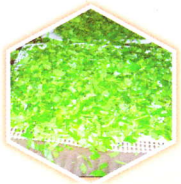
Commercial Chawki Rearing



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PREFACE

Chawki silkworm rearing plays a vital role in bivoltine sericulture industry by providing robust chawki worms for the production of quality bivoltine cocoons with improved yields. Chawki rearing must be carried out scientifically with technical skill and expertise and this is not possible for all the farmers. Establishment of commercial chawki rearing centres (CRCs) was given special emphasis during XI & XII plan by Central Silk Board and State Sericulture Departments (DoSs).

National Workshop on Innovative Technologies and Best Practices in Sericulture is being organized & Central Silk Board-Bangalore, Ministry of Textiles : Govt. of India at Central Sericultural Research & Training Institute (CSRTI), Mysuru to felicitate the sericulture famers for their achievements for innovative technologies and best practices in Kisan Nurseries, Productivity improvement (Chawki Rearing, Cocoon yields & Seed production), Reeling, Higher Returns and Best Innovations. Two sericulturists are being conferred awards in each state from 27 states across India. On this occasion, CSRT-Mysuru is bringing out a booklet on Commercial Chawki Rearing for the benefit of sericulturists across India. The booklet provides latest information on comprehensive package of practices recommended for exclusive chawki mulberry garden, chawki rearing, chawki certification system, CRC establishment, registration of CRCs, capacity building & training programmes.

Even though several hundreds of CRCs were established in the country, earlier they have not seen the success and acceptance by the farmers as they were not supported by appropriate and economically viable technologies and adequate infrastructure facilities. CSRTI-Mysuru in collaboration with Japan International Cooperation Agency (JICA) developed a viable CRC model and appropriate chawki rearing practices in mulberry sericulture sector. Catalytic Development Programme (CDP) implemented by Central Silk Board and DoSs significantly contributed to establish several CRCs. Chawki certification is a pre-requisite for the success of bivoltine crops and forms the key component of bivoltine rearing technology package as CRCs ensure assured crops by reducing the incidence of diseases in late instars.

CRC enterprise has re-emerged today, in areas where it had disappeared earlier and has witnessed innovations resulting in uniform hatching and crop stability. CRCs are now an integral part of mulberry sericulture and are a vital cog in the sustainability of bivoltine sericulture. Commercial CRCs are being operated by individual entrepreneurs/SHGs/NGOs with the sole objective to produce good quality healthy worms for the farmers leading to better cocoon yields. The stupendous success of Cluster Promotion Programme in its 2nd phase reflects importance of the CRCs as backward linkages in bivoltine silk production across India. Today most of the farmers prefer to rear CRC reared chawki worms than brushing eggs on their own and the tremendous growth witnessed in bivoltine raw silk production (3870MT during 2014-15) in the recent years could be attributed to CRC activities and their tribe is increasing day by day. Around 800 CRCs are registered as per Central Silk Board (Amendment 2006) act throughout the country in both mulberry and non-mulberry sectors.

The authors are thankful to Dr. Sanjay Kumar Panda, IAS, Secretary, Ministry of Textiles and Dr. Nagesh H Prabhu, IFS, Member Secretary, Central Silk Board for constant support and encouragement. The authors would like to extend thanks to all the scientists of CSB, whose contributions and inputs have been incorporated in the booklet. The authors express their gratitude to CRC entrepreneurs and DoS officials for sharing their insights and experiences. I hope that this booklet on commercial chawki rearing would be beneficial to aspiring entrepreneurs, sericulture famers and department personnel.

V Sivaprasad

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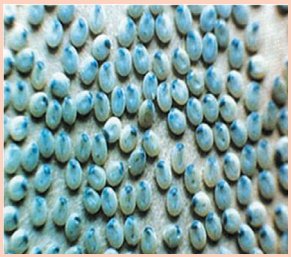
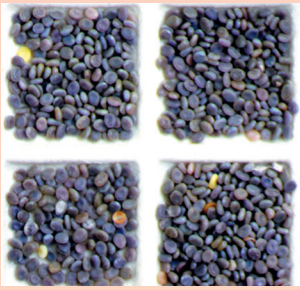




CHAWKI REARING

Young age silkworm rearing generally called as chawki rearing has become a vital cog in the sericulture industry. Silkworm larval stage from hatching to cocoon spinning is of about 23-24 days duration, which is clearly differentiated in to five instars by four moults. The stage from hatching up to the end of second moult covering the first two instars is considered as the young age or chawki stage. Chawki rearing refers to the rearing of young silkworms under controlled micro climate. The process of chawki rearing may be compared to the establishment of nursery in horticulture and plantation crops. The purpose of chawki rearing is to grow quality silkworms under disease free environment, to reduce the cost and silkworm rearing duration with famers, and to improve the cocoon quality and productivity. Robust and healthy worms ultimately produce quality cocoons. In the developed silk producing countries like China, Korea and Japan, the farmers (95%) receive silkworm as chawki worms. The young age silkworms are referred as Chawki (India), Kego (hairy silkworms in Japan) and Ants (China). The basic requirements for successful commercial chawki rearing centre (CRC) are suitable rearing house for chawki rearing with required rearing appliances, well maintained and irrigated exclusive chawki mulberry garden and well trained man power.

Advantages of CRCs

- Proper Egg Incubation & Good Hatching
- Robust & Disease-Free Chawki Worms
- Prevention of Crop Loss & Cocoon Crop Stabilization
- Increased Yield of Good Quality Cocoons
- Reduction in Production Cost of Cocoons
- Higher Profits
- Synchronization of Crops
- Distribution of Labour for Other Works

Before the advent of CRCs, farmers generally used to procure silkworm eggs from government or private grainages and incubate the eggs and grow the worms in their dwelling houses or in the silkworm rearing houses. The chawki being a vulnerable stage requires perfect hygiene and suitable micro-climate. Quite often, the farmers cannot provide the required care and environment, which leads to improper hatching, unhealthy young worms and ultimately a poor cocoon yield and returns. The CRCs facilitate the farmers to purchase healthy and uniform chawki worms after 2nd moult at a reasonable rate, saving them nine days' labour and from the delicate task of incubation, brushing and young age rearing. It is recorded that the cocoon productivity from CRC supplied worms is about 20-25% higher. The CRCs also promotes batch rearing among the farmers, and also helps to increase the number of crops per year for more sustainable economic returns.

Chawki rearing must be carried out scientifically with technical skill and expertise, which is now provided to the famers by the commercial enterprises known popularly as Chawki Centres or Commercial Chawki Rearing Centres (CRCs). In recent years several commercial CRCs have been established by private entrepreneurs across India, especially in the traditional sericulture areas. Supply of chawki worms is an integral part of bivoltine silk promotion programmes of the Central Silk Board, and is being strictly implemented in its Cluster Promotion Programme (CPP) and Institute Village Linkage Programmes (IVLP). The CSRTI, Mysuru has designed and is operating a model CRC for distributing chawki worms to farmers as an institutional activity and also for training the entrepreneurs and farmers in CRC operation.

MULBERRY CULTIVATION TECHNOLOGY - EXCLUSIVE CHAWKI GARDEN

Package of Practices for Chawki Mulberry Garden	
Land & Soil	Flat Land Porous & Fertile Soil Sandy Loam Soils Good Drainage Soil pH: 6.5-7.5 Organic Carbon: >0.65
Plantation Area	3.2 cares Four Blocks (0.8 acres each)
Plant Spacing	90cm x 90cm Paired Row (150 + 90) x 60 cm
Manure (FYM)	40 MT/ha/year Two Split Doses After 1st & 5th Harvests
Chemical Fertilizer (N:P:K kg/ha/year)	260:140:140 8 Equal Doses
Form of Chemical Fertilizers	Straight

The basic requirement for a CRC is a well maintained exclusive chawki mulberry garden. CSRTI, Mysuru has developed an exclusive package of practices for irrigated chawki mulberry garden. Mulberry leaf quality plays an important role for healthy and successful chawki rearing and the nutritional requirement of chawki worms is completely different from that of late age worms. The leaves fed to chawki larvae should be tender, soft, succulent and rich in protein (25%), carbohydrate (14%) with at least 80% moisture content. The common technology package is not adequate enough to meet such specific leaf quality requirement.

Irrigation Frequency	1.5 acre-inch @ Interval of 7-10 days
Training & Pruning	Top Clipping Pruning of crown (4 times/year)
Crops/ Year (Nos)	Eight Alternate Leaf Picking & Shoot Harvest

Pruning and Training:

After the establishment period of 8-10 months, the plants should be pruned at a crown height of 20cm above the ground level preferably during the onset of monsoon season. The leaf harvest starts 35 days after the bottom pruning, and will be continued for seven days. The terminal bud is clipped off 3 days after the chawki leaf harvest. The second leaf harvest starts 25–30 days after top clipping and shoot-lets are harvested to rear the next batch of chawki worms. Thereafter, the plants are again pruned as described earlier, that is about 80- 90 days after the first pruning depending on season and growth. This cycle of events is repeated four times for conducting eight crops per annum. However, pruning may be delayed during winter season.

