

Sericulture Technologies

Developed by

CSRTI Mysore



Dr. Bharat B. Bindroo
Dr. Satish Verma

SERICULTURE TECHNOLOGIES DEVELOPED BY CSRTI MYSORE

Dr. Bharat B. Bindroo
Director, CSRTI Mysore

Dr. Satish Verma
Scientist E (Engineer), CSRTI Mysore



Central Sericultural Research & Training Institute
(ISO 9001 : 2008 Certified)
Central Silk Board – Ministry of Textiles – Govt. of India
Manandavadi Road, Srirampura
Mysore 570 08 India

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Authors

Dr. Bharat B. Bindroo

Dr. Satish Verma

Published by:

Director

Central Sericultural Research & Training Institute

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PREFACE

The Central Sericultural Research & Training Institute (CSRTI), Mysore was established in 1961 at Channapatna, midway between Bangalore and Mysore and later shifted to Mysore in 1963. Today, this institute has grown up into a centre of excellence and an international centre for research and training in the field of mulberry sericulture sciences and technology. The institute has become the backbone of sericulture industry in Karnataka, Tamilnadu, Andhrapradesh, Kerala, Maharashtra, & Madhyapradesh which all together contribute over 85 % of mulberry silk produced in India.

Through its dedicated team of scientists and workers, CSRTI, Mysore has developed many high yielding varieties of mulberry, races of silkworms producing high quality and quantity of silk, easy and economic methods of mulberry cultivation, full-proof diseases and pest control in mulberry and silkworms, labour saving silkworm rearing techniques and devices, etc. Today, the techniques developed at CSRTI, Mysore have transformed sericulture into a highly profitable farm based activity from a mere subsidiary occupation in the past. Mechanization has made mulberry cultivation and silkworm rearing feasible at large scale. This has attracted a large number of new farmers to take up sericulture in Southern and Central India.

Today, CSRTI, Mysore has completed 52 years and during this period many technologies have been developed by its researchers. Most of the CSRTI technologies have been widely adopted by the farmers. A number of products, equipments and machines developed by institute have been patented and commercialized after validation both at laboratory and field level confirming the 3E formula of effectiveness, easiness and economic viability. Now, a large number of farmers specifically in South India are realizing the benefits of these technologies as evidenced by the results of two mega programmes namely JICA and IVLP during X & XI Five Year Plan period. Hence, it is time now to take account of all the technologies.

This booklet gives account of various mulberry & sericulture technologies developed by CSRTI, Mysore. The booklet also indicates the level of adoption of the technologies in the field by the farmers. A list of the products, equipments and machines patented and commercialized has also been given in this compilation.

Dr. Bharat B. Bindroo
Dr. Satish Verma

Dated : 17th March 2014

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About CSRTI Mysore

The Central Sericultural Research & Training Institute, Mysore was established under the aegis of Central Silk Board, Ministry of Textiles, Govt. of India. It was started at Channapatna on 1st April 1961 after taking over the Sericulture Research Institute of erstwhile Mysore province and shifted to Mysore in the year 1963. With the inclusion of the training



component, the Institute was renamed as - Central Sericultural Research & Training Institute in the year of 1965.

Today the Institute has grown into a premier Institution for mulberry sericulture research *par excellence* with all modern facilities and infrastructure. Over the decades, the Institute has gained National and International repute. The Institute undertakes entire gamut of sericultural R & D activities to cater to the needs of the on-farm sector of the mulberry silk industry of the southern states (Karnataka, Andhra Pradesh, Tamil Nadu and Kerala) which contribute about 90% of the silk of the country besides catering to the R&D needs of Maharashtra, Gujarat & Madhyapradesh which are nontraditional sericulture states. With its well developed infrastructure and strong indigenously developed technological base, the Institute has made a mark as a leading R & D institution on Tropical sericulture in the country and is well recognized as a center for higher learning and advanced training on international front. Its role in generation of trained human resource has been always on high pedestals, both at domestic and international levels. So far, it has trained over 18,000 persons in different aspects of sericulture science and technology including 700 foreign students because of its quality training. The Institute holds ISO 9001 Certificate for its training programmes.

Besides conducting research and training on all aspects up to cocoon production of mulberry sericulture, the institute also offers consultancy and advisory services for national and international agencies involved in sericulture activities. The institute also provides support to the farmers, industry and state governments through regular services on pre planned programmes.

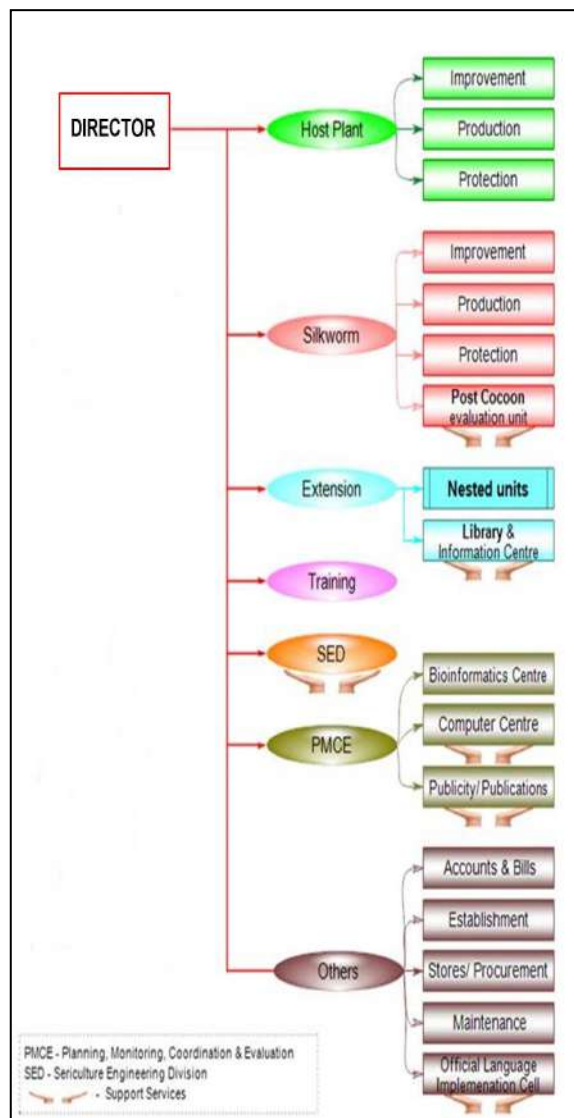
The Institute has also obtained internet domain registration and the address is www.csrtimys.res.in.

Vision : To become an International Sericulture Institute Par-Excellence in Bivoltine Sericulture.

Mission : To achieve excellence in application oriented research to transform Indian sericulture Industry from the subsistence level of production to a vibrant competitive commercial production base

Mandate :

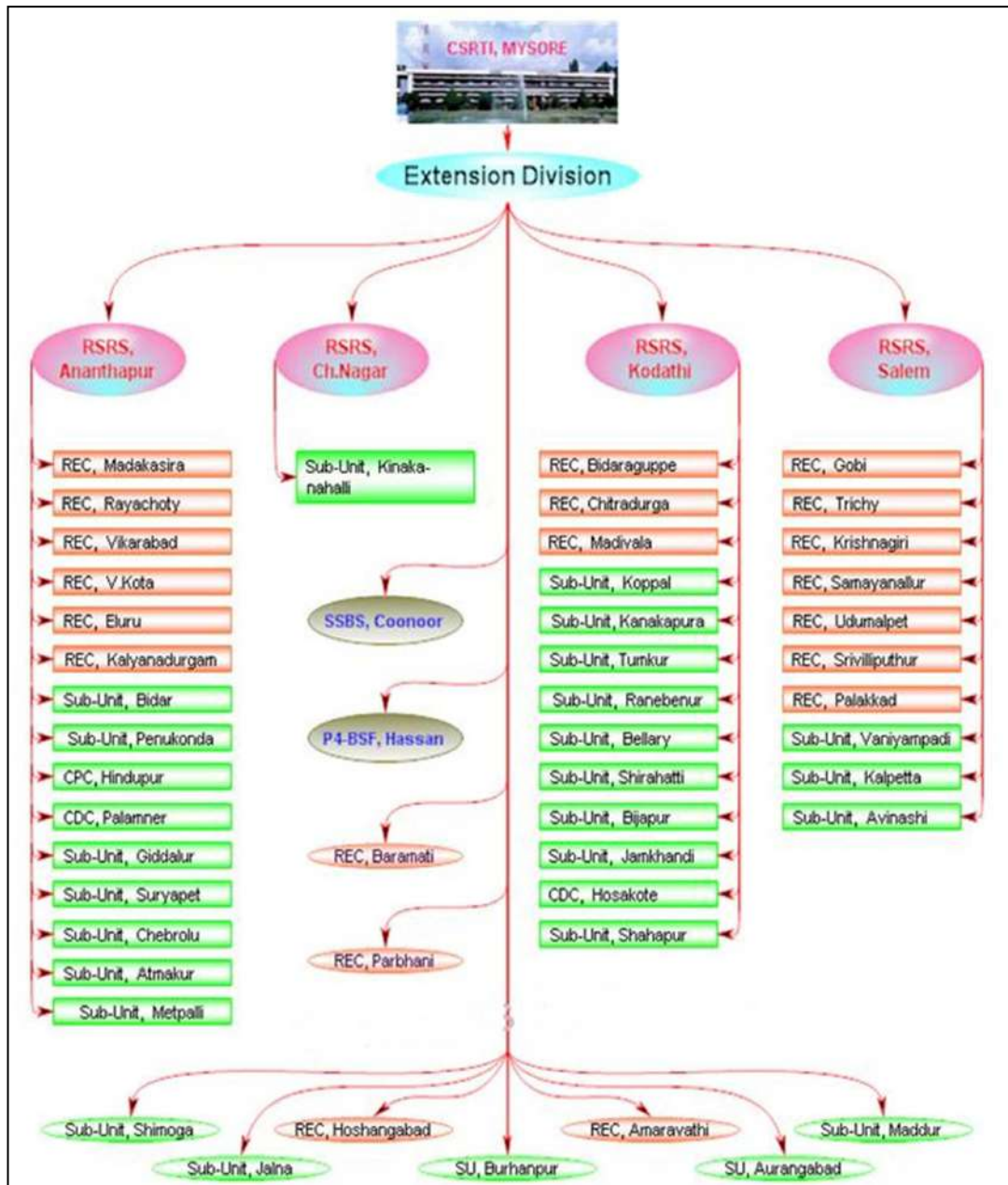
1. Conduct scientific, technical and economic research to enhance production, productivity and quality of Indian silk
2. Development of package of practices for mulberry and silkworm rearing and its dissemination
3. Commercialization of products and Technologies
4. Transfer of Technology
5. Enhance production of import substitute silk through Transfer of Technology
6. Training
7. Strengthening institutional framework to support ongoing research and related programmes
8. Maintenance of Breeders Stock (P4 layings),
9. Publication of R&D innovations and package of practices for knowledge dissemination
10. Disease Forecasting and Forewarning
11. Collaborative Research Programmes with other R&D organizations in India and abroad



