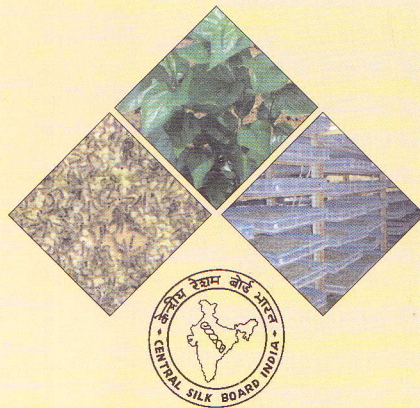


**Workshop on
ROLE OF CHAWKI REARING CENTRES (CRC)
IN BIVOLTINE SILK PRODUCTION
13th December 2013**

COMMERCIAL CHAWKI REARING
- Exploring New Horizons



**Central Sericultural Research & Training Institute
Central Silk Board, Min. of Textiles, Govt. of India
Manandavadi Road, Srirampura, Mysore - 570 008**

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CENTRAL SERICULTURAL RESEARCH AND TRAINING INSTITUTE
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Preface

The Central Sericultural Research and Training Institute, Mysore, established in 1961 has so far successfully conducted many seminars, workshops and *Krishimelas* for disseminating the technologies developed. These programmes are well structured for adoption of the stakeholders of the sericulture industry. On a similar line, a workshop on *Role of Chawki Rearing Centres (CRC) in bivoltine silk production* is being organized on 13th December 2013 to update the knowledge and adoption of *Chawki* rearing technologies. The package of practices for *Chawki* mulberry garden, disinfection, hygiene and disease management, handling and incubation of silkworm eggs, commercial *Chawki* rearing techniques, artificial diet rearing techniques, mechanization of *Chawki* rearing and economics of *Chawki* rearing centres besides rules and regulations governing registration of *Chawki* rearers will be discussed to enhance the knowledge of the concerned, especially CRC entrepreneurs with special reference to Bivoltine Sericulture.

During the XII Plan, CSB is implementing Cluster Promotion Programme to promote the production of Internationally Graggable bivoltine silk. The supply of disease free quality *Chawki* worms is a basic prerequisite for the production of bivoltine silk. Starting from brushing to disposal of worms to the farmers, every day special care should be taken in hygiene, feeding, spacing, cleaning, bed disinfection, moulting and handling to attain the success. By using the *Chawki* worms, our farmers can fully utilise their resources by increasing the number of rearings and reducing the cost of production. Stability in crop performance can be achieved by utilising *Chawki* worms.

In this occasion, I thank the Sri. Bisse Gowda, Chairman, Central Silk Board and Smt. Ishita Roy, IAS, Member Secretary, for their constant support and encouragement. I also thank all the resource persons who have contributed papers on various aspects of CRC techniques and also the CRC owners and the CDFs who are participating in this workshop. I am sure, this workshop will have a positive impact on the quality production in bivoltine silk in general and *Chawki* production in particular.

Mysore
13.12.2013

(Dr. B. B. Bindroo)
DIRECTOR

Contents

Title	Author	Pages
1. Maintenance and management of <i>Chawki</i> mulberry garden	T. Thippeswamy, Dasappa and B. B. Bindroo	1-3
2. Commercial <i>Chawki</i> rearing techniques	G. S. Vindhya, S. B. Nagaraj and B. B. Bindroo	4-13
3. Incubation technology of silkworm seed	B.S.Angadi	14-18
4. <i>Nutrid</i> for <i>Chawki</i> silkworm rearing (<i>Bombyx mori</i>)	Kanika Trivedy, G. S. Vindhya and B. B. Bindroo	19-24
5. Disinfection and hygiene for <i>Chawki</i> rearing	M. Balavenkatasubbaiah, A.R. Narasimha Nayaka and B. B. Bindroo	25-28
6. Economics of <i>Chawki</i> rearing centres	H. Jayaram and B. B. Bindroo	29-35
7. Central Silk Board (Amendment) Act, 2006 Rules and Regulations governing registration of <i>Chawki</i> silkworm rearers	B.S.Angadi and K. Sashindran Nair	36-40

MAINTENANCE AND MANAGEMENT OF CHAWKI MULBERRY GARDEN

T. Thippeswamy, Dasappa and B. B. Bindroo

Central Sericultural Research & Training Institute, Mysore

Chawki or young age silkworm rearing plays a vital role in sericulture industry. Robust and healthy worms ultimately produce quality cocoons. The basic requirements for *Chawki* rearing are: a suitable rearing house with required appliances, well maintained irrigated mulberry garden and trained manpower. Among all the factors responsible for healthy/successful *Chawki* rearing, leaf quality plays an important role. More over, the nutritional requirement of *Chawki* worms is totally different from that of the late age worms. The leaves fed to *Chawki* larvae should be tender, soft, succulent and rich in protein (25%), carbohydrate (14%) with a minimum moisture of 80%. The availability of such specific and suitable quality leaf in general mulberry garden is not adequate, as these leaves contain less moisture (less than 70%) and poor in the required nutritional constituents. Thus, a separate mulberry garden for quality leaf production for young age silkworm rearing (*Chawki*) is imperative. Hence, a strategy has been evolved to develop a cost effective package of practices for exclusive *Chawki* mulberry garden maintenance.

Technology

Soil: The plantation should be raised in a flat/levelled land with porous and fertile soil. Sandy loamy soil with good drainage having a pH ranging from 6.5 – 7.5 and organic carbon above 0.65 is preferred.

Area: Two acre in four blocks of half acre each with 32 crops/year i.e., @ 8 crops/plot (half acre block).

Variety: S36, V1 or G2 (newly evolved).

Spacing: Indo-Japanese system of plantation (paired row) with (5' + 3') x 2' or (4' + 3') x 2' suitable for mechanized cultivation is recommended. Since the plants are not allowed to grow beyond 45 days, this system with (4' + 3') x 2' spacing (6300 plants/acre) is preferred.

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. After 35 days of bottom pruning, harvesting of leaf commences and continues for seven days *i.e.*, feeding the larvae up to second moult. At the end of 10 days, the top terminal bud is to be clipped off. 25 – 30 days after top clipping, second leaf harvesting as shoot-let is to be done for rearing of *Chawki* worms up to second moult. There after, the plants are again pruned at crown height as earlier *i.e.*, 80 – 90 days after the first pruning depending on the season and growth. The above cycle of events to be repeated for four times to get 8 crops in a year. Thus, the plants are to be pruned at the crown four times in a year after 2nd, 4th, 6th and 8th crop matching the training schedule. However, pruning may be delayed during winter season (November to January).

Manures and fertilizers: Organic input requirement for *Chawki* garden is more than that of the general mulberry garden. Farm yard manure (FYM) to be applied @ 50 MT/ha/year and preferably in two split doses. Accordingly 40 MT FYM is required for two acre *Chawki* garden @ 10 MT for each block of half acre (5MT each in May-June & Oct-Nov). It is also suggested to apply other organic inputs like VAM, Bio fertilizer, Vermi-compost etc., in desirable quantities to sustain soil health for production of quality mulberry leaf.

Chemical fertilizers: The recommended dose of chemical fertilizers – NPK is 260:140:140 kg/ha/year. It is to be applied in eight equal split doses *i.e.*, @ of 32.5:17.5:17.5 kg/ha/crop after each harvest. Chemical fertilizers should be preferably applied in the form of Ammonium sulphate, Single super phosphate and Murate of potash @ 32kg, 22kg, 6kg respectively for each half acre block per crop. This should be followed by irrigation with an interval of 4-5 days.

