

CSRTI-Mysuru

**SOUTH ZONE
MULBERRY SERICULTURE
TECHNOLOGY DESCRIPTOR**



Central Sericultural Research & Training Institute (CSRTI)

ISO 9001: 2015 Certified

Central Silk Board, Ministry of Textiles : Govt. of India

Manandavadi Road, Srirampura, Mysuru-570008, India

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Foreword

Technologies successfully adopted today in the field of mulberry sericulture are synonymous with Central Sericultural Research & Training Institute (CSRTI), Mysuru. The Institute has provided much needed impetus for the development and progress of sericulture in the south Indian states and contributed enormously to the silk production in the country. The quantum leap in productivity could be achieved due to the timely interventions over a period of time through the development and refinement of technologies. The seri-farmers benefited by adopting new silkworm hybrids, mulberry varieties, machines and products/technologies for crop production, crop protection including pest & disease management. The potential of newly developed mulberry varieties and silkworm hybrids were realized completely through recommended package of practices and resulted in higher productivity and sustainability in mulberry sericulture.

CSRTI-Mysuru being the premier R&D institute takes pride for the enhanced productivity in south Indian states specifically and in the country as a whole in mulberry sericulture. This **Technology Descriptor: South Zone Mulberry Sericulture** presents salient features of technologies widely accepted by the seri-farmers in the southern states. The valued contributions of scientists and technical personnel of CSRTI-Mysuru are highly appreciated. The consistent support of Shri K.M. Hanumantharayappa, Honb'le Chairman, Central Silk Board and Dr. H. Nagesh Prabhu, IFS, Member Secretary, Central Silk Board is greatly acknowledged in bringing about the publication. I hope that **Technology Descriptor: South Zone Mulberry Sericulture** would be of immense help to the sericulture farmers, extension personnel and other stakeholders.

Dr. V. Sivaprasad
Director
CSRTI-Mysuru

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Mulberry Varieties



V1

- Year of recommendation: 1997
- Parentage: S30 × C776

Salient features

- Quick sprouting after pruning/leaf harvest
- High rooting ability (94%)
- Leaf: Large, entire, ovate, glossy & dark green
- Medium Inter-nodal distance: 5.20 cm
- Tolerant to –
 - leaf spot
 - powdery mildew
 - leaf rust
- Moderately tolerant to leaf blight
- Leaf yield potential: 50-60 MT/ha/year

Nutritive value

Moisture 78%

Protein 27%

Carbohydrate 26%

Recommended for

Irrigated tracts of all southern states

Tips for best results

Adopt recommended package of mulberry cultivation

- Year of recommendation: 2003
- Parentage: *Morus multicaulis* × S13

Salient features

- Quick sprouting after pruning/leaf harvest
- High rooting ability (92%)
- Leaf: Large, entire, cordate, smooth, glossy, dark green and wavy surface
- Short Inter-nodal distance: 3.90 cm
- Tolerant to –
 - leaf spot
 - resistant to leaf rust
- Leaf yield potential: 65 MT/ha/year

Nutritive value

Carbohydrate 25%

Protein 26%

Moisture 75%

Recommended for

Irrigated tracts of southern states

Tips for best results

Adopt recommended package of mulberry cultivation

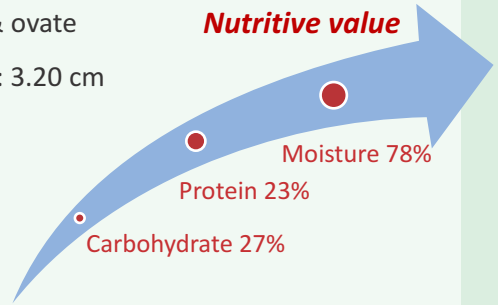


S13

- Year of recommendation: 1990
- Parentage: Open pollinated hybrid of Kanva-2

Salient features

- Quick sprouting after pruning/leaf harvest
- High rooting ability (80%)
- Leaf shape: Small, entire & ovate
- Short inter-nodal distance: 3.20 cm
- Tolerant to –
 - leaf spot
 - powdery mildew
 - leaf rust
 - Moderately tolerant to tukra infestation
- Leaf yield potential: 13-16 MT/ha/year



Recommended for

Semi-arid tracts of all southern states with red soils

Tips for best results

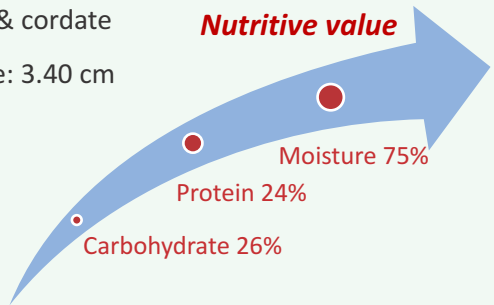
Adopt recommended package of mulberry cultivation

- Year of recommendation: 1990
- Parentage: S30 × C776

Salient features

- Quick sprouting after pruning/leaf harvest
- High rooting ability (75%)
- Leaf shape: Small, entire & cordate
- Short inter-nodal distance: 3.40 cm
- Tolerant to –
 - leaf spot
 - powdery mildew
 - leaf rust
- Leaf yield potential: 13-16 MT/ha/year

Nutritive value



Recommended for

Semi-arid tracts of all southern states with black soils

Tips for best results

Adopt recommended package of mulberry cultivation

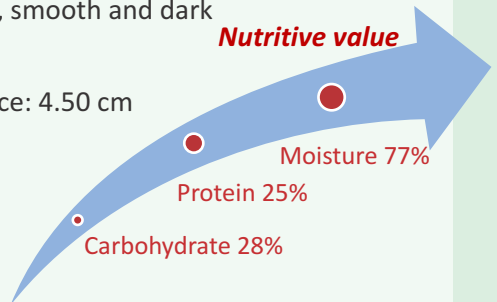


MSG2

- Year of recommendation: 2015
- Parentage: BR4 × S13

Salient features

- Quick sprouting after pruning/leaf harvest
- High rooting ability (89%)
- Leaf: Large, entire, cordate, smooth and dark green
- Medium inter-nodal distance: 4.50 cm
- Moderately tolerant to –
 - leaf spot
 - leaf rust
- Leaf yield potential: 22-23 MT/ha/year



Recommended for

Semi-arid tracts of southern states. Also suitable for growing as small trees under protective irrigation

Tips for best results

Adopt recommended package of mulberry cultivation

- Year of recommendation: 1986
- Parentage: Mutant of Berhampore local

Salient features

- Quick sprouting after pruning/leaf harvest
- Low rooting ability (48%)
- Leaf: Large, entire, cordate, glossy & green
- Short inter-nodal distance: 3.53 cm
- Tolerant to –
 - leaf spot
 - powdery mildew
 - leaf rust
- Moderately tolerant to leaf blight
- Leaf yield potential: 28 MT/ha/year

Nutritive value

Moisture 78%

Protein 25%

Carbohydrate 25%

Recommended for

Chawki mulberry gardens in red lateritic soils of Andhra Pradesh, Karnataka and Tamil Nadu

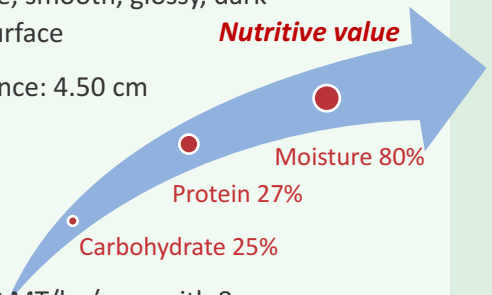
Tips for best results

Adopt recommended package of mulberry cultivation

- Year of recommendation: 2004
- Parentage: *Morus multicaulis* × S34

Salient features

- Quick sprouting after pruning/leaf harvest
- High rooting ability (94%)
- Leaf: Large, entire, cordate, smooth, glossy, dark green and slightly wavy surface
- Medium Inter-nodal distance: 4.50 cm
- Moderately Tolerant to –
 - leaf spot
 - leaf rust
- Leaf yield potential: 36-38 MT/ha/year with 8 crops/year schedule (alternate leaf picking and shoot harvest)



Recommended for

For exclusive chawki gardens in red laterite soils of southern states

Tips for best results

Adopt recommended package of chawki garden maintenance

- Year of recommendation: 2003
- Parentage: Punjab local × Kosen

Salient features

- Quick sprouting after pruning/leaf harvest
- High rooting ability (85%)
- Leaf: Large, entire, cordate, smooth & dark green
- Medium inter-nodal distance: 4.30 cm
- Tolerant to –
 - leaf spot
 - moderately resistant to leaf rust
- Leaf yield potential: 23-25 MT/ha/year

Nutritive value

Moisture 73%

Protein 23%

Carbohydrate 18%

Recommended for

Resource constraint conditions
(50% reduction in fertilizer and irrigation)

Tips for best results

Adopt recommended package of mulberry cultivation



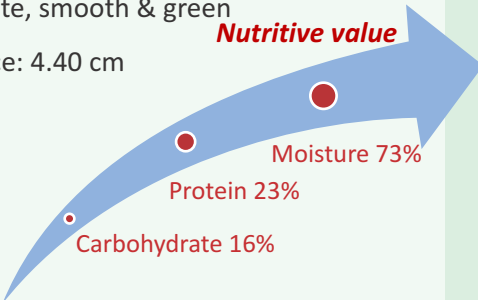
RC2

- Year of recommendation: 2004
- Parentage: Punjab local × Kosen

Salient features

- Quick sprouting after pruning/leaf harvest
- High rooting ability (89%)
- Leaf: Medium, entire, cordate, smooth & green
- Medium inter-nodal distance: 4.40 cm
- Tolerant to –
 - leaf spot
 - moderately resistant to leaf rust
- Leaf yield potential: 21-23 MT/ha/year