Organisational Set-up : CSRTI is the largest and most diversified institution engaged in Sericultural R & D in the country, supported by about 200 Scientists, Agricultural Engineers, Sociologists and Economists, working in close coordination, both at main institute and in the nested units spread over in the southern states besides Maharashtra, Gujarat & Madhyapradesh for development of appropriate technologies and their transfer. The R & D activities and technology developments are carried out in different sections of the four major divisions: Moriculture, Sericulture, Extension and Training. The Director monitors the progress of the R & D activities of the Institute and the nested units with the support of Planning, Monitoring, Coordination and Evaluation cell.

CSRTI Mysore Extension Network

To facilitate validation and effective translation of laboratory findings (technologies) to the field, this Institute has a three-tier system of extension network – **Regional Sericultural Research Stations (RSRS)**, **Research Extension Centres (REC)** and **Sub Units**. The Regional Sericultural Research Stations (RSRSs), located in major sericultural zones of the southern states and carry out region specific adaptive research and technology trials to recommend the technologies suited to the regional requirements besides providing training to farmers and grass root level extension staff. The RECs and Sub-units share the major responsibility of technology transfer to the stake holders and also to provide all technological and input support to them.



Training Centre

Human Resource Development in sericulture is one of the important mandates of the Institute. The institute is recognized as a flagship centre for generation of trained human resource in the field of tropical sericulture. It provides training in tropical sericulture both at international and national level. This Institute is



affiliated to University of Mysore for conducting Post-Graduate Degree Course and Ph.D. programmes in sericulture. It is also recognized by Dept. of Biotechnology and Dept. of Science & Technology, Govt. of India for conducting various training programmes, especially for socio-economic development and technological empowerment of the rural poor, weaker sections and women sericulturists.

The training wing houses well equipped class rooms with audio visual gadgets and the programmes are manned by qualified faculty, recognized by various universities. Hostel facilities are available to accommodate about 125 persons and are equipped with all modern facilities. The training standards at CSRTI, Mysore are very high and institute holds ISO 9001 :2008 for its training programmes.



Infrastructure / Facilities Available

- Well equipped Mulberry Breeding & Genetics, Mulberry Agronomy, Soil Science & Chemistry, Mulberry Disease & Management, Mulberry Physiology, Silkworm Breeding, Silkworm Pathology & Diseases Management, Silkworm Rearing Technology, Silkworm & Mulberry Pest management laboratories with all modern facilities to carry out advanced research in sericulture science such as silkworm breeding, silkworm pathology, mulberry breeding, mulberry cultivation, mulberry pest and diseases management, etc. with attached mulberry gardens and rearing houses.
- Large scale mulberry gardens and silkworm rearing houses for technology validation and farmers training.
- Model Chawki Rearing Centre (CRC) of 5000- 6000 dfls capacity to promote the concept of commercial CRC.
- Fully equipped Molecular Biology and Biotechnology Laboratory to conduct advanced research at molecular levels of both mulberry & silkworm.
- Sericultural Engineering workshop facilities to support in designing prototype development and fabrication of machines/ equipments. The centre has been developed into centre of excellence for design, development, testing and demonstration of sericulture equipments and machines.



- Computer Center provides computing and internet facility all sections through LAN, for sharing the files and information. The LAN also supports on-line and off-line presentations through multimedia / LCD projectors.



- Bioinformatics Center established with the financial assistance of DBT under the National Bioinformatics Network and provides database retrieval service to the scientists of the different institutions involved in Seri biotechnology research of the southern states.



- Library, the main information resource centre, is equipped with all modern facilities has a collection of 10434 books, 6524 bound volumes of scientific journals and 85 journals. In addition, it also maintains a collection of dissertations (272), Ph.D. Theses (32) and technical reports (29). It also provides CD-ROM Database (AGRIS, BIOSIS, BIOTECHNOLOGY CITATION INDEX, EKASWA (Patenting) and DATABASE facilities to its members and bring out half yearly report "Seridoc" besides publishing and compilation of literature on sericulture..



- Two seri-technology museums and IVRS system provides latest sericulture information



A. Mulberry Varieties

(a) For Irrigated Conditions



K₂ (M₅) : This was the first variety recommended by institute. K₂ is selection from Mysore Local isolated at Kanva near Ramanagaram Taluq of Bangalore district. The variety yields 32 MT leaf/ha/year.

S-54 : The variety was evolved in 1984 and became popular in South India under irrigated conditions. The variety yields 35 MT leaf/ha/year.



S-36 : The variety was evolved & recommended in 1986 and became popular in South India under irrigated conditions. The variety yields 45 MT leaf/ha/year and found more suitable for young age silkworm rearing. This variety grows well in red lateritic soils.

V-1 : The variety was evolved and recommended in 1997. It yields 55-60 MT leaf/ha/year of mulberry leaf. This is the most popular mulberry variety in the States of Karnataka, Tamilnadu, Andhrapradesh, Kerala and Maharastra. This variety is suitable for both young and late age silkworm rearing.



G-2 : The variety was evolved in 2003 for irrigated conditions for raising mulberry gardens exclusively for young age silkworm rearing. The variety yields 38-40 MT leaf /ha/year.

G-4 : G₄ is an elite mulberry variety evolved in 2003 for irrigated conditions specifically and for late age silkworm rearing. The variety yields 55-60 MT leaf/ha/year.



(b) Varieties for Rainfed conditions

S-13 : The variety was evolved & recommended in 1990 for rainfed conditions or areas with limited irrigation. This variety yields 12-14 MT leaf /ha/year.



S-34 : The variety was recommended in 1990 for rainfed conditions with alkaline soils and limited irrigation. This variety yields 12-14 MT leaf/ha/year.



RFS-135 : The variety was evolved in 1986 for rainfed conditions or areas with limited irrigation. This variety yields 30-35 MT leaf/ha/year.



RFS-175 : The variety was evolved in 1990 for rainfed conditions or areas with limited irrigation. This variety yields 40-45 MT leaf/ha/year.



AR-11 : The variety was evolved in 1999 for rainfed and semi-arid conditions or areas with limited irrigation. This variety yields 8-10 MT leaf/ha/year.



RC-1 : This variety evolved in 2002 is suitable for sub optimal conditions (atleast 50 % reduction in water and manures). It yields 24-26 MT leaf/ha/year. This variety is suitable for late age silkworm rearing.



RC-2 : This variety evolved in 2002 is suitable for sub optimal conditions (atleast 50 % reduction in water and manures). It yields 24-26 MT/ha/year. This variety is suitable for late age silkworms.



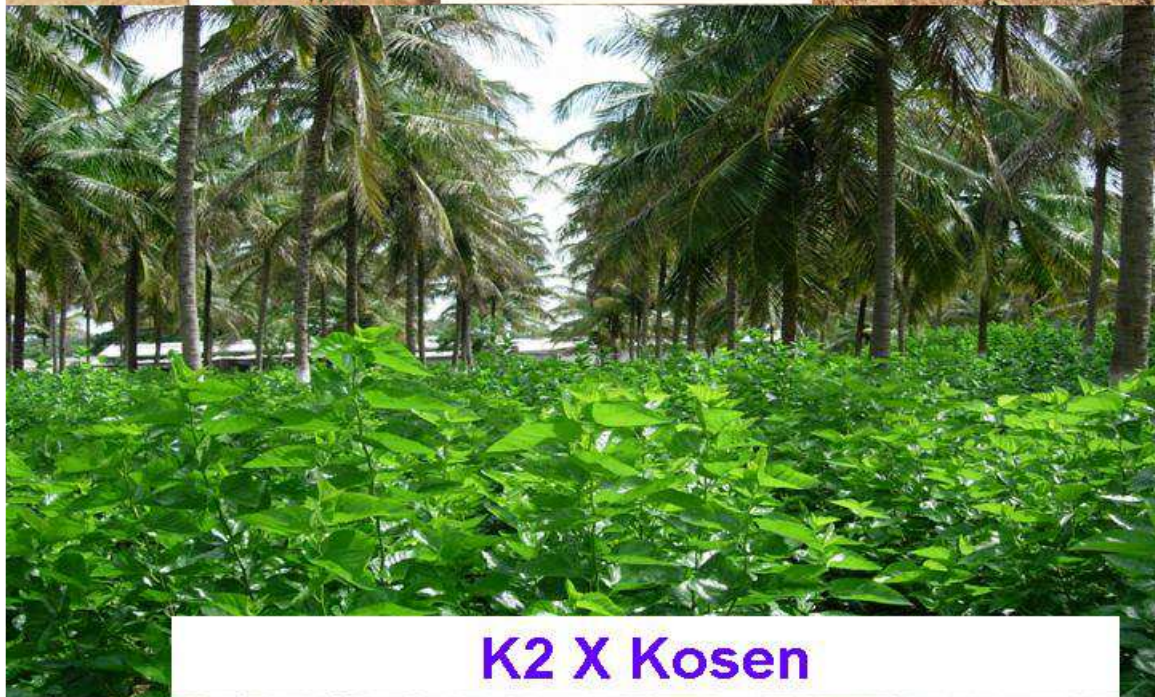
(c) Varieties for Alkaline conditions

AR-12 : The variety was evolved in 2000 for alkaline soils with pH > 8.5. This variety yields 25 MT leaf/ha/year.