Irrigation: Of all the factors, irrigation is known to bear the highest correlation with respect to yield and quality of mulberry . It requires one and half acre inch (3.75 cm) irrigation water (85,000 gallons) /hectare once in 4-5 days by ridge furrow (channel) method. Accordingly 68,000 gallons of water *i.e.*, 17,000 gallons for each half acre plot is to be given per irrigation. Though the requirement of water per irrigation in *Chawki* garden do not differ with that of the general mulberry garden, the frequency (number of irrigations) per crop varies.

Leaf harvest: Individual leaf plucking is recommended for 1st, 3rd, 5th and 7th crop while the shoot-lets are to be harvested in 2nd, 4th, 6th and 8th crops for *Chawki* rearing.

Pest & Disease control: Pest and disease control measures are to be taken up regularly. It is advisable to go for mechanical and biological control methods as the use of chemicals may have an adverse effect on *Chawki* rearing due to early harvest in eight crop schedule.

Advantages of the Technology

- The above technology ensures an yield of 32 – 36 tonnes of *Chawki* leaves /ha/year as against 8-10 MT /ha/year of *Chawki* leaves obtained from general garden through selected harvesting. In this method, almost 100% of the leaves produced are suitable and used for *Chawki* rearing.
- Qualitatively the leaves produced by the above technology are superior (80% leaf moisture, 25% leaf protein and 13% leaf sugar) compared to the leaf obtained from the general garden (70% leaf moisture, 21 % leaf protein and 11% leaf sugar) The superior leaf quality has also been proved in feeding trials of *Chawki* rearing.
- Annually, approximately 1,80,000 to 2,00,000 dfls /ha can be reared up to 2nd stage by adopting the above package of practices in 32 -36 crop schedule (3 crops /month with brushing once in 10 days) @ 20 kg *Chawki* leaf /100 dfls.

*Quality mulberry leaf ensures healthy and robust growth of larvae
resulting in successful cocoon crops*

COMMERCIAL CHAWKI REARING TECHNIQUES

G. S. Vindhya, S. B. Nagaraj and B. B. Bindroo

Central Sericultural Research & Training Institute, Mysore

The young age silkworm rearing or *Chawki* rearing is a vital aspect of sericulture industry for the development of healthy larvae and harvesting of successful cocoon crop. The success of the *Chawki* rearing technology depends upon the perfect understanding of the requirements of silkworms at this stage, manipulation of nutritional and ecological conditions to obtain maximum growth and care to raise robust and healthy batch of young silkworms. Incidence of silkworm diseases in late instars, poor cocoon crop and sometimes even complete crop failures have been attributed to the bad management during young age silkworm rearing and hence *Chawki* rearing must be carried out scientifically with technical skill and expertise.

Silkworm larval stage, from hatching to spinning is about 23-24 days duration, clearly differentiated in to instars by four moults. The first two instars, i.e., till the end of second moult, form the young age or *Chawki* and last two instar form late age. Therefore, young age rearing represents raising of larvae up to II moult. Among many interlinked factors that decide the success of silkworms rearing, *Chawki* rearing technique is the most important. In order to raise the healthy stock of vigorously growing silkworms, the system of *Chawki* rearing must be quite effective. Hence, scientific method of young age rearing is an important component of technology of silkworm rearing which determines the success or failure of cocoon crop.

In the developed countries like Japan, China and Korea, about 95% of the farmers receive *Chawki* reared larvae (young age silkworms) whereas in India it is only 10-15% at the most. In India where the situation is more heterogeneous with regard to rearing facilities, environmental conditions and cultivation practices, *Chawki* rearing is a must to reduce the crop loss and to increase the cocoon yield. The advantages of co-operative/ *Chawki* rearing of young silkworms are many. Some of them are -

- Stabilization of cocoon crop and increase in yield
- Improvement in the quality of cocoons. Control over disease spread
- Reduction in rearing expenditure and
- Distribution of labour for other works.

Characteristics of young age silkworms

- Young age worms grow very fast
- Show resistance to high temperature (27°C to 28°C) and humidity (80% to 90%)
- They are fond of dim light of 15-20 lux and avoid strong light and darkness
- They are rather strong to low air circulation of 0.3 m per sec.
- Have low ingestion and high digestibility
- They are weak to carbonic gases
- They are highly susceptible to the diseases
- Newly hatched larvae have low water content, but once intake of mulberry leaf starts, water content rapidly increases to 76-79% during 1st instar and 83-85% during 2nd instar.

Handling of silkworm eggs

Silkworm eggs are supplied to farmers for commercial rearing on 3rd and 5th day of oviposition in case of multivoltine and acid treated bivoltine eggs or after the termination of hibernation in bivoltine eggs. During transportation of eggs, the following precautions should be taken by avoiding -

- exposure to direct sunlight and high temperature
- transportation in sealed box without perforations
- storing the eggs in enclosed places with poor ventilation
- direct or indirect contact with tobacco
- exposure to fumes, fertilizers, petroleum and insecticides
- physical shocks

Silkworm eggs should be transported from the grainages during the cooler hours of the day. As far as possible, eggs should be incubated in the grainage/cold storage and should be supplied during eye spot stage *i.e.*, two days prior to hatching and kept in a black paper cover.

Commercial CRCs play an important role in -

- Producing uniform and healthy silkworm larvae and cocoons
- Reducing the chances of contamination and spread of diseases
- Reducing the cost of cocoon production

- Facilitating better resource management by taking more crops

The important aspects of young age silkworm rearing management are -

- A suitable separate compact rearing house
- Appliances such as trays, stands, heaters, humidifiers, generator, *etc.*
- A well maintained mulberry garden exclusively for *Chawki* rearing with V1 or S36 variety and assured irrigation facility and adequate agro inputs.
- Skilled manpower with rearing experience for scientific *Chawki* rearing.

Rearing house for *Chawki* rearing (5000 dfls capacity)

It is desirable to have a separate rearing house or room for young silkworms preferably with RCC roofing with good ventilation. If the rearing house is too big, it is difficult to maintain optimum temperature and humidity. Young age rearing house or room can also be used as an incubation room for silkworm eggs. A measurement of 32 x 30 ft rearing hall and two rooms of 10 x 20 ft each, one for store room and other for leaf storage are required for rearing 5000 dfls per batch.

Separate *Chawki* garden

An exclusive mulberry garden of 3.20 acres for *Chawki* rearing of 5000 dfls per batch should be maintained.

- Variety: V1/S36
- Spacing: 90 x 90cm or 150 x 90 x 60 cm
- Manure: 40 MT/ha/yr
- Fertilizer: 260:140:140 Kg NPK/ha/yr
- Irrigation: 3.75 cm water for 4-6 days (85,000 gallons)
- Leaf yield: 28-30 MT/ha/yr.

1,60,000 dfls can be reared up to 2nd moult from 3.20 acre garden @ 23 kg leaf for 100 dfls. From the normal mulberry garden 40,000 dfls only can be brushed/hectare/year.

Equipments required for 5000 dfls capacity/batch

Name of the item	Quantity
Plastic trays(3 x 2 ft)	600
Rearing stand (preferably PVC)	30
Feeding stand	10
Plastic basins	20
Power sprayer	1
Room heater	2
Humidifier	2
Wet & dry thermometer	1
Brushing & incubation frames(plastic)	100
Bed cleaning nets	500
Air cooler	2
Leaf chopping machine	2
Dust bins	5
Plastic crates	4
Disinfection masks	2

Disinfection

Young age worms show low resistance to diseases. Bivoltines are easily susceptible to diseases compared to Cross Breeds. Therefore, pathogen free atmosphere should be created for control of diseases through effective disinfection and maintaining hygienic conditions in and around the rearing house. The rearing trays and other equipments used in rearing should be dipped in the disinfection tank of 4 x 3 x 2 ft dimension of 672 litres capacity containing 2% bleaching powder solution filled up to half of the tank for 10 to 15 minutes and sun dried.

