



WELCOME

TO

DEPARTMENT OF SERICULTURE

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SILKWORM REARING -1



SERICULTURE

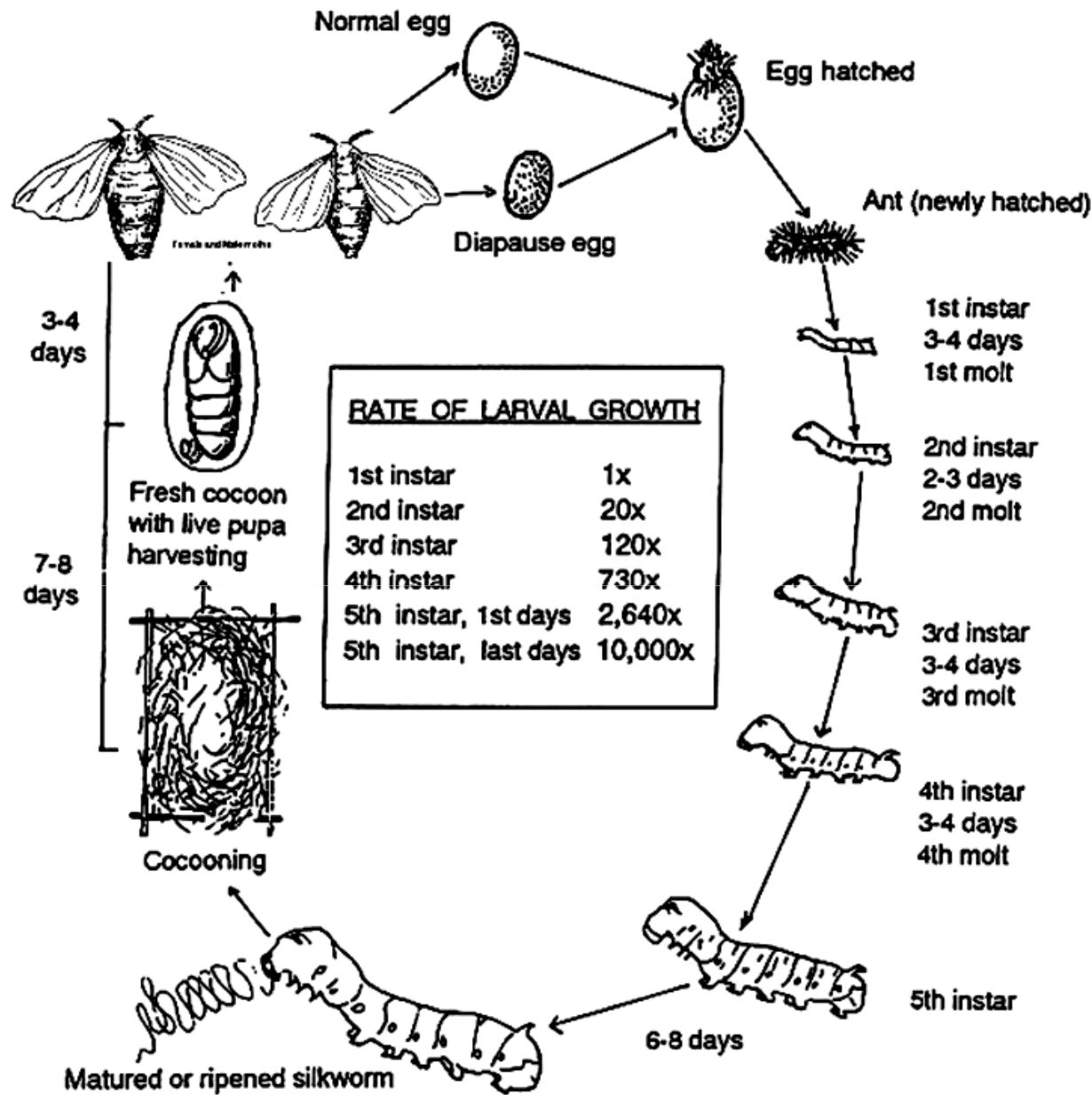
Sericulture is an agro-industry, the end product of which is SILK.