(d) Shade tolerant variety

Sahana (K2 x Kosen) : This grows well under shade in a coconut garden in peninsular states of India. This variety yields 25 MT leaf/ha/year.



WELL GROWN MULBERRY GARDENS

Nursery for raising mulberry saplings



The mulberry cuttings with 3-4 healthy buds made from well matured mulberry shoots should be planted in soil beds of 120 cm x 180 cm at space of 10 cm in rows with 20 cm distance between them. The nursery should be irrigated frequently and weeding carried out periodically.

Top working for replacement of local mulberry varieties

This technology consists of grafting a bud of high yielding variety like V₁ or S₃₆ to a mulberry plant of local or any other variety. This helps in quick replacement of local mulberry varieties with high yielding varieties without uprooting the plants.



Multiplication techniques using green wood cutting

The soft and semi-soft wood cuttings exhibited high survival (90%) in V₁ variety. The rate of multiplication through soft wood is nearly 3 times higher than normal multiplication system. From 1/5th of hectare garden, about 1/2 a million saplings could be raised in a year. The saplings raised through this method are very cheap.



C. Mulberry Cultivation Technologies

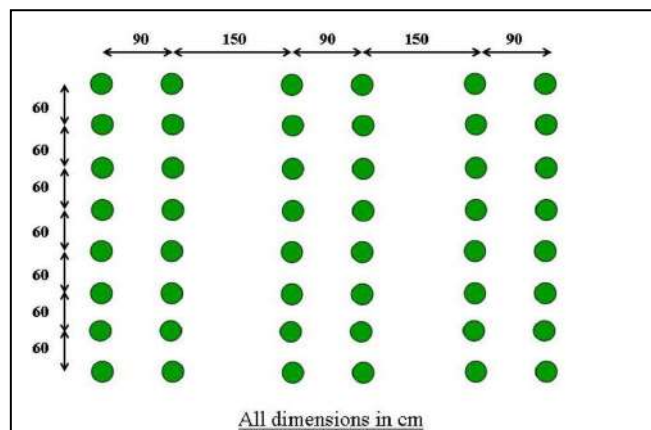
Pit system for plantation

To facilitate fast establishment, the mulberry saplings are planted in 30cm x 30cm x 30cm pits at spacing of 60 cm or 90 cm. The roots propagate fast and plants establish fast. This plantation method was recommended by CSRTI, Mysore in 1980s. A hectare of mulberry garden contains 12,345 plants.



Paired Row Plantation

The paired row plantation for mulberry was developed and introduced at CSRTI, Mysore in 1995. It facilitates movement of power tillers and tractors for intercultural and other operations in a mulberry garden. This system of plantation



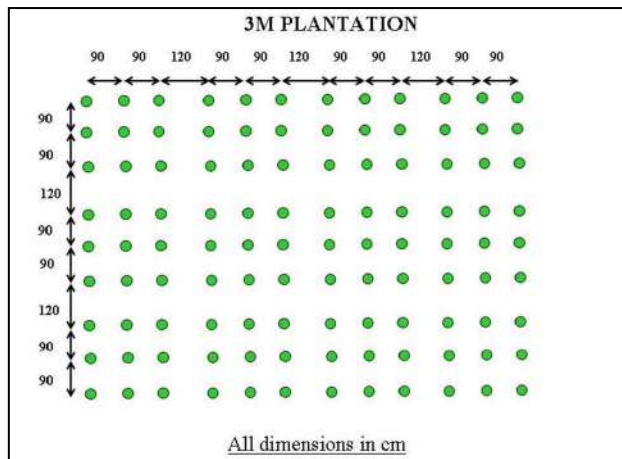
reduces dependency on man and animal power for intercultural operations. $(5'+3') \times 2'$ is the most common paired row plantation system adopted by a large number of farmers. Here, the distance between two rows of pair is 90 cm (3'). The space between two pairs is 150 cm (5'). The plant to plant space in a row is 60 cm (2'). The total number of plants per hectare is 13, 437. The mechanized cultivation improves the quality of leaves and curtails expenditure on intercultural operations by atleast by half.



3M Plantation System for Mulberry

The Paired row plantation system have many distinct advantages except that movement of a tractor or a power tiller is feasible only along the rows. To plough the land across the rows to uproot the weeds between the plants, the farmer should use animal plough. This is feasible only for small mulberry gardens. To totally mechanize various operations in a mulberry garden and allow a power tiller or a tractor to move along and across the rows, 3M plantation system was developed by CSRTI, Mysore in 2005. In this plantation method, there are 9,677 plants per hectare. The cost of intercultural operations can be curtailed by 50 % by adopting 3M plantation methods. The soils are well aerated due to cross ploughing.

This method is very much suitable for large scale mulberry cultivation. There is improvement in plant growth and the quality of leaves due to thorough cultivation and total uprooting of the weeds by the machines.



Mulberry cultivation package for young age silkworms (Chawki Rearing)

Cultivation of mulberry in spacing of 90 cm x 90 cm or paired row plantation [(150+90)x60 cm)/(5'+3')x2'] with 40 MT of farm yard manure/ha/year and NPK @ 450:140:140 kg/ha/year in eight splits in the form of straight fertilizers and adopting top clipping method of training (alternate harvesting of leaves and shoots) produces 30 Mt/ha/year of quality leaves for rearing of young age silkworms. S-36 and V₁ are suitable for young age silkworm rearing.



Mulberry cultivation package for late age silkworm rearing

Cultivation of mulberry in spacing of 90 cm x 90 cm or paired row plantation [(150+90)x60 cm)/(5'+3')x2'] with 20 MT of farm yard manure/ha/year and NPK @ 350:140:140 kg/ha/year in two splits in the form of straight fertilizers. Farmers can get 50 Mt/ha/year of quality leaves from V₁ and 40 MT/ha/year of quality leaves from S-36 for late rearing of young age silkworms.



Package for mulberry cultivation as tree

The package consists of mulberry variety as S-13, plant spacing as 2.4 m x 2.4 m, crown height of plants as 150 – 180 cm, and fertilizer dose as 50:25:25 kg/ha/year of NPK. The green manuring during rainy season helps in improving the soil fertility. The trees yield mulberry leaves @ 6–7 MT/ha/year. The mulberry can be harvested 4 times in a year.



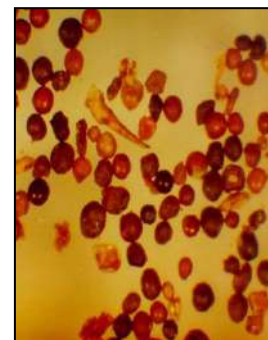
Azotobacter biofertiliser for nitrogen economy

Azotobacter biofertiliser @ 20 kg per year/ha in 5 equal splits (4 kg/crop mixed with 200 kg of powdered FYM) has been found to curtail 50 % of the chemical Nitrogen input without any adverse effect of leaf quality and yield.



Vesicular-Arbuscular Mycorrhiza (VAM) inoculation of mulberry gardens

By inoculation of mulberry during nursery stage using soil based inoculam of VA-mycorrhiza containing mixed culture of *G. mosseae* and *G. fasciculatum* results in better growth of the plants. The inoculation of established mulberry plants with VAM (1000 kg) by intercropping maize and application of VAM curtails phosphatic fertilizer requirement by 50 %.



Dual inoculation of mulberry with Azotobacter & VA-mycorrhiza

The technology involves introduction of Azotobacter biofertiliser along with VA-mycorrhiza in the rizosphere of mulberry for achieving synergistic effect of both the organisms in the same environment so as to facilitate effective utilization of the nitrogen and phosphorus by the mulberry plants. The technology ensures saving of Nitrogen and phosphatic fertilizer atleast by 50 %.

Foliar spray of zinc for mulberry

Foliar spray of Zinc Sulphate (1% aqueous solution sprayed 20 - 25 days after pruning to the mulberry garden under irrigated conditions augments leaf yield of mulberry by 20 %.



Foliar spray of iron for mulberry

Foliar spray of Iron (0.5% Ferrous Sulphate solution sprayed 20 - 25 days after pruning to the mulberry garden under irrigated conditions augments leaf yield of mulberry by 12 - 15 %.



Split application of fertilizers and farm yard manure for alkaline soils

Application of 350 kg/ha/year of N (5 splits) : 150 kg/ha/year of P_2O_5 (5 splits) : 150 kg/ha/year of K_2O (2 splits) and 25 MT of farm yard manure (3 splits) in alkaline soils increases the mulberry leaf yield by 10 - 12%.

Sulphur application to mulberry crop

It is recommend to use inorganic fertilizers like Ammonium Sulphate to mulberry plants as sulphur helps in conversion of nitrogen to protein in mulberry.

Reduced doses of Potassium to mulberry crop

Analysis of soils collected from mulberry gardens in Karnataka, Tamilndu and Andhra Pradesh indicated high potash status. Application of potash @ 90 kg/ha/year was found as effective as applying 120 kg/ha/year in these soils and same was recommended.

Seriboost – Liquid fertilizer of micronutrients for increasing mulberry productivity

Seriboost (a product of SERICARE) was tested for mulberry, is a multinutrient formulation used as foliar spray containing all necessary nutrients in a balanced proportion and in easily available form for healthy growth of mulberry thereby producing good quality cocoons. Seriboost is sprayed at 0.25 % in two sprays per crop after pruning/leaf picking (1st spray 23-25 days after pruning and 2nd spray 3-25 days after pruning).