Mulberry Varieties: Mulberry varieties with higher levels of succulence and nutrition are suitable for healthy and robust chawki worms. S36 is the mulberry variety recommended for chawki rearing. However, V1 is the mostly exploited mulberry variety for chawki gardens. G2 variety is being popularized currently for CRCS.

S36 mulberry variety belongs to *M. indica* and evolved from Berhampore local by chemical mutagenesis and recommended for young age silkworm rearing (chawki garden) in southern India in 1984 by CSRTI-Mysuru. The variety is characterized by moderate rooting ability; total leaf yield: 38-45 tonnes/ha/year under assured irrigated conditions; moisture content: 76%; protein: 22%; carbohydrate: 28%; moderate tolerance to leaf spot & powdery mildew.

V1 (Victoria1) belongs to *M. indica* and developed from a cross of S-30 and Berc 776 by conventional breeding. V1 is recommended for assured irrigated conditions for young and late age silkworm rearing in 1996 by CSRTI-Mysuru. V1 is characterized by profuse flowering; total leaf yield: 60 tonnes/ha/year; moisture content: 80%; protein: 24.6%; total sugars: 17%; moderate tolerance to leaf rust and leaf spot; quick sprouting; high rooting ability: 94%.

G2 mulberry variety is a hybrid of *Morus multicaulis* and S34 and is a high yielding variety recommended for exclusive chawki garden. Under assured irrigation and under the recommended package of practices, G2 variety yields about 38MT good quality chawki leaves/ha/year in an 8 crops schedule with alternate leaf picking and shoot harvest. The G2 is

characterized by erect branches, thick dark-green leaves, high moisture content [80.30%], high moisture retention [83.40%], high sprouting [96%] and rooting [94%] ability. The comparative performance of G2, S36 & V1 mulberry varieties recommended depicts the advantages of G2 variety.

Chawki Garden Management: The whole plot is divided into 4 plots each to rear 5000 dfls/crop at 10 days interval to realize 32crops/year. Organic inputs like VAM, Bio fertilizer, Vermicompost etc. in desirable quantities are applied to the chawki garden to sustain soil health and fertility status for the continuous yield of quality leaf. Pest and disease control measures are undertaken regularly with mechanical and biological control methods as application of chemicals pesticides and fungicides to the garden have adverse effect on chawki silkworms.

G2 Mulberry Veriety

Agronomical Description			
Variety	G2	S36	V1
Chawki Leaf Yield (MT/ha/yr)	38.00	27.94	31.86
Shoots/Plant (Nos)	10-12	8-0	10-12
Total Shoot Length (cm)	1170	924	1280
Inter-Nodal Distance (cm)	4.50	3.53	5.20
Leaf Size (cm)	L: 21-24 B:16-9	L: 20-23 B:16-19	L: 20-23 B:13-15
Leaf Surface	Smooth Glossy wavy	Smooth Glossy pale green	Smooth glossy dark green
100 Leaf Weight (g)	460	465	560
Sprouting (30th day)	96%	70%	90%
Rooting (90th day)	94%	48%	94%

Advantage G2

- Suitable for young-age [chawki] silkworm rearing
- Yields 33% more chawki leaves than S36 and 20% more than V1
- Good rooting ability and easily propagated through cuttings
- Quick regeneration capacity
- Moderately resistant to leaf spot & leaf rust

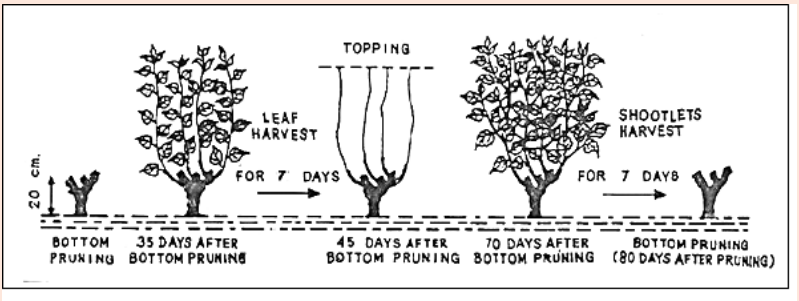
Leaf Quality			
Parameters	**G 2**	**S 36**	**V 1**
Nitrogen (%)	4.21	4.05	4.19
Phosphorus (%)	0.32	0.32	0.33
Potassium (%)	2.20	2.21	2.14
Protein (%)	26.31	25.31	26.19
Total Sugars (%)	12.85	11.89	12.13
Reducing Sugars (%)	1.46	1.45	1.41
Starch (%)	11.06	11.96	11.90
Total Carbohydrates (%)	23.91	23.85	24.03
Fibre Content (%)	10.74	10.73	10.73
Total Chlorophyll Content [mg/g FW]	3.654	3.252	3.726
Moisture Content (%)	80.30	79.90	80.10
Moisture Retention % (after 6 hours of harvest)	83.40	82.90	83.20

Chawki Rearing Performance			
Parameter	**G 2**	**S 36**	**V 1**
Moulting Percentage after II moult	97.40	98.10	97.40
Weight of Ten larvae after II moult [g]	0.435	0.380	0.400

Advantages of Exclusive Chawki Garden

- Ensures chawki leaf yield of 38MT/ha/year as against 8-10 MT/ha/year from general garden through selected harvesting
- 100% leaves/shoot-lets are suitable for chawki rearing
- Production of qualitatively superior mulberry leaf (80% leaf moisture, 25% leaf protein & 13% leaf sugar) as compared to the leaves obtained from general garden (70% leaf moisture, 21 % leaf protein & 11% leaf sugar)
- Annually, approximately 1.80 - 2.0 lakh dfls /ha can be chawki reared in 32 crop schedule (3 crops/month with brushing once in 10 days @ 20 kg chawki leaf /100 dfls)

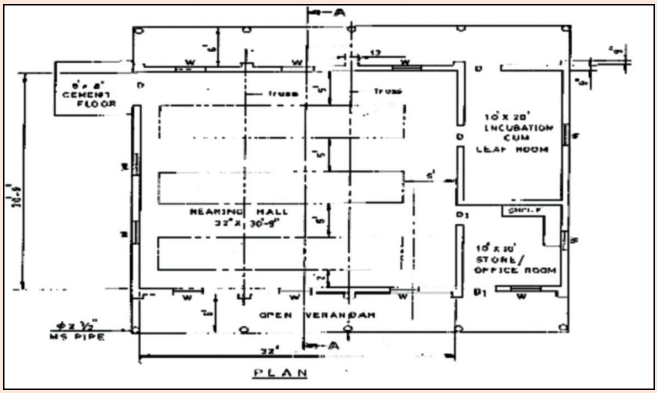
Quality Mulberry Leaf Ensures
Healthy & Robust Silkworm Growth Results in Successful Silk Cocoon Crops


TOPPING
LEAF HARVEST
FOR 7 DAYS
SHOOTLETS HARVEST
FOR 7 DAYS
20 cm.
BOTTOM PRUNING
35 DAYS AFTER BOTTOM PRUNING
45 DAYS AFTER BOTTOM PRUNING
70 DAYS AFTER BOTTOM PRUNING
BOTTOM PRUNING (80 DAYS AFTER PRUNING)

CHAWKI SILKWORM REARING

Chawki Rearing House

A separate rearing house with adequate rearing space and sufficient ventilation is essential for a CRC to enable effective disinfection, maintenance of optimum environmental conditions of humidity & temperature and hygienic conditions. The rearing building should be constructed away from the dwelling houses and late age rearing buildings and preferably close to the chawki mulberry garden. The ideal CRC building is designed by CSRTI-Mysuru for rearing 5000 dfls/crop and 32 crops in a year. The CRC building should have RCC roof and adequate facilities for good ventilation. If the CRC building is larger than required, maintenance of micro-climate would become tougher.. The CRC room can also be used as incubation room for silkworm eggs. The CRC building should possess a rearing hall measuring 32 x 30 ft and two rooms of 10 x 20 ft each for leaf preservation and for storing rearing appliances.



