5855	Identification of stable source of resistance against major foliar diseases of muga host plants Som (*Perseabombycina)*	Oct, 2011 – Sept, 2014	S3 and S6 Som morphotypes of Som screened against leaf spot and leaf blight disease, showed resistance. S3 and S6 Som morphotypes are being popularized.
122	APS-5856	Development of Egg Preservation Schedule in Muga silkworm, *Antheraeaassamensis*, Helfer.	April, 2011-June, 2015	The longest embryonic developmental stage was detected at the ages of 68 to 72 hr. old embryo. Embryonic chart was prepared for different developmental stages of muga silkworm eggs. It was observed that muga silkworm eggs can be preserved up to 15 days at 7 ^{0}C with > 85 % hatching which is almost equal to the control. Bioassays of the

				eggs showed average ERR of 53.19 % against 55.66 % in the control.
123	APR-5858	Eri silkworm (*Samiaricini* Donovan) rearing and cocoon production in relation to host plant castor genotypes (*Ricinus communis* Linn.) raised under rainfed conditions in semi-arid region	Nov, 2011 - Oct, 2014	The Eight genotypes screened indicate that, CSH – 103, CSH – 105 and CSP – 003 have been found to possess high leaf yield potential and also can tolerate higher temperature during summer. Thus it can be used for Eri rearing throughout the year. The mineral (CSH – 106, CSH – 105) and carbohydrate content were found to higher in CSPR – 201 and CSPR – 202 which would support optimal growth of 2nd and 3rd instar Eri silkworms.
124	AIP-5861	Molecular approaches in characterization and utilization of gut microflora from Muga Silkworm *Antheraeaassamensis* for enhancing productivity of Muga culture in North Eastern India. (In collaboration with IARI, New Delhi)	June, 2012 - May, 2015	Pure cultures of gut-bacteria were screened for antimicrobial activity against three entomo-pathogenic bacterial strains *Pseudomonas aeruginosa*, *Escherichia coli* and *Bacillus subtilis*. Two most potential gut-bacteria were selected and identified by 16S rDNA homology and the consensus sequences were submitted to NCBI database. Muga silkworm gut-bacteria isolate no MGB-14 showed highest *in-vitro* lipolytic activity. Three selected beneficial gut-bacteria were mass cultured on nutrient broth medium and fed to muga silkworm during 3rd instar rearing on som plant. Two beneficial gut-bacteria consortium received from IARI, New Delhi were mass cultured on Nutrient broth medium. The culture broth was sprayed on som plants during the 3rd instar rearing of muga silkworm (*Jethua and Aherua crop*). During *Jethua crop,* the average larval weight, cocoon weight, shell weight, SR% and ERR% were increased in the gut-bacteria treated samples in comparison to that of the control.
125	PRP-5862	Screening of Microbial Flora (Potential Biofertilizer) of Castor Rhizosphere and Development of INM Package in	July, 2012 - July, 2015	Pure culture of eight *Azospirillum sp*., fourteen *Azotobacter sp*., fifteen phosphate solubilizing bacteria (PSB) and eight *Pseudomonas* sp. were isolated from the castor rhizosphere soil samples. Altogether, 10 combinations of the biofertilizer