Posan – A multinurient formulation for correcting the nutrient deficiencies in mulberry

Posan is a multinutrient formulation for foliar spray. It contains all the essential nutrients in a balanced and easily available form for healthy growth of the mulberry thereby catering the complete nutritional requirement of the silkworms. It also enhances the mulberry leaf yield upto 20%.



Green manuring and dry weed mulching for rainfed gardens

Raising of green manuring crops (cowpea, moth bean, horse gram@ 20 kg seeds/ha/yr) once and its incorporation in the soil before flowering (after 40-45 days of growth) during the rainy season, followed by weed mulching



after rainy period for efficient in-situ soil moisture conservation to increase the yield of leaf by 10 - 12 % besides improvement in quality of leaf.

Drip Irrigation System for Mulberry

CSRTI, Mysore developed and introduced drip irrigation system to mulberry plantations for effective use of irrigation water which is becoming scarce in most of the sericulture prominent areas. For mulberry both micro-tubes and drippers are suitable. The laterals should be placed along the rows with a dripper between two plants in 90 x 90 cm plantation. In paired row a lateral is placed between two rows and water emitter, a micro-tube or dripper, between four plants.

With drip irrigation system, there is water saving upto 45 % when compared to furrow irrigation. Presently a drip irrigation system for a mulberry costs about Rs. 60,000/ hectare. A large number of farmers have adopted drip



irrigation systems for mulberry plantations in peninsular India.

D. Recycling of Sericulture Wastes

Compost making out of sericulture wastes

On a sericulture farm a large quantity of mulberry shoots are available which normally go waste or used as firewood. CSRTI, Mysore developed a technology to convert the mulberry shoots into high nutritionally rich compost.

The decomposition of mulberry shoots is very slow and time consuming process. To fasten the composting process, the mulberry shoots should be cut and crushed into small pieces. The crushed shoots are put into compost pits and covered with soil. The mulberry shoots normally takes 9-12 months for decomposition but by following the methodology developed by CSRTI, Mysore, the compost can be made ready in 4-5 months. This technology saves money besides enriching the soil.



Vermin-Compost from Sericulture Waste

Mulberry needs a lot of organic matter in the form of FYM to maintain desirable level of carbon and other micronutrients in the soil. To overcome the problem of availability of FYM and help a sericulture farmer to produce FYM at their own, the vermin-composting technology was introduced by CSRTI, Mysore during the year 1995.



On a sericulture wastes such as left over leaves, silkworm litter, mulberry shoots, weeds, etc. can be converted into high quality nutritionally rich vermin- compost with help of earthworms. The vermin-composting of a sericulture farm reduces the dependency on chemical fertilizers which are harmful to soils.

Use of Silkworm Litter & Waste for Biogas Generation

The silkworm litter is very good and continuous source of fuel for biogas generation. About 1.7 m³ of biogas can be generated by using 30-40 kg of silkworm litter per day. The silkworm litter can be supplemented to animal dung in a bio gas plant. The biogas from silkworm litter and sericulture wastes can be used by the farmers for cooking, heating water, lighting, etc. The slurry from biogas plants is very rich in nutrients and can be used as manure for mulberry gardens.



E. Mulberry Disease Management

a. Management leaf diseases of mulberry

Leaf Spot (*Cercospora moricola*)

Foliar spray of 0.2 % solution of Bavistin (Carbendazim 50 % WP) solution is very effective for control of leaf spot disease in mulberry.



Powdery Mildew (*Phyllactinia corylea*)

Foliar spray of 0.2 % solution of Bavistin (Carbendazim 50 % WP) or Karanthane (Dinocap 30 % EC) is very effective for control of powdery mildew in mulberry.



Leaf Rust (*Cerotelium fici*)

Adoption of wider spacing, avoiding delay in harvesting leaves and foliar spray of 0.2 % solution of Kavach (Chlorothalonil 75 % WP) is very effective for control of leaf rust in mulberry.



Bacterial Blight (*Pseudomonas syringae pv.mori*/ *Xanthomonas campestris pv.mori*)

Pruning at a height of 30 cm above the ground during rainy season in high rainfall areas and spraying 0.2 % solution of Stretomycin or Dithane M-45 (Mancozeb 75 % WP) is very effective for control of bacterial disease in mulberry.



Management root disease of mulberry

Bionema – A bionematicide for control of root knot disease

The *Verticellium chlamydospreum* based bio-formulation developed by CSRTI, Mysore is very effective against root knot (*Meloidogyne incognita*) disease of mulberry. It reduces the diseases upto 80-85 %.



Raksha – A biofungicide for the control of root rot disease

A bio formulation of *Trichoderma harzianum* is very effective for management of root rot (*Fusarium solani* & *F oxysporum*) diseases of mulberry. The diseases is reduction is upto 75-80 %.

Nursery Guard – A biofungicide for the management of mulberry nursery diseases

Nursery Guard is very effective for control and management of nursery diseases like stem canker & die back [*Lasiodiplodia* (=Bortyodiplodia) *theobromae*], collar rot (*Phoma sorghina* & *P. mororum*) and cutting rot (*Fusarium solani*), a bio-formulation of *Trichoderma pseudokoningii*. It suppresses the incidence of nursery diseases by 80 % & increases sapling survivability by 40%.

Chetak – A bioformulation for control of major mulberry diseases

Chetak controls all major foliar diseases of mulberry such as leaf spot, powdery mildew, leaf rust and blights and major soil borne diseases viz., stem canker, cutting rot, bie back, root knot, root rot and diseases complex (nematode + root rot pathogens). The diseases is reduction is upto 85-90 %.

Bio-mix (consortium for management of root disease complex)

Bio-mix is a consortium of *Trichoderma harzianum* and *T. viride* developed for management of root disease complex. The disease reduction is upto 75-80 %.

Tri-mix (Bio consortium for management of root rot)

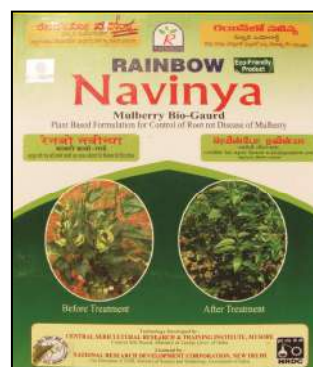
Tri-mix prepared from region specific (Karnataka, Tamilnadu and Andhra Pradesh) isolates of *Trichoderma harzianum* was developed for management of root rot disease caused due to pathogen complexity (*F. solani*, *F. oxysporum*, *B. theobromae* and *M. phaseolina*). The disease reduction is upto 75-80 %.

Compo-mix for production of disease suppressive quality compost

Compo-mix is a *Trichoderma* based bio-inoculants used for hastening both aerobic and anaerobic composting process to produce compost with disease suppressive quality. One kg of Compo-mix is required for treating 1,000 kg of raw material.

NAVINYA – A plant based product for management of root rot disease in mulberry

Navinya is an eco-friendly product (80% plant components & 20% chemicals) for control of root rot diseases in mulberry. It is a target specific, eco-friendly plant based formulation and does not affect beneficial microflora in soil. The disease control is around 80-90%.



NEMAHARI - A plant based product for management of root knot disease in mulberry

Nemahari is a target specific, eco-friendly plant based formulation and does not affect beneficial microflora in soil. It is absorbed by the roots easily and inhibits nematode population and its multiplication in soil and mulberry roots. Nemahari is an eco-friendly product (75% plant components & 25% chemicals).

c. Management of mulberry pests

IPM against Mealy Bug causing Tukra in Mulberry

The IPM against Tukra consists of clipping of affected apical portion of mulberry and burning it, spray of 0.2 % solution of DDVP (Nuvan) and release of predatory beetle *Cryptolaemus montrouzieri* and *Scymnus coccivora* @ 625 adults/hectare.



IPM against Mulberry Leaf Roller

The IPM against mulberry leaf roller comprising of clipping of affected portion of mulberry plant, burning it or dipping in 0.5% soap solution, spraying 0.8 % solution of DDVP (Nuvan) once in 10 days after harvesting of leaf/shoots and release of pupal parasitoid *Tetrastichus howardii* @ 1,25,000 adults/hectare and *Trichogramma chilonis* – an egg parasitoid @ 3 Trichocard/week/ hectare.



IPM against Bihar hairy Caterpillar

The IPM against Bihar hairy caterpillar consists of regular monitoring of the pest by destruction of egg masses and gregarious young caterpillars which are found in lower surface of the leaf. Deep ploughing and flood irrigation helps in killing the pupae. Keeping of poisonous baits inside the trench will also help in killing the caterpillars. The caterpillars can also be killed by spraying 0.15% solution of DDVP (Nuvan).



F. Silkworm Races and Hybrids

a. Bivoltine Hybrids

CC_{1x}NB₄D₂

This hybrid has 20-22% shell ratio and 17-19% silk recovery. The silk obtained is of 2A grade. The renditta is 7 - 8. This hybrid was authorized in 1995.



CA₂ x NB₄D₂ This hybrid has 20-22% shell ratio and 17-19% silk recovery. The silk obtained is of 2A grade. The renditta is 7 - 8. This hybrid was authorized in 1995.

CSR₂ x CSR₄

This hybrid has high shell ratio (23-24%) and raw silk recovery (19-20%) and yield over 65 kg cocoons/100 dfls. The silk obtained from the cocoons is of international grade (3A-4A). This hybrid was authorized in 1997.



CSR₁₂ x CSR₆

This hybrid has high shell ratio (23-25%) and raw silk recovery (19-20%) and yield over 65 kg cocoons/100 dfls. The silk obtained from the cocoons is of international grade (3A-4A). This hybrid was authorized in 1999.

SR₃ x CSR₆

This hybrid has high shell ratio (23-25%) and raw silk recovery (19-20%) and yield over 70 kg cocoons/100 dfls. The silk obtained from the cocoons is of international grade (3A-4A). This hybrid was authorized in 1999.