Nutritive value



Moisture 73%
Protein 23%
Carbohydrate 16%

Recommended for

Resource constraint conditions
(50% reduction in fertilizer and irrigation)

Tips for best results

Adopt recommended package of mulberry cultivation

- Year of recommendation: 2004
- Parentage: S41 (4x) × C776 (2x)

Salient features

- Quick sprouting after pruning/leaf harvest
- High rooting ability (90%)
- Leaf: Large, entire, cordate, smooth & dark green
- Short inter-nodal distance: 3.75 cm
- Tolerant to –
 - leaf spot
 - moderately resistant to leaf rust
- Leaf yield potential: 16-17 MT/ha/year in alkaline soils; 22-24 MT/ha/year in reclaimed alkaline soils

Nutritive value

Moisture 74%

Protein 23%

Carbohydrate 21%

Recommended for

Alkaline soils of southern states with pH upto 9.50

Tips for best results

Adopt recommended package of mulberry cultivation



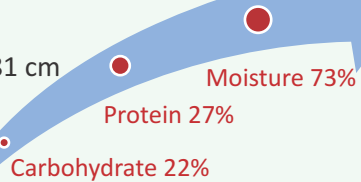
Sahana

- Year of recommendation: 2004
- Parentage: K2 × Kosen

Salient features

- Quick sprouting after pruning/leaf harvest
- High rooting ability (80%)
- Leaf: Large, entire, cordate, glossy & dark green
- Medium inter-nodal distance: 4.81 cm
- Tolerant to –
 - leaf spot
 - moderately resistant to leaf rust
 - Moderately tolerant to tukra infestation
- Leaf yield potential: 25-30 MT/ha/year as inter-crop in coconut plantations

Nutritive value



Recommended for

As inter-crop in coconut plantation

Tips for best results

Adopt recommended package of mulberry cultivation

Mulberry: Production & Protection



Nursery for raising mulberry saplings

- Year of recommendation: 1992

Salient features

- Well drained land with loamy soil is ideal for nursery
- The land to be ploughed or dug 30-40 cm deep
- Allow for weathering in sun for 2-3 weeks
- Prepare beds of size of 300 cm x 120 cm
- Provide irrigation channels of 25-30 cm width & 20 cm depth
- Treat the cuttings with 0.2% Bavistin solution for 10-15 min
- Plant cuttings at 8 cm distance in rows 20 cm apart
- Irrigate immediately after planting and then once in 4-5 days
- Apply chemical fertilizer after 55-60 days
- Use 3-4 months old saplings to establish plantation



In nurseries saplings get established quickly and grow vigorously and ensures uniform growth.

Do's

- For clayey or black cotton soil, add sand to beds
- Select healthy, 6-8 months old 10-15 mm thick cuttings

Dont's

- Don't use stout lower and tender-green portion of shoots
- Tukra or scale infested cuttings should not be used



Mulberry cultivation for late age silkworm rearing

- Year of recommendation: 2001

Salient features

- Cultivate mulberry in spacing of 90 cm x 90 cm or in paired rows [(150+90)x60 cm/ (5'+3')x2']
- Apply 20 MT of farm yard manure/ha/year in two splits and NPK @ 350:140:140 kg/ha/year in five splits in the form of straight fertilizers
- V1 and G4 are suitable for late age silkworm rearing



Provides quality leaves for rearing of late age silkworms

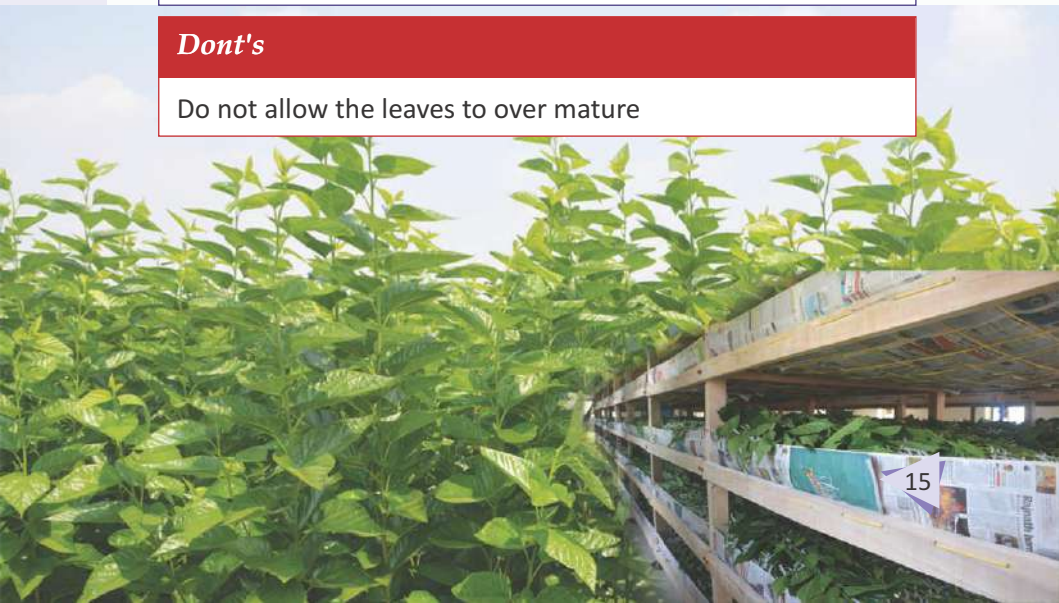
- Expenditure: ₹ 20000/- per acre
- Cost benefit ratio: 1:3

Do's

Harvest leaves as per schedule for maximum utilization of quality leaf

Dont's

Do not allow the leaves to over mature



Paired row system of plantation

- Year of recommendation: 1995

Salient features

- In this system of plantation plants are raised in paired rows
- The distance between two rows in a pair is 90 cm (3'). The space between two pairs is 150 cm (5') and distance between plants in a row is 60 cm (2')
- With this spacing, a total of 13,888 plants can be planted in a hectare



Facilitates movement of power tillers and tractors for intercultural operations

- Expenditure: ₹ 21000/- per acre
- Cost benefit ratio: 1:2

Do's

Select high yielding mulberry varieties

Dont's

Do not plant closer than recommended

Pruning and Training of Mulberry

- Year of recommendation: 1997

Salient features

- Pruning at uniform height facilitates development of proper stump to maintain ideal shape
- Facilitates uniform growth of entire plantation and allows mechanized inter-cultivation activities
- Uniform growth results in reduction in diseases and improved productivity

Establishment of plantation and stump development

- Plant healthy saplings and prune at a height of 15 cm from the ground
- Allow plant to grow for six months without leaf harvest, and take up first rearing by leaf picking
- Later select 3 strong & healthy shoots in each plant and prune at a height of 25cm from the ground
- After every rearing, cut all shoots at a height of 30 cm from the ground and remove the weak and dry branches.
- Maintain only 10-15 healthy shoots/plant

Usage

Plantation with proper stump development facilitates healthy growth and quality leaves

Do's

- Maintain 10-15 healthy shoots/plant by removing weak shoots
- Use sharp secateurs for pruning
- Thin out all weak shoots between 30-40 days of pruning
- Stump development is useful for mechanized pruning using bush cutters

Dont's

- Do not prune plants at ground level, while pruning with machines
- Do not allow more than 15 shoots/ plant



Soil test based fertilizer application

- Year of recommendation: 2004

Soil test based recommendation of manures and fertilizers

Salient features

- Mulberry growth depends on soil fertility and availability of nutrients
- Soil fertility needs to be analyzed periodically to assess the soil nutrient status
- Fertilizer recommendations based on soil fertility need to be adopted for judicious use of fertilizers

Organic Carbon (%)		FYM *
< 0.3		15
0.3 - 0.65		12
0.65 - > 1.0		10
pH	Urea #	AS #
< 6.0	50	
< 6.0		140

Available P (kg/ha)	SSP #	Available K (kg/ha)	MoP#
< 10	80	0 - 45	20
10 - 15	75	46 - 90	18
16 - 25	70	91 - 134	16
26 - 40	65	135 - 179	14

*MT/acre/yr; # kg/ acre/crop; AS Ammonium sulphate; SSP Single super phosphate; MoP Muriate of potash



The application of specified doses of fertilizers and manures recommended based on soil test results leads to effective maintenance of soil fertility status

Do's

- Collect soil samples after pruning of mulberry plantation but before fertilizer application
- Collect separate samples for soils differing in texture, colour, yield pattern
- Reclaim problematic soils adopting proper remedial measures

Dont's

- Do not collect soil samples immediately after rain, irrigation and from bunds, near compost pits, marshy and water logged areas
- Do not dry the soil samples under direct sun or in hot temperature



Integrated Nutrient Management (INM) in mulberry cultivation

- Year of recommendation: 2003

Salient features

- Integrated approach of nutrient management consists of chemical and biological means of soil health management, which are eco-friendly and cost effective

INM package

- Organic fertilizers: Apply farmyard manure (FYM) @ 8 MT/acre in two split dosages. FYM may be curtailed to 4MT/acre in the subsequent years as green manuring contributes to 50% of organic manure
- Grow two green manure inter-crops at the onset of monsoon and mix in the soil or compost it
- Apply neem cake @ 200 kg/acre once during monsoon or in 5 split doses
- Bio-fertilizers: Apply 8kg Seri-azo and 2kg Seri-phos/acre/year in 5 equal doses
- Spray Poshan, a multi-nutrient foliar spray @ 7ml/litre after 25 days of pruning
- Chemical fertilizers: Apply chemical fertilizers as recommended & once the organic content improves (>0.65%), curtail 50% of fertilizers