Chawki Rearing Appliances (5000 dfls/Batch)	
Item	Quantity
Plastic Trays (3 x 2 ft)	600
PVC Rearing Stands	30
Feeding Stands	10
Plastic Basins	20
Power Sprayer	1
Room Heater	2
Humidifier	2
Wet & Dry Thermometer	1
Plastic Incubation Frames	100
Bed Cleaning Nets	500
Air Cooler	2
Leaf Chopping Machine	2
Dust Bins	5
Plastic Crates	4
Disinfection Masks	2

Specifications of Chawki Rearing Appliances & Equipments	
Appliance/ Equipment	Specificationsz
Plastic Trays	• Single piece injection moulded HDPE trays with double walls • Outer dimension: 900mm L x 600mm B x 80mm H • Perforated bottom with diamond shape criss-cross ridges
HDPE Crates	• Outer Dimension (mm): 600 (L) x 400 (B) x 425 (H) • Inner Dimension (mm) - 565 (L) x 365 (B) x 420 (H) • Weight:- 2.85kg; Shape: Rectangular • Perforations on all sides except the bottom
Incubation frame	• Capacity 50 dfls (25000 silkworm eggs) • Grooves for uniform distribution of eggs

Electrical Operated Hi-Pressure Portable Power Sprayer	• HDP (2 piston) pump powered by 1 HP Single phase ISI mark electric motor, 1440 rpm, 220 volts, 50Hz, mounted on MS Tubular frame • 2 ½ m suction hose, 2½ m bypass, 30 m hose (BP-150kg / cm2) • 3 ft stainless steel spray gun; working pressure: 12 -15 kg / cm2
High pressure Portable Power Sprayer	• HDP (2 piston) pump powered by 1.5-2.0 HP reputed ISI mark engine, petrol start, kerosene/ diesel run mounted on MS Tubular frame • 2½ m suction hose, 2½ m bypass, 30m hose (BP-150kg / cm2) • 3ft stainless steel spray gun; working pressure 12 - 15 kg / cm2
Portable Generator Set	• Frequency: Hz 50 – 60 Hz; Rated AC voltage: 220 – 240 V • Max output 1.5 KW / 2 HP • Operating noise level: (7M) DB (A) – 60 -61 • Recoil type start
Leaf Chopping Machine	• Motor rating : ½ to 1 hp 220 V • Size of cutting : 5 mm to 25 mm; Capacity : 150- 250 kg/hr • Leaf storage tray capacity : Minimum 5 kg • Conveyor for leaf feeding • Cutting blade made of high speed carbon metallic body
PVC Pipe Chawki Rearing Stand	• Material : PVC; Sections : Tubular • Capacity : 100 trays of 2' x 3' size • Overall length : 23' ; Overall height : 7'; Overall width : 2' • No. of tiers : 11
Humidifier cum Heater	• Power: 220 V 50 Hz Single phase • Water pump capacity: 0.25 HP Moist air blower • fan capacity: Sweep 450mm, 150W, Rpm-1400; Air flow - 2000m3/hr • Water tank capacity: 20litres; Water Sprayer: per hour 8 – 10 litres • Working Principle: humidification & cooling of air evaporative cooling • Room Volume: 480 M3 (20m x 6m x 4m) • Heater Wattage: 2.0 KW • Hot air blower capacity: Sweep 300mm, Watt-65, Rpm-1350; Air flow - 2000m3/hr Distance of throw of Hot air 8 m • Castor wheels for movement with handle at arm height

Humidifier	• Evaporation capacity: 7.5l/h; Air circulation: 800m3/h • Water supply connection: 7mm • Water evaporation per HP: 30 l /h; Water displacement per HP (MM): 4000; Maximum water pressure : 0.3-6 Bar • Motor : 0.2 HP; Motor speed : 2800 RPM • Fitted with humidistat assembly for regulating humidity with auto cut-off and switch • Movable stand for mounting • Entire unit made of sturdy MS metal frame
Air Cooler	• The body should be made of fiber cooling area :at least 60 sqm • Air delivery : at least 3000 m3 /h • Speed control facility : required • Cooling medium : wood wool / Steel wool • Louver movement : motorized • The unit should be portable water level indicator Castor wheels
Room Heater	• Heating coil linear, circular heating coil with ISI mark • Power input: 16 A, AC, 100 - 200 W with heat regulator • Thermostat Capillary type; 10-500°C temperature regulation with 1.5 sq mm; 5m extended multi strand ISI copper cable • Heat dissipation fan fitted with Heavy duty 1/9 HP motor should disperse the heat at 360 degrees • Temperature gain 100°C in 1800 cuft room air space within 2 h • Body cold rolled & annealed; chemical resistant epoxy • Paint coated MS sheet power cable (2.5 sq.mm, 3 phase, double insulated, 5m length, ISI, multi strand copper power cable with 16A, branded ISI 3pin plug Top
Flame Gun	• Gas burner: Dia 4.5 cm x 7.5 cm long with front open gap and bend pipe of 1 cm diameter with LPG gas regulator made of Brass Steel Tube : Diameter 1.5 cm, length 1 m including hand grip
	• Reinforced flexible PVC pipe: Dia 12.5 mm nylon breaded x 5 m length with hose clamps • LPG gas regulator (ISI) with gas lighter
Powder Duster	• Material: Plastic; Height: 5" Dia 5.5" • Handle Stainless steel on upper side fitted with SS crews; Sieve lid 5.5"dia, threaded, circular, removable, with nylon mesh sieve supported with ribs at the bottom • Mesh Nylon, monofilament, woven, 250 holes/sq.inch • Glass marbles: 5 nos; Spares: 3 sieve lids & 5 marbles

Tray washing cum Disinfection Machine	• Pressure pump rating : 1 hp 220V • Disinfectant storage tank : 100 litres • Body" Metallic Spraying gun with variable spraying pattern
Dry & Wet Bulb Thermometer	• Measuring range: -35°C to 55°C • Accuracy: Highly accurate with ± 0.01°C accuracy • Teakwood base for vertical mounting • Scale engraved on acrylic sheet
Binocular Microscope	• Fully capable of hosting accessories like phase contrast kit with 10x & 40x condensers and eye piece for alignment and dark field • Interchangeable 45 degree inclined binocular tubes co-axial ball bearing guide ways focusing system • With objective lenses of 10x, 20x & 40x • Mechanical stage with ball bearing slides and soft feel • Centring telescope eyepiece 15x & high transmittance green filter • Special non – reflective multi-layer coating to the phase ring objectives • All objectives are to be par focalised and par cantered • Product should be as per BIS (ISI) standard
Paraffin Paper	• 80 GSM brown paper including wax coating • Melting point of wax: 55°C • Width: 112cms; length: 30m

Disinfection and Hygiene Maintenance

Early instars (I, II & III) of silkworms are more susceptible to diseases compared to late instars, and bivoltine silkworms are more susceptible to diseases than multivoltines. Any lapse in the maintenance of hygiene properly in the in CRC may lead to crop loss for all the farmers, who have received the young worms from that CRC. Hence, meticulous disinfection and adoption of hygienic rearing techniques are of paramount importance in commercial chawki rearing centres operations.

One of the major constraints in silk cocoon production is the incidence of silkworm diseases. Diseased silkworms extrude pathogens into the rearing environment and form the source of infection for further spread of the disease. These pathogens are highly stable and persist in silkworm rearing environment for longer periods. Destruction of disease causing pathogens is called disinfection and the most effective method is by utilizing chemicals. Chawki rearing is considered as the most crucial stage in silkworm rearing and proper disinfection of CRC building, rearing appliances and maintenance of hygiene are the important activities for prevention of diseases. CSRTI-Mysuru has developed an effective and comprehensive package for silkworm disease management.

Disinfection

Quantity of Disinfectant Solution:

The total requirement of disinfectant solution for CRC/late age rearing house, its surroundings and appliances is estimated based on the floor area (Length × Breadth of floor) of the rearing house. Effective disinfection is carried out by utilizing 1.5 litre/sq.m floor area or 140 ml/sq.ft floor area of rearing house (height 3 m /10 ft). 500ml/sq.m or 14 ml/sq.ft is additionally required for every increase in height by 1 meter or 1 feet, respectively + 35% of total quantity for the surroundings and rearing trays.

Recommended Disinfectants

- 2% Bleaching powder in 0.3% slaked lime solution
- 2.5% Sanitech/Serichlor in 0.5% slaked lime solution
- 0.05% Asthra solution

Effective disinfection is carried through drenching spray of disinfectant solution in all the nook and corners of the CRC using power sprayer.

Preparation of 2% Bleaching Powder Solution		
Ingredients	For One Liter	For 100 Litres
Bleaching Powder (ISI; 32% Chlorine)	0.020 kg	0.020 × 100 = 2 kg
Slaked Lime	0.003 kg	0.003 × 100 = 0.3 kg
Water	1 liter	1 × 100 = 100 litres

- Add little water to the bleaching powder and slaked lime and make a paste
- Add rest of water to this paste and stir-mix well and keep for 10 minutes
- Use the supernatant for disinfection of rearing house

Preparation of 0.05% Asthra Solution		
Ingredients	For One Litre	For 100 Litres
Asthra Powder	0.5 g	0.5 × 100 = 0.05kg
Water	1 liter	1 × 100 = 100 litres

- Mix the required quantity of Asthra powder to the water and stir thoroughly
- Keep for 2 hours for dissolution of the disinfectant and use for disinfection of rearing house

Disinfection Schedule		
Day/Event	Activity	Details of Activity
On Completion of Rearing	1	First disinfection of CRC & appliances with recommended disinfectants; preferably 2% Bleaching powder solution
3 days Before Brushing	2 3	Cleaning & washing of CRC building Rearing Trays disinfection
2 days Before Brushing	4	Second disinfection of CRC & appliances with recommended disinfectants
1 day Before Brushing	5 6	Dusting 5% Bleaching powder in slaked lime powder surrounding environs of CRC Open the windows of CRC for ventilation and to free the gases accumulated

Disinfection of Rearing Appliances: An ideal disinfectant tank (4ft x 3 ft x 2 ft; 672 litres) is constructed for immersing the small rearing appliances for effective disinfection. The tank is filled with disinfection solution at half capacity (336 litres) to immerse the rearing appliances. All the smaller rearing appliances including rearing trays should be dipped for an hour in the tank and dried in sun. Good quality power sprayer and disinfection masks are prerequisites for effective disinfection.