The rearing house should be disinfected with 2% bleaching powder solution using power sprayer. The solution should be sprayed @ 140 ml per sq. ft. as 1st stage of disinfection. 48 hours before brushing, second stage of disinfection should be conducted with any of the following solutions.

1. 2.5% Sanitech in 0.5% slaked lime solution.
2. 0.05% Astra solution.

Hygiene maintenance

- Restricted entry
- Wash hand and feet with soap
- Walk over foot mat soaked with 5% bleaching powder
- Sprinkle lime and Bl. Powder around rearing house
- Collect and properly dispose unhealthy/unsized worms
- Mop rearing house with 2 % bleaching powder

Surface sterilization of silkworm eggs

Silkworm eggs must be surface sterilized by dipping in 2% formalin solution for 10 minutes and dried in shade before incubation.

Incubation of silkworm eggs

Providing optimum climatic conditions for healthy development of embryo is called incubation. During incubation, the eggs should be spread in a single layer to provide uniform humidity and temperature. It aims at uniform development and ensures uniform hatching. In the incubation room it is desirable that the temperature and humidity are kept at optimum level. Incubation of silkworm eggs should be done in a room having temperature of 25°C, relative humidity 80%, air current of 0.3m per sec. and photoperiod 16 hrs. light and 8 hours dark.

Black boxing

Two days before hatching, the colour of the eggs changes into a lighter shade with a blue point i.e. pin head stage. This is the head pigmentation stage. The next day the egg colour changes into blue and is called as the body pigmentation stage. At this stage the eggs are transferred to dark room, the hatching can be inhibited to certain extent and the growth of embryo which are late can be accelerated. This process is called black boxing of eggs.

Black boxing is done by covering the silkworm eggs in black paper or cloth. To avoid the escape of newly hatched larvae from the egg sheet, the eggs must be wrapped in a tissue paper during the body pigmentation stage. Farmers should be given a black bag containing pigmented eggs from the grainages instead of distributing eggs in early stages.

Exposing to light

The uniform hatching of all the eggs can be made possible only when these eggs are exposed to bright light for 2 to 3 hours. On the expected day of hatching the eggs are exposed to light at 7.00 a.m. Good hatching can be obtained by 10.00 a.m. This is the ideal time for brushing. Delayed brushing should be avoided.

Brushing of silkworm eggs

The process of transferring of newly hatched larvae from egg sheet to rearing seat is called brushing. For this either a soft camel brush or feather is employed. For sheet eggs and loose eggs the brushing technique varies.

Brushing of sheet eggs

- On the day of hatching, the egg sheets should be removed from the black boxing and spread uniformly in one layer on a tray with paraffin paper as seat.
- Hatching is obtained after two hours exposure to light.
- Mulberry leaves of size 0.5 cm sq. 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 and the first feeding is given to the larvae. The rearing bed covered with another sheet of paraffin paper to complete the operation of brushing.

Brushing of loose eggs

Loose eggs come in egg cases of 50 dfls and are about 30000 eggs in each. If they are allowed in the cases proper incubation is difficult as the eggs are not spread in single uniform layer. This may result in improper hatching. To avoid this, plastic incubation frames are used. The following are the advantages of plastic incubation frames.

- All eggs get optimum temperature and humidity.
- Hatching is 90-95%.
- The plastic frames can be repeatedly used after disinfection.

The Incubation frame should be shifted to plastic tray of 3 x 2 ft size having paraffin paper as seat. The inner frame is removed gently. The tissue paper covered on

the eggs should be removed and kept by the side of frame. Nylon net measuring 40 x 30 cm having 2-4 mm radius holes is applied on the outer frame. Mulberry leaf cut into 0.5 cm sq is spread on both the net and tissue paper. Another paraffin paper is covered on this and kept for 3 to 4 hours. Nylon net can be removed after transferring the larvae to the plastic tray. The egg shells along with unhatched eggs should be separated and hatching percentage can be worked out.

Bivoltine hybrid eggs are produced in loose eggs form. The following are the advantages of loose eggs.

- Egg numbers remains same in all seasons.
- Surface sterilization and acid treatment of eggs is easy and effective.
- Unfertilized eggs can be separated.
- Egg preservation, transportation and incubation are easy.
- Hatching is higher.

Leaf quality

The quality of leaf plays major role in production of healthy and robust *Chawki* worms. For young silkworm rearing the quality of leaf should be as follows:

- Soft, succulent
- 80% moisture
- 25% Protein
- 14% Carbohydrates

CRC plan for rearing 5000 dfls (32 Crops/year) brushing once in 10 days)

1. Quantity of layings/year	-1,60,000(5000 dfls- 32 crops)
2. Batches/year	- 32 batches
3. Quantity of layings/batch	- 5000 Dfls
4. Mulberry garden	- Separate <i>Chawki</i> garden (8 crops/year)
5. Quantity of leaf required	- 1000 kg/5000 layings
6. Area of mulberry garden	- 3.2 acre

7. *Chawki* garden management: Divide the garden in to 4 parts.

Brushing 5000 layings from each part (once in 10 days)

Part-1 0.8 acre	Part-2 0.8 acre
Part-3 0.8 acre	Part-4 0.8 acre

Schedule of Disinfection, Preparation for brushing and *Chawki* rearing (After completion of *Chawki* rearing and distribution of *Chawki* worms)

Day	Details of activities
Day 1	Cleaning and washing of rearing trays, rearing stands and other equipments used during <i>Chawki</i> rearing with 2% bleaching powder solution and sun drying.
Day 2	Disinfection of CRC and rearing appliances Trays disinfection
Day 3	Arrangement of rearing trays, old news paper and paraffin paper for brushing. Transportation of eggs from cold storage (Black boxed incubation frames with eggs).
Day 4 1 st day of 1 st instar	Incubation frames along with eggs are exposed to light. Brushing is to be done with chopped mulberry leaf feeding
Day 5 2 nd day of 1 st instar	Extension of bed (provide spacing by expanding 1 tray into 3 trays). Feed all the trays
Day 6 3 rd day of 1 st instar	Extension of bed (Expand 3 trays in to 6 trays). Feed chopped mulberry leaves to all trays
Day 7 4 th day of 1 st instar	Observe the bed and dust lime powder after settling for moult.
Day 8 1 st day of 2 nd instar	Once the worms come out of moult, dust recommended bed disinfectant before 30 minutes of feeding (Resuming). Apply cleaning nets and then feed chopped leaf to all the trays.
Day 9 2 nd day of 2 nd instar	Clean the beds with nylon nets. Feed chopped mulberry leaves to all the trays.

Day 10 3 rd day of 2 nd instar	Observe the bed and dust lime powder after settling for moult.
---------------------------------------------------------	----------------------------------------------------------------

Leaf and bed space requirement for young age silkworms/ 100 Dfls (60,000 CSR hybrid larvae)

Stage & day	Leaf (kg)	Spacing		No. of plastic trays (3 x 2 ft)
		Beginning of the Instar	End of the Instar	
I-1	1.00	9.0 sq. ft. 6660 larvae	36 sq ft. 1660 larvae	2 to 6
I-2	1.50			
I-3	2.00			
I-4	0.75			
II-1	5.50	36 sq. ft. 1660 larvae	72 sq ft. 830 larvae	6 to 12
II-2	8.50			
II-3	3.75			
Total	23.00			

Environmental conditions required for young age rearing

Particulars	I instar	II instar
Temperature	28°C	27°C
Humidity	85% - 90%	85%

Requirement of bed disinfectant (for 100 dfls till second instar)

Stage of Dusting	Disinfectant	Quantity / 100 dfls (g)
Worms settle for first moult	Lime powder	50
When the worms settle for 1 st moult	Vijetha/Ankush	50
Worms settle for second moult	Lime powder	150

Care During moult

- Remove paraffin papers when worms prepare for moulting.
- Stop feeding of leaf and allow drying of bed
- Dust lime powder on the moulting larvae

- When 95% of the larvae came out of moult, dust recommended bed disinfectant.
- After 30 minutes of dusting bed disinfectant, give feeding after applying nylon net.