Usage

Adoption of Integrated approach of Nutrient Management improves soil health and productivity

Do's

- Prefer crops like sunhemp, dhaincha *etc.*, for green manures
- Mix biofertilizers, Seri-azo and Seri-phos in FYM and apply 15 days before or after application of chemical fertilizers
- Compost seri-waste by adopting seri-composting technology to improve organic carbon content

Dont's

- Do not mix bio- and chemical fertilizers while applying to soil
- Do not allow green manure crops to grow up to flowering/seed setting
- Do not burn mulberry shoots removed from the bed, instead use for composting

Drip Irrigation

- Year of recommendation: 1995

Salient features

- An efficient water management system for mulberry
- One lateral is placed in between two mulberry rows and one microtube in amidst 4 plants
- The peak demand for water per plant/day in dry season is –
 - 1.2 litres for 60 × 60 cm plantation
 - 2.0 litres for 90 × 90 cm and paired row system
- Less water usage as compared to other irrigation systems
- Saves water up to 40% without affecting leaf yield



Technology for rainfed and semi irrigated conditions

Expenditure: ₹ 45,000/- per acre

Do's

- Use filters to avoid blockage of microtubules
- While ploughing, remove the laterals and microtubes

Dont's

- Do not use hard water for drip irrigation as it clogs the microtubes
- Do not use drip, where percolation is not proper

Mulberry cultivation package for young age silkworms

- Year of recommendation: 2001

Salient features

- Cultivate mulberry in spacing of 90 cm x 90 cm or paired rows [(150+90)x60 cm/ (5'+3')x2']
- Apply 40 MT of farm yard manure/ha/year and NPK @ 260:140:140 kg/ha/year in eight splits in the form of straight fertilizers
- Adopting top clipping method of training (alternate harvesting of leaves and shoots) 30 MT/ha/year of quality leaves for rearing young age silkworms can be produced
- S36, V1 and G2 are suitable for young age silkworm rearing



Provides quality leaves for rearing young age silkworms

- Expenditure: ₹ 20,000/- per acre
- Cost benefit ratio: 1:3

Do's

Harvest leaf as per schedule for maximum utilization of quality chawki leaf

Dont's

Do not allow the leaves to over mature



Package for tree mulberry cultivation

- Year of recommendation: 2000

Salient features

- Choose S-13 mulberry variety and plant with a spacing of 2.4 m x 2.4 m. Maintain crown height of plants at 150 – 180 cm, and provide fertilizer @ 50:25:25 kg/ha/year of NPK under rainfed conditions
- Grow green manure crops during rainy season for improving the soil fertility
- The trees yield mulberry leaves @ 6–7 MT/ha/year
- Mulberry leaves can be harvested 4 times in a year
- Full productivity would be reached after three years

Usage

Suitable for water deficit or low soil moisture conditions

- Expenditure: ₹ 20,000/- per acre
- Cost benefit ratio: 1:1.6

Do's

Use water efficient mulberry varieties

Dont's

Do not plant with closer spacing



Affordable Micro Irrigation Technology (AMIT)

- Year of recommendation: 2013

Salient features

- Irrigation through a network of plastic pipes with laterals and emitters connected to a drum/water tank placed at a height of one meter
- Cost effective and eco-friendly technique to revive rainfed sericulture for poverty alleviation & employment generation
- For situations where ground water sources are fast depleting
- Effective utilization of available water resources
- Can overcome unpredictable power supply
- A farmer having 1000 liters of water output per day can easily maintain 680 mulberry plants as trees by supplying 2-2.5 liters water per plant on alternate days

Advantages

- Saves water, labour & energy
- Reduction in cost of cultivation
- Water use efficiency rate is more than 95%

Usage

- More appropriate for tree plantation
- Can be practiced where there is deficit & erratic rainfall
- Can overcome water, energy and labour constraints

Do's

- Pump and store water depending on availability of power
- Use appropriate tubes and emitters

Don't's

- Do not use inferior quality drip pipes and end emitters

Trenching and mulching

- Year of recommendation: 2012

Salient features

- Open trenches (1.5' width and 1' depth) along alternate rows
- Fill the trenches with mulberry leaves, shoots and silkworm litter and if available foliage of neem, Pongamia and Glyricidia and cover with dug out soil
- Green manure crops can be grown during the onset of monsoon (June and Oct-Nov) and they can be mulched before flowering



The trench serves as rainwater harvesting canal/sink facilitating quick decomposition of mulberry shoots in to nutrient-rich compost.

- **Advantages over alternative technology:** Fertility building by sub-soil bio-massing/manuring and soil moisture conservation by organic mulching
- Expenditure: ₹ 15,000/- per acre
- Cost benefit ratio: 1:1.54

Do's

- Mulch fresh foliage and shoots
- Cover trenches with dug-out soil

Dont's

- Do not leave trenches open



Foliar application of POSHAN

- Year of recommendation: 2011

Salient features

- Poshan is a multi-nutrient formulation
- Foliar spray of Poshan results in 20% increase in leaf yield, besides improving leaf quality
- Feeding Poshan sprayed leaves helps in uniform growth of silkworms, production of cocoons with improved shell weight and shell percentage



Preparation and application

- 1 litre of *Poshan* should be diluted in 140 liters of water and sprayed on one acre of mulberry (@7ml/l)
- Spray once per crop
- Spraying is to be done on the foliage, 25 - 30 days after pruning or leaf picking, between 8 & 11 am till the leaves are drenched

Usage

For mulberry leaf nutrient management and higher leaf yield

- Expenditure: ₹ 250/- per crop/acre
- Cost benefit ratio: 1:7
- Safe period for feeding silkworms: 48 h of spray

Do's

- Spray during cooler hours of the day
- If it rains within 6 h of spray, repeat
- Recommended for irrigated gardens only

Don't's

- Don't spray against direction of wind

Composting & Vermi-composting from Seri-residue

- Year of recommendation: 1995

Salient features

- 12-15 MT biodegradable farm residue is generated from one ha of mulberry garden, which can be turned into compost
- Make a compost pit of 15'L x 5'B x 3'D in an elevated area
- Spread the farm residue layer by layer in the pit
- Apply fresh cowdung or spent slurry after each layer
- Fill the pit to a height of 30-40 cm above ground level, close it by plastering with mud and cow dung slurry
- Using earthworms, the organic residue can be rapidly decomposed
- *Eudrillus eugineae*, *Eisenia foetida* and *Perionyx excavatus* can be used for this purpose



By composting/vermi-composting process, seri-farm residue is recycled as high nutrient manure

Advantages over alternative technology: The mulberry shoots normally take 9-12 months for decomposition, but by this method the compost is ready in 4-5 months

Do's

- Maintain moisture by sprinkling water periodically
- Protect the pit with a thatched roof

Dont's

- Do not water once vermicast is detected



Navinya - a plant based formulation for management of root rot disease of mulberry

- Year of recommendation: 2011

Salient features

- Target specific eco-friendly plant based formulation
- Does not affect beneficial microflora in the soil
- Easy to apply
- Shelf life of two years



Preparation and Application

- Prune dried or wilted plant showing root rot symptoms at 1ft from ground level
- Remove soil around the collar region of the plant to form a basin and avoid over-flowing of the applied formulation
- Prepare solution by thoroughly mixing 10g of Navinya in 1 l water (1kg Navinya/100 l sufficient for 100 plants)
- Pour 1 liter of solution over the pruned stump so as to drench completely
- Cover the collar region with soil
- Treat the surrounding plants also to prevent spread of disease

Usage

For management of root rot disease of mulberry

- Expenditure: ₹ 300/- for 500 g (for treating 50 plants)
- Cost benefit ratio: 1:4.5

Do's

- Remove completely dried and dead plants, and burn. Then replant with new saplings dipped in 0.4 % Navinya solution for 15 min
- Treat as soon as root rot symptoms appear

Dont's

- Don't irrigate the treated plants for 3-4 days after treatment
- Don't store the product in damp places
- Don't keep the product within the reach of children



Nemahari - a plant based formulation for management of root knot disease of mulberry

- Year of recommendation: 2012

Salient features

- A target specific, eco-friendly plant based formulation
- Does not harm beneficial microflora in soil
- Easily absorbed by the roots
- Inhibits multiplication of nematodes
- Easy to apply
- Shelf life is two years

Preparation and application

- Mix 16 kg Nemahari with 160 kg FYM (for 1 acre)
- Make 15 cm deep trenches along root zone of plants in rows
- Apply the mixture in the trench and cover with soil
- Repeat 70-80 days after first application
- A third application is recommended 140-150 days after second application if infection is severe (> 50 galls / plant)



Management of root knot disease of mulberry

- Expenditure: ₹ 100/- per kg
- Cost benefit ratio: 1:2.2

Do's

- Irrigate moderately immediately after treatment
- Treat as soon as initial symptoms of root knot appear
- Apply compost to improve organic carbon in the soil
- Thoroughly wash farm implements used in the infected garden

Don't's

- Don't store the product in damp places
- Don't keep the product within the reach of children
- Avoid overflow of water from the treated mulberry gardens



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IPM of pink mealybug, *Maconellicoccus hirsutus*

- Year of Development: 1990

Salient features

- Mealybug is a major sucking pest of mulberry with a wide host range
- Occurs throughout the year, but predominant during summer
- Causes leaf yield loss of about 1800 kg/acre/year
- Lays 350-500 eggs; incubation 6-9 days; nymphal period 23-27 days, thus completes life cycle in 30-36 days

Management approaches

Mechanical Method

- Remove and destroy infested portions by burning or dipping in 0.5% soap solution