Surface Disinfection of Silkworm Eggs

In addition to the initial surface disinfection performed at the seed production centre or at the grainage, as a measure of precaution, the surface disinfection of silkworm eggs should be conducted one more time at CRC level. This is quite essential if the eggs are transported before pin head (head pigmentation) stage. This ensures that contamination from other sources during the transit is not carried over into the chawki stage. In case of loose eggs, silkworm eggs are transferred into a cloth or nylon bag and immersed in 2% formalin solution for about 10 minutes and subsequently eggs are air-dried. These eggs are transferred to the incubation frames for incubation. The sheet eggs are surface disinfected in 2% formalin by dipping.

Bed Disinfectant Application (100 dfls till II instar)		
Larval Stage	Disinfectant	Quantity/ 100 dfls (g)
Worms Settling for 1st moult	Slaked Lime Powder	50
Worms in 1st moult	Vijetha/ Ankush	50
Worms Settling for 2nd moult	Slaked Lime Powder	150
Disinfectants are dusted as a thin layer uniformly @ 3g/sq.ft using a duster/muslin cloth		

Maintenance of Hygiene

Disinfection of CRC and its surroundings including appliances aims at destruction of pathogens in the rearing environment before the initiation of chawki rearing. However, pathogens can gain entry into CRC through the movement of workers, personnel handling, air-drift and from diseased silkworms. Recommended hygienic measures are undertaken prior to brushing and also during the rearing for the prevention of secondary sources of contamination and to harvest successful crops.

Measures to Maintain Hygiene

- Wash hands and feet with the recommended disinfectant solution before entering the CRC and also after attending the rearing
- Wash hands with disinfectant after every bed cleaning
- Collect diseased/dead/weak larvae from the rearing bed with forceps/chop-sticks into a basin containing disinfectant solution and destroy them by burning
- Collect silkworm bed refuse into litter basket/vinyl sheet meant for it
- Prevent flooring of bed refuse during bed cleaning
- Disinfect the leaf storage room along with the rearing room
- Store mulberry leaves in a separate room
- Cover the mulberry leaves with wet gunny cloth
- Dust slaked lime powder on the rearing bed when the worms settle for moult
- Disinfect silkworm body & rearing seat by dusting Ankush/Vijetha after I moult before resumption
- Rear Chawki larvae under recommended optimum temperature, humidity and spacing conditions for healthy growth
- Feed silkworms with quality mulberry leaves for robust chawki

Handling of Silkworm Eggs

Any encounter withadverse environmental conditions at egg stage results in a variety of embryonic disorders leading to the deterioration of quality leading the death of embryo. The intensity of damage to embryo depends on the exposure of eggs to the intensity of adverse conditions. Meticulous care needs to be taken for ensuring uniform, healthy, growth and development of the embryo resulting in higher hatching.

Egg Transportation - Care

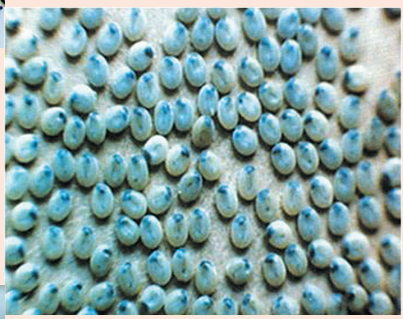
- Transport eggs during cool hours of the day
- Avoid exposure to direct sun light
- Avoid contact with chemicals, fertilizers & pesticides
- Avoid injury to eggs by physical shocks
- Provide optimum temperature (25°C) & ventilation to avoid suffocation of embryos

Incubation of Silkworm Eggs

The process of providing optimum temperature humidity and photoperiod to facilitate healthy growth and development of embryo is known as incubation. This should be done at incubation chambers or special facility attached in CRC itself. Proper incubation ensures good hatching of healthy larvae on a single day. Low cost incubation devices such as double brick wall chambers could also be utilized. For incubation of loose eggs, loose egg incubation frames should be used for uniform development of embryo and good hatching. These frames are useful for incubation, black boxing and brushing of loose eggs.

Black Boxing for Synchronized Hatching

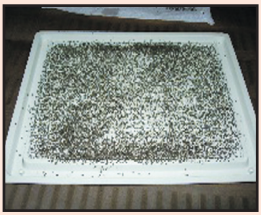
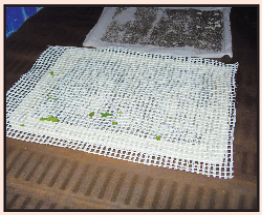
- Eggs are subjected to complete darkness for 48 hours prior to hatching (at the head pigmentation stage)
- The egg sheets or the incubation frames are wrapped with black paper/ cloth
- Black boxing is done when more than 50% eggs reach head pigmentation stage
- Bivoltine hybrids: Black boxing has to be done 60 hours prior to hatching for acid treated & 72 hours in case of hibernated eggs
- Preferably make the incubation room or incubation chamber dark
- On the expected day of hatching, black boxed eggs are exposed to diffused light to stimulate hatching
- Wait for 2-3 hours for complete hatching



Brushing of Chawki Silkworms

The process of transferring of newly hatched larvae from egg sheet to rearing seat is called brushing. Either a soft-fibred brush or feather is employed for brushing just hatched silkworms on sprinkled cut-mulberry leaves. Optimal temperature and humidity are maintained in the chawki rearing centre for proper chawki rearing.

Sheet Eggs	Loose Eggs
• On the day of hatching, egg sheets are removed from black boxing and spread uniformly in a single layer in the chawki rearing tray with paraffin paper seat • Complete hatching is observed after two hours exposure to light • Mulberry leaves cut into 0.5 sq.cm are sprinkled on the newly hatched larvae on the egg sheet • After 30 minutes when all the larvae gather on the leaves, they are transferred to the rearing seat giving suitable spacing • First feeding is given to larvae in the chawki made in rearing tray • Rearing bed is covered with another sheet of paraffin paper to complete the operation of bushing for 3-4 hours • Egg sheets are collected and hatching percentage is calculated	• Each loose egg box contains 50 dfls (about 30000 eggs) where the eggs remain packed in single layer. The frames are placed in the rearing trays over paraffin sheet. • Proper incubation is very difficult in loose egg boxes • Plastic incubation frames are used to spread the eggs in single uniform layer. • Incubation frame are shifted to rearing tray (3 x 2 ft) having paraffin paper as seat • Inner frame and the covering with tissue paper are removed gently and tissue paper covered on the eggs also is removed and kept aside • Nylon net (40 x 30 cm; 2-4 mm lattice) is applied over the frame • Mulberry leaves cut into 0.5 sq.cm are sprinkled on the newly hatched larvae on both net and tissue paper • Rearing bed is covered with another sheet of paraffin paper to complete the operation of bushing for 3-4 hours • Second paraffin paper is covered on this and kept for 3 to 4 hours • Nylon net is removed after transferring the larvae to the rearing • Egg shells along with un-hatched eggs are separated and hatching percentage is calculated • Plastic incubation frames can be re-used after disinfection


Leaf preservation

Environmental Conditions for Young Age Silkworm Rearing		
Particulars	I instar	II instar
Temperature	28°C	27°C
Humidity	85 - 90%	85%

- Optimal temperature is maintained by using an electric heater or charcoal stove, especially during night time in winter season
- Optimal humidity is achieved by adopting by using paraffin paper/ blue polythene sheet as seat & cover

Characteristics of Chawki Silkworms

- ✓ High growth rate, only 6% of total mulberry leaf is consumed up to III moult
- ✓ Body water content is very low in newborn larvae and increases rapidly up to II instar
- ✓ Needs succulent mulberry leaves with high moisture content
- ✓ Need quality nutrition through mulberry leaf/artificial diet
- ✓ Resistant to high temperature and high humidity
- ✓ Weak against pesticides, chemicals, gases and susceptible to diseases

Leaf & Bed Spacing Requirements for Young Age Silkworms (100 dfls = 60,000 Larvae of CSR hybrids)				
Stage & Day	Leaf Quantity (kg)	Spacing		Count of Rearing Trays (3 x 2 ft)
		Beginning	End	
I-1	1.00	9.0 sq. ft @ 6660 larvae/ sq.ft	36 sq.ft @ 6660 larvae/sq.ft	2 to 6
I-2	1.50			
I-3	2.00			
I-4	0.75			
II-1	5.50	36 sq. ft @ 1660 larvae/ sq.ft	72 sq.ft @ 830 larvae/ sq.ft	6 to 12
II-2	8.50			
II-3	3.75			
Total	**23.00**			
The chawki worms are distributed to the farmers in 12 trays/100 dfls				

Chawki rearing can be undertaken in different ways, but most popular and effective method is stand rearing and followed meticulously in all the CRCs. Chawki larvae are reared in plastic rearing trays of 2 x 3' size. The trays are arranged in a rearing stand made with PVC pipes.