Chawki Certification

Before distribution of *Chawki*, the worms should be tested and if the batch found free from disease then only the batch should be distributed to the farmers. A certificate to that effect should be issued. For testing, weak and unsize larvae should be picked randomly from the batch and tested.

Transportation of *Chawki* worms

- Transport worms under 2nd molt
- Wash and disinfect the vehicle
- Transport during cooler hours
- Do not transport under crowded condition
- Shorter distance is better
- After reaching to farmers house spread the rearing bed and allow for good aeration.

INCUBATION TECHNOLOGY OF SILKWORM SEED

B. S. Angadi

National Silkworm Seed Organisation, Central Silk Board, Bangalore

The prolonged domestication of *Bombyx mori* L. for more than 3000 years has resulted in the loss of its natural resistance and this insect's behavior during any stage of its life cycle is exceedingly sensitive to the multiple environmental conditions. Any encounter with adverse environmental conditions at egg stage results in variety of embryonic disorders leading to the deterioration of egg quality and ending up in the death of embryo. The intensity of damage depends upon the degree of deviation from the optimum environmental conditions. Thus taking meticulous care by providing ideal environmental conditions is inevitable to ensure uniform, healthy, growth and development of the embryo targeting higher hatching.

Incubation is a process of preserving silkworm eggs under optimum temperature, humidity and photoperiod conditions to facilitate uniform development of embryo and ensure good hatching of healthy larvae on a single day. Incubation is the last step of seed production and first step in silkworm rearing. The objectives of incubation are;

- To ensure uniform development of embryo and good hatching on a single day.
- To ensure hatching of different races on designated dates to facilitate F1 production by commercial grainages.
- To maintain vigour and health of the newly hatched larvae.
- To maintain the voltinism of a race.

Activities of incubation

Disinfection of the incubation place

Disinfection is a very important activity prior to the commencement of incubation, where eradication of disease causing germs, from the place of incubation is ensured. Hence, prior to incubation, disinfection of the incubation chamber, appliances and surface sterilization of silkworm seeds become an unavoidable task.

Surface sterilization

Before the silkworm seeds are shifted to the incubation chamber, they should be surface sterilised with 2% formalin solution for not less than 10 minutes. Formalin owing to its reducing action on the pathogens effectively destroys them if they are lodged on the seeds or seed sheets during the course of oviposition.

Silkworm seeds can be easily surface sterilised with 2% formalin for 10-15 minutes, if produced in loose form also. In the case of sheet seeds, it is advisable to use high quality sheets, which can withstand 10-15 minutes formalin dipping. If the seeds are not properly surface streilised, the pathogens lodged on the chorion will be consumed by the larvae during the process of hatching. As result of which there will be infection and larvae die due to diseases and form the source of secondary contamination for other larvae. Improper surface sterilization can be one of the major causes for cocoon crop losses. Silkworm seeds can be safely surface streilised on any day of the development except during pin head and blue egg stages.

In addition to the initial sterilization performed at grainage level as a measure of precaution, the sterilization process could be repeated once again by the CRCs, if transported before pin head (head pigmentation) stage. This is done to ensure that contamination from other sources during the transit is not carried over. In the case of loose eggs, they have to be taken out of the container, transferred into a cloth bag or nylon bag and immersed in formalin solution for about 10 minutes. The eggs are then dried and subsequently processed. The relation between the 2% formalin dipping duration and the extent of possible percentage of infection is indicated in the following table.

Dipping duration	% of infection
Just dipping	26.40 ± 3.20
2 minutes	15.60 ± 2.61
5 minutes	1.60 ± 1.67
10 minutes	0.00 ± 0.00
Control	41.20 ± 5.22

Transportation of silkworm eggs

Transportation of silkworm eggs is usually done during its incubation period. Thus utmost care should be taken during transportation.

- Egg should be transported only during cool hours of the day.

- The eggs should not be transported during 4th /5th day of development.
- During transportation, the eggs should be provided with optimum temperature, humidity and proper aeration
- The eggs should not be transported in polythene covers or airtight containers as it increases the incidence of dead eggs.

Embryo test

During the course of incubation the embryonic test will help in

- Forecasting the day of hatching and hatching
- It also confirms the proper development of the embryo

Environmental conditions for incubation

Main environmental factors are temperature, relative humidity photoperiod and aeration.

Temperature

- Temperature is one of the most important factors, which, decides the growth and development of embryo.
- Optimum temperature for incubation is $25\pm 1^{\circ}\text{C}$. incubation at this temperature also helps in maintaining diapause characters of bivoltine race.

Humidity

- Humidity helps in maintaining water content of the eggs.
- Optimum humidity of 70–80% helps in maintaining uniform development of eggs and prevents desiccation.

Aeration

- Aeration during incubation is very much essential as eggs are physiologically very active.
- Aeration helps in providing oxygen for developing embryo and driving out poisonous gases.

Photoperiod

Photoperiod of 16 L: 08 D (Light: Dark) upto pinhead stage is very essential for uniform growth and development of embryo and maintaining voltinism.

Black boxing

It is a technique adopted to obtain synchronized hatching. The eggs are subjected to complete darkness for 48 hours prior to hatching *i.e.*, when the eggs have attained head pigmentation stage.

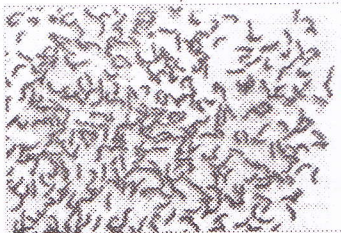
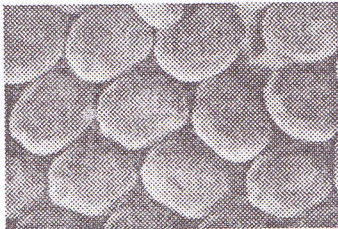
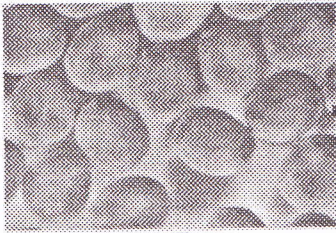
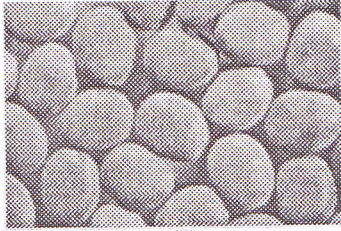
- The suitable time for black boxing is when more than 50% eggs reach to head pigmentation stage. For CSR bivoltine breeds black boxing has to be ensured 60 hours prior to hatching for acid treated eggs and 72 hours in case of hibernated eggs.
- The eggs should be black boxed by wrapping with black cloth or paper. It is preferable to make the incubation room or incubation chamber totally dark.
- After black boxing, on the day of hatching the eggs are exposed to diffused light to stimulate hatching

Brushing

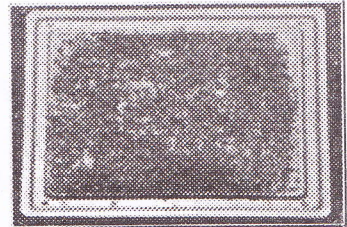
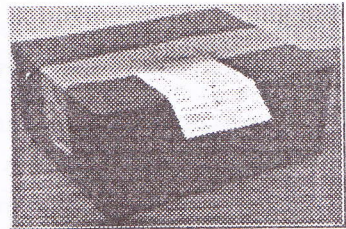
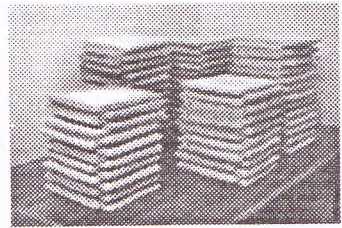
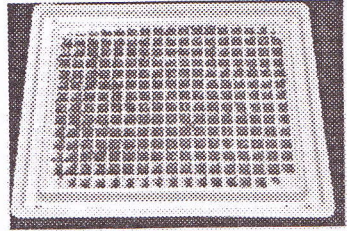
Brushing of silkworm eggs is a process of transferring the hatched larvae to the rearing bed and feeding with mulberry leaf.