Chemical Method

- Spray 0.2% DDVP (76% EC) (@2.63 ml/l) 15 - 20 days after pruning.
- Safe period for feeding silkworms: 15-17 days after spray

Biological Method

- Release lady bird beetles, *Scymnus coccivora* @500 beetles or *Cryptolaemus montrouzieri* @250 beetles/ac/year in two splits at an interval of 6 months

Usage

Effective in the management of mealybug in mulberry

- Expenditure: ₹ 800/acre/year
- Cost benefit Ratio: 1: 4

Do's

- Top clip mulberry plants when silkworms settle for 4th moult
- Spray insecticides during cool hours.
- Release beetles only after 8-10 days of chemical spray

Don't's

- Don't spray insecticide against direction of wind
- Do not spray insecticide after releasing beetles



Classical Biological Control of papaya mealybug, *Paracoccus marginatus*

- Year of Development: 2010

Salient features

- It is an exotic pest native to Mexico
- First reported in Tamil Nadu (2009) and subsequently spread to neighbouring states and caused heavy loss to sericulture industry
- Lays 400-600 eggs; incubation 8-10 days; nymphal period 22-25 days, thus completes life cycle in 30-35 days

Management approaches

Mechanical Method

- Remove the infested portions with secature and pile up at one corner of the garden

Biological Method

- Inoculative release of exotic nymphal parasitoid, *Acerophagus papayae* @ 1 vial (about 100 adults)/acre in pest infested gardens and other alternate host plants such as Papaya, Parthenium, Jatropha, Hibiscus, etc.



Effective in management of papaya mealybugs

Availability of Parasitoids

- Parasitoids are supplied free of cost by the National Bureau of Agricultural Insect Resources (NBAIR), ICAR, Bengaluru (Contact: 080-2351 1982)

Do's

- Take measures to encourage build up of population of natural enemies in the mulberry gardens

Dont's

- Don't spray insecticide against papaya mealybug, as it may worsen the situation
- Don't remove or destroy alternate host plants such as Parthenium, Jatropha etc., containing mummified mealybugs.



IPM of leaf roller, *Diaphania pulverulentalis*

- Year of Development: 1997

Salient features

- Leaf roller is a seasonal pest of mulberry
- Occurs from June to February with peak incidence during September to November
- Lays 80-150 eggs with an incubation period of 2-3 days
- Larval & pupal periods last for 8-12 and 7-9 days, respectively
- Completes life cycle in 17-24 days

Management approaches

Mechanical Method

- Remove and destroy infested portions along with the caterpillar by burning or dipping in 0.5% soap solution

Chemical Method

- Spray 0.15% DDVP (76% EC) (@2 ml/l) 12-15 days after pruning
- Safe period for feeding silkworms: 12 days after spray

Biological Method

- Release *Trichogramma chilonis*, an egg parasitoid @ 4 trichocards/acre/crop (from July to February)

Usage

Effective in management of leaf roller in mulberry

- Expenditure: ₹ 800/acre/year
- Cost benefit Ratio: 1: 4

Do's

- Plough deeply to expose the leaf roller pupae to birds
- Release egg parasitoids after 10 days of chemical spray
- Spray insecticides during cool hours

Dont's

- Do not spray insecticide after releasing egg parasitoids
- Don't spray insecticide against direction of wind



IPM of Bihar hairy caterpillar, *Spilarctia obliqua*

- Year of Development: 1995-96

Salient features

- Sporadic pest, which defoliates mulberry
- Occurrence coincides with onset of monsoon and continues up to February
- Lays 1000-1200 eggs with an incubation period of 5-7 days
- Larval & pupal periods last for 28-30 & 12-14 days, respectively
- Completes life cycle in 45-51 days

Management approaches

Mechanical Method

- Collect and destroy egg masses and gregarious young caterpillars by burning
- Deep ploughing exposes the pupae to the birds & scorching sun
- Flood irrigation kills the pupae

Chemical Method

- Spray 0.15% DDVP (76% EC) (@2 ml/l) 12-15 days after pruning
- Safe period for feeding silkworms: 12 days after spray

Biological Method

- Release *Trichogramma chilonis*, an egg parasitoid @ 4 trichocards/acre/crop



Effective in management of Bihar hairy caterpillar

- Expenditure: ₹ 1000/acre/year
- Cost benefit Ratio: 1:3

Do's

- Plough deeply to expose the pupae to birds
- Release egg parasitoids only after 10 days of chemical spray
- Spray insecticides during cooler hours

Dont's

- Do not spray insecticide after releasing egg parasitoids
- Don't spray insecticide against direction of wind



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Chrysopid (Green Lacewing) for Thrips Management

- Year of Development: 2016

Salient features

- Chrysopids (green lacewing) are broad spectrum predators in many agricultural crop system
- The important Chrysopids include *Chrysoperla* sp. & *Mallada* sp.
- Adults are green coloured insects with net-like wings which feed on nectar, pollen and other sugar sources
- Lay about 600-800 stalked eggs in small groups on leaves and other plant parts or nearby pest colony, which hatch in 3-4 days
- The larvae feed voraciously on thrips and other soft bodied insects and hatched larvae of Lepidopteran pests as well as Mites for 8-10 days
- They form silky cocoons from which adults emerge in 5-7 days
- Life cycle completes in 16-21 days, males live for 30-35 days and females upto 60 days

Recommendation

- 1000 eggs/acre two times at an interval of one week
- Eggs available in the form of egg cards, which may be stapled / tied to terminal leaves

Usage

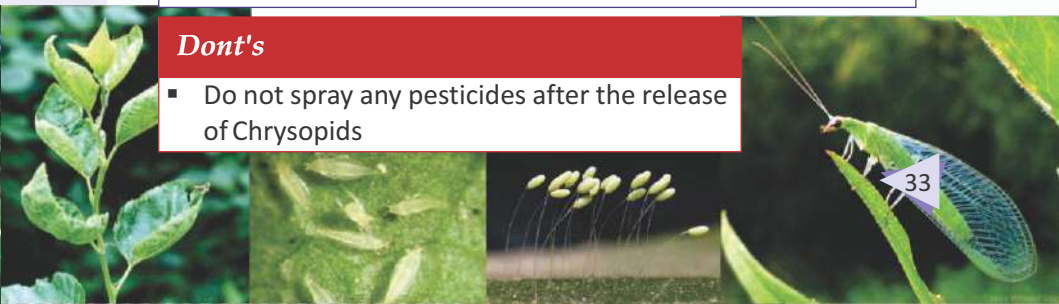
Effective in the management of thrips and other soft bodied pests including Mites in mulberry

Do's

- If infestation is severe, spray Rogor (3ml/l) 12-15 days after pruning and release Chrysopids after 8-10 days (safety period for feeding mulberry leaf to silkworms is 20 days)

Dont's

- Do not spray any pesticides after the release of Chrysopids



Silkworm Hybrids



- Year of recommendation: 1997

Salient features

- Productive bivoltine hybrid
- Plain larvae with bluish white body colour
- Larval period: 23-24 days
- Bright white hybrid shaped cocoons with medium grains
- Cocoon yield: 65-70 kg /100 dfls
- Pupation rate: >90 %
- Raw silk: 17-18 %
- Reelability: 86-90 %
- Filament length: 1000 m
- Fibre quality: 2A-3A
- Renditta: 5.5-6.0
- Better crop stability with commercial farmers

Recommended for

Irrigated areas of Karnataka, Andhra Pradesh, Telangana, Tamil Nadu, Uttar Pradesh, Madhya Pradesh and Maharashtra

Tips for best results

Adopt recommended rearing package



CSR16 × CSR17

- Year of recommendation: 1997

Salient features

- Productive bivoltine hybrid
- Marked larvae with bluish white body colour
- Larval period: 23-24 days
- Bright white hybrid shaped cocoons with medium grains
- Cocoon yield: 65-70 kg /100 dfls
- Pupation rate: >90 %
- Raw silk: 18-19 %
- Reelability: 86-90 %
- Filament length: 1050 m
- Fibre quality: 2A-3A
- Renditta: 5.5-6.0
- Alternative to CSR2 × CSR4



Recommended for

Irrigated areas of Karnataka, Andhra Pradesh, Telangana, Tamil Nadu, Uttar Pradesh, Madhya Pradesh and Maharashtra

Tips for best results

Adopt recommended rearing package



FC1 × FC2 (CSR6 × CSR26) × (CSR2 × CSR27)

- Year of recommendation: 2000

Salient features

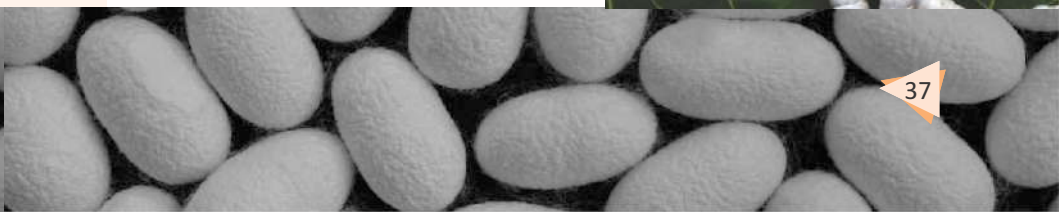
- Productive bivoltine double hybrid
- Marked larvae with bluish white body colour
- Larval period: 23-24 days
- Bright white hybrid shaped cocoons with medium grains
- Cocoon yield: 70 -75 kg /100 dfls
- Pupation rate: >90 %
- Raw silk: 18-19 %
- Reelability: 86-90 %
- Filament length: 1100 m
- Fibre quality: 2A-3A
- Renditta: 5.3-6.0
- Better crop stability with commercial farmers
- Better seed crop performance and higher seed recovery