		Ericulture		strains were prepared by mixing carrier material (e.g. vermicompost and charcoal) with final microbial load @ 108 cfu/g. Treatment combinations were applied in the experimental castor plantation. Application of this INM package can enhance the leaf yield by 15-20% against the untreated plants. The average leaf biomass increase over control was in the range of 15-20%.
126	MOE-5863	Sustainable rural livelihood: adoption and refinement of improved technologies of eri culture in Brahmaputra Valley of Assam	Dec, 2012 – March, 2015	Socio-economic survey was conducted in different places. 20 Self Help Groups (SHGs) were formed covering 405 beneficiaries. 20 eri spinning machines, 90 plastic mountages and 90 bamboo platform rearing equipments and other critical inputs were distributed among the beneficiaries. Technology demonstrations, training /skill development programmes etc. were conducted. 4400 dfls of improved eri silkworm breed/race were distributed to farmers. Eri cocoon production enhanced from 7.20 to 12.85 kg per 100 dfls and yarn productivity up to 205 gm per 8 hours.
127	ARC-5864	Studies on the insect fauna associated with Muga-ecosystem in North East India with emphasis on the illustrated diagnostics	Aug, 2012 – July, 2015	Collected specimens preserved in Silkworm Repository and identification of the specimen is completed. Microscopic photographs have been taken for developing diagnostic keys. Database for identified species was completed for 900 specimens. Preparation of description for collected specimens of wild silk moth is completed.
128	APR-5865	Etiology of bacterial diseases and molecular characterization of the pathogens of muga silkworm in NE India	March, 2013- March, 2018	Five bacterial pathogens of Muga silkworm were Identified based on sequencing of 16S RNA gene. Five bacterial species have been identified as *Lysinibacillussphaericus* *L. fusiformis* *Pseudomonas aeruginosa* *Serratia marcescens* *Enterococcus casseliflavus*
129	APR-5866	Sustainable eri silkworm rearing:	Mar, 2013 – Feb,	It was estimated that full grown *Ailanthus grandis* tree (>8 years)

		evaluation of *Ailanthus* species	2016	produces 35-40 T of leaf biomass annually, whereas *Ailanthus excels* produces 28-30 T as compared to 20-22 T in case of Kesseru. Nursery raising techniques were standardized. Bio-chemical constituents of Borpat *(A. grandis*), Borkesseru (*A. excelsa*), Kesseru (*Heteropanaxfragrans*) and Castor *(Ricinus communis*) were analyzed for the samples in different maturity level of leaves (tender, Semi-tender and mature) in four seasons. It was found that T2 (Castor + Borpat) is the best treatment among all other combinations. Rearing of eri C2 breed on *Ailanthus grandis* was conducted with 294 farmers (2640 dfls) and recorded average single shell wt. (0.47 g), single cocoon wt. (3.58 g), cocoon yield per dfl (275 nos.), cocoon shell yield (12.93 kg per 100 dfls) and ERR (88.94%). Biochemical constituents of different *Ailanthus* species were found to be 32.3 to 40.07 % carbohydrate *in Ailanthus* which is at par with castor. Crude protein was highest in *Ailanthus excelsa* (15.23-18.67%). Phenol content was the lowest in *Ailanthus grandis*. Evaluated different *Ailanthus* species for eri silkworm rearing. The lowest larval period (18.33±0.58 days) was observed in the treatment 2, which was at par with *Ailanthus grandis* (T1). The highest mature larval weight was 9.61±0.09 g in T2 and T4.
130	ARP-5867	Characterization, transmission and cyto-pathology of infectious flacherie and cytoplasmic polyhedrosis virus in muga silkworm *Antheraea assamensis* Helfer	July, 2013 – March, 2018	Silkworm pathogens are isolated from diseased muga silkworm samples. Viral DNA/RNA was isolated Amplification of Viral RNA/ DNA is further repeated. The TEM/SEM analyses have been completed and viral particles have been reported in the infected samples. The transmission patterns of the pathogens were studied.
131	ARP-5868	Isolation and characterization of	April, 2014 –	Haemolymph samples isolated from challenged with heat killed *Candida*