- On the expected day of hatching usually at 6 am, the eggs should be exposed to light. Natural daylight is sufficient to obtain hatching.
- Immediately after hatching the larvae should be brushed by providing tender *Chawki* leaves with 75% or above moisture content.

Stages of development



Black boxing and hatching of loose eggs



NUTRID FOR CHAWKI SILKWORM REARING (*BOMBYX MORI*)

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Diet *Chawki* rearing is a city business that can be started in any season. Any one who does not have land can get skilled training in this subject and start this business successfully by hiring a building, purchasing dfls and diet, do successful *Chawki* and sell to late age silkworm farmers. An here no hazzles of incubation period (minimum 1 year), saplins raising, plantation, growth, maintenance, fertilizer application, pest control, harvesting, irrigation, etc.

In tropical conditions, mulberry leaf does not contain sufficient moisture and balanced nutrients throughout the year, which are highly essential for young instar silkworm. Therefore it was felt to develop a suitable artificial diet using low cost ingredients for providing nutrients in optimum quantity to young instar silkworm so that late instar worms will attain sufficient robustness against diseases. A promising diet (Nutrid) has been developed at Central Sericultural Research and Training Institute, Mysore for rearing silkworms up to II moult. *Chawki* rearing can be carried out on artificial diet (I and II instar) and late instar rearing (III, IV & V instars) continued with mulberry leaf.



For Kolar Gold PM x CSR2 (cross breed), it can be a universal diet. Layings can be successfully reared on *Nutrid*. *Nutrid* is available with M/s. SERICARE, Bangalore. For bivoltines, CSRTI, Mysore evolved special breeds/hybrids such as

CSR2(A) x CSR4(A) (authorized), Chamraja(A), Krishnaraja(A) (double hybrid) etc, also *Nutrid* can be used.

Advantages

- Saves labour during young age rearing.
- Provides balanced nutrition to young age silk worms leading to stable cocoon crops.
- Ensures good hygiene and reduces early infection.
- Only one feeding is required in each instar.
- No bed cleaning is needed during *Chawki*. So, chances of missing larvae is minimum.
- No need to maintain separate *Chawki* garden.
- Rearing cost is reduced due to reduction in labour during *Chawki* rearing.

Details of material required and diet rearing procedure given in Annexure I and Annexure II

- As per the requirement, one small room can be used for artificial diet rearing.
- A pathogen free environment is required as in the case of normal leaf rearing.
- Room temperature is to be maintained at 29°C by using a heater with thermostat.
- Non-ventilated plastic trays are to be used for diet rearing.
- The trays are to be piled one over the other to maintain bed humidity at around 90%.
- During moulting the trays should not be piled and the room temperature is to be increased to 30°C to keep the bed dry.

Comparative economics of *Chawki* rearing on semi-synthetic diet and mulberry leaf
(For 100 dfls)

Items	Diet	Leaf
Quantity	6.00 kg	20 kg
Material cost	Rs. 600.00	Rs. 100.00
Labour cost	Rs. 400.00*	Rs. 1400.00#
Bed disinfectant	Rs. 25.00	Rs. 50.00
Total	Rs. 1025.00	Rs. 1550.00
Total savings	Rs. 525.00	

* 2 mandays for 7 days,

7 mandays for 7 days, Rs. 200.00/manday

Annexure I: Materials required for diet *Chawki* rearing (for 100 dfls)

1. Dfls	100
2. Artificial diet	6 kg
3. Rearing room	10' x 10' x 10'
4. Instruments required	Yamato balance (1 kg capacity): 1 Thermometer: 1 Humidistat: 1 Circumferential room heater with thermostat control: 1
5. Wooden/Iron item	Working table: 1 Wash basin: 1 Feeding stand (Folding): 1 <i>Chawki</i> stand (2' x 3'): 1 Ant wells: 4
6. Utensils	Knife: 1 Spoons : 2 Steel scrappers : 2
7. Plastic ware	Plastic rearing trays (2' x 3' size): 10 Blue polythene sheets: 10 Hand sprayer: 1
8. Consumables	Cotton roll (absorbent): 1 Stickers for labeling News paper: 1 kg Packing tape (2" wide): 1 Soap: 1

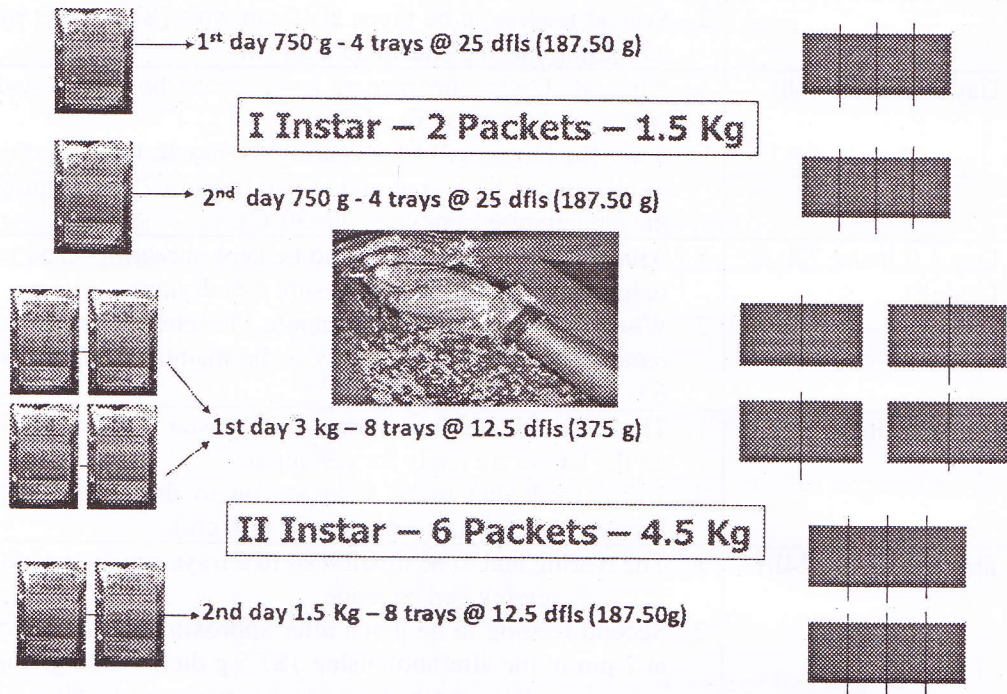
9. Chemicals	Rectified spirit: 1 litre
10. Miscellaneous	Spatula: 1 Forceps: 2 Disposable gloves: 25 pairs Feather: 2 Black cloth: 10 mts Chappals: 6 pairs Scissors: 1