Recommended for

Irrigated areas of all parts of India

Tips for best results

Adopt recommended rearing package



Chamaraja (CSR50 × CSR51)

- Year of recommendation: 2012

Salient features

- Robust bivoltine hybrid
- Marked larvae with bluish white body colour
- Larval period: 23-24 days
- Bright white hybrid shaped cocoons with medium grains
- Cocoon yield: 70-75 kg /100 dfls
- Pupation rate: >90 %
- Raw silk: 19-20 %
- Reelability: 86-90 %
- Filament length: 1150 m
- Fibre quality: 2A-3A
- Renditta: 5.0-5.5



Recommended for

Irrigated areas of all parts of India and suitable for adverse conditions

Tips for best results

Adopt recommended rearing package

Jayachamaraja (CSR50 × CSR52) × (CSR51 × CSR53)

- Year of recommendation: 2012

Salient features

- Productive bivoltine double hybrid
- Marked larvae with bluish white body colour
- Larval period: 23-24 days
- Bright white hybrid shaped cocoons with medium grains
- Cocoon yield: 70-75 kg /100 dfls
- Pupation rate: >90 %
- Raw silk: 19-20 %
- Reelability: 86-90 %
- Filament length: 1100 m
- Fibre quality: 2A-3A
- Renditta: 5.0-5.5
- Better crop stability with commercial farmers

Recommended for

Irrigated areas all over the country and suitable for adverse conditions

Tips for best results

Adopt recommended rearing package



G11 × G19

- Year of recommendation: 2014

Salient features

- Double hybrid for sub-optimal conditions
- Plain larvae with bluish white body colour
- Larval period: 23-24 days
- Bright white hybrid shaped cocoons with medium grains
- Cocoon yield: 65-70 kg /100 dfls
- Pupation rate: >90 %
- Raw silk: 17-18 %
- Reelability: 86 %
- Filament length: 950 m
- Fibre quality: 2A-3A
- Renditta: 5.5-6.0
- Better digestibility and higher survival
- Suitable for all regions and seasons



Recommended for

All regions

Tips for best results

Adopt recommended rearing package

- Year of recommendation: 2015

Salient features

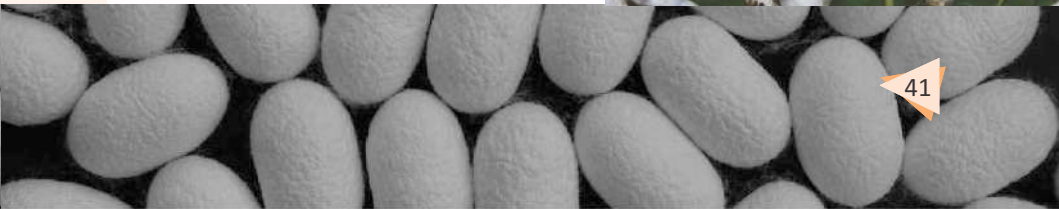
- Productive bivoltine hybrid
- Marked larvae with bluish white body colour
- Larval period: 23-24 days
- Bright white hybrid shaped cocoons with medium grains
- Cocoon yield: 70-75 kg /100 dfls
- Pupation rate: >90 %
- Raw silk: 19-20 %
- Reelability: 86-90 %
- Filament length: 1100 m
- Fibre quality: 2A-3A
- Renditta: 5.0-5.2
- Highly productive and suitable for all seasons

Recommended for

All agro-climatic conditions

Tips for best results

Adopt recommended rearing package



PM × CSR2

- Year of recommendation: 2000

Salient features

- Productive multi x bivoltine
- Plain larvae with bluish white body color
- Larval period: 24 days
- Light greenish yellow oval cocoons with slightly more floss and medium grains
- Cocoon yield: 60 kg /100 dfls
- Pupation rate: >95.4%
- Raw silk: 79-80%
- Reelability: >84-85%
- Filament length: 800-900 m
- Renditta: 6.0-7.0
- Better crop stability in the field



Recommended for

South Indian States

Tips for best results

Adopt recommended rearing package

Cauvery Gold (MV1 × S8)

- Year of recommendation: 2015

Salient features

- Productive improved cross breed tolerant to silkworm diseases
- Plain larvae with bluish tinge white body
- Larval period: 22-23 days
- Pupation rate: >90%
- Cocoon yield: 75-85 kg /100 dfls
- Light greenish yellow oval cocoons with less floss, compact shell and medium grains
- Reels completely till pelade layer resulting in high raw silk recovery of 75–79%
- Raw Silk: 14.80%
- Reelability: 85-90%
- Filament length: 910 - 960 m
- Renditta: 6.0-6.5
- High tenacity (>3.7 g/d), elongation (>22%) and cohesion (>60 strokes) making the cocoons fit for reeling on multi-end and Automatic Reeling Machines
- Fibre quality: 2A-3A

Recommended for

South Indian States throughout the year

Tips for best results

Adopt recommended rearing package



Silkworm: Production & Protection



Chawki Rearing Technology

- Year of recommendation: 1997

Salient features

- Chawki rearing (rearing of young age silkworms up to II moult) is the most crucial stage in silkworm rearing and one of the deciding factors in the success of cocoon crop
- Young age silkworms are characterized by maximum growth rate and should be grown under high temperature (27-28°C) and high humidity (80-90%) for optimal growth
- As chawki worms are susceptible to diseases, pathogen free conditions are maintained by adopting strict disinfection and hygiene measures

Chawki rearing

- Expose the eggs to bright diffused light for 2-3 hours
- Apply nylon brushing net (2-4 mm mesh) on the hatched larvae and sprinkle freshly chopped soft chawki leaves and cover with paraffin paper for 3-4 hours. Transfer the bed to the rearing tray and spread the larvae and feed some more chopped leaves
- Maintain optimal temperature and humidity in the chawki room adopting suitable methods
- Provide nutritious leaf twice a day and provide adequate spacing by increasing number of trays as the chawki worms grow (65 sq. ft./100 dfls at the end of II instar)



Chawki Rearing Technology Contd...

- Remove paraffin paper one hour before every feeding and allow cross ventilation
- Dust slaked lime when worms settle for moult and dust bed disinfectant when larvae come out of moult
- Conduct chawki certification during II moult, dust lime and transport to the farmers in cool hours



Scientific chawki rearing is vital for development of healthy larvae and harvesting of successful cocoon crops

Do's

- Maintain exclusive chawki mulberry garden to get soft, succulent and nutritious mulberry leaves
- Equip CRCs with necessary equipments like rearing trays, heaters, humidifiers, hygrometers, sprayer, etc., and vehicles for transportation and distribution of worms
- Black box the eggs at pin head stage
- Maintain strict hygiene

Dont's

- Do not transport eggs during hot hours; Do not cover beds with paraffin paper during moult



Chawki Certification for successful silkworm crops

- Year of recommendation: 2002

Salient features

- To ensure appropriate growth and health of young silkworms prior to distribution
- Essential to implement the CRC concept efficiently for achieving better production and productivity at farmers' level

Components

- Quantification of missing larvae
- Quantification of larval uniformity
- Assessment of larval growth
- Health status of the larvae

Certification

- Missing larval percentage should be less than 5%
- Percentage of undersized larvae should be less than 15%
- Standard weight of 100 bivoltine hybrid larvae during II moult should be 3.4 to 3.8 g & for cross breeds it should be 2.2 to 2.6 g
- If pebrine is detected, the batch is not fit for distribution & it should be rejected & burnt. Disinfect the CRC immediately

Usage

To certify the chawki larval growth and health status prior to distribution to the farmers

Do's

- Certify the batch when worms are settled for II moult / immediately after II moult.
- Use good binocular microscope having 600x magnification for examination

Dont's

- Don't certify the batch when the worms are in 1st instar
- If pebrine is detected, don't distribute to the farmers



Nutrid – Semi-synthetic diet for rearing young age silkworms

- Year of recommendation: 2001

Salient features

- The diet allows *Chawki* rearers to rear multi x bivoltine hybrids of their choice on semi-synthetic diet up to II moult
- A nutritive and hygienic alternative that reduces infections in the early larval stages

Advantages

- Only two feeds per instar
- No cleaning of rearing beds required
- No dusting of disinfectants or lime required
- Saves on cost of manpower by 70% in *Chawki* rearing



Recommended for rearing *Chawki* worms

Do's

- Follow the temperature and humidity regime strictly
- Pile up the trays one above the other to preserve bed humidity
- Transfer the trays onto rearing stands while larvae settle for moult to keep the beds dry

Dont's

- Don't keep the rearing bed moist while the larvae are moulting
- Don't ever apply the diet onto the larvae, do the opposite
- Don't leave the trays open when the larvae are feeding



Late age Silkworm Rearing Technology

- Year of recommendation: 1997

Salient features

- Rearing of silkworm larvae from III to V instar and up to cocooning is called late age rearing
- Late age silkworm rearing must be conducted in a separate rearing house with good ventilation and structure/design facilitating effective disinfection
- An *ante*-chamber should be built at the entrance of the rearing house to prevent entry of uzi fly
- For mounting and harvesting cocoons, *Verandah* is built along eastern and western walls of rearing house

Late age rearing

- Always use chawki worms reared up to II moult in CRCs.
- Spread the larvae on the shoot bed and dust bed disinfectant 30 minutes before resuming feeding
- Provide two feedings with fresh coarse mulberry leaves in a day
- Maintain optimal temperature and humidity (24-26°C and 75-80% RH) in the rearing house by adopting appropriate methods
- Dust slaked lime when worms settle for moult and dust bed disinfectant when larvae come out of moult
- Provide adequate space for the optimal growth of larvae. In shoot rearing method provide 3 sq.ft bed area and in tray rearing method 2 sq.ft for every dfl reared



Late age Silkworm Rearing Technology Cont...