CSR₁₆ x CSR₁₇

This hybrid also has high shell ratio (23-25%) and raw silk recovery (19-20%) and yields over 70 kg cocoons/100 dfls. The silk obtained from the cocoons is of 3A-4A grade. This hybrid was authorized in 1999.

CSR₁₈ x CSR₁₉

This hybrid is suitable for rearing throughout the year specially during summer months and yields on an average of 58 kg cocoons/100 dfls. The average renditta of 5.5 & silk grade of 2A-3A can be realized from this hybrid. This hybrid was authorized in 1999.



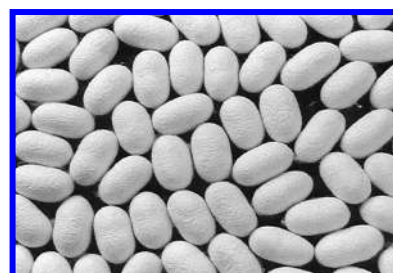
Thin denier hybrid - CSR₄₈ x CSR₄

This hybrid has long filament (>1500 m) and thin filament (dernier < 2.4d). This can be used for production of fine silk fabric. The silk is of 3A - 4A grade. This hybrid was authorized in 2005.

Krishnaraja - Double Hybrid

(CSR₆ x CSR₂₆) x (CSR₂ x CSR₂₇)

This hybrid exhibits high fecundity besides survival of more than 95 % and raw silk more than 20 % .It was widely accepted by the farmers of AP, Karnataka and TN. The average yield obtained ranges 65-70 kg/100 dfls. This hybrid was authorized in 2005.



Chamaraja - CSR₅₀ x CSR₅₁

This race is recommended for rearing through out the year particularly during in summer season. The race yields 65 kg cocoons/100 dfls. The silk obtained from the cocoons is of international grade (2A-3A).

GEN Hybrid (GEN₃ x GEN₂)

The hybrid has been evolved through the new approach of molecular marker assisted selection by transferring high activity amylase genes from the polyvoltines into the genetic background of productive bivoltine breeds. The hybrid has recorded an average yield of 64 kg/100 dfls. The race has renditta of 6.5



PM x CSR8 (Sex Limited)

This hybrid consists of sex limited male parent CSR8 which enables the P₁ farmers in selling only the white cocoons (male) to the grainages and the yellow cocoons (female) can be sold for reeling which fetch additional money to farmers.



CSR₂ (Sex Limited - Nandi)

This hybrid consists of sex limited male parent CSR₂ enables the P₁ farmers in selling only the white cocoons (male) to the grainages and the yellow cocoons (female) can be sold for reeling which reduces the production cost of eggs.



b. Multivoltine Hybrids



MY₁ x NB₁₈

This hybrid is suitable for rearing in all seasons in irrigated areas. The hybrid yield 44-45 kg of cocoons/100 dfls at field level. The renditta of this hybrid is 8 - 8.5 This hybrid was authorized in 1995.

P₂D₁ X NB₁₈

This hybrid is suitable for rearing in all seasons in irrigated areas. The hybrid yield 53-55 kg of cocoons/100 dfls at field level. The renditta of this hybrid is 8 - 8.5 This hybrid was authorized in 1995.



RD₁ x NB₁₈

This hybrid is suitable for rearing in all seasons in rainfed areas. The hybrid yield 30 kg of cocoons/100 dfls at field level. The renditta of this hybrid is 8.5 - 9. This hybrid has short larval duration by 3-4 days. This hybrid was authorized in 1995.

BL₂₃ x NB₄D₂

This hybrid is suitable for rearing in all seasons in rainfed areas. The hybrid yield 26 - 27 kg of cocoons/100 dfls at field level. The renditta of this hybrid is 8.5 This hybrid was authorized in 1997.



BL24 x NB4D2

This hybrid is suitable for rearing in all seasons in irrigated areas. The hybrid yield 48-50 kg of cocoons/100 dfls at field level. The renditta of this hybrid is 7.5 - 8.5 This hybrid was authorized in 1997.



Kapila - BL43 x NB4D2

This hybrid is suitable for rearing in all seasons in irrigated areas. The hybrid yield 60 kg of cocoons/100 dfls at field level. The renditta of this hybrid is 7.5 - 8 This hybrid was authorized in 2002.

Cauvery - BL67 x CSR19

This hybrid is suitable for rearing in all seasons in irrigated areas. The hybrid yield 60 - 65 kg of cocoons/100 dfls at field level. The renditta of this hybrid is 6.5 - 7. This hybrid was authorized in 2005.



Varuna - BL24 x C. Nichi

This hybrid is suitable for rearing in rainfed areas. The hybrid yield 30 - 35 kg of cocoons/100 dfls at field level. The renditta of this hybrid is 10- 11. This hybrid was authorized in 2005.

Jayalakshmi - ND7 x CSR2

This hybrid is suitable for irrigated areas. The hybrid yields 60-65 kg cocoons/100 dfls. The renditta is 6.5. Gradable silk is obtained from this race.



L14xCSR2 - An improved cross breed with superior quality

L14 x CSR2, is a Multi x Bivoltine hybrid developed by CSR&TI, Mysore. This silkworm hybrid has 96.0% pupation, 1.971g cocoon weight, 21.5 SR%, 1008 m filament length, 16.58 raw silk percentage, 91p neatness, 89 (strokes) cohesion, 1.45

size deviation, 99% neatness, 22% elongation, and is capable of producing 2A-3A gradable silk. This hybrid has the yield potential of 78.6 kg cocoons/100 dfls.

c. Coloured Silk

The CSRTI, Mysore has developed a novel technique for inducing the silkworms to produce coloured silk. This will help in production of silk with different natural colours.



G. Silkworm Rearing Technologies

Rearing House Models

Rearing house models of different rearing capacity for young and late age silkworms developed. These models have been adopted by many young age silkworm rearers (CRCs) and late age silkworm rearers. The separate rearing houses have given boost to production of quality cocoons and silk.



Sheet Egg Transportation Bag

The silkworms eggs should be transported very carefully from egg production/cold store to rearing house. It should not be exposed to heat and jerks. An egg transportation bag designed and developed by CSRTI, Mysore is very effective and safe.



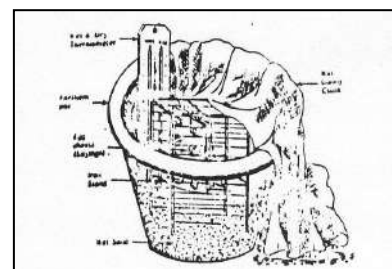
Loose Egg Transportation and Incubation Bag

To facilitate safe transportation and incubation of loose eggs of silkworms, a simple bag is designed and developed by CSRTI, Mysore. By using this bag, the jerks to silkworms eggs are avoided.



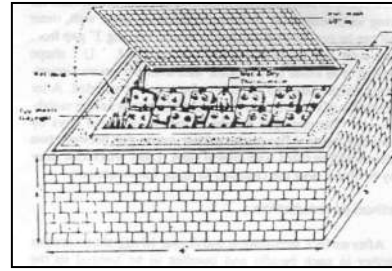
Earthen Pot for Incubation of silkworm Eggs

To facilitate individual farmers for incubation of the eggs, a specially designed earthen pots have been developed by CSRTI, Mysore. One can incubate 250 – 300 dfls in a pot. Inside the pot 25–26 °C temperature and 80–85 % relative humidity can be maintained leading to high hatching of eggs.



Double Brick Walled Chamber for Incubation of silkworm Eggs

For incubation of silkworms eggs at Chawki rearing centres a double brick walled chamber has been designed and developed by CSRTI, Mysore. The gap between two walls should be filled with coarse and moist sand. Wire mesh door fixed at the top to prevent entry of insects, rats, etc. to chamber. The chamber can accommodate 5000 – 6000 dfls. One can The sands helps in maintaining 25 – 26 °C temperature and 80 – 85 % relative humidity inside the egg chamber leading to high hatching of eggs.



Hydrodynamic incubator

It consists of a metal frame fixed with gunny cloth. The gunny cloth covered box is placed in a tray containing water. The water rises by capillary action and evaporates from the gunny cloth cooling the air inside. It can be used for preservation and incubation of eggs.



Loose Egg Incubation Frame

To provide optimal environmental conditions during incubation of loose eggs, low cost incubation frames have been developed by CSRTI, Mysore. The frames are very useful for incubation, black boxing and brushing. More than 90 % hatching can be achieved by using incubation frames.



PVC Stands for Chawki rearing

PVC stands for Chawki rearing centres are made up of PVC pipes and other accessories. They can be fabricated and assembled easily by the farmers. The PVC stands are corrosion free and heat resistant. They are much cheaper when compared to wooden and metallic stands.



Environator

It consists of a metal frame covered with gunny cloth. An arrangement is made for dropping water from top. Water from wet gunny cloth evaporates thus cooling air inside. The plastic trays of 2' x 3' size can be placed inside the environator. This can be used for Chawki rearing and late age rearing in hot regions.



Brushing Net for young age silkworms

HDPE monofilament shade net of 35% shade is suitable for silkworm loose egg brushing. This net reduces the number of missing larvae during young age silkworm rearing. The nets can be reused, cleaned and disinfected easily.



A simple device for Chawki leaf preservation

It consists of a rectangular bamboo tray, bamboo mat and a funnel to be placed in the centre for aeration. It is cheap, can be fabricated locally. It can be washed and disinfected very easily. Mulberry leaves for young age/Chawki silkworms can be preserved for 10-12 hours.



Plastic Chop Sticks

CSRTI, Mysore developed plastic chop sticks for handling of the young age silkworms. They are better than bamboo chop sticks and can be easily disinfected.



Blue Polythene sheet for young age silkworm rearing

Blue polythene has been found better and cheaper when compared to paraffin wax coated paper used during young age silkworm rearing. The polythene sheet can be easily disinfected and reused.



Wrap up Method of Chawki Rearing

In this method the paraffin paper is folded from all four sides instead of covering to avoid moisture loss from the rearing bed. About 15 – 20 % relative humidity can be increased in the rearing bed.