Sericulture Industry consists

- **Production of Mulberry leaves**
 - **Rearing of silkworms & Cocoon production**
 - **Silk reeling, processing and textile manufacture**
- Sericulture Technology
- Silk Technology
-
- ```
graph LR; A[Production of Mulberry leaves] --- B[Sericulture Technology]; B --- C[Rearing of silkworms & Cocoon production]; C --- D[Silk Technology]; D --- E[Silk reeling, processing and textile manufacture];
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# LIFE CYCLE OF *BOMBYX MORI*



## Voltinism

**Embryonic Stage**

**Larval Stage**

**Moulting**

**Mature Worm**

**Spinning of the cocoon**

**Uni - 1 gen/yr**

**Bi - 2 gen/yr**

**Mv - 6-8 gen/yr**

**MV: Egg-9-12**

**Larva- 20-24**

**Pupa- 10-12**

**Moth- 3-6**

**BV: Egg-11-14**

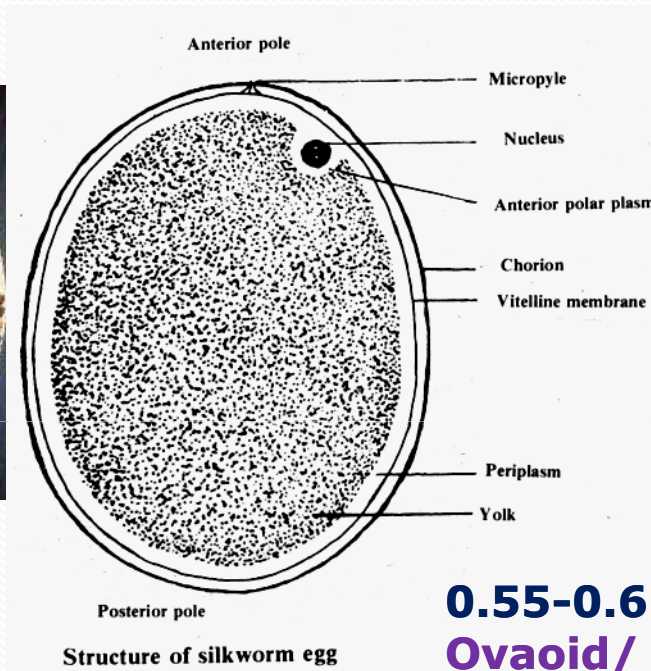
**Larva- 24-28**

**Pupa- 12-15**

**Moth- 6-10**

**0.9-1.2 mm**

**One Laying**



**1-1.3 mm**

**0.55-0.6mg**  
**Ovaoid/ Spherical**  
**Flat at ventral side**  
**Micropyle**  
**Respiratory channels**

## Silkworms At Different Ages

Newly hatched larvae