ANNEXURE II: Mulberry Diet rearing technology for 100 dfls

Day	Activity
Diet rearing preparation	<ol style="list-style-type: none"> 1. The layings should be incubated at 25°C and 80% humidity. 2. The layings should be packed at pigmentation stage (blue egg). 3. 25 dfls to be wrapped in tissue paper so that all the eggs face the tissue paper. 4. Black boxing to be done at blue egg stage and care to be taken to maintain 80% humidity. 5. When the layings are in black box, preparation for brushing to be made. 6. Room should be disinfected as in case of leaf rearing.
One day before diet rearing	<ol style="list-style-type: none"> 1. Rearing room temperature to be maintained between 28-29°C and relative humidity at 75-80 %. 2. All sides of 10 trays (2' x 3' sized) to be closed with packing tape. 3. Newspaper and blue polythene to be spread over trays. 4. Blue polythene sheets are to be cleaned with wet cotton in 70% alcohol.
Day 1 (0h)	<ol style="list-style-type: none"> 1. Layings to be exposed on brushing date at 7 am 2. Brushing to start at 10 am 3. The diet to be scrapped (187.5 g) on to the egg sheets containing hatched larvae using stainless steel scrapper. 4. Tap the larvae from the egg sheets and tissue paper after 30 minutes and make rearing bed of 30 x 50 cm. 5. Trays to be piled one over the other and an empty tray to be kept on top to prevent diet drying (This will maintain humidity of 90%).
Day 2 (I instar 24h)	<ol style="list-style-type: none"> 1. After 24 hours (10 am in the next day), rearing beds are

Day	Activity
	to be checked for uniform distribution of larvae 2. Second feeding to be given at 10 am with 187.5 g diet by increasing the bed size to 35 x 58 cm.
Day 3 (I instar 48h)	1. After 48 hours, the rearing beds are to be turned and spread to the size of 50 x 70 cm. 2. Since the larvae will be preparing for moult, the humidity to be reduced by giving gap in two trays to 75 % keeping the temperature same (<i>i.e.</i> , 29~30°C).
Day 4 (I instar 72h & I moult)	1. After 72 hours, the trays are to be kept in rearing stand to reduce the humidity and to ensure diet drying. 2. When the larvae are under moult, the temperature to be reduced by 1°C and humidity to be maintained between 60~70%.
Day 5 (II instar 0h)	1. The larvae should be resumed for II instar at 4 pm when all the larvae are ready for resumption. 2. 750 g fresh diet to be scrapped on to the rearing bed keeping the bed size same (<i>i.e</i> 50 x 70 cm).
Day 6 (II instar 24h)	1. The rearing bed to be distributed to 2 trays equally and 50 x 75 cm. rearing bed be made. 2. Second feeding to be given after approximately 24 hours at 2 pm in the afternoon using 187.5 g diet. While giving second feeding, the bed size to be increased to 50 x 81 cm.
Day 7 (II instar 48h)	1. After 48 hours in second instar at 10 am, the bottom blue polythene sheet to be removed 2. In the evening at 4 pm, the humidity to be reduced by giving gap between two trays to 75% and keeping the temperature same (<i>i.e.</i> 29~30°C).
Day 8 (II moult)	1. 2 nd moult - the trays are to be kept in rearing stand for diet drying. 2. When the worms are settling for moult, the humidity to be reduced to 70% keeping the temperature at 28~29°C.
Day 9 (III instar)	The larvae to be distributed to farmers when all the larvae are out of moult (III instar) and ready for resumption to III instar.

Diet requirement for 100 Dfls. - 8 Packets - 6 kg



DISINFECTION AND HYGIENE FOR CHAWKI REARING

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Central Sericultural Research and Training Institute, Mysore-570 008

One of the major constraints in silk cocoon production is the diseases, in silkworm. Diseased silkworms extrude pathogens into the rearing environment and form the source of infection. These pathogens are highly stable and persist for longer period in silkworm rearing environment. Destruction of disease causing pathogens is called disinfection. It can be done by various methods but the most effective one is chemical method.

Chawki rearing is considered to be most crucial stage in silkworm rearing. Hence, proper disinfection of *Chawki* rearing centre (CRC), rearing appliances and practice of hygienic measures are the important integral activities in *Chawki* rearing to prevent/manage the diseases.

Disinfectants recommended by CSR&TI, Mysore and their concentrations

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

Requirement 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 of floor × Breadth of floor) of the rearing house.

The quantity required is 1.5 liter/sq. m floor area or 140 ml/sq. ft. floor area of rearing house (height 3 m /10 ft.). Add 500ml/sq.m or 14 ml/sq. ft. for every increase in height by 1 m or 1 ft. respectively + 35% of total quantity (CRC surrounding and trays disinfection).

Spray the disinfectant to drench all the nook and corners of the *Chawki* rearing house using power sprayer.

Preparation of 2% bleaching powder in 0.3% slaked lime solution

- Find the ingredients and their quantity from Table 2.

Table 2: Ingredients required for the preparation of 2% bleaching powder in 0.3% slaked lime solution

Ingredients	Quantity of ingredients	
	For 1 l	For multiple of 1 l
Bleaching powder	0.020 kg	$0.020 \times * = \dots\dots\dots$ kg
Slaked lime	0.003 kg	$0.003 \times * = \dots\dots\dots$ kg
Water	1.000 l	$1.000 \times * = \dots\dots\dots$ l

*: Quantity of disinfectant solution to be prepared

- Add little water to the bleaching powder and slaked lime and make a paste. Add this paste to the rest of water and stir it well. Keep for 10 minutes and use the supernatant for disinfection.

Preparation of 2.5% Sanitech / Serichlor in 0.5% slaked lime solution (500 ppm Chlorine dioxide in 0.5% slaked lime solution)

- Find the ingredients and their quantity from Table 3.

Table 3: Ingredients required for the preparation of 2.5% Sanitech/Serichlor in 0.5% slaked lime solution

Ingredients	Quantity of ingredients	
	For 1 l	For multiple of 1 l
Sanitech / Serichlor	0.025 lt	$0.025 \times \dots * \dots = \dots\dots\dots$ l
Activator	0.0025 kg	$0.0025 \times \dots * \dots = \dots\dots\dots$ kg
Slaked lime	0.005 kg	$0.005 \times \dots * \dots = \dots\dots\dots$ kg
Water	0.975 l	$0.975 \times \dots * \dots = \dots\dots\dots$ l

*: Quantity of disinfectant solution to be prepared

- Sanitech/Serichlor is available in 5 liter can or in 500 ml bottle with one packet (50g) of activator for every 500 ml of solution. Take the activator crystals in to a basin/bucket and add Sanitech/Serichlor solution to it and keep it for 10 minutes. Add activated Sanitech/Serichlor to water. Finally add slaked lime to this solution and mix thoroughly and use for disinfection.

4. Preparation of 0.05% Asthra solution

- Find the ingredients and their quantity from Table 4.

Table 4. Ingredients required for the preparation of 0.05 % Asthra solution

Ingredients	Quantity of ingredients	
	For 1 l	For multiple of 1 l
Asthra powder	0.5 g	$0.5 \times \dots * \dots = \dots \text{ g}$
Water	1.000 l	$1.000 \times \dots * \dots = \dots \text{ l}$

*: Quantity of disinfectant solution to be prepared

- 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.

Schedule of disinfection

day	Activity	Details of Activity
On completion of rearing	1	1 st disinfection of CRC and appliances (2% Bleaching powder in 0.3% slaked lime / 2.5% Sanitech/ Serichlor in 0.5% Slaked lime solution/ 0.05% Asthra solution).
3 days before brushing	2	Cleaning and washing of CRC building
	3	Trays disinfection
2 days before brushing	4	2 nd disinfection of CRC and appliances (2% bleaching powder in 0.3% slaked lime solution / 2.5% Sanitech/Serichlor in 0.5% Slaked lime solution / 0.05% Asthra solution / 2% formalin solution).
1 day before brushing	5	Dusting disinfectant (5% Bleaching powder in slaked lime) surrounding the CRC
	6	Open the windows of CRC for ventilation.