Chawki Worm Feeding

Quality mulberry leaves produced from exclusive chawki garden should be harvested during cool hours of the day. The leaves/shoot-lets are preserved with wet gunny cloth to avoid leaf drying in a separate leaf preservation room or an exclusive area. Hygiene should be maintained in leaf preservation area

2-3 feeds/day to chawki worms is recommended for healthy growth of larvae. Leaves need to be chopped and fed to enable uniform feeding

utilizing leaf chopping machine to preserve moisture and nutrition. The bed space of chawki worms should be increased to facilitate drying using chopsticks before first feeding every day.

Bed Cleaning

Chawki silkworms need to be grown in chawki rearing house with high humidity. Left-over leaf and litter accumulated in the rearing bed increases bed humidity and leads to multiplication of pathogens. The larval bed is spread with chopsticks every day before first feeding to dry the bed and to provide optimum spacing for healthy growth. However, bed cleaning during first instar is not recommended as it could increase the percentage of missing larvae. Bed cleaning is necessarily undertaken only once during second instar (before settling for second moult). Cleaning nets are used for bed cleaning to avoid secondary contamination. The rearing house floor is wiped with 2% bleaching powder in 0.3% slaked lime solution after bed cleaning.

Moulting Care

- Remove paraffin papers when the worms are preparing for moulting
- Stop further feeding of leaf and allow drying of bed
- Dust lime powder on the moulting larvae
- When 95% of the larvae come out of moult, dusting of bed disinfectant is recommended
- 30 minutes later, the larvae are fed after applying nylon net

CHAWKI CERTIFICATION

The supply of disease free quality chawki worms is a basic pre-requisite for the production of bivoltine silk. Chawki certification is essential and usually given during 2nd moult before supply of the chawki worms to farmers. Chawki certification consists of the following four tests: Quantification of missing larvae; Quantification of larval uniformity; Assessment of larval growth; Health status of the larvae.

1. Quantification of Missing Larvae

- Collect the information on hatching (%) from CRC
- Place square paper board (10 × 10 cm) on a rearing bed and collect all the larvae available in the space of 100 sq.cm

- Collect one sample per 100 Dfls
- Count the number of larvae collected
- Estimate the total larvae in a tray (60 × 90 cm = 5400 sq.cm) using following formula:

$$\text{No. of larvae / tray} = \frac{\text{No. of larvae/100 sq.cm x 5400 sq.cm}}{100}$$

No. of larvae/100 dfls = No. of larvae/Tray x No. of trays kept for 100 dfls

No. of missing larvae/100 dfls = No. of larvae brushed – Estimated larvae/100 dfls

$$\text{\% missing larvae} = \frac{\text{Missing larvae}}{\text{No. of larvae brushed}} \times 100$$

Inference: If the missing larval percentage is 5 and above, it indicates poor rearing management.

2. Quantification of Larval Uniformity

- Randomly collect 3-5 batches of 100 larvae each from different trays
- Separate undersized larvae and count the number
- Calculate % of undersized larvae using the following formula:

$$\text{\% of undersized larvae} = \frac{\text{No. of undersized larvae}}{\text{Total number of larvae}} \times 100$$

Inference: If the percentage of undersized larvae is 15 and above, it indicates that larvae are weak/diseased or a result of poor rearing management.

3. Assessment of Growth of Larvae

- For every 100 dfls randomly collect 100 under-moult larvae from different trays
- Take the weight of larvae by using sensitive electronic balance

Inference: The standard weight of 100 bivoltine hybrid larvae during 2nd moult should be between 3.4 - 3.8g and for crossbreeds between 2.2 - 2.6g. If the weight is less than the standard, it indicates that larval growth is not optimum.

4. Health Status of Larvae

- ✓ Collect the suspected diseased larvae/dead/weak/unsettled larvae from different trays
- ✓ Subject them to visual diagnosis for different diseases. For confirmation, conduct microscopic examination for the presence of pathogens by technically qualified personnel

Disease Diagnosis	Visual Symptoms	Microscopic Observation	
Grasserie	Unsettled larvae; aimless crawling; swollen inter segmental regions; shining skin; oozing milky fluid	Presence of polyhedra	If samples reveal pebrine disease, the batch is not fit for distribution and it should be rejected and burnt. CRC is disinfected immediately and recommended prophylactic measures should be followed stringently. CRC is monitored for pebrine for the future chawki batches including the testing of egg shells.
Flacherie	Undersized larvae; inactive larvae; vomiting & flaccidity	Presence of bacteria	
Muscardine	Restricted larval movement; dead larvae; hardened larvae; white mummified larvae	Presence of fungal hyphae	
Pebrine	Under-sized larvae; delayed moulting	Presence of oval spores	

FORMAT OF CHAWKI CERTIFICATE			
Name of the CRC:		Address:	
Date of Brushing:		Hatching %:	
Source of dfls:		Lot No. :	
Breed/Hybrid:		No. of dfls:	
Stage of Larvae:		No. of trays kept/100 dfls :	
Chawki Certification System		Norms	Observation
Assessment	Missing Larvae	< 5%	✓
	Larval Uniformity [under sized larvae]	<15%	✓
	Growth of larvae (wt./100 larvae)	3.4 - 3.8 g (BV) 2.2 - 2.6 g (CB)	✓ ✓
Visual & Microscopic Examination	Grasserie	Free	✓
	Examination	Free	✓
	Muscardine	Free	✓
	Pebrine	Free	✓
REMARKS: BATCH IS FIT FOR DISTRIBUTION Date: XX-XX-XX XXXXXX Signature Name & Designation:			

TRANSPORTATION OF CHAWKI LARVAE

After chawki certification, the young silkworms during the moult are transported in a vehicle to the farmers during cool hours of the day. Care should be taken that young worms are not disturbed during the transportation.

ECONOMICS OF CHAWKI REARING

(5000 Dfls/Batch & 32 Batches/Year =1.6 lakh dfls/annum)

Chawki Rearing Centres (CRCs) location at the places of cocoon production is gaining popularity and is currently working as backward linkage to the farmers. Several private entrepreneurs are running CRCs on commercially in many parts of Karnataka, Tamil Nadu and Andhra Pradesh. Model CRC established at CSRTI-Mysuru lead to the evolution of solid model for economically viable CRC operations.

A: Non-Recurring Costs					
Particulars	**Unit Rate/ Number**	**For 5000 dfls**	**Total Cost (Rs.)**	**Life Span (Years)**	**Depreciation (Rs.)**
Rearing House (42' X 32')	600/ Sq.ft	1650	990000	25	39600
Plastic Rearing Trays (2'x3')	480	600	288000	15	19200
PVC Rearing Stands	12000	5	60000	20	3000
Incubation Frames	50	100	5000	15	333
Feeding Stands	200	10	2000	15	133
Chopping Machine	35000	1	35000	20	1750
Litter Baskets	100	10	1000	15	67

Plastic Basins	50	20	1000	10	100
Leaf Collecting Basket	50	25	1250	5	250
Bed Cleaning Nets	50	600	30000	10	3000
Heaters	5000	2	10000	5	2000
Humidifiers	15000	1	15000	10	1500
Power Sprayer	18000	1	18000	10	1800
Disinfection Mask	2000	1	2000	15	133
Thermometer	1000	1	1000	15	67
Interest on Capital					82721
Other Costs					1000
Total: Non-Recurring (A)			**1459250**		**75683**

B: Recurring Costs			
Particulars	**Requirement**	**Rate (Rs.)**	**Total Costs (Rs.)**
Bleaching Powder (kg)	150		
Sanitech (litre)	120	40	6000
Lime (kg)	250	70	8400
Paraffin Paper (meter)	1000	15	3750
Bed Disinfectant (kg)	115	12	12000
Labour Charges		50	5750
(5 mandays/ 6 days)	1152	232	267264
Cost of Chawki Leaf	35200	15	528000
Cost of Layings	160000	600	960000
Electricity Charges	Lumpsum		18000
Other Costs	Lumpsum		1500
		Total Recurring (B)	1762664

Abstract of Costs	
Head	Amount (Rs.)
Non-Recurring C00ost (A)	75,683
Recurring cost (B)	17,62,664
Total of (A+B)	18,38,347
CRC owners profit margin @ 10 % of total cost (A+B)	1,83,835
Risk factor @ 5 % of recurring cost (B)	88,133
Total Expenditure per annum (3+4+5)	21,10,315
No. of Dfls brushed per year	1,60,000
Chawki Rearing cost per 100 dfls (6/7) (Rs.)	1319.00

REGISTRATION OF CRCs

Central Silk Board formulated meaningful modifications in the existing rules and regulations governing sericulture in the wake of liberalization policy and globalized market economy way for quality improvement. Central Silk Board (Amendment) Act, 2006 was passed by the Parliament (Gazette of India; 14th September 2006); relevant rules were subsequently notified (28th September 2007); and Central Silk Board Silkworm Seed Regulations (2010) were notified on 16th March 2010. The Government of India in compliance with the provisions made in the Central Silk Board (Amendment) Act, 2006 introduced the procedure for registration of silkworm seed producers, chawki rearers and dealers in silkworm seed or chawki silkworm. The registration process is undertaken by the implementing agency "Registration Committee" appointed by the Central Silkworm Seed Committee (CSSC). Director, National Silkworm Seed Organization (NSSO) is the Chairperson of the Registration Committee and is authorized to register and maintain the records of silkworm seed producers, commercial chawki rearers, seed cocoon producers and dealers apart from ensuring the adherence of quality norms in the seed sector. Most of the CRCs registered rear mulberry silkworm chawki and their tribe is in demand.