3mm

Enlarged



Second Instar larvae



Third Instar Larvae



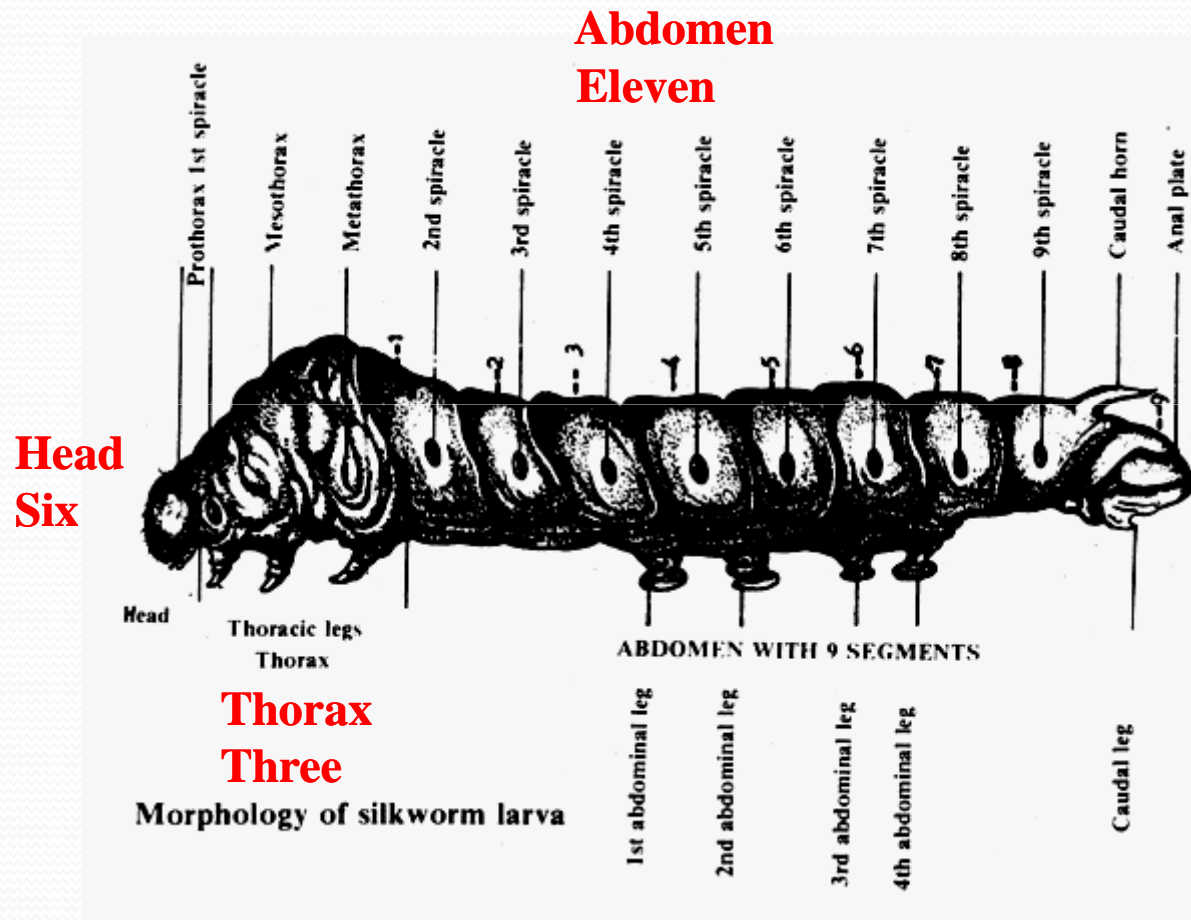
Fourth instar larvae



10cm

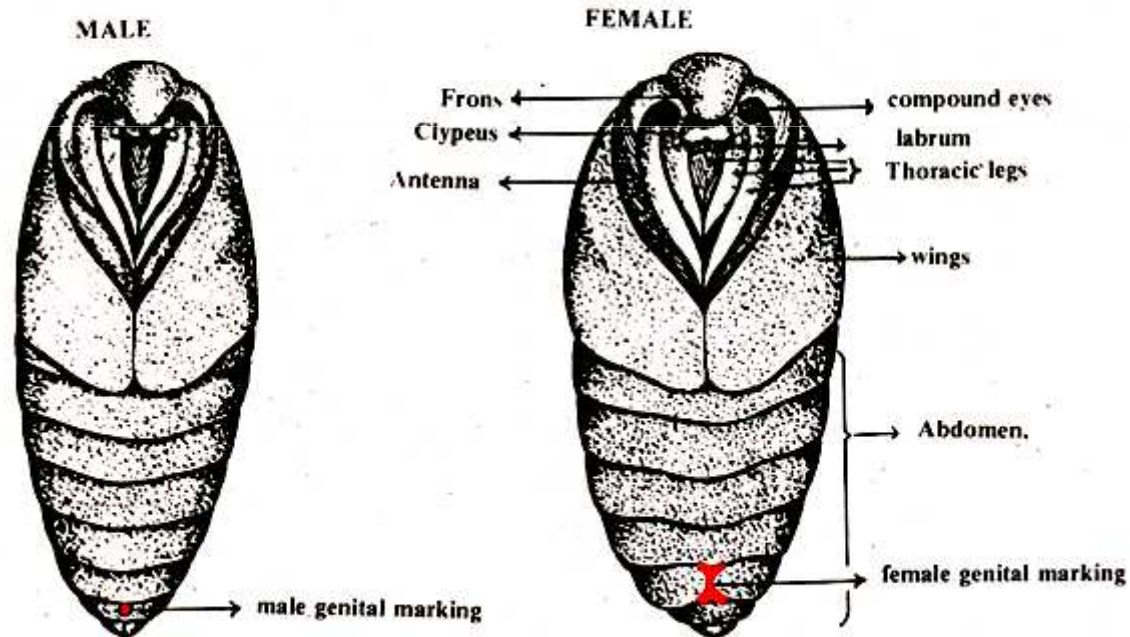
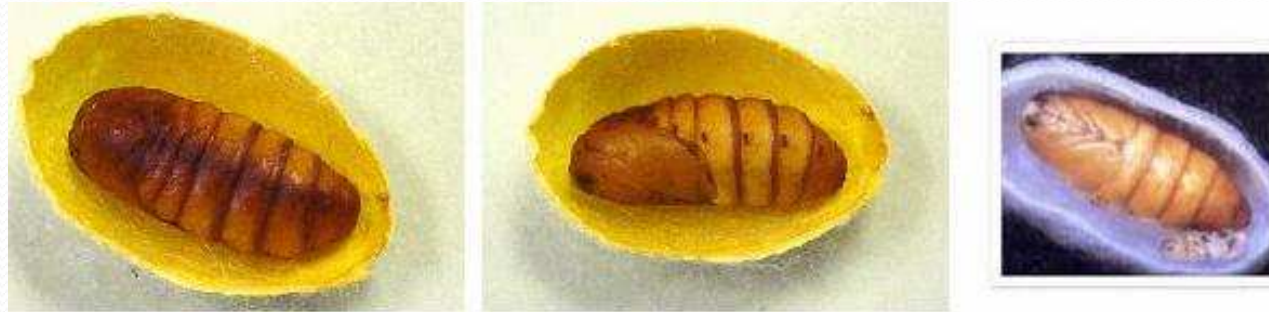
Fifth instar Larvae







# PUPA

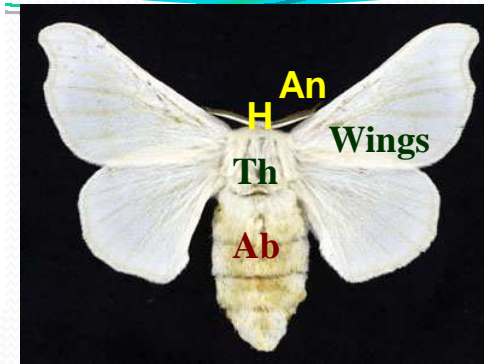


male and female pupa - *Bombyx mori* Sexual Marking at Pupal stage

# Moth



**Female and Male moths**



**Paired Female and Male moths**

**Female and Male moths**



**Female moth**

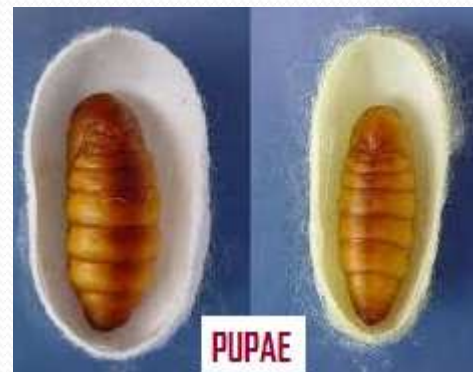


**Egg laying Female moths**

# Definition/meaning



DIAPAUSING/ NON DIAPAUSING EGGS



# Definition/meaning continued.....

**Fecundity :-** Total number of eggs laid by a female moth after mating.

**Hatching %:-**The number of larvae hatched from disease free layings.

$$\text{Hatching percentage} = \frac{\text{No. of eggs hatched in a laying}}{\text{Total no. of eggs per laying}} \times 100$$

**Larval Duration:-** Total duration in hours from the time of hatching to that of spinning.

# Definition/meaning continued.....

## Cocoon yield

***Yield of cocoons by number:-*** This represents the survival rate of larvae that spin cocoons.

$$\text{Yield of cocoons by number} = \frac{\text{Total no. of cocoons harvested}}{\text{Total no. of larvae brushed}} \times 10,000$$

***Yield of cocoons by weight:-*** It is the total quantity of good cocoons in kilograms obtained for a standard unit of 10,000 larvae brushed.

$$\text{Yield of cocoons by weight} = \frac{\text{Total wt. of cocoons}}{\text{Total no. of cocoons harvested}} \times \text{yield of cocoons by number}$$

## Definition/meaning continued.....

***Filament length:*** Total length of filament (meters) of single cocoon reeled using epprouvette (A reeling device for monococoon reeling).

***Denier:*** Denier is the thickness of the filament and can be calculated using the following formula.

$$\text{Denier} = \frac{\text{Weight of the reeled silk}}{\text{Length of the reeled silk}} \times 9000$$