Hygienic measures

Disinfection of CRC its surrounding and 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 workers, drift and from diseased silkworms. Hygienic measures are meant for prevention of these secondary sources. Following measures are advised to adopt:

- Wash hands and feet with disinfectant solution before entering the CRC and also after attending the rearing. Wash hands with disinfectant after every bed cleaning.
- Collect diseased/dead/sick worms from the rearing bed with forceps/chopsticks in a basin containing disinfectant solution and destroy them by burning.
- Collect silkworm bed refuse into litter basket/vinyl sheet meant for it. Never allow the bed refuse to fall on the floor during bed cleaning.
- Store mulberry leaves in a separate room. Disinfect the leaf storage room along with the rearing room. Cover the mulberry leaves with wet gunny cloth.
- Dust slaked lime powder in the rearing bed when the worms settle for the moult.
- Disinfect silkworm body and rearing seat by dusting *Ankush/Vijetha* after I moult before resumption.
- Rear *Chawki* larvae under recommended optimum temperature, humidity and spacing conditions so that the larvae grow healthy and resistive to infection. Avoid rearing silkworms under fluctuating temperature and humidity and over crowd conditions. Such conditions make silkworm weak and lose ability to resist infection.
- Feed silkworm with quality mulberry leaves so that they grow physiologically strong and express high level of resistance to microbial infection.

- Wash hands and feet with disinfectant solution before entering the CRC and also after attending the rearing. Wash hands with disinfectant after every bed cleaning.
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- Feed silkworm with quality mulberry leaves so that they grow physiologically strong and express high level of resistance to microbial infection.

ECONOMICS OF CHAWKI REARING CENTRES

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Chawki rearing or young age silkworm rearing is crucial for successful crop harvest in sericulture. The rate of success of sericulture crops mainly depends on the robust and healthy *Chawki* worms. *Chawki* worms distributed through *Chawki* Rearing Centres (CRCs), located at the places of production is gaining popularity right now. The advantages of *Chawki* worms supplied through CRCs ensure the supply of healthy and robust young age silk worms, uniform worms for rearing and reduced chances of contamination & spread of diseases. As a development initiative of the government through the Catalytic Development Programme (CDP), many private entrepreneurs are taking to running of their own CRCs. This has already gained popularity in many parts of Karnataka, Tamil Nadu and Andhra Pradesh. The advantages of CRCs have to be explored and benefited by a large number of farmers for the successful crops in the future years.

Many attempts were made to evolve a solid model for running an economically viable model of a CRC. Managing *Chawki* plot in a single plot or as per the model developed at CSRTI, Mysore to adopt 2 acres (4 plots) are two methods by which CRCs can manage the *Chawki* rearings. The leaf and shoot lets harvested alternatively by the CSR & TI, Mysore model ensures rearing of 32 batches of *Chawki* worms while the single plot model ensures brushing in 24 batches per year. Following are the norms adopted under both the models of CRCs.

Table 1: Norms for rearing *Chawki* worms in CRCs

Technology	1 hectare (Single plot)	2 acres (4 plots)
Mulberry variety	V1/S36	V1/S36
Spacing	150 cm + 90 cm × 60 cm (Paired row system)	150 cm + 90 cm × 60 cm (Paired row system)
Leaf/ shootlets yield	29000 kg/ha/year	28000 – 30000 kg
No. of batches for rearing	2 batches per month (24 batches per year)	8 batches per plot per year (32 batches per year)
No. of dfls reared per	5000 dfls	5000 dfls

batch		
Leaf requirement per batch	1000 kg	1000 kg
Inputs		
Farm Yard Manure	40 MT/year	40 MT/Year
Fertiliser	225:150:150 kg/ha/year	260: 140:140

Cost of production of *Chawki* silkworms

The cost of production of *Chawki* worms in CRCs and the benefits accrued from selling of these worms are worked out in the following tables. The economics for both the models are made available in the following tables.

Model 1: With one hectare *Chawki* mulberry garden (24 crops per year)

Table 2: Establishment cost of *Chawki* mulberry garden (Rs/hectare)

Particulars	Cost (Rs)
1. Tractor tilling (10 h/ha), Harrowing (6 h/ha) @ Rs.600/h	9,600
2. Final land preparation (10 pairs of bullock/ha) @ Rs.300/pair.	3,000
3. Farm yard manure (20 MT) @ Rs.800/MT	16,000
4. Farm yard manure application (20 MD) @ Rs.200/MD (broadcasting)	4,000
5. Planting preparation: Ridge-Furrow 75 MD	15,000
6. Planting material (10 cartloads) @ Rs.1000/cartload	10,000
7. Cutting preparation (8 MD) (20,000 @ 2,500 cuttings/MD)	1,600
8. Planting (50 MD)	10,000
9. Hoeing/weeding 3-4 times (125 MD)	25,000
10. Miscellaneous expenditure	3,000
Total	97,200

MD: Man days

Table 3: Maintenance cost of *Chawki* mulberry garden (Rs/hectare)

Particulars	Cost (Rs)
1. Farm yard manure (40 MT) @ Rs. 800/MT	32,000
2. Fertilizer cost: NPK 225:150:150 kg/ha/year; Ammonium Sulphate @ 1240 kg/ha/year, Single Super Phosphate @ 952 kg/ha/year and Murriate of Potash @ 256 Kg/ha/year	24,313
3. Manure and fertilizer application (40 + 30 MD @ Rs.200/MD)	14,000
4. Irrigation (365 MD)	73,000

5. Intercultivation 20 MD & 8 pairs of bullock - 8 times per year @ Rs. 200/MD and Rs.250/- per bullock pair	51,200
6. Leaf harvest (290 MD @ 100 kg leaf per MD)	23,200
7. Pruning (20 MD)	4,000
8. Land revenue	250
9. Interest on working capital	3,326
Total	2,25,288

Table 4: Rearing building and equipments for CRC (Value in Rupees)

Rearing building/equipment	Quantity	Cost per unit (Rs)	Total Cost (Rs)	Life span (Years)	Depreciation (Rs.)
1. Rearing house for Chawki rearing (1800 sq.ft.)	1 No.	300*	5,40,000	25	21,600
2. Plastic rearing trays (3' x4')	400 No.	500	2,00,000	10	20,000
3. Incubation frame	100 No.	150	15,000	4	3,750
4. Leaf chopping machine	1 No.	10000	10,000	10	1,000
5. Wooden Chawki stands	20 No.	1000	20,000	10	2,000
6. Feeding stands	6 No.	500	3,000	5	600
7. Leaf chopping board	4 No.	500	2,000	5	400
8. Knives	4 No	200	800	2	400
9. Generator	1 No.	50000	50,000	10	5,000
10. Room heater	2 No	8000	16,000	5	3,200
11. Humidifier	2 No.	8000	16,000	5	3,200
12. Power sprayer with mask	1 No.	30000	30,000	10	3,000
13. Room cooler	2 No.	2000	4,000	5	800
14. Microscope	1 No.	1000	2,000	5	400
15. Wet & dry thermometer	2 No.	1000	2,000	5	400
Total cost/Depreciation cost			9,10,800		65,750

* Unit cost/sq.ft.