- Provide spacing of 700-800 sq. ft. bed area for 100 dfls
- Provide sufficient quality mulberry shoots from irrigated mulberry plantation



Shoot feeding and shelf rearing of silkworms optimizes and improves the cocoon yield and quality; Reduces cost of cocoon production and drudgery

Do's

- Harvest mulberry shoots for IV & V instar larvae during cooler hours of the day with sharp saw/brush cutter
- Preserve shoots by wrapping with wet gunny cloth and stack vertically in upright position
- Shoot feeding is effective in saving on labour and time with less chances of secondary contamination
- 50-70 larvae per square feet is ideal for rearing.
- Collect unequal/diseased worms and destroy
- Adopt proper bed disinfection methods to prevent diseases and maintain hygiene
- When more than 40% of worms mature, mount using appropriate mountages

Dont's

- Do not dust bed disinfectants on feeding larvae
- Do not delay feeding after dusting of bed disinfectant



Mounting and Harvesting Techniques

- Year of recommendation: 1997

Salient features

- 25°C temperature, 60-65% humidity, good ventilation and uniform light are necessary in the mounting room for obtaining good quality cocoons
- Mount only matured larvae. Mounting of un-ripened or over mature larvae results in defective and inferior quality cocoons
- Presently, bamboo mountages (chandrike), plastic collapsible mountages and rotary mountages are in use
- Rotary mountages are ideal to produce quality cocoons of uniform size and high reelability
- Mounting on bamboo *chandrikes* results in higher defective cocoons and large variations in cocoon size and shape
- Plastic collapsible mountages are used mainly as self mounting devices to save labour during spinning. Quality of cocoons harvested is inferior to those spun on rotary mountages
- Cocoons should be harvested after the completion of pupation (6th day after spinning) manually or using harvesting tools



Mounting and Harvesting Techniques Cont...



Proper mounting and harvesting results in production of quality cocoons fetching higher economic returns to the stakeholders

Do's

- Maintain temperature around 25°C and relative humidity around 65% during spinning to produce quality cocoons
- Provide cross ventilation and uniform illumination in the mounting room
- Moulting hormone (Sampoorna) may be used for quick and uniform maturity and stimulating spinning
- Use deflossing machines to remove floss on the cocoons

Dont's

- Do not expose mountages to direct sunlight during spinning
- Do not pile bamboo *chandrikes* one over the other
- Do not harvest cocoons before complete pupation



Disinfection and hygiene in silkworm rearing using Bleaching powder

- Year of recommendation: 1992

Salient features

- Effective disinfectant against all silkworm pathogens
- Cost effective chlorine based disinfectant
- The technology involves spraying of 2% bleaching powder in 0.3% slaked lime solution

Preparation

- To prepare 100 liters disinfectant solution, mix 2 kg bleaching powder and 300 g slaked lime powder in 100 litres of water



- Disinfection of rearing houses, surroundings and appliances
- Maintenance of personal and rearing hygiene

Expenditure: ₹ 140/- for rearing 100 dfls
Cost benefit ratio: 1: 7

Do's

- Use quality bleaching powder (with 30-32% available chlorine)
- Use freshly prepared lime powder for mixing with bleaching powder
- Use mask while spraying the solution

Dont's

- Never prepare the solution in direct sunlight
- Don't spray on metals as it is highly corrosive
- Don't use muddy and impure water



Disinfection and hygiene in silkworm rearing using Chlorine dioxide (*Sanitech/Serichlor*)

- Year of recommendation: 1996

Salient features

- Commercially available as Sanitech/Serichlor at 20,000 ppm
- It is less corrosive, less hazardous and highly germicidal

Preparation of 100 l 2.5% (500 ppm) Chlorine dioxide in 0.5% slaked lime solution

- Take 250 g activator crystals in a basin/bucket
- Add Sanitech/Serichlor solution (2.5 l)
- Keep for 10 minutes
- Add activated Sanitech/Serichlor to 97.5 l water
- Add 500 g slaked lime
- Mix thoroughly and use for disinfection



- Disinfection of rearing houses, surroundings and appliances
- For maintenance of personal and rearing hygiene

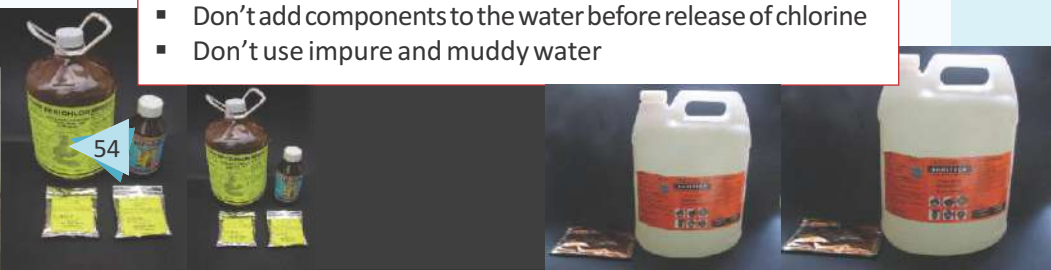
Expenditure: ₹ 500/- for rearing 100 dfls
Cost benefit ratio: 1:8

Do's

- Make sure that the mixture turns yellow after mixing the activator crystals
- Use recommended quantity of activator crystals
- Wear a mask while spraying

Dont's

- Never prepare the solution under direct sunlight
- Don't mix Sanitech/Serichlor solution, activator crystals and slaked lime powder together
- Don't add components to the water before release of chlorine
- Don't use impure and muddy water



Disinfection and hygiene in silkworm rearing using *Asthra*

- Year of recommendation: 2009

Salient features

- A general disinfectant for Sericulture
- Effective against all silkworm pathogens at 0.05% conc.
- Easy to prepare and spray

Preparation

- Mix 50 g of *Asthra* in 100 litres of water to prepare 0.05% disinfectant solution
- After adding *Asthra*, stir thoroughly
- Keep for 2 hours before spraying

Usage

- Disinfection of rearing houses, surroundings and appliances
- For maintenance of personal and rearing hygiene

Expenditure: ₹ 200/- for rearing 100 dfls

Cost benefit ratio: 1:9

Do's

- Use the disinfectant solution 2 hours after mixing *Asthra* powder
- Wear a mask while spraying the solution

Dont's

- Don't use impure and muddy water



Disinfection and hygiene in silkworm rearing using Sanitech Super (*Chlorine dioxide*)

- Year of recommendation: 2014

Salient features

- Commercially available as Sanitech Super at 40,000 ppm
- Less corrosive, less hazardous and highly germicidal
- Spray 1.25% Sanitech Super (500 ppm Chlorine dioxide) prepared in 0.5% slaked lime solution & spray @ 1.5 litre /sq. m

Preparation of 100 lit. Sanitech Super in 0.5% slaked lime soln.

- Take 125 g activator crystals in a basin/bucket
- Add 1.25 litres Sanitech Super solution to it
- Keep it for 10 minutes
- Add activated solution to 98.75 litres water
- Add 500 g slaked lime
- Mix thoroughly and use



- Disinfection of rearing houses, surroundings & appliances
- For maintenance of personal and rearing hygiene

Expenditure: ₹ 350/- for rearing 100 dfls

Cost benefit ratio: 1:8

Do's

- Make sure that the mix turns yellow on adding activator crystals
- Use recommended quantity of activator crystals
- Wear a mask while spraying the solution

Dont's

- Never prepare the solution under direct sunlight
- Don't mix Sanitech Super solution, activator crystals and slaked lime powder together
- Don't put Sanitech Super solution, activator crystals and slaked lime powder directly to the water



Disinfection and hygiene in silkworm rearing using *Serifit*

- Year of recommendation: 2015

Salient features

- *Serifit* is effective against all common pathogens of silkworm
- It suits all types of rearing houses and does not need air tight conditions
- Less corrosive, less hazardous and highly germicidal
- Spray of 0.20% *Serifit* solution for disinfection of rearing house and rearing appliances @ 1.5 litre /sq. m

Preparation of 100 litres of 0.20% Serifit Solution

- Add 200 g of *Serifit* granules in 100 litres of water
- Mix thoroughly
- Keep for 30 min before spraying



- Disinfection of rearing houses, surroundings and appliances
- For maintenance of personal and rearing hygiene

Expenditure: ₹ 180/- for rearing 100 dfls

Cost benefit ratio: 1: 9

Do's

- Use the disinfectant 30 min after mixing *Serifit* granules
- Wear a mask while spraying the solution

Don't's

- Don't use impure and muddy water for preparing the solution



Prevention of common silkworm diseases with *Vijetha*

- Year of recommendation: 1995

Salient features

- Silkworm body and rearing seat disinfectant against spread of all silkworm diseases
- The first powder formulation for preventing all silkworm diseases
- A patented technology (Indian Patent No.186852/ 28-09-1998)

Application

- After every moult before resumption and on 4th day of V instar after ensuring that no eatable leaf is left in the rearing bed
- Dust on silkworm body and rearing seat @ 3 g/sq. ft. during I & II instars and @ 5 g/sq. ft. during III, IV & V instars



For prevention of common silkworm diseases during rearing

Expenditure: ₹ 300/- for rearing 100 dfls
Cost benefit ratio: 1:6

Do's

- Feed the silkworms 30 minutes after dusting
- Wear a mask while dusting
- Keep the powder in air tight containers
- Dust the recommended quantity

Dont's

- Don't dust the mixture on feeding larvae
- Don't cover the tray or rack after dusting
- Don't use Vijetha after expiry date