Eligibility Criteria for Registration

- The chawki silkworm rearer shall possess a matriculate pass certificate and a certificate course in sericulture from a recognized institution for having undergone training in chawki silkworm rearing for not less than three months in a sericulture institution under State or Central Silk Board or any other recognized institution
- A chawki rearer who is already operating the chawki rearing centre shall not be required to possess the prescribed qualification, but he shall undergo refresher course training on chawki silkworm rearing for not less than a period of one month
- He/she shall undertake to rear a minimum quantity of 1.5 lakh DFLs per annum from the third year of registration
- He/she shall possess a minimum of two acres of Chawki mulberry garden of improved variety with irrigation facility or sufficient mulberry trees
- He/she shall possess the chawki rearing house in a suitable location with adequate rooms for storing leaf, rearing silkworms and other requirements and shall have adequate ventilation
- He/she shall possess the appliances or equipment as specified

Procedure of Registration and Grant of Certificate

- Any person intending to involve in commercial chawki rearing of the silkworm seed of any notified kind or variety shall apply to the Registration Committee in the prescribed form, Form12 (Form-13 as of now) under rule 47 (1) in triplicate along with a fee of Rs.100/- payable in cash, by Indian Postal Order or demand draft from a commercial bank along with the relevant enclosures.
- A licensed Chawki rearer already operating the commercial chawki rearing centre shall also get himself/herself registered by submitting the application as stated above.

Registration Process

1. The Registration Committee on receipt of application under rule 47 shall examine in the case of an existing entrepreneur whether the applicant has submitted the documentary evidence in proof of earlier license or certificate or permit to indicate that that they have been engaged in Chawki rearing.
2. In case of a new applicant the Committee shall examine whether he/she has submitted the documentary evidence in proof of the minimum educational qualification and training undergone as required for registration

3. An alpha-numeric identification number for each registration shall be issued by the Registration Committee, and a register containing the details of all such registered personnel/ bodies shall be maintained.
4. An application may be withdrawn at any time before the requested service is rendered. The applicant will remain responsible for payment of expenses incurred in connection with the processes already initiated
5. The certificate of registration shall be valid for a period of five years, on expiry of which the application for renewal in the prescribed form shall be submitted to the Registration Committee at least a month before the expiry of the registration
6. Any application for registration may be rejected under Rule 50 by the Registration Committee (a) for noncompliance with the Act or the Regulations relating to conditions for registration or (b) when it is not practicable to provide the service for which it is registered after giving reasonable opportunity of being heard
7. Every applicant whose application is rejected, shall be notified in writing, within 30 days of application, the grounds on which the application has been rejected

CRC Registration Made Easy

Eligibility

- The CRC owner shall possess a matriculate certificate and a certificate for having successfully undergone three months chawki rearing training from a recognized institution
- Should possess required infrastructure (mulberry garden, chawki rearing house, required equipments) and trained manpower
- An existing chawki rearer (as on 31.3.2006) is exempted from educational qualification and training requirement
- Should brush 1.5 lakh dfls chawki worms/annum from the 3rd year of Registration

Procedure of Registration

- Submit the application in Form-13
- Enclose a demand draft for Rs.100 drawn in favour of Member Secretary, CSB payable at Bengaluru
- Enclose certificates in support of qualification and training or the copy of the license held
- Enclose the list of infrastructure, equipment etc.
- The Registration Committee examines the application and if found eligible, issues the Registration Certificate
- Applications without the enclosures are kept in abeyance; the applicants are notified and if failed to produce, the applications are rejected
- The certificate bears an alphanumeric registration number
- The certificate is valid for 5 years and needs renewal after the time lapses

Compliance

A registered Chawki rearer shall -

1. procure only the certified hybrid seed from a Registered silkworm seed producer that meet the quality standards as specified in Chapter V of the regulation
2. rear and transact only the variety or kind of silkworm as indicated in the certificate of registration
3. not change the venue of the Chawki rearing center without the written permission of the Registration Committee
4. rear the Chawki worms adopting methods & procedure stipulated in the Chapter V
5. conduct testing of Chawki worms as stipulated in the Regulation (Chapter V)
6. not refrigerate the eggs or Chawki worms
7. maintain up to date record of hybrid seed procurement, larval examination details, disease incidence and disposal of Chawki worms and submit quarterly reports in Form-2
8. give free access to the records and products for the Seed Officer or Seed Analyst or any other officer so appointed or authorized by the Registration or Central Silkworm Seed Committee, during his visit and provide such assistance as may be required
9. if there is an incidence of pebrine, he shall discontinue the rearing and reject and destroy the entire batch of larvae and shall take prophylactic measures to prevent contamination
10. inform immediately such incidence in writing to the Seed Officer and seed producer with the necessary details such as the source of seed, lot number, date of purchase, date of examination, stage of examination and the details of test results
11. certify the Chawki worms as 'Tested OK' if found disease free and authenticate with stamping including his name and date of transaction.

Cancellation of Certificate of Registration

If the Registration Committee is satisfied, either on a reference made to it or its own examination

(a) that the registration granted by it has been obtained by misrepresentation of the facts; or

(b) the person has, without reasonable cause, failed to comply with the terms & conditions subject to which the registration has been awarded or

(c) has contravened any of the provisions of the Act or the Rules made there under;

then, without prejudice to any other penalty to which the holder of the registration may be liable under this Act, the Registration Committee may, after giving the holder of the registration, an opportunity of showing cause, cancel the registration. The Registration Committee shall notify in writing the cancellation of registration made under 8 E (2) (viii).

Inspection Process

1. All registered Chawki rearers shall abide by the quality standards specified from time to time by the CSSC and those who contravene the conditions of registration are liable to be punished under the provisions of the Act
2. The persons authorized by the Committee will inspect the Chawki rearer as and when required for the purpose of verification and fulfillment of all the laid down conditions/guidelines and procedures for silkworm seed production and trade
3. If the Registration Committee is convinced that the Registration was obtained by misrepresenting the facts or the person failed to comply with the terms and conditions without reasonable cause or the person has contravened the provisions of the Act or Rules then RC may cancel the registration after giving an opportunity for showing the cause.

The chawki rearing of mulberry silkworms has become a thriving entrepreneurship in the sericulture industry in India today. About 800 CRCs have been registered to undertake the chawki rearing activity across the country.

Responsibility of Registered CRCs

- Procure only the certified hybrid seed from Registered Seed Producers that meet the specified standards
- Rear the chawki worms adopting methods and procedure stipulated in the Regulation and distribute disease free chawki leading to successful cocoon crop
- Conduct testing of chawki worms for all batches
- Do not refrigerate the eggs or chawki worms
- Maintain up-to-date record of hybrid seed procurement, larval examination details, disease incidence and disposal of chawki worms

Registered CRCs in India

State	CRCs (Nos)
Andhra Pradesh	49
Assam	6
Bihar	5
Chhatisgarh	27
Himachal Pradesh	8
Karnataka	409
Manipur	20
Madhya Pradesh	49

- On incidence of pebrine, discontinue the rearing, reject and destroy the entire batch of larvae and take prophylactic measures to prevent contamination
- Inform immediately in writing to the Seed Officer and seed producer indicating source, lot number, date of purchase, date of examination, stage of examination and the details of test results
- Certify the chawki worms as 'tested ok' if found disease free and authenticate with stamping including date of transaction
- Submit quarterly reports in Form-2 to RC
- Strictly abide by the quality standards specified by the CSSC and those who contravene the conditions of registration are liable to be punished under the provisions of the Act

Maharashtra	9
Nagaland	4
Odisha	26
Sikkim	7
Tripura	11
Tamil Nadu	30
Uttarakhand	6
Uttar Pradesh	6
West Bengal	65
Total	**737**

Few success stories of commercial chawki rearing centres are compiled herewith for inspiration and motivation to the aspiring entrepreneurs. The success of these particular CRCs are already a legend in traditional sericultural states of Karnataka, Andhra Pradesh and Tamil Nadu. Several young people are attracted to the CRC business models and a constant stream is getting trained at CSRTI-Mysuru.