		anti fungal peptides from muga silkworm *Antheraea assamensis* Helfer (collaboration with NEIST, Jorhat and IIT, Kharagpur and funded by DBT)	June, 2017	and *Aspergillus* species from muga silkworms were analyzed through PAGE gel electrophoresis and protein bands of different size were observed. Low molecular weight peptides of about 12kd size were observed in fungal treated larvae againt untreated larvae. Antimicrobial activity was clearly observed in the purified crude extract. The 12kd fragment is being purified for their anti-microbial activity, molecular size, amino acid sequence and mode of action. The HPLC analysis clearly showed a few fraction being synthesized at a higher rate as compared to non immunized haemolymph clearly indicating increased protein synthesis after treatment.
132	AIB-5869	Popularization of new eri breed C2 at farmers' field	Oct, 2014 - Sep, 2015	Conducted awareness programmes covering 400 farmers. Organized five batches of training programmes covering 150 farmers in eri host plant management, improved rearing techniques and C2 breed seed production. One technology demonstration programme on C2 breed rearing was organized. More than 37000 eri C2 breed were distributed to farmers under SMV and other farmers during 2015-16.
133	PIN-5871	Development of Biointensive module for organic muga silk production	Nov, 2014 - Oct, 2015	Documentation of Indigenous Knowledge Practices (ITKs) in respect of muga siikworm rearing, host plant management, pest, diseases and predator management was completed. Documented ITKs of muga silkworm rearing and developed an organic module applying organic inputs, viz. vermi-compost and bio-pesticides, phyto-chemicals etc. Identified actual causes of declining muga production, documentation and validation of ITK and development of Organic module against Flacherie disease.

134	AIB-5879	Development of suitable combinations / hybrids of eri silkworm with sustainable performance for commercial exploitation	Nov, 2014 - Oct, 2017	Two eri silkworm hybrids viz. YP x GBZ and GBS×GBZ superior to the existing C2 breed were developed and recommended for field use.
135	MOT-5883	Impact of Training on Knowledge and Adoption Level of Improved Technologies of Muga Culture	Sept, 2016 – March, 2018	It is found that farmers training had a positive impact on knowledge and adoption of the farmers which in turn increased the cocoon production and productivity of the muga farmers.
136	APS-5881	Development of suitable incubation device for incubation of Eri silkworm eggs to overcome hatching problem during summer	Sep, 2016 – July, 2018	Rearing performance of Eri silkworm hatched in different incubation devices was assessed at farmer's field during June, 2018 at SMV, Titabar. Highest hatching percentage (79.5%) was observed in Matka (earthenware pot), which is significantly different from rest of the devices while lowest hatching percentage (74%) was observed in Control (regular practice). 2 to 3^{o}C lower temperature recorded in the earthen pot against ambient temperature ranging from 26 to 37^{0}C during summer. The devices were tested at REC, Kokrajhar and validated at farmer's level in SMV, Dadhora showing conformity with institute's result.

9. Central Silk Technological Research Institute (CSTRI), Bangalore

#	Project code	Project Title	Project duration	Out come of the project
137	CYR 7056	Design and development of Automatic silk reeling machine for Indian filatures for production of International / Superior grade raw silk from Multi-Bivoltine and Bivoltine hybrid cocoons	Jan, 2013 to Jan, 2016	Indigenous Automatic Silk Reeling Machine for production of superior grade raw silk from Indian cocoons was developed. Standardization of process parameters for the production of superior grade raw silk from Indian bivoltine and multibivoltine cocoons was done.
138	CYD 7062	Development of Automatic conveyor cocoon drying machine	Dec,13 to Nov,14 (Extn up, to mar, 15 completed in Dec, 2017)	Indigenous automatic conveyor hot air drier has been developed for the first time in India, in different capacities. Technology of drying the Indian cocoons in Indigenous automatic conveyor hot air drier was developed.
139	CYR 7075	Studies on improving the cohesion characteristics of multibivoltine raw silk / Tasar silk / Muga silk using sericin in reeling process	Feb, 2016 to Jan, 2018	Application of Bivoltine sericin powder / Guar gum on the mulberry and Tasar raw silk during the process of small reel permeation for improving the cohesion of raw silk was developed. The weaving trials indicate that the technology enables the multibivoltine and Indian tasar silk can be used as warp in both powerlooms and handlooms.
140	CFC 5059	Studies on the abrasion resistance of silk upholstery fabrics	May,13 to April,15	Silk upholstrery fabric with high abrasion resistance was developed. Database of fabric parameters and properties of the commercially available upholstrey fabrics were created. Industry can use standardazied constructional parameters of fabrics and finishes for developing silk upholstery fabrics to achieve abrasion resistance required for export purpose.