Prevention of muscardine disease using *Vijetha Supplement*

- Year of recommendation: 2001

Salient features

- Anti-fungal formulation for the prevention of spread of muscardine
- A specific bed disinfectant for preventing muscardine disease during rainy and winter seasons, in addition to Vijetha

Application Schedule - Req. quantity/100 dfls (g)

Larval stage	Tray rearing	Shoot rearing
3 rd day of IV instar	600	900
2 nd day of V instar	1,000	1,300
6 th day of V instar	1,400	1,800
Total	3,000	4,000

Usage

For prevention of Muscardine disease

Expenditure: ₹ 300/- for rearing 100 dfls

Cost benefit ratio: 1:5

Do's

- Dust on silkworm body and rearing seat @ 3g/sq. ft.
- Feed the silkworms after 30 minutes of dusting
- Wear a mask while dusting
- Keep the powder in air tight containers

Dont's

- Never dust the mixture on feeding larvae
- Don't cover the tray or rack after dusting
- Dusting should not be done when silkworms are under moult or eatable leaves are available in the bed



Prevention of all common diseases of silkworm using *Ankush*

- Year of recommendation: 2003

Salient features

- An eco- & user-friendly silkworm body & rearing seat disinfectant
- Effective against the spread of all major diseases of silkworm
- Ingredients are biodegradable and eco friendly

Application Schedule for 100 dfls (g)

Stage	Rearing method	
	Tray	Shoot
After I moult *	72	72
After II moult *	144	144
After III moult *	288	540
After IV moult *	768	1,440
3 rd day of V instar	1,076	1,600
5 th day of V instar	1,348	2,160
Total	3,696	5,956

* before resumption

Usage

For prevention of all common diseases of silkworm during rearing

Expenditure:
₹ 300/- for rearing 100 dfls
Cost benefit ratio: 1: 7

Do's

- Use as a general bed disinfectant for prevention of all common diseases of silkworm
- Wear a mask while dusting
- Feed the silkworms after 30 minutes of dusting

Dont's

- Never dust the mixture on feeding larvae
- Don't cover the tray or rack after dusting



Suppression of Grasserie and Flacherie diseases in silkworm using *Amruth*

- Year of recommendation: 2003

Salient features

- An eco and user friendly botanical based formulation for the control of grasserie and flacherie diseases
- The first ever curative formulation against silkworm diseases

Preparation (for 100 dfls)

- Mix *Amruth* powder in water @ 20 g/litre. Sprinkle 70 ml of *Amruth* solution per kg of mulberry leaf/shoot

Schedule	Amruth (g)	Water (ml)	Leaf/Shoot (kg)
After 2 nd feed of II moult	07	350	5
After 2 nd feed of III moult	53	2,650	38
After 3 rd feed of IV moult	90	4,500	67
Total	150	7,500	110



For suppression of Grasserie and Flacherie diseases in silkworms

Expenditure: ₹ 150/- for rearing 100 dfls
Cost benefit ratio: 1:5

Do's

- Use freshly prepared solution
- Mix the solution with hand

Don't's

- Don't use sprayer for sprinkling the solution
- Don't dry the leaves for longer time



IPM of Uzi fly, *Exorista bombycis*

- Year of recommendation: 2002

Salient features

- Uzi fly is an endo-larval parasitoid of silkworm
- Inflicts 10-15% loss to silkworm crop
- Occurs throughout the year, but predominant during rainy season
- Lays 400-500 eggs with an incubation period of 2-3 days
- Larval and pupal periods last for 6-8 days and 10-12 days, respectively
- Completes life cycle in 18-20 days
- Adults survive for 15-21 days

Management approaches

Exclusion Method

- Fix wire mesh/nylon net on all doors and windows
- Fix doors with automatic closing mechanism
- Provide *ante*-chamber at the entrance of the rearing house

Uzi trap

- Dissolve one tablet in 1 litre of water and keep in white trays both inside and outside the rearing house on window sills throughout the rearing period

Biological Method

- Release *Nesolynx thymus* (ecto-pupal parasitoid) during V instar @2 pouches/100 dfls
- From each pouch, about 10,000 *N. thymus* adults emerge
- Single parasitoid may parasitize 4-5 uzi pupae
- 40-60 parasitoids develop on each uzi pupa



IPM of Uzi fly, *Exorista bombycis* Cont...

- After mounting of spinning worms, keep the pouches near mountages
- After harvesting of cocoons, keep them near manure pit

Cultural Method

- After completion of rearing, separate the silkworm litter from mulberry twigs
- Pack the litter in plastic bags, close and keep for a minimum of 15 days before throwing in the litter pit
- Alternatively, litter can be buried in soil immediately after rearing

Advantages

- Maintains uzi infestation consistently below 2%
- Eco-friendly, effective and economical

Usage

Effective in the management of Uzi fly

Expenditure: ₹ 150/- 100 dfls rearing
Cost benefit Ratio: 1: 5

Do's

- Continue keeping uzi trap inside the rearing house even after spinning for up to 15 days to ensure trapping of flies emerging from uzi pupae present in the room
- Collect uzi fly pupae from inside rearing house/mounting & harvesting place and burn immediately

Dont's

- Do not throw uzi infested silkworms in open area, instead put them in 2% bleaching powder solution for 24 h before discarding
- Do not keep the door open even after rearing to avoid escaping of uzi flies



Sampoorna - A hormone for uniform maturity of Silkworms

- Year of recommendation: 2003

Salient features

- Orally administer to silkworms by spraying the diluted *Sampoorna* over mulberry at the onset of spinning
- All the larvae will mature within 12-18 hours after spraying
- Can be used to save the crop under exigency conditions (disease outbreak or leaf shortage)

Advantages

- Spinning will be initiated within 12-18 hours
- Increase in pupation rate
- Marginal increase in yield and price of cocoons
- Less defective cocoons
- Cocoons can be marketed one day early



Early uniform maturity of silkworms & synchronised spinning

Do's

- Use each vial of 10 ml *Sampoorna* for about 20,000 larvae
- One vial of *Sampoorna* should be mixed in 2 litres of water.
- Spray the mixture onto a thin layer of leaf spread on the larvae at the onset of spinning
- Wear a hand gloves while preparing the mixture

Don't's

- Don't spray directly on the larvae
- Don't feed large quantities before spraying
- Don't leave the larvae unattended for more than six hours after treatment



Samruddhi (JHA Technology) for enhanced cocoon/silk production

- Year of recommendation: 2007

Salient features

- *Samruddhi* can be administered to any silkworm breed/hybrid
- V instar larval duration prolongs by 12 to 24 h necessitating two additional feeds

Application

- Mix one vial (5 ml) of *Samruddhi* in 2.5 litres of water to form an emulsion
- Spray directly on larvae (50 dfls) after 48 h in V instar

Advantages

- 6 to 12 kg increase in cocoon yield or 1 kg silk / 100 dfls
- Cocoon yield increases by up to 15%



Increases cocoon and shell weight by 12-15% with no adverse effect on shell percentage

Do's

- Administer the product at 48 h of V instar in bivoltine and at 24 h in cross breeds
- Apply the product only after mixing thoroughly in water
- Spray the emulsion directly onto the larvae before feeding preferably in the morning

Dont's

- Never apply *Samruddhi* if sufficient leaf is not available
- Do not feed the larvae immediately after the treatment, wait for a minimum of 30 min
- Do not mount the treated larvae until properly ripe



Young-age silkworm (*Chawki*) rearing houses

- Year of recommendation: 2002

Salient features

- Chawki* rearers can create and maintain optimum environmental conditions for young-age silkworms - 27 to 28°C and 85 to 90% RH
- Rearing hall: wall to wall 8 m x 8 m (25' x 25') with a height of 14' at the centre and 10' at the side walls for rearing 5,000 dfls per batch
- Separate rooms for leaf storage and storing equipment
- Ante-room at the entrance to ensure hygiene
- 6' open verandah around the rearing hall

Advantages

- Facilitates maintenance of optimum temperature and humidity conditions
- Thorough disinfection & maintenance of hygiene are possible

Usage

Appropriate for large scale commercial chawki rearing

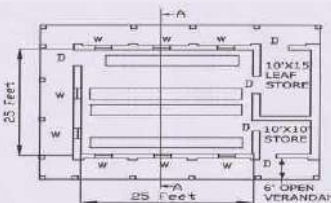
Cost: ₹ 3.0 lakhs

Do's

- Construct as per plan
- Ensure adequate ventilation and illumination

Dont's

- Do not store leaf inside the rearing hall



Late-age silkworm Rearing Houses

- Year of recommendation: 2007

Salient features

- Facilitates maintenance of optimum environmental conditions
- Suitable for rearing both bivoltine and multivoltine silkworms
- Rearing hall: 6 x 6 m (20' x 20') for 100 dfls. Add 6 m to the length of the hall for every additional 100 dfls
- Height: 14' at the centre and 10' on the sides to accommodate 5 shelves for rearing

Advantages

- Separate room for leaf storage and ante-room to maintain hygiene and restrict entry of pests & predators
- Facilitates effective disinfection and maintenance of optimum rearing environment



Long term benefits to rearers through production of quality cocoons

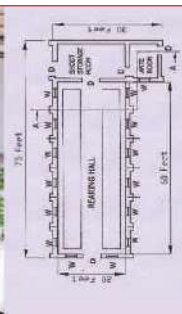
Cost : ₹ 4.0 Lakhs for 1,000 sq.ft. (for rearing 250 dfls)

Do's

- Construct as per plan

Dont's

- Do not store leaf and other rearing materials inside rearing hall



PVC Stands for young-age (*Chawki*) silkworm rearing

- Year of recommendation: 2004

Salient features

- Sericulturists can assemble the stands by themselves
- Non-corrosive and hence disinfectants do not cause any damage
- 40% cheaper than metal stands
- Light in weight and hence can be moved easily
- Do not absorb or release heat. Hence, does not add to temperature inside rearing hall

Advantages

- Easy, durable and cost effective



Appropriate for large scale commercial chawki rearing

Cost: ₹ 12,000/- per stand of 100 trays capacity

Do's

- Use quality material

Dont's

- Never use flame gun for disinfection of PVC units



PVC Stands for late-age silkworm rearing

- Year of recommendation: 2016

Salient features

- Durable
- Light in weight
- Corrosion free
- Easy to clean and disinfect
- Simple to erect

Advantages

- Easy maintenance of rearing conditions
- Saves energy as the PVC is non absorbent of heat
- Height and space between racks can be altered as per requirement



Large scale silkworm rearing for cocoon production

Cost : ₹ 60/sq. ft.