***Leaf-Cocoon Ratio:*** Units of mulberry leaf required to produce one unit of cocoons.





**The silkworm rearing programme in a farm is determined by the following considerations.**

- 1. Conditions of mulberry growth, yield of mulberry leaf, quality of mulberry leaves and time of availability.**
- 2. Availability of labour for leaf harvesting and rearing of silkworms.**
- 3. Facilities for rearing silkworms *i.e.*,**
  - a. Suitable Building**
  - b. Equipments**

## **a. Rearing House:**

**Silkworm rearing demands certain specified environmental conditions, Particularly as regards temperature and humidity.**

**Rearing houses are planned and constructed to provide and maintain Proper environmental conditions to ensure good quality cocoons as the silkworms are poikilotherms**

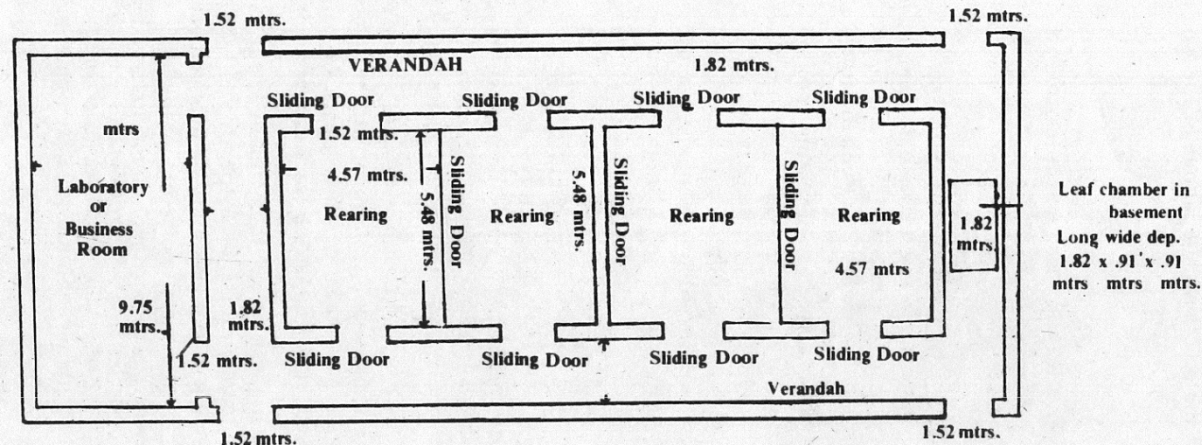
**Generally 2 types of rearing houses are known**

- 1. Shelf rearing**
- 2. Shoot rearing**

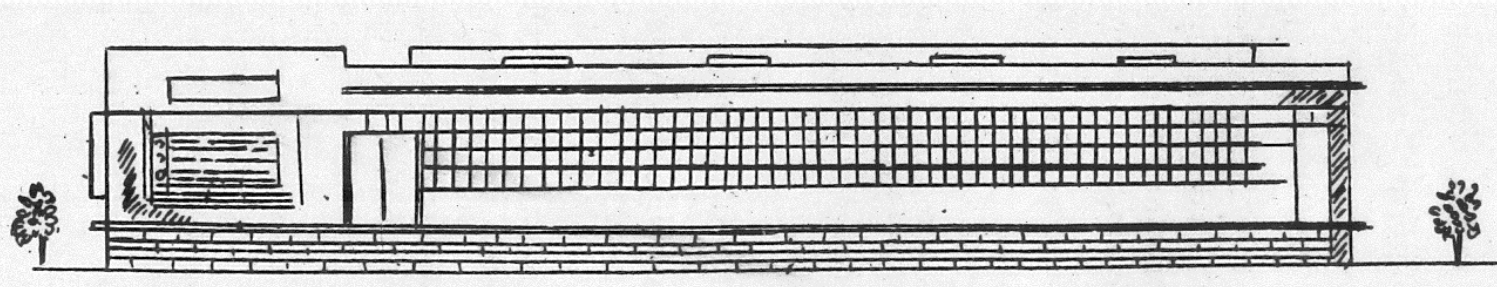
# Model Rearing House

## Rearing House Building Plans

1.