SUCCESS STORIES

CRCs – Centres of Entrepreneurial Excellence

Chawki silkworm rearing plays a vital role in bivoltine sericulture industry as only robust chawki worms can produce quality bivoltine cocoons. Poor cocoon crops and even complete crop failures have been attributed to the improper management practices during young age silkworm rearing. All the farmers may not be capable to undertake scientific method of chawki rearing following the right packages of practise right from disinfection and egg incubation through the course of chawki rearing under the controlled micro-climate. To achieve these objectives and to improve cocoon productivity, establishment of CRCs was given special attention during XI & XII plan by Central Silk Board and DoSs of Karnataka, Tamil Nadu and Andhra Pradesh. JICA and IVLP programmes stressed upon the importance of healthy chawki worms with chawki certification as pre-requisite for the success of bivoltine crops. CRCs ensure assured crops by reducing the incidence of diseases in late instars. Today most of the farmers prefer to rear CRC reared chawki worms than brushing eggs on their own and the tremendous growth witnessed in bivoltine raw silk production (3870MT during 2014-15) in the recent years could be attributed to CRC activities and their tribe is increasing day by day. About 800 CRCs are registered as per Central Silk Board (Amendment 2006) act throughout the country in both mulberry and non-mulberry sectors. Few success stories of CRCs in Karnataka, Tamil Nadu and Andhra Pradesh which inspired several entrepreneurs to take up this profession are presented here.

Keerangere-CRC, Keerangere, Kanakapura, Karnataka

Mobile: 09945910795

Keerangere-CRC made a humble foray into the then not-so-popular enterprise of commercial silkworm chawki rearing in 1994. The times when average cocoon yield with farmers' was hovering around 30 kg/100 dfls with rampant crop losses. Believing in the workable concept of scientific silkworm chawki rearing with an intention to improve the crop performance at the farmers' field, Mr. K. Sadashiva of Kanakapura Taluk took up the enterprise against the odds and made considerable impact in sericulture in the first year of operation itself (rearing house

Impact of Keerangere-CRC

- Technology transfer in coordination with CSB & DoS to about 20000 farmers
- Inspired prospective & potential entrepreneurs
- Assumed the role of an industry watch dog for quality chawki
- Proven PPP model for CRC

measuring 510 sq.ft; one acre of mulberry; a work force of their four family members; 1.20 lakh dfls to about 1000 farmers). Initial two years of operations saw the CRC incurring losses batch after batch, however the next 16 years were highly successful commercially and the growth of CRC has been exponential in terms of sales and operating profits.

Today the CRC conducts its activities in an expansive area (30200 sq.ft) including sufficient spaces for critical and supporting activities. It is equipped with all modern facilities including more than 7000 chawki rearing trays, rearing stands, power sprayers, leaf crates, room heaters, humidifiers etc. Financial assistance to the CRC is provided under different programmes by CSB and Dos-Karnataka. The CRC is supported with 25 acres of well maintained and irrigated chawki mulberry garden of high yielding varieties. It is also equipped with adequate water and power supply units (>100KVA) including backup generators.

Keerangere-CRC : Key Statistics

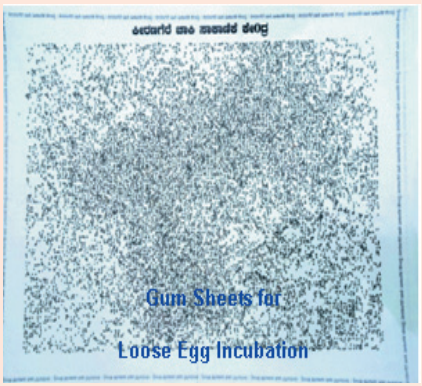
Year	Distribution of Chawki Larvae (dfls)	Bivoltine Hybrids	Farmers Covered	Cocoon Yield/100 dfls (kg)
2009-10	4908362	206475	49085	64.00
2010-11	4611387	471125	46127	64.60
2011-12	7354279	504475	73545	69.00
2012-13	7498500	433000	88434	65.00
2013-14	7387815	192975	78499	74.00
2014-15	5977775	251590	64728	70.00

Keerangere-CRC is a sterling example of PPP model with DOS & CSB for popularizing bivoltine sericulture. The CRC entered into an agreement with NSSO as Franchisee CRC in 2005 for procuring bivoltine dfls (at 15% discount on dfls & 2% annual incentive on dfls cost) to chawki rear and distribute the worms to farmers. The CRC distributes around chawki worms of 60 lakh dfls to farmers including 2-5 lakh bivoltine hybrids across Karnataka covering about 80000 sericulturists. The farmers rearing chawki worms supplied by the CRC have recorded an average cocoon yield of 65kg/100 dfls. The CRC also supports farmers with technical assistance through consistent crop monitoring at farmers' level. The CRC operations today have an annual turnover of Rs. 6 crores with net profits of about Rs. 50 lakhs.

Innovations of Keerangere-CRC
Accolades Won

- Spacing Scales
- Chawki Transportation Boxes
- Gum Sheets for Loose Eggs
- Modified Leaf Preservation

Keerangere-CRC won several awards as a commercial chawki rearing centre from the CSB & DoS-Karnataka for their exemplary services to the farmers and thereby improving cocoon crop productivity. Keerangere-CRC envisages increasing the brushings of 20 lakhs bivoltine dfls per annum; transform Ramanagaram to an absolute bivoltine district by promoting CB farmers to switch over to bivoltine hybrids; establish automated incubation chambers for effective egg incubation and establish linkage of bivoltine farmers with Automatic Reeling Machine (ARM) entrepreneurs.



Keerangere-CRC stands for excellence in commercial chawki rearing activities not only in Karnataka but also for the entire country and serves as a working model for upcoming CRCs & for prospective entrepreneurs. Keerangere-CRC won the hearts of farmers by assured cocoon crops (average cocoon yield: 65kg/100dfls) with crop losses being less than 2%. It also provides employment to several youth around the area with handsome salaries and welfare measures. The entrepreneur feels that CRC success is not only because of education, technology and skill, but also to the driving force of burning desire to serve the farmers community.

Amman-CRC, Manupatti, Udumalpet, Tamil Nadu

Mobile: 09786698961

Udumalpet in Tamil Nadu is the most progressive bivoltine sericulture area over the years and its progress could be mainly attributed to several well established CRCs. The Amman-CRC at Manupatti village was established by Shri T. Sundararj during 2005 under IVLP programme

supported by Central Silk Board in coordination with DoS-Tamil Nadu. The CRC is equipped with sufficient infrastructure facilities and rearing equipments and presently operates at maximum potential with around one lakh dfls brushed every month (30000 dfls/batch) covering 100-120 farmers.

Amman-CRC Chawki Mulberry Garden (variety in acres)
V1 (12)
G2 (2)
RC1 (0.5)
RC2 (0.5)

Very few farmers in Tamil Nadu came forward to take chawki reared worms initially. A series of awareness programmes conducted by CSB and DoS promoted CRC activities in the area, and the improved yield with the chawki-reared worms gradually promoted the concept and the CRC became popular. Today Amman CRC has 15 acres of chawki mulberry garden with improved varieties and follows recommended package of practices for producing quality mulberry leaf suitable for chawki worms. The CRC has two buildings (41' × 33' & 31' × 33'). Separate incubation chamber, chawki leaf storage/chopping space, automatically controlled temperature and humidity maintenance system, auto-spray system for disinfection and its own chawki worm transportation vehicles are available with the CRC. Amman-CRC is managing single plot model with one hectare and follows shoot harvest to ensure rearing of 24 batches of chawki worms per year. Amman-CRC acts as a role model in Tamil Nadu by adopting scientific methods during proper care in egg incubation, disinfection, chawki rearing and maintenance of quality chawki leaf. The CRC supplies quality chawki worms also to the neighbouring districts like Tiruppur, Coimbatore, Tiruchi, Madurai and Erode. Chawki reared worms are now established as the secret of success in the field for bivoltine hybrid rearings and bivoltine raw silk production.

Commercial CRC as Family Business: To produce quality chawki worms at commercial level skilled man power is very much essential. Amman CRC needs 15 mandays everyday for mulberry garden management and chawki rearing. Whole time involvement of all five family members in addition to the engagement of skilled personnel on daily wages is the mantra for the progress made by Amman-CRC. The CRC supplies healthy chawki worms to the sericulturists leading to successful bivoltine crops since 2005 and occupies first position in Tamil Nadu with 50% coverage. Every batch of chawki is

Programme	Chawki Worms Supplied (Dfls)
IVLP (2004-2008)	1290855
CPP-1st Phase (2008-2012)	2276075
CPP-2nd Phase (2013 onwards)	1226350

certified by following scientific method of certification and then distributed to the famers during II moult. The CRC earns a net profit of Rs.2.00 lakhs per annum with a cost-benefit ratio of 1.17.

Amman-CRC establishment contributed immensely for the bivoltine cocoon production not only in Udumalpet area, but also in other neighbouring districts of Tamil Nadu and Kerala. The quality chawki production and its meticulous and timely supply to farmers improved the stabilized cocoon yields with the harvests being an average of 75kg/100 dfls. The service oriented activities undertaken by the CRC contributed for overall economic empowerment of sericulturists in the area.

Chawki Garden - G2 Variety

Chawki Garden - G2 Variety

Transportation of Chawki

Sri Venkateswara Bivoltine Chawki Centre, V.Kota, Kuppam, Andhra Pradesh.