141	CFW 7080	Development of diversified silk knit wear products/garments using International quality Indian silk	Feb, 2016 to Jan, 2017	Optimised the raw silk quality for silk knitting & process parameters in silk processing. Developed different types of silk knitwear fabrics viz. single jersey, Interlock, rib and pique and converted them to garments for men, women and kids. Identified the suitable reelers, twisters, conewinder, dyer and knitters and developed the silk knit wear garments.
142	CYR 7058	Fine tuning of cocoon quality index [CQI] for unfavorable season	Jan, 2013 to Dec, 2014	Revised CQI formulae and regression analysis for arriving at revised estimated renditta for both Bivoltine hybrid cocoons and Multibivoltine cross breed cocoons reared under unfavourable conditions was developed.
143	CYR 7069	Production of Novel raw silk yarn by cocoon filament entanglement method during reeling	Jan, 2015 to Dec, 2016	Developed a reeling machine with an attachment to rotate cocoon during reeling to produce Novel raw silk. Standardization of novel raw silk production using Box & Behnken design of experiments with basin and reel speed in the ratio of 2:1.
144	CYR 7076	Standard-ization of pre-steaming techniques for improving the winding performance of raw silk skeins	Feb, 2016 to Jan, 2017	Standardized the pre-steaming conditions for both bivoltine and multibivoltine raw silk. Studied the characterization of pre-steamed raw silk in relation to surface modifications. Worked out the economics of pre-steaming and its advantages.
145	CYR 7052	Develop-ment of energy efficient re-reeling machine to reduce fuel consumption in a multiend silk reeling unit	Sep, 2012 to Aug, 2014	4-window re-reeling machine has been developed. Using this machine there can be significant saving in the energy used for re-reeling of silk yarn.

146	CYR 5061	Study on evaluation of Muga Cocoon Stifling Processes on Reeling Performance & Quality of Muga Raw Silk.	Sep,2013 – Aug, 2015	Hot Air Electrical Stifling Technology for Muga Cocoons was developed for reeling sector.
147	CYF 7070	Studies on Silk carpets: Influence of structure on carpet properties	Jan, 2015 to Dec, 2016	Sourced spun silk yarn for production of carpets through NHDC. Spun silk was partially degummed, bleached and dyed. Silk carpets using symmetrical and asymmetrical knots were developed for studies.
148	CYR 7078	Studies on sericin dissolution characteristics	Feb, 2016 to Jan, 2018	It was found that reelability can be calculated using UV Spectrophotometer absorbance values by testing sericin dissolved liquor sample after boiling cocoon shells at 92°C for 5 min. SEM images indicate that low humidity and low temperature reared cocoons have better reelability.
149	CED 7068	Modification of Eri spinning preparatory machines for productivity and quality	Jan, 2015 to June, 16 (March 2017)	Eri cocoon opening cum lap forming machine has been developed. This machine is capable of opening around 5 Kg. of degummed Eri cocoons and forming laps. These laps will be further processed in Amber charaka line of spinning machinery for spinning of Eri yarn.
150	CED 7054	Modification of Existing Reeling and Spinning machine for commercial utilization in tasar sector	Feb, 2013 to Mar, 2015	Developed five different reeling machines suitable for all grades of Tasar Cocoons. Optimized the Reeling speed of all the machines. Developed solar operated spinning machine. Field trials have been conducted at four different locations for the evaluation of the performance of the machines.