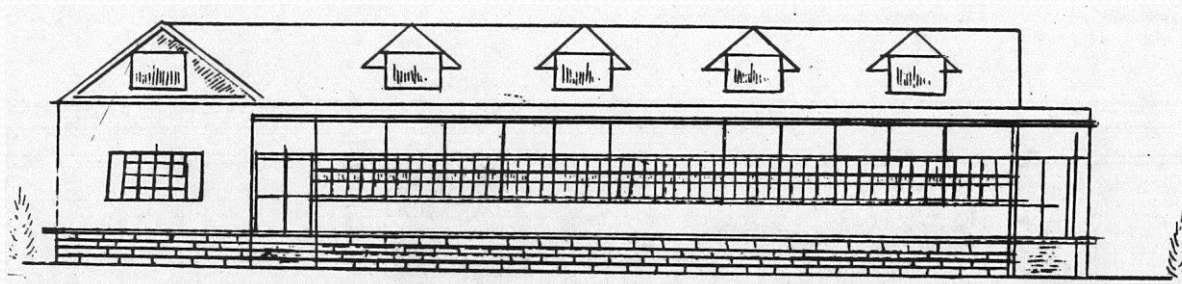
### Ground Plan



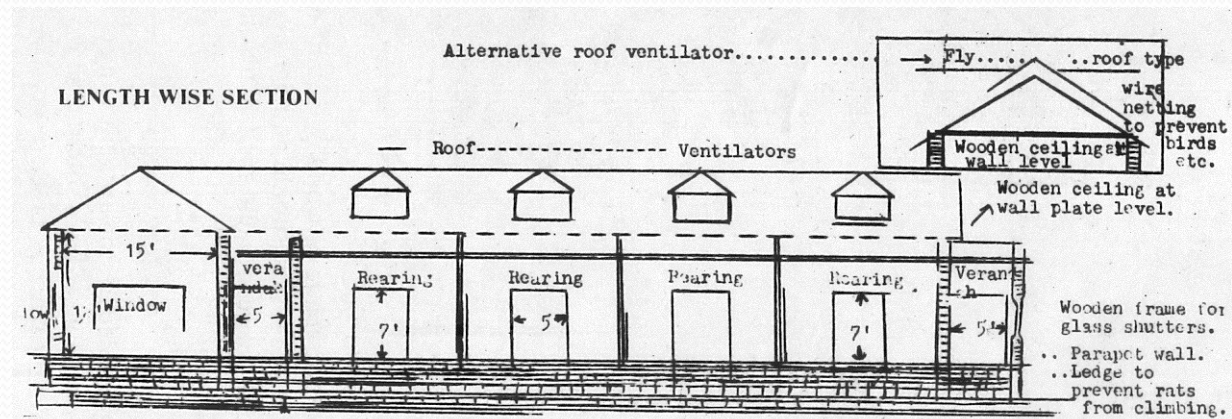
### Front Elevation (R C C Roofing)

## Rearing House Building Plans

2.



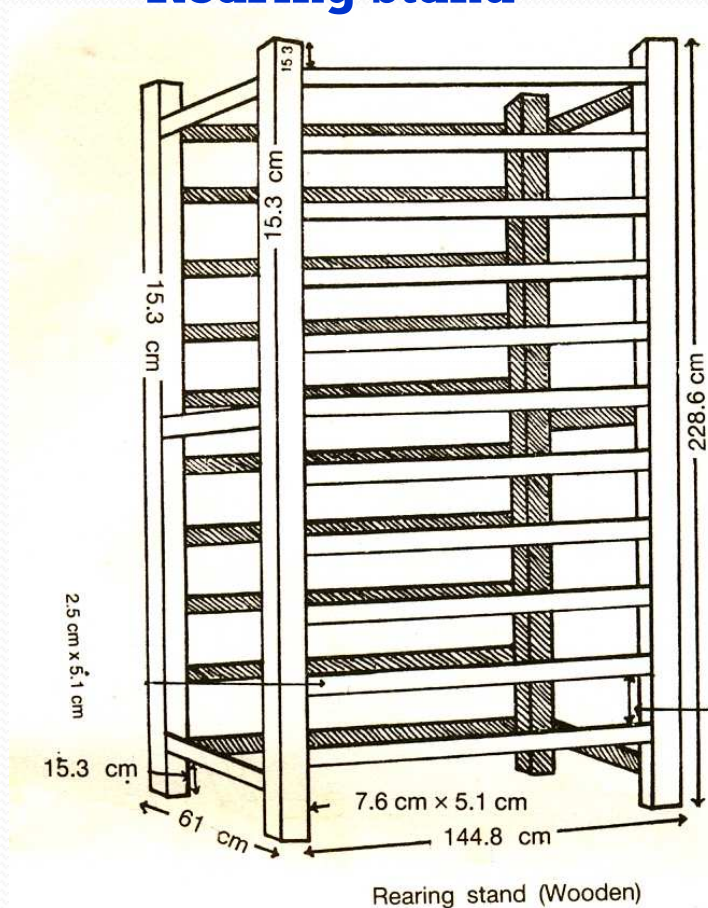
### Front Elevation (Gable Roof)



### Length Wise Section

# Rearing Appliances

## Rearing Stand

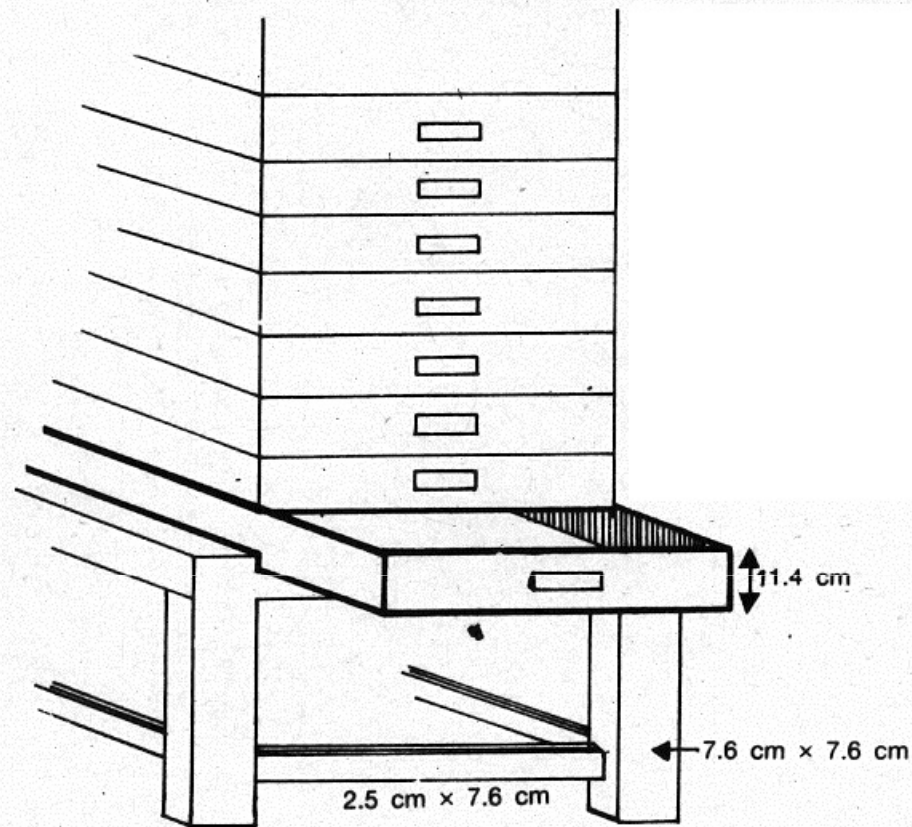


## Rearing Stand

These are made of wood or steel or bamboo and are portable.

The trays are arranged on the shelves and each stand can accommodate ten trays. These are used for keeping the trays containing silkworms.

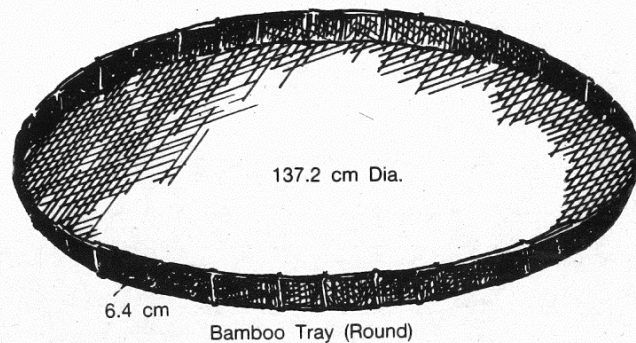
The standard length / width of the stand are given with picture. However, it can be altered depending on the requirement.



Chawki rearing box with stand

**These are used for rearing early stage larvae. They are made Of light wood and of convenient size for easy handling. The dimensions are given on the picture.**

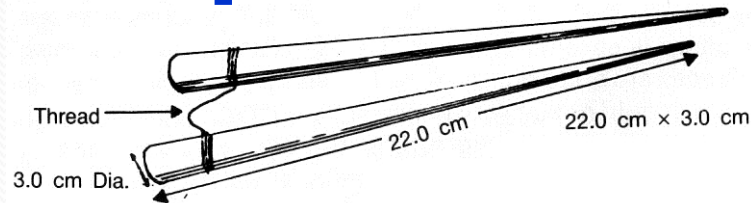
## Rearing Trays are used to rear silkworms



- **Bamboo Trays:** Are economical, light weight, easy to handle and easy for disinfection by smearing with cow dung followed by sun drying. These are very popular in both Karnataka and West Bengal. The size / diameter is varies according to the requirement and maker.

- **Wooden/PVC Tray:** The wooden trays are made of light wood and of convenient size for easy handling. However, PVC trays are more popular as they are light weight, easy handling & easy for disinfection with any chemical.