Cleaning of Chawki bed by Rolling of Rearing bed

It saves labour and time. Two workers can clean 300 trays in two hours. This method is hygienic as it avoids mixing of larvae with litter.



Nutrid Semisynthetic diet for Young Age Silkworms

Semi synthetic diet has been developed for rearing of young age silkworms. It ensures the supply of balanced nutrition to the silkworms, maintains hygiene during rearing and leads to development of robust silkworms. The product has been commercialized by name NUTRID.



Chawki Transportation Frame

This frame made up of iron can be used for hold plastic trays containing young silkworms during transportation. A set of frame costs Rs. 200/-disinfected easily.



Shoot Rearing

After 2nd moult the larvae can be shifted to shoot racks and further reared with mulberry shoots. By adopting shoot rearing a farmer can save 60% time in feeding and 23% in bed cleaning. One also saves 12.5% expenditure in equipments. In all, the shoot rearing can atleast 40 % labour requirement for late age silkworm rearing. There is also 15-20% leaf saving in shoot rearing method. Today this technology is widely adopted by the farmers in all the states of southern India, Maharastra and Madhyapradesh.



Cool Guard for heat reduction in late age silkworm rearing houses

Application of Cool Guard coat on the roof of the silkworm rearing houses reduces heat inside the late age silkworm rearing houses by 3-4 °C. It is very suitable for hot regions.



Rearing Schedule for CSR₂xCSR₄ & BL₂₄xNB₄D₂ hybrids

Standard rearing schedule for these hybrids was worked out. Both CSR & BL hybrids require 20% more feed (91440 and 122 kg/100 dfls, respectively) and 20 % more rearing bed area (575 and 480 sqft/100 dfls, respectively). Cocoon yield was increase by 5-8 kg/100 dfls when compared to conventional rearing schedule.



Phytoecdysteroid for Synchronized Maturation of Silkworms

Administration of active content of ecdysteriod to 5th instar silkworm at the onset of the spinning through mulberry leaf @ 2.5 mg/100 ml water/kg of leaf/1000 silkworms shortens the mounting duration to 18-24 hours. The product has been commercialized by the trade name as Sampoorna.



Samrudhi – A Juvenile Hormone for Silkworms

Samrudhi is an insect juvenile hormone. It makes the silkworms to build heavier cocoons with higher silk content. When the Samrudhi is sprayed during last stage of silkworms, it increases the larval duration by one day, makes the silkworms to eat mulberry leaf more vigorously. By use of Samrudhi, the cocoon yield could be increased by 8-10 kg/100 dfls and reelers get 8-10 % more silk.



Jobrai Method of Silkworm Harvesting

Jobrai method involves shaking of the mulberry shoots containing matured silkworms over a plastic sheet. By this method a farmer can save 38-40 % of time and labour required for manual picking without affecting the cocoon quality.



Mounting Hall for spinning of the cocoons

To facilitate use of rotary and other type of mountages, mounting halls of different capacities have been designed and developed by CSRTI, Mysore. The mounting hall helps the farmers in maintaining proper temperature and relative humidity during spinning of the cocoons for high reliability of silk.



Plastic Bottle Brush Mountage

It is helpful for self mounting. Over 40 % time can be saved during mounting. The cost of plastic brush mountages for 100 dfls is Rs. 15,000/-. The life of the mountage is 15 years.



Plastic Collapsible Mountages

These mountages are made of expanded plastic mesh with hexagonal openings. The plastic mesh is folded in pleats of 10 cm. The plastic mountages can be kept in the rearing bed itself. A plastic mountage covers an area of 90 cm x 120 cm. The silkworms crawl on the mountages to make the cocoons.



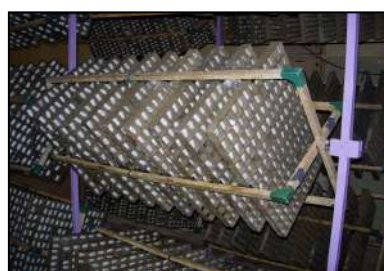
Card Board Rotary Mountage

The rotary mountage is the best among all mountages as it reduces the percentage of defective cocoons, and floss. It improves the quality of silk and results in high reelability and silk grade 2A-3A. The cocoons harvested from rotary mountages fetch more prices.



Plastic Rotary Mountage

The card board mountages have less life. Plastic rotary mountages which have more life than card board have been developed by CSRTI, Mysore. The cocoon harvesting from these mountages with machines is easy and faster.



Rotary Mountage Stands

The rotary mountages are hanged from ceiling of the rearing house with help of steel wire hooks and hence a separate mounting hall is required for rotary mountages. The farmers can use the space available between the rearing racks, verandah, leaf storage room, etc. for rotary mountages with help of the stands. These stands allow better rotation of rotary mountages which results in uniform distribution of the silkworm in cocooning frames. The stands can be assembled and dismantled quickly.



New Mountages

(i) *Vertical Cardboard Mountage*

These are made out of bamboo mat and card board frames. A loosely woven bamboo mat of size 1.8 m x 1.2 m is supported with bamboo sticks on either side. Small holes are left on the mat for ventilation. Eight partitions are made on the mat by fixing split bamboo sticks. Eight cardboard frames are required for each mat which in all can accommodate 1,248 worms.



Horizontal Cardboard Mountage

Two or three card board frames of the rotary mountage are fixed to a rectangular wooden frame. Two pins are provided on both sides of the frame for rotation of the mountage.



Cocoon Transportation Bag

HDPE Monofilament bags are very suitable for packing and transportation of silk cocoons. There is good aeration in the cocoons. The bags can be washed and disinfected easily. The bags are reusable. The bags are available in 10 and 20 kg cocoon capacities.



H. Silkworm Diseases & Pest Management

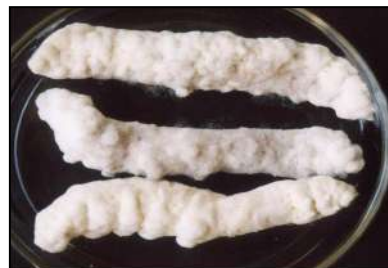
Formalin Chaff Application for control of muscardine

Formalin chaff is mixture of partially brunt paddy husk and formalin. It prevents spread of muscardine disease in silkworms.



Chemotherapy of muscardine diseases in silkworms

The chemotherapy against muscardine was developed to cure silkworms from infection by fungus *Beauveria bassiana*. It involves feeding of mulberry leaves sprayed with 0.1 % solution of systemic fungicide during 3rd, 4th & 5th instar.



Disinfection and hygiene in silkworm rearing houses using bleaching powder

To overcome major disadvantages associated with formalin based disinfection, bleaching powder (30 % chlorine) was recommended as disinfectant. The technology suggests spraying 2 % bleaching powder solution prepared in 0.3 % of slaked lime solution @ 1.5 litres/m² of floor area of the rearing house. The bleaching powder is also recommended for disinfection of rearing equipments.



Disinfection and hygiene in silkworm rearing houses using Chlorinedioxide

To overcome disadvantages with formalin & bleaching powder, spray of stabilized Chlorinedioxide (ClO₂), a non corrosive, non hazardous and non pungent, was found very effective. Spray of 500 ppm ClO₂ solution (2.5%) prepared in 0.5% slaked lime solution @ 1.5 lit/m² of floor area is found to be adequate for maintaining pathogen free environment in a silkworm rearing house.



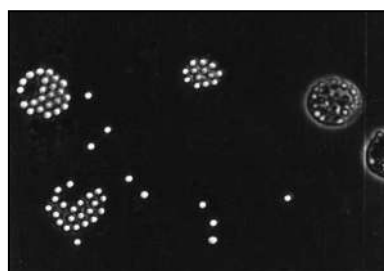
Diagnosis and management of diseases in silkworm rearing

Integrated technology covering disinfection of the rearing houses, its surroundings and also appliances, stands, etc. with Chlorinedioxide (ClO_2), high level of hygiene in young and late age instars, early diagnosis of diseases, silkworm body and rearing bed disinfection with Vijetha was developed and recommend for successful cocoon crops.



Determination of health status of Chawki silkworms

This technology helps in determining the health status of Chawki silkworms. It involves scientific sampling of Chawki worms during a specific period and examination for different diseases by visual and microscopic examination. It suggests a bench mark of disease level to certify them as healthy colony or diseased colony. Based on the prevalence level of disease in the batches, the CRC can be advised to distribute or reject or take specific measures to contain disease.



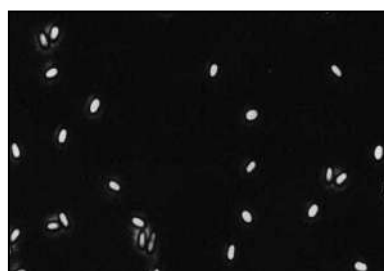
Colloidal textile dye based dipstick immunoassay for detection of BmIFV in silkworms

Colloidal textile dye based dipstick immunoassay offers a simple and specific method of detection of infectious flacherie disease in silkworms. It involves dipping of nitrocellulose specific antibody based dipstick in homogenate of sample and then dipping the stick in antibody dye reagent. In positive sample a colored spot develops which indicate presence of flacherie.



Pebrine detection for commercial silkworm egg production

The moths forming a group of 20 are picked randomly. They are homogenized and the homogenate filtered, centrifuged and sediment examined for Pebrine. It is an efficient, simple and adaptable method for examination of moths in a large number.



Resham Keet Ousadh (RKO)

RKO was the first silkworm body and rearing bed disinfectant developed in 1986. It protects silkworm from diseases during young and late age silkworms. It became very popular among farmers during nineties.



Vijetha

Vijetha, developed during 1996, is a silkworm body bed disinfectant which protects silkworms from diseases during young and late age.



Vijetha Supplement

Vijetha Supplement is developed for protection of silkworms specially against muscardine.



Ankush

Ankush is an eco-friendly silkworm body bed disinfectant which protects silkworms from diseases during young and late age. It is biodegradable, non hazardous and non toxic.