Table 5: *Chawki* silkworm rearing cost and revenue generated – Model 1

Particulars	Cost & Returns (Rs per year)
1. <i>Chawki</i> mulberry leaf production cost (from Table 3)	2,25,288
2. Apportioned cost of establishment of mulberry garden (from Table 2)	6,480
3. Total mulberry leaf production cost (A)	2,31,768
4. Leaf produced (kg/ha)	30000
5. Cost of producing 1 kg mulberry leaf	7.73
6. Cost of dfls (Rs 500/100 dfls)	6,00,000
7. Cost of disinfectants and lime	1,20,000
8. Labour for silkworm rearing @ 6 labour/day	4,38,000
9. Miscellaneous	10,000
10. Depreciation cost of rearing house & equipments (from Table 4)	65,750
11. Interest on fixed investment	87,437
12. Total silkworm rearing cost (B)	13,21,187
13. Total <i>Chawki</i> silkworm production cost (A + B)	15,52,955
14. Less: Cost of dfls	6,00,000
15. Net production cost (C)	9,52,955
16. <i>Chawki</i> worms selling Price (Rs/100 dfls)	1,000
17. Total revenue from selling <i>Chawki</i> worms (D)	12,00,000
18. Net revenue from supply of <i>Chawki</i> silkworms (D – C)	2,47,045
19. Cost: Benefit Ratio	1.26

Note: a. Apportioned cost of mulberry garden is worked out by dividing the establishment cost by economic life span of the garden i.e., 15 years

b. Transport and marketing costs are not included

Model 2: With 2 acres (4 plots) Chawki mulberry garden (32 crops per year)

Table 6: Establishment cost of Chawki mulberry garden (Rs/ 2 acres)

Particulars	Cost (Rs)
1. Tractor tilling (8 h), Harrowing (4 h/ha) @ Rs.600/h	7,200
2. Final land preparation (8 pairs of bullock/ha) @ Rs.300/pair	3,000
3. Farm yard manure [FYM] (20 MT) @ Rs.800/MT	16,000
4. FYM application (20 MD) @ Rs.200/MD (broadcasting)	4,000
5. Planting preparation : Ridge-Furrow 60 Man days	12,000
6. Planting material (8 cartloads) @ Rs.1000/cartload	8,000
7. Cutting preparation (6 MD) (12,000 @ 2,000 cuttings/MD)	1,000
8. Planting (40 MD)	8,000
9. Hoeing/Weeding 3-4 times (100 MD)	20,000
10. Miscellaneous expenditure	3,000
Total	82,200

Table 7: Maintenance cost of Chawki mulberry garden (Rs/2 acres)

Particulars	Cost (Rs)
1. Farm yard manure (40 MT) @ Rs.800/MT	32,000
2. Fertilizer cost (NPK 260:140:140 kg/ha/year) Ammonium Sulphate @ 1240 kg/ha/year, Single Super Phosphate @ 952 kg/ha/year and Murriate of Potash @ 256 kg/ha/year	25,692
3. Manure and fertilizer application (40 + 30 MD) @ Rs.200/MD	14,000
4. Irrigation (365 MD)	73,000
5. Intercultivation 20 MD & 8 pairs of bullock - 8 times per year @ Rs 200/MD and Rs.250/- per bullock pair	51,200
6. Leaf harvest (290 MDs @ 100 Kg. leaf per Manday)	23,200
7. Pruning (20 MD)	4,000
8. Land revenue	250
9. Interest on working capital	3,326
Total	2,26,667

Table 8: Rearing building and equipments for CRC (Value in Rupees)

Rearing building/equipment	Quantity	Cost per unit (Rs)	Total Cost (Rs)	Life span (Years)	Depreciation (Rs.)
1. Rearing house for <i>Chawki</i> rearing (1800 sq.ft.)	1 No.	300*	5,40,000	25	21,600
2. Plastic rearing trays (3' x4')	400 No.	500	2,00,000	10	20,000
3. Incubation frame	100 No.	150	15,000	4	3,750
4. Leaf chopping machine	1 No.	10000	10,000	10	1,000
5. Wooden <i>Chawki</i> stands	20 No.	1000	20,000	10	2,000
6. Feeding stands	6 No.	500	3,000	5	600
7. Leaf chopping board	4 No.	500	2,000	5	400
8. Knives	4 No	200	800	2	400
9. Generator	1 No.	50000	50,000	10	5,000
10. Room heater	2 No	8000	16,000	5	3,200
11. Humidifier	2 No.	8000	16,000	5	3,200
12. Power sprayer with mask	1 No.	30000	30,000	10	3,000
13. Room cooler	2 No.	2000	4,000	5	800
14. Microscope	1 No.	1000	2,000	5	400
15. Wet & dry thermometer	2 No.	1000	2,000	5	400
Total cost/Depreciation cost			9,10,800		65,750

* Unit cost/sq.ft.

Table 9: *Chawki* silkworm rearing cost and revenue generated – Model 2

Particulars	Cost & Returns (Rs per year)
1. <i>Chawki</i> mulberry leaf production cost (from Table 7)	2,26,667
2. Apportioned cost of establishment of mulberry garden (from Table 6)	5,480
3. Total mulberry leaf production cost (A)	2,32,147
4. Leaf produced (Kg/ha)	30000
5. Cost of producing 1 kg mulberry leaf	7.74
6. Cost of dfls (Rs 500/100 dfls)	7,50,000
7. Cost of disinfectants and lime	1,50,000
8. Labour for silkworm rearing @ 8 labour/day	5,84,000
9. Miscellaneous	10,000
10. Depreciation cost of Rearing House & equipments (from Table 8)	65,750
11. Interest on fixed investment	87,437
12. Total Silkworm rearing cost (B)	16,47,187
13. Total <i>Chawki</i> silkworm production cost (A + B)	18,79,334
14. Less: Cost of dfls	7,50,000
15. Net Production cost (C)	11,29,334
16. Selling Price (Rs/100 dfls)	1000
17. Total Revenue from selling <i>Chawki</i> worms (D)	16,00,000
18. Net revenue from supply of <i>Chawki</i> silkworms (D – C)	4,70,666
19. Cost : Benefit Ratio	1.42

Note: a. Apportioned cost of mulberry garden is worked out by dividing the establishment cost by economic life span of the garden i.e., 15 years

b. Transport and marketing costs are not included

**CENTRAL SILK BOARD (AMENDMENT) ACT, 2006
RULES AND REGULATIONS GOVERNING REGISTRATION OF CHAWKI
SILKWORM REARERS**

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Central Silk Board shouldering the responsibility of developing the sericulture industry across the country, intended meaningful modifications in the existing rules and regulations governing sericulture on the wake of the liberalization policy and globalized market economy so that the trade practices of sericulture produces are liberalized in consonance with other commodities paving way for quality improvement. Accordingly, Central Silk Board (Amendment) Act, 2006 was passed by the Parliament and got published in the Gazette of India, on 14th September, 2006. Subsequently the relevant rules were notified on 28th September, 2007 and the Central Silk Board Silkworm Seed Regulations, 2010 was notified on 16th March, 2010.

The Government of India, in compliance with the provisions made in the Central Silk Board (Amendment) Act, 2006 has 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 Registration Committee appointed for this purpose by the Central Silkworm Seed Committee (CSSC), the authority responsible for implementing the Act.

The Director, National Silkworm Seed Organization 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 at every segment of seed sector.

Eligibility for registration

1. 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.

2. 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.
3. He/she shall undertake to rear a minimum quantity of 1.5 lakh DFLs per annum from the third year of registration.
4. He/she shall possess a minimum of two acres of *Chawki* mulberry garden of improved variety with irrigation facility or sufficient mulberry trees.
5. 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.
6. He/she shall possess the appliances or equipment as specified.

Procedure of registration and grant of certificate

1. 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 – Form -12 (*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.
2. 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 alphanumeric 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

Conditions to be complied with by the registered seed producer, *Chawki* rearer and dealer in silkworm seed or *Chawki* larvae

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 and procedure stipulated in the Regulation (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.

Notification of cancellation of registration:

The Registration Committee shall notify in writing the cancellation of registration made under 8 E (2) (viii).

Controlling and supervising the 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.



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