Mobile: 09441600614

Shri. R. Venkatramappa from a sericulturist family of V. Kota in Andhra Pradesh started CRC activities inspired by the Verification of Bivoltine Technology of JICA implemented by CSRTI, Mysuru and DoS- Andhra Pradesh. He used to rear the chawki reared silkworms from Gundisettipalle-CRC managed by JICA team. His experience of growing the chawki-reared worms under ideal CRC conditions prompted him to establish Sri Venkateswara Bivoltine Chawki Centre at V. Kota. The CRC was established in September 2005 with guidance from the scientists of JICA team involved in popularization of bivoltine sericulture technology in Kuppam and REC,-V. Kota. The integrated approach followed by the CRC involving chawki concept along with services for disinfection, hygiene, technologies for silkworm rearing and quality leaf production has proven to produce better cocoon productivity and better returns to the farmers of the area.

The CRC is a trendsetter in Andhra Pradesh and has all the infrastructure facilities for an ideal CRC (plastic trays, incubation frames, leaf chopping machine, humidifier, room heaters, power sprayer, brushing nets etc.) and is assisted under IVLP through CSRTI- Mysuru. Though the CRC activity was initiated with about 10,000 dfls per month, the quantum of brushings increased to about 4 lakh dfls per annum by 2014-15 through the good will gained among the sericulturists of the area. CRC business expanded tremendously and now operates in an expansive area (75 x 37 ft). The modern CRC is equipped with solar power, office room, generator, wall mounted humidifiers, heaters, exhaust system, vehicles to fetch silkworm eggs in black boxed condition and for the transportation of chawki worms. The CRC also established a Seri-Polyclinic for timely supply of disinfectants and other critical inputs required for sericulturists.

Sri Venkateswara Bivoltine CRC-V.Kota : Key Statistics			
Year	Distribution of Chawki Larvae (dfls)	Farmers Covered	Cocoon Yield/100 dfls (kg)
2009-10	234400	814	62.3
2010-11	293300	993	66.3
2011-12	294350	1012	66.4
2012-13	319700	1220	66.7
2013-14	387150	1320	69.8
2014-15	404650	1499	69.1

Innovative Systems: The CRC has V1 mulberry as chawki plantation (9.0 acres) under paired row system with drip irrigation. The entire family is involved in chawki rearing and CRC management. The CRC developed an innovative model to run a mobile disinfection unit (on charge-basis) to benefit the farmers. The entrepreneur developed a gas-run-room heater to maintain optimum temperature in the CRC during cooler seasons. The entire family including women (wife & daughter-in-law) is trained in chawki rearing technology at CSRTI-Mysuru. The REC-V.Kota in close coordination with and DOS, Andhra Pradesh technically monitors the bivoltine chawki rearings undertaken by the CRC.

Sri Venkateswara Bivoltine Chawki Centre-V.Kota reared about 28 lakh dfls of bivoltine hybrids since inception benefitting 1560 farmers, who could achieve an average cocoon yield ranging from 62.3 to 69.8 kg/100 dfls spanning 9509 crops. The successful operations of the CRC in Kuppam division resulted in rapid shift from crossbreed rearings to bivoltine rearings at farmers' level throughout the year. The CRC follows the batch brushing meticulously and three brushings are accomplished every month facilitating effective monitoring of crops by officials and easy marketing. The exemplary service by the CRC resulted in a stupendous development of sericulture in the area recording a shift from 3.51 lakhs DFLs in 2007-08 to 11.55 lakhs during 2014-15

The sound management of CRC has resulted in becoming highly remunerative enterprise. The economic analysis of previous three years

indicates that major part of the expenditure is on the cost of leaf production followed by the labour. The average revenue obtained by sale of chawki worms during the period was Rs. 30 lakhs and the cost benefit ratio varied from 1.6:2.0. The net profits from CRC are about Rs. 15 lakhs per annum with increase in dfls brushed recording higher net income. The CRC entrepreneur expresses that CRC activity is a profitable venture providing periodical income at 10 days interval and is a self employment venture with reasonably good profits besides contributing for the growth of bivoltine sericulturists in the area. Sri Venkateswara Bivoltine CRC-V.Kota won several accolades for contribution to bivoltine sericulture and innovations made for the entrepreneur and his daughter-in-law received SERI-PATTU award (2014) for CRC entrepreneurship. The progress and success achieved by this enthusiastic entrepreneur is a role model Commercial CRC to replicate in other areas for the development of sericulture.

ARTIFICIAL DIET FOR CHAWKI REARING

Nutrid
(Semi-Synthetic Diet for Rearing Chawki Silkworms)

Moisture content in the mulberry leaf is very important for the healthy growth of young age silkworms (I & II instars). The moisture deficiency is more often observed in tropics affecting the balanced nutrition of the silkworms. In advanced sericulture countries like Japan, artificial diets are utilized for rearing young age silkworms.as mulberry leaf will not be available throughout the year, A semi-synthetic artificial diet, Nutrid, has been developed by CSRTI-Mysuru using low-cost ingredients for providing adequate quality nutrition to young age silkworms. The feeding of Nutrid to chawki worms renders robustness against diseases to the late instar silkworms. Nutrid is utilized for rearing silkworms up to II moult and the late instar silkworm rearing (III, IV & V) is continued with quality mulberry leaf. The utilization of Nutrid helps to minimize the missing larvae during chawki and thereby improving the cocoon yields.

Nutrid Feeding

- A small room is designated for artificial diet rearing
- Pathogen-free & hygienic environment is maintained in CRC
- Maintenance of 30°C room temperature
- Non-ventilated plastic trays are used for diet rearing
- Piling of trays is resorted to maintain humidity at ~90%
- Trays should not be piled up during moulting period
- Nutrid is available in hygienic tetra-packs of 0.75kg for convenience
- Total requirement of Nutrid/100 dfls is 8kg (I instar: 1.5kg & II instar: 4.5kg)

Advantages of Nutrid

- Saves labour
- Provides balanced nutrition
- Ensures stable cocoon crops
- Fed only once in each instar
- No bed cleaning is required
- No need for separate chawki garden
- Reduced rearing costs

CSRTI-Mysuru has licensed the NUTRID technology to M/S. Sericare Healthline Pvt. Ltd., Bangalore for commercial exploitation through NRDC, New Delhi. The firm is operating a CRC at Doddaballapur, Karnataka for the promotion of bivoltine sericulture and utilizes Nutrid for chawki rearing. Nutrid fed chawki silkworms are distributed to the famers to harvest successful bivoltine crops.

Artificial Diet for Vanya Silkworms: Successful development of artificial diet (Nutrid) for mulberry chawki silkworms and the advantages of semi-synthetic diets for chawki rearing prompted CSRTI-Mysuru to develop artificial diets specific for different types of vanya silkworms. These are essentially designed with specific host-plant leaf powders and required nutrients for the healthy growth of tasar, eri and muga silkworms. These artificial diets were evaluated in the laboratory and field for the benefit of sericulture industry.

TRAINING PROGRAMMES IN CHAWKI REARING

Skilled manpower is essential for successful operation of chawki rearing activity and chawki rearing skills are very crucial for the sericulture industry special as they are vital to cocoon crop sustainability. Moreover, the entrepreneurs interested in setting up CRC should invariably have undergone prescribed training in chawki from a recognized CSB or DoS institution to get registered as a chawki rearer. The CSRTI, Mysuru is regularly conducting training in chawki rearing for two types of entrepreneurs: one for commercial CRC operators, and the other for farmers for their skill development

Chawki Rearing for Sericulturists for Skill Enhancement (Duration: 10 days)

- Short duration training programme to sericulturists for enhancing their skill in chawki rearing with special reference to bivoltine hybrids
- To create awareness on importance of chawki rearing to improve crop stability & sustainability
- Hands-on training in disinfection & hygiene, chawki silkworm rearing, maintenance of CRC microclimate
- Skills imparted through theory classes on package of practices for chawki garden, importance of incubation & black boxing of silkworm eggs, CRC technology, management of pest & diseases of mulberry & silkworm.
- Exposure visit to the progressive farmers' fields & CRC units

Commercial Chawki Training for CRC Entrepreneurs (Duration: 90 days)

- For CRC entrepreneurs or persons willing to start CRC as an enterprise to enable them to obtain "Registration Certificate" as Registered Chawki Rearer
- To promote entrepreneurship & dissemination of new technology to farmers
- Candidates should have passed minimum matriculation
- Hands-on training on chawki through participatory programmes, demonstration & theory classes
- Trainees actually attend 8 batches of chawki rearings including chawki rearing on artificial diet to master the skill of chawki rearing technology with special reference to bivoltine hybrids
- Skills are also imparted in mulberry cultivation technologies, package of practices for maintenance of chawki garden, composting and Vermicomposting, management of pest & diseases of mulberry, egg incubation & block boxing techniques, maintenance of microclimate in chawki rearing house, disinfection & hygiene maintenance, management of silkworm pest & diseases, chawki certification, late age silkworm rearing, mechanization etc..
- Field exposure visits are undertaken to commercial CRCs for trainees' interaction with the CRC owners
- Successful completion of training leads to issue of Certificate required for obtaining CRC registration from CSB, Bangalore

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