## Chop sticks

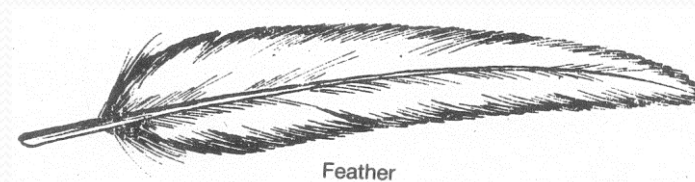


**These are made of bamboo and dimensions are given in the picture.**

**Direct handling of young age worms is to be avoided for hygienic and to prevent damage to young worms.**

**A pair of chop sticks is used to pick early stage larvae**

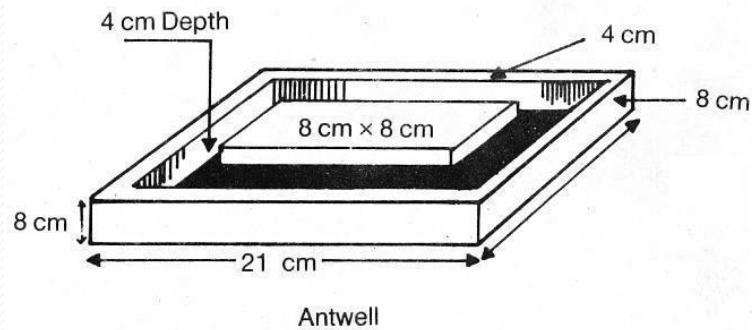
## Feather



**Birds feather, preferably white ones are used for brushing the delicate newly hatched worms onto the rearing bed.**



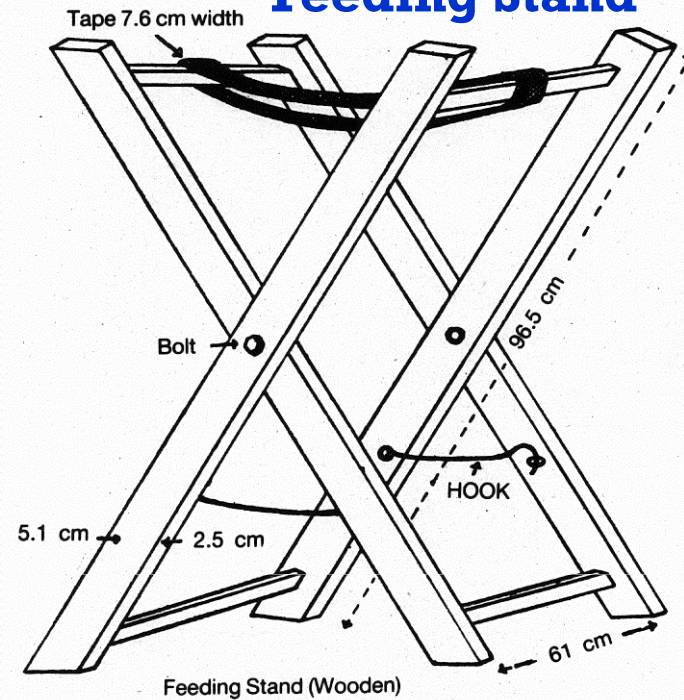
## Ant Well



**These are made up of either cement or stone blocks or PVC material and the dimensions are given with picture.**  
**The legs of the cocoon preservation stands rest on the center of the block an water is poured into the groove to stop the ants and other wingless or crawling insects climbing on to racks as they are gregarious predators.**

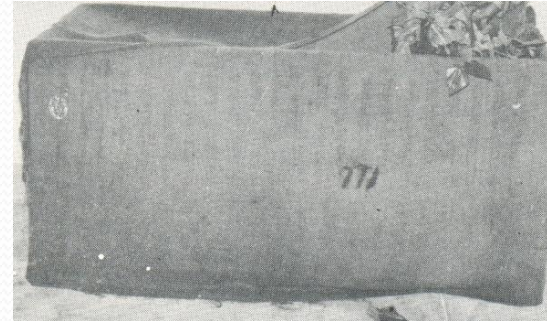
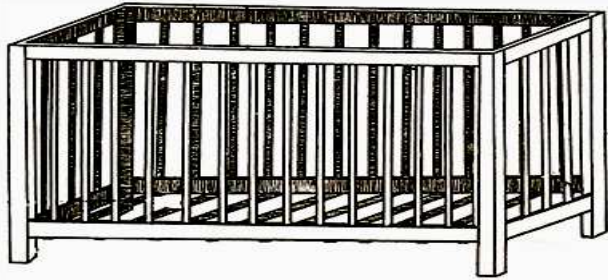
**Each stand leg must rest in a well.**

## Feeding Stand