151	CYR7071	Development of suitable cooking technology and characterization of Railey cocoons	Jan, 2015 to Dec, 2016	Analyzed shell content of Tasar Railey and Daba cocoons. Developed cooking methodology based on shell content. Optimized cooking process for both Wet and Dry Reeling techniques. Standardized reeling parameters.
152	CYF 5060	Design and development of silk based composite materials for wound dressing applications.	June,13 to Dec, 2015	Silk based biocomposite materials with all types of silk fibres as reinforcements & mulberry fibroin as matrix with honey, Aloe-vera as active ingredients were developed. All the silk fabrics along with biocomposites found to be non-toxic as per cyto-toxicity studies. Tasar silk fibroin is recommended for biomaterial applications with long period of material property retention (up to 3 years).
153	CYF 7067	Development of eri silk based nonwoven fabrics as facial masks for cosmetic applications.	Jan, 15 to Dec, 16	Facial masks using eri nonwoven fabrics were produced with sericin based cosmetic formulations. Eri nonwoven fabric was produced by wet laid (spun-lace) process with Eri silk. Evaluated physical & mechanical properties of eri non-woven fabrics.
154	CYS 5057	Studies on Comfort Properties of Eri Silk and Wool Blended Fabrics for Winter Wear Applications	Jan, 2013 to Dec, 14 (Extn. Mar 15)	Eri silk and wool blended fabrics provide better strength, wicking property and surface smoothness than 100% wool fabric. Thermal insulation, crease recovery, pilling resistance and fullness than 100% eri silk fabric. Shows excellent hand values as winter suit.
155	CFC 7065	Biofinishing of tasar silk fabric using enzymes	Jan, 15 to Dec, 16	Biofinishing has provided significant improvement in tasar fabric properties i.e., drape, bending length, wicking behaviour, air permeability & crease recovery, smoothness, lustre & hand value. No adverse effect was observed on tensile and tearing strength of the fabric. No much significant change has been observed in colour strength of fabric.

156	CFC – 7051	Study of comfort properties of silk woven fabrics and modification of the same with plasma treatment.	Oct,12 to Aug, 14 (Feb, 15)	24 varieties of Soft silk and Dupion silk fabrics with different structural parameters were developed. Plasma treatment was done and analysed for structural, functional, Low stress mechanical and comfort properties.
157	CFW – 7079	Characterisation & evaluation of silk union (backed) fabrics	Feb, 16 to Jan, 18	Soft and Dupion silk varieties of silk union (backed) fabrics in two types i.e. single layer fabrics and weft backed fabrics in plain, twill & sateen weaves with different material for back have been developed & characterised.
158	CFC 7087	Systematic purification of Mulberry silk sericin for topical skin applications.	March, 17 to Feb, 18	Developed technology for complete removal of Lead & Cadmium, 95 % removal of Chromium & 85% removal of Copper from sericin Characterized unhydrolyzed/high molecular weight and hydrolysed sericin. Structural characterization of unhydrolyzed/ high molecular weight and hydrolysed sericin using FTIR
159	CFC - 7064	Characterization of silk sericin for cosmetic applications	June,14 to Nov, 16	Developed techniques for isolation of sericin from degumming liquor and preparation of sericin hydrolysate below 20 kDa molecular weight for cosmetic application. Characterised bivoltine mulberry silk sericin. Developed sericin based cosmetics such as skin creams, soaps, etc.
160	CYR 7063	Finance to the mulberry silk reeling sector – A study on flow, needs, gaps and way forward	Dec,13 - Nov,14	Institutional credit to the silk reeling sector is very low as compared to other sectors. Significant difference noticed between availability and requirement of WC of the reeling units. Inadequate loan amount, procedures, security, previous default, etc. were main problems Measures suggested for improving the credit flow.

161	CYR 7082	A study on the price behaviour of cocoons & raw silk and its impact on the silk reeling sector	May,16 - Nov,17	Cocoon price is correlated significantly with raw silk prices and cocoon prices at various markets. It is also correlated significantly at time lag 0. Similarly, imported & domestic raw silk price is significantly correlated at time lag 0. The impact of price fluctuations on reeling industry indicated that it adversely affects the working capital (WC) availability of reeling units, with no significant advantage to reeling units in situations of cocoon price decrease / raw silk price increase.
162	CFC-7066	Development of easy care finish for wash and wear applications on silk fabrics.	Jan, 15 to Dec, 16	Evaluated of the varieties of soft silk fabrics, dyeing of silk with reactive dyes which also perform the role of cross linking agent. Developed finishing process to improve crease recovery of soft silk.