Amrut

Amrut is an eco-friendly plant based non toxic, non polluting and biodegradable powder formulation for control of silkworm diseases. It has to be mixed with water and sprayed over mulberry leaves.



IPM Against Uzi Fly (*Exortisa bombycis*)



The IPM against Uzi Fly consists of preventive methods like providing wire mesh on all windows, automatic door closure, anteroom to prevent uzi flies from entry into rearing hall and storing leaf/shoots in a separate room.

Placing Uzi trap tablet solution near windows and entry points helps in trapping and killing uzi flies. The spray of Uzicide after

second moult also controls uzi fly. For biological control *Nesolynx thymus* shall be released inside the rearing house. It parasitizes the uzi pupae.

IPM Against Dermestid Beetles in Grainages

The components of the IPM package developed against the beetles in the pierced cocoon storage rooms in the grainages are : removal of grubs and adults of the beetles in the room using vacuum cleaner and spray of 0.028 % Deltamethrin solution on the floor and walls of pierced cocoon storage rooms and gunny bags used for cocoon storage.



RAKSHA REKHA - An insecticidal chalk

Raksha Rekha was developed by CSRTI, Mysore protection of silkworms from ant. A thick lines of 2.5 cm is drawn around the legs of the rearing stands and materials for controlling the ants from reaching to the silkworms in the rearing beds.



ASTRA – An eco-friendly rearing house disinfectant

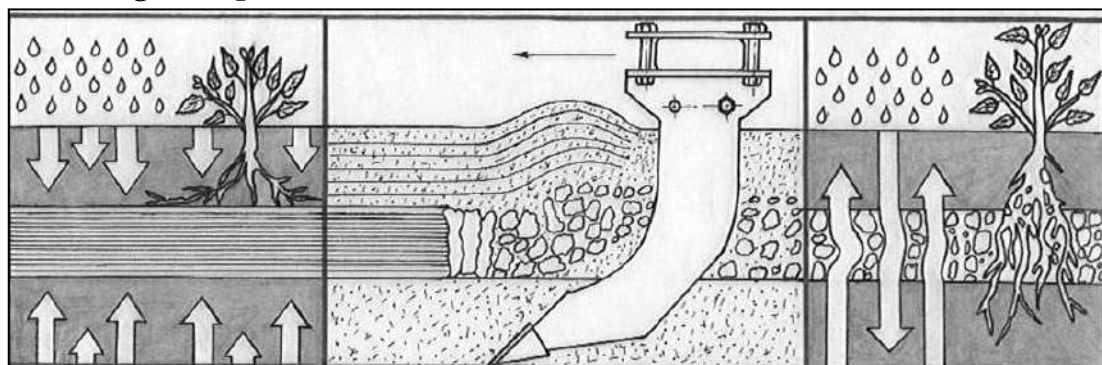
It is an eco-friendly spray disinfectant, which is effective against all silkworm pathogens at low concentration (0.05%). Astra disinfectant is an effective in destroying the pathogenic microbes in the rearing house which can be used safely at lower concentration for disinfection of rearing house and successful crop harvest. It causes very minimum corrosion to iron mesh and other materials in the rearing house.



I. Tools, Appliances & Machines for Sericulture

Machines for Rain Water Harvest & Conservation for Irrigated Mulberry Gardens

Mulberry is cultivated for leaves for silkworm rearing. It must be irrigated frequently for production of nutritious leaves with high moisture content for production of silk rich cocoons. To reduce irrigation frequency and irrigation requirement, the soil should be loosened to possible extent. A tractor operated sub-soiler, can be used for loosening soil up to 60 cm and breaking hardpan.



Machines for Rain Water Harvesting & its in-situ Conservation

Rain water harvesting and its in-situ conservation is very important in sericulture. A tractor operated trencher facilitates to open about 45 cm wide and 30-40 cm deep trenches. The trenches are made across the slope to cut run-off and store the water in trenches. The rain water in the trenches seep down to earth and recharge the wells.



Machines for Making Pits

Many times, pits are made for mulberry plantation particularly for tree plantation. Power tiller and tractor operated auger diggers can be used to make pits at faster rate and less cost. Power tiller auger digger can open pits up to 12" diameter and 18" depth whereas the tractor operated auger diggers can open pits up to 24" in diameter and 2.5' depth.



Mulberry Cutting Preparation Machine

The mulberry is propagated vegetatively through cuttings. The cuttings are prepared manually. To facilitate cutting preparation, CSRTI, Mysore developed a power operated cutting preparation machine. 1,200-1,400 mulberry cuttings can be prepared in one hour.



Machines for Intercultural Operations in Mulberry Gardens

Intercultural operations in a mulberry garden can be carried out with help of power weeders, power tiller operated rotavator and cultivator and tractor operated cultivators. The power tiller and tractor operated machines are readily available at most of the places and can be owned

or hired by the farmers. Minor tine adjustments have to be made in tractor operated cultivators for carrying out intercultural operations.



Sprayers for Chemical Application in Mulberry Gardens

Different type of hand operated sprayers for chemical application in mulberry such as knapsack, compression, power operated mist blower of different brands available in the market were tested for their use for chemical spray in mulberry gardens. Self-propelled, power tiller and tractor mounted sprayers available in the market were also tested for their suitability for mulberry gardens.



Hand Tools for Mulberry Cultivation and Shoot Harvesting

Pick-axe, shovel, spade, crowbar, sickle, bill hook, secateur and pruning saw are some of the common hand tools used for mulberry cultivations. These are available at most of the places.



Knapsack mulberry shoot harvester

The knapsack engine operated mulberry pruner cum shoot harvesters (available in market as brush cutters) are very useful for fast pruning and harvesting of mulberry shoots. Around 500 -750 kg of mulberry shoots could be harvested per hour with the machine. The machine was found very useful for medium and large silkworm rearers.



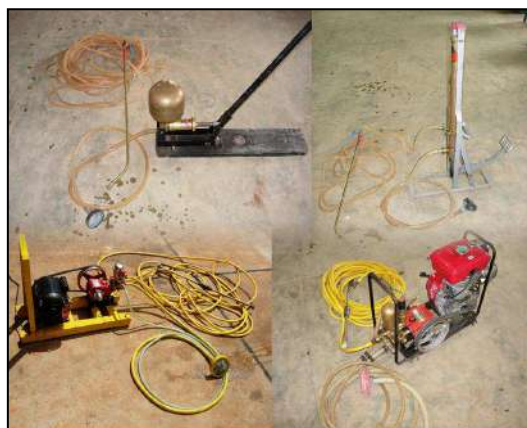
Mulberry Shoot Crushing Machine

This machine cuts and crushes mulberry shoots into small pieces which facilitate fast decomposition of mulberry shoots. This machine is very useful for production of compost or vermin compost out of sericulture waste. The machine cuts and crushes all other type of plant materials including coconut fronds. The machine is powered by 5 hp electric motor.



Sprayers for disinfection of silkworm rearing houses

Different type of hand, foot, engine and electric motor operated sprayers for are available in market for disinfection of silkworm rearing houses.



Electric Power Sprayers

CSRTI, Mysore developed a low cost electric sprayer for disinfection operations in sericulture. It is fitted with $\frac{1}{2}$ hp electric pump set or a twin piston HTP pump . The disinfection is quiet effective with both sprayers. $\frac{1}{2}$ hp electric pump set sprayer is suitable for small rearing house say up to 300-400 dfls capacity whereas twin piston pump sprayer is suitable for rearing house on 400 dfls and above capacity.



Flame Gun

Fire is the best disinfectant. It is not only cheap but also eco-friendly. A Flame Gun using LPG as fuel is an effective and efficient tool for disinfection of silkworm rearing houses, rearing equipments, mountages, etc. The flame gun can also be used for floss removal from bamboo, plastic & rotary mountages. It is also useful for disinfection of plastic trays used in egg production and chawki rearing centres.



Chawki Leaf Chopper

To facilitate chopping large quantity of mulberry leaves in short time, CSRTI, Mysore developed a Chawki Leaf Chopper. It cuts 150-175 kg of mulberry leaves in an hour. The machine is powered by 1/2 hp electric motor and can also be operated manually, whenever power fail. The machine can cut leaf into different sizes.



Seri Humidifier cum Heater

A Seri-Humidifier cum Heater designed and developed by CSRTI, Mysore consists of a humidifying unit. A heating unit is provided for winter season and colder hours of the day. This machine is very suitable for young age silkworm rearing. The machine can also be used for late age rearing during summer season to maintain desired level of the relative humidity in the rearing houses.



Battery Operated Duster

To facilitate dusting of bed disinfectants over silkworms, CSRTI, Mysore developed a battery operated duster. It avoids dust from flying and thus avoids health hazards to the workers.



Matured Silkworm separator

To facilitate the separation of the matured silkworms from mulberry shots, CSRTI, Mysore designed and developed manual for small and medium farmers and also a motorised silkworm separators for medium and large silkworm rearers. The manually operated machines separates about 40-50 dfls silkworms in one hour whereas the motorised machine can separate over 125 dfls in one hour.



Cocoon Harvesters for Rotary Mountages

To facilitate cocoon harvesting from rotary mountages, CSRTI Mysore's Hand and pedal operated cocoon harvesters are very effective and efficient equipments. Capacity : Hand operated Harvester (25-30 frames/h, Foot Operated harvester (50-60 frames/h).



Cocoon Deflossers

The loose layer of floss on a silk cocoon should be removed before reeling. Most of the farmers remove floss and clean cocoons manually. To facilitate mechanical deflossing, the CSRTI, Mysore designed and developed hand operated, Hand operated cum motorised and a fully motorised deflossing machines. All three types of the deflossers have been commercialized and readily available to the farmers.



Capacities of machines

- Hand deflossers (25-30 kg/h)
- Motorised cum hand operated deflossers (50-60 kg/h)
- Motorised deflossers (75-80 kg/h)

Pressing & Bundling Tool for Plastic Mountages

Plastic mountages are pressed and bundled manually which not only takes time but pressing is not uniform. To facilitate pressing and bundling of plastic mountages, CSRTI, Mysore developed a simple tool.