Do's

- Use quality material

Dont's

- Never use flame gun for disinfection of PVC units



Mechanisation



Mulberry cutting preparation machine

- Year of recommendation: 1995

Salient features

- Mulberry cuttings preparation is fast and efficient
- Cuttings obtained are without any damage
- The machine is electrically operated

Advantages

- While a worker can prepare 1,500-2,000 cuttings in a day manually, this machines can produce 1,200-1,400 cuttings in one hour
- The machine reduces drudgery in cutting preparation



- Cuttings preparation is made easy
- Can save labour and time
- Avoids damage to the cuttings

Cost: ₹ 10,000/-

Do's

- Hold the shoots firmly against the cutting blade

Dont's

- Never use very thick shoots for preparation of cuttings



Mulberry leaf chopper

- Year of recommendation: 2001

Salient features

- Can cut 150-175 kg mulberry leaves in one hour
- The machine is powered by ½ hp electric motor
- Can also be operated manually

Advantages

- Cuts large quantities of mulberry leaves in a short time
- Can cut leaf into different sizes to suit the age of larvae



- Facilitates chopping large quantity of mulberry leaves in short time
- Useful in Commercial Chawki Rearing Centres

Cost: ₹ 30,000/-

Do's

- Feed the leaves gently into the machine
- Provide sufficient work area around the machine

Dont's

- When manually operated, should not be connected to power supply



Mulberry shoot crushing machine

- Year of recommendation: 1995

Salient features

- This machine is very useful for production of compost or vermi-compost out of sericulture residue
- The machine cuts and crushes all types of plant materials including coconut fronds
- The machine is powered by a 5 hp electric motor

Advantages

- Facilitates quick conversion of bio-degradable material into compost or vermi-compost
- Saves time and energy



- This machine cuts and crushes mulberry shoots into small pieces, which facilitates fast decomposition

Cost: ₹ 40,000/-

Do's

- Feed moderate quantum for crushing

Dont's

- Too hard wooden parts should not be put into the machine



Dusting machine for young age silkworm rearing

- Year of recommendation: 2014

Salient features

- Facilitates dusting of lime and bed disinfectants over young age silkworms
- This is an electrically operated machine

Advantages

- Durable and efficient
- Ensures uniform dusting
- User friendly as exposure to chemicals is minimum



Usage

- Useful in chawki rearing centres, where a large number of rearing trays are handled

Cost: ₹ 30,000/-

Do's

- Use smooth and clumps free lime/bed disinfectant

Dont's

- Do not use wet or dampened powders in the machine



Mature Silkworm Separator

- Year of recommendation: 2002

Salient features

- Manual separator for small and medium farmers
- Motorised separator for large scale farmers

Advantages

- Saves time and manpower
- Manually operated machines separate about 40-50 dfls silkworms in one hour
- Motorised machines can separate over 125 dfls worms in one hour
- Avoids delay in spinning due to manual operations, especially while using rotary mountages

Usage

- To facilitate separation of mature silkworms from mulberry shoots

Cost: Manual machine ₹ 6,000/-; Motorised machine ₹ 10,000/-

Do's

- Gentle operation is enough for separation process
- Handle carefully to avoid damages to worms

Dont's

- Do not resort to separation before larvae mature



Seri Room Heater

- Year of recommendation: 2006

Salient features

- Heavy duty electrically operated heater
- Suitable to maintain desired temperature in the silkworm rearing houses

Advantages

- Durable and efficient

Usage

- To maintain desired temperature in rearing houses

Cost: ₹ 5,000/-

Do's

- Place on a level ground

Dont's

- Do not use in open type rearing houses



Seri Humidifier cum heater

- Year of recommendation: 2007

Salient features

- Functions as a humidifier as well as a heating unit
- Desired humidity and temperature can be maintained in the rearing house

Advantages

- Dual use as humidifier and heater
- Desired relative humidity and temperature can be set
- Temperature or humidity or both can be set as per requirement

Usage

- Suitable for young age silkworm rearing
- Suitable for late age rearing during summer to maintain desired humidity

Cost: ₹ 16,000/-

Do's

- Ensure sufficient water in the machine
- Set desired temperature and humidity to suit the larval age

Dont's

- Do not use in open type of rearing houses



Plastic tray washing machine

- Year of recommendation: 2015

Salient features

- Equipped with pressurised water spray and scrubbing system
- Facilitates maintenance of hygiene in *chawki* rearing and egg production centres
- Helps in efficient management in Chawki Rearing Centres

Advantages

- Time and labour saving device
- About 100 trays can be washed in one hour



- Washing of plastic trays in *Chawki* Rearing Centres and egg production centres

Cost: ₹ 35,000/-

Do's

- Ensure use of sufficient quantum of water and disinfectants

Dont's

- Do not put trays of dimensions other than specified



Cocoon Harvesters for Rotary Mountages

- Year of recommendation: 2001

Salient features

- Facilitates harvesting of cocoons from rotary mountages easily and quickly
- Hand operated and foot operated harvesters are available

Advantages

- Saves time and labour
- No damage to cocoons while harvesting



- For easy & quick harvesting of cocoons from rotary mountages

Cost: ₹ 8,000/-

Do's

- Fix the rotary frame with the cocoons in the slot properly
- Apply gentle pressure

Dont's

- In case of hand operated harvester, do not apply pressure on one side only



Cocoon Harvester for Collapsible Plastic Mountages

- Year of recommendation: 2015

Salient features

- Electrically operated machine
- Saves time and labour

Advantages

- Can harvest from 150-160 mountages in one hour
- Deflossing and cleaning also takes place while harvesting



- Harvest cocoons from plastic collapsible mountages

Cost: ₹ 18,000/-

Do's

- Insert the mountages between the shafts and move gently

Dont's

- Do not put more than one moutage at a time
- Pluck flimsy cocoons from mountages before harvesting



Cocoon Deflosser

- Year of recommendation: 2002

Salient features

- The loose layer of unreelable floss can be effectively removed
- Manual, motorised and motorised-cum-hand operated versions are available

Advantages

- Fast and labour saving
- Deflossing is efficient
- Cost effective

Usage

- Helps in removal of floss and cleaning the cocoons before reeling

Cost: Manual machine ₹ 2,500/-; Motorised machine ₹ 12,500/-
Motorised-cum-hand operated ₹ 10,000/-

Do's

- Feed the cocoons in a single layer
- Clean the floss collected on the machine frequently

Dont's

- Do not feed cocoons in more than one layer



Folding and bundling tool for plastic mountages

- Year of recommendation: 2002

Salient features

- Facilitates maintaining the shape of plastic mountages

Advantages

- Well maintained mountages help in better cocoon formation
- Helps in utilization of less space for storing the mountages



- To fold and bundle plastic mountages for better durability

Cost: ₹ 200/-

Do's

- Fold the mountages one by one into the frame

Dont's

- Do not preserve without bundling



Seed cocoon cutting machine

- Year of recommendation: 1998

Salient features

- Facilitates fast cutting of seed cocoons in the grainages
- Reduces drudgery in cocoon cutting
- Adjustable to cocoon size

Advantages

- Helps in efficient management of silkworm seed production centres
- Can cut 5,000-5,500 cocoons per hour

Usage

- For efficient seed cocoon cutting in grainages

Cost: ₹ 35,000/-

Do's

- Select and place uniform sized cocoons in the slot

Dont's

- Avoid double and flimsy cocoons



CSRTI-Mysuru

In pursuit of excellence



Central Sericultural Research & Training Institute (CSRTI), Mysuru is a pioneering institution in the field of sericulture striving for the overall development of mulberry silk industry in the country. CSRTI-Mysuru is a full-fledged centre of

excellence providing R&D and HRD support to enhance silk productivity and quality ensuring higher economic returns sericulturists. With a vision to become an International Sericulture Institute par Excellence in Bivoltine Sericulture, CSRTI-Mysuru made immense contributions through scientific and technological innovations, extension management strategies and skill development in different aspects of mulberry sericulture from soil to cocoon production. CSRTI-Mysuru is well-equipped with modern laboratories, quality mulberry gardens and adequate infrastructure to undertake advanced research, modern Library, Computer networking and Bioinformatics Centre for aiding in R&D activities. CSRTI-Mysuru also has established a mechanism to validate the developed technologies/products through on-station and on-farm trials at its Regional Sericultural Research Stations, Research Extension Centres and sub-units. Sericultral Engineering division facilitates designing machines for mulberry cultivation and silkworm rearing and fabrication of prototypes. The training division of CSRTI-Mysuru caters to the needs of capacity building and skill development of stakeholders in tropical sericulture not only in the mandated states, but also in other states of India and overseas students. The staff of CSRTI-Mysuru, on ISO 9001:2015 accredited institution, is oriented towards achieving excellence in application oriented research to transform Indian sericulture into a vibrant globally competitive industry.

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