Plastic Tray Washing Machine

To facilitate washing of plastic trays in Chawki rearing Centres and Silkworm Egg Production Centres, a motorized tray washing machines equipped with pressurized water spray and brushing system can be used. About 60-70 trays can be washed in one hour.



Silkworm Seed Cocoon Cutting Machine

To facilitate fast cutting and reduce drudgery in cocoon cutting, CSRTI, developed a motorized Cocoon Cutting Machine. It cuts about 5000-5500 cocoons per hour. The machine reduces drudgery in cocoon cutting.



Silkworm Leaf Litter Separator

This machine separates litter from leaf and shoots. The litter can be used as feed to biogas plants. The machine separates litter from 500-600 kg leaves or shoots in one hour.



Seri Room Heater

To facilitate silkworm rearers maintaining the temperature inside the rearing house, CSRTI, Mysore designed and developed a simple electrically operated Seri Heater.



Cocoon Harvester for Collapsible Plastic Mountages

CSRTI, Mysore designed and developed an electrically operated machine for harvesting cocoons from plastic collapsible mountages. The machine can harvest cocoons from 150-160 mountages in one hour (100 dfls). The machine also deflosses and cleans the cocoons.



Young-age Silkworm Dusting Machine

To facilitate dusting of lime and bed disinfectants over young age silkworms also called as chawki worms. CSRTI, Mysore designed and developed a motorised dusting machine to help the Chawki Rearing centres to mechanise the dusting work. The machine can dust 18-20 trays in one minute.



J. Value Addition to Sericulture

Production of non-woven flat silk

CSRTI, Mysore developed technology for production of non-woven or flat silk for various industrial applications. The product got an International Patent.



Mulberry leaf health Drink (Spoorthi)

Spoorthi is made out of specially cultivated mulberry leaves. The regular use of Spoorthi helps in checking the sugar and blood pressure levels in human beings.



Extraction of Sericin from Silk Cocoons

CSRTI, Mysore developed an innovative process for extraction of Sericin from Bivoltine Cocoons. The sericin contains 18 amino acids besides 8 essential amino acids, which are necessary for human body. Sericin from silk cocoons is 99.9% pure and has high medicinal applications. It is an antioxidant, coagulant, chemo protective and nutrient supplement. Sericin can be used for manufacturing facial creams, lotions and gels.



Preparation of silkworm powder

CSRTI, Mysore developed an innovative process for preparation of silkworm powder which is of high medicinal value. The silkworm powder is an anti-diabetic, anti-hypertension, and anti aging.



Extraction of silkworm pupae oil

CSRTI, Mysore developed an innovative process for extraction of oil from silkworm pupae which is rich in unsaturated fatty acids. The pupae oil contains oleic palmitic, stearic, palmitoleic, linolenic, linoenic, archidic, myristic, lauric acids and phospholipids. The silkworm pupae oils can be used in paints, varnishes, soaps, candle industry, pharmaceuticals, and biodiesel.



Preparation of silkworm pupae powder

CSRTI, Mysore developed an innovative process for preparation of silkworm pupae powder. It contains 56% crude protein, 3.5% fibre, and 3.5% ash. The silkworm pupae powder is very rich in sodium, calcium, potassium and phosphorus. Silkworm pupae powder can be used as food supplement.



Extraction of fibroin from silk cocoons

CSRTI, Mysore developed an innovative process for extraction of fibroin from degummed silk cocoons. Fibroins have high use in medicinal and health industry, cosmetics, toiletries, tissue regeneration and repair, scaffolds and matrices.



Silkworm pupae as human food

CSRTI Mysore developed dishes out of eri silkworm pupae which are used as food in the north eastern states of India. The eri silkworm are very rich source of protein and fatty acids. They contain 45% protein, 20% fat and 5% ash.



In vitro culture of Cordyceps

CSRTI Mysore has developed technology and standardized the process for invitro culturing of Cordyceps, an entomophagous fungus with diverse biological activities and high pharmacological commercial value on mulberry silkworm pupae.



Cocoon Art Craft

Different designs of garlands, flowers, bouquets, gift items, etc. have been developed from mulberry cocoons. These products have high value and demand in market due to elegance and long keeping quality.



K. TECHNOLOGIES PATENTED BY CSRTI MYSORE

| No. | Technology | Patent No. | Granted on |
|-----|---|------------|------------|
| 1 | Machine for crushing shoots | 198697 | 21/02/1997 |
| 2 | A process for the preparation of a biofungicide | 192883 | 27/06/1997 |
| 3 | Uzi trap | 188408 | 16/09/1997 |
| 4 | Vijetha - A bed disinfectant | 186852 | 28/09/1998 |
| 5 | Process for preparation of artificial diet(Nutrid) | 218430 | 03/02/1999 |
| 6 | An evaporative cooling apparatus | 216639 | 08/05/2001 |
| 7 | A Process for obtaining ecdysteroid | 193857 | 14/06/2001 |
| 8 | Nursery guard - a biofungicide | 220394 | 02/11/2001 |
| 9 | Bionema | 219129 | 05/03/2002 |
| 10 | Semisynthetic diet for tropical tasar | 240259 | 12/06/2007 |
| 11 | Universal semisynthetic diet for multi x bi hybrids | 247304 | 10/09/2007 |
| 12 | An environator | 216222 | 10/03/2008 |
| 13 | An evaporative cooling apparatus | 216639 | 17/03/2008 |
| 14 | A machine for pruning of mulberry plants | 217215 | 26/03/2008 |
| 15 | Seri-torch - flame gun | 223321 | 09/09/2008 |

L. TECHNOLOGIES COMMERCIALIZED BY CSRTI MYSORE

| No. | Technology |
|-----|--|
| 1 | Uzi trap |
| 2 | Vijetha - A bed disinfectant |
| 3 | Process for preparation of artificial diet (Nutrid) |
| 4 | A Process for obtaining ecdysteroid (Samporna) |
| 5 | Seri-torch - flame gun |
| 6 | Cocoon de-flossing machine |
| 7 | RKO- A bed disinfectant for silkworm |
| 8 | Production of non-woven flat silk sheet |
| 9 | Plastic Rotary & New Mountages for Harvest Quality Cocoons |
| 10 | Hand Operated Mature Silkworm Separator & Collector: |
| 11 | Navinya a formulation for control of mulberry root rot |
| 12 | Poshan a multinutrient formulation for mulberry |
| 13 | Mulberry leaf chopping machine |
| 14 | Hydrodynamic incubator |
| 15 | Battery operated powder duster |
| 16 | Electric sprayer |
| 17 | Motorized-cum-hand operated silk cocoon Cleaning m/c |
| 18 | Hand operated silk cocoon cleaning |
| 19 | Chawki leaf chopper |
| 20 | Azotobactor bio-fertilizer for mulberry |
| 21 | Seri-Humidifier-cum-Heater |
| 22 | High Pressure Sericulture Sprayer |
| 23 | Amruth - Bed disinfectant |
| 24 | Vijetha Supplement Powder (Silkworm Bed Disinfectant) |
| 25 | Asthra- disinfectant for managing diseases of silkworm |
| 26 | Ankush- a new bed disinfectant |
| 27 | Samrudhi(JHA) |
| 28 | Pedal operated composite cocoon harvester |
| 29 | Mulberry leaf health drink- Spoorthi |
| 30 | Colour Silk |
| 31 | Seri Heater |
| 32 | Cocoon Harvester for Collapsible Plastic Mountages |

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| Title of Publication | Authors | Year |
|---|--|------|
| 1. Economics of Sericulture under rained conditions | M S Jolly | 1986 |
| 2. Economics of Sericulture under irrigated conditions | M S Jolly | 1986 |
| 3. Organisation of Industrial Bivoltine Sericulture for Tropics | M S Jolly | 1986 |
| 4. Mulberry Cultivation in South India | S Krishnaswamy | 1986 |
| 5. Mulberry Descriptor | S B Dandin & M S Jolly | 1986 |
| 6. Collection, Conservation & Evaluation of Mulberry (<i>Morus</i> spp.) Germplasm | M S Jolly & S B Dandin | 1986 |
| 7. Prospects of Sericulture in Tea & Coffee Plantations | M S Jolly | 1987 |
| 8. Proceedings of the Meeting on Prospects of Sericulture in Tea and Coffee Plantations | K Sengupta | 1987 |
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| 10. Genetics Resources of Mulberry and Utilisation | K Sengupta & S B Dandin | 1989 |
| 11. A Guide for Bivoltine Sericulture | K Sengupta | 1989 |
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| 15. Improved Method Rearing Young Age (Young) Silkworms | K Krishnaswamy | 1990 |
| 16. Problematic Soils of Mulberry Garden and Their Management | P C Bose & K Sengupta | 1990 |
| 17. Sericulture Practices for Hilly Areas of South India | M N Narasimhanna, N M Kanyadi, C Ravi Kumar & H K Basavaraju | 1990 |
| 18. A Treatise on the Acid Treatment of Silkworm Eggs | N M Biram Saheb, K Sengupta & G Vemananda Reddy | 1990 |
| 19. Diseases and Pests of Mulberry and Their Control | K Sengupta, Govindaiah & Pradip Kumar | 1991 |
| 20. A Guide for Bivoltine Rearing (in Hindi) | R K Datta | 1992 |
| 21. Problems of Soils and Their Management in Mulberry Gardens in Tropics (In Hindi) | P C Bose & K Sengupta | 1993 |
| 22. Manual on Bivoltine Rearing, Race | R K Datta, H K Basavaraja & | 1996 |

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| 30. Seri Success through farmer's Innovation | S M H Qadri | 2011 |
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| 35. Resham Krishi Mardarshika (in Hindi) | GV Prasad, T Mogili, M Raghupati, Satyanarayan Raju & SMH Qadri | 2013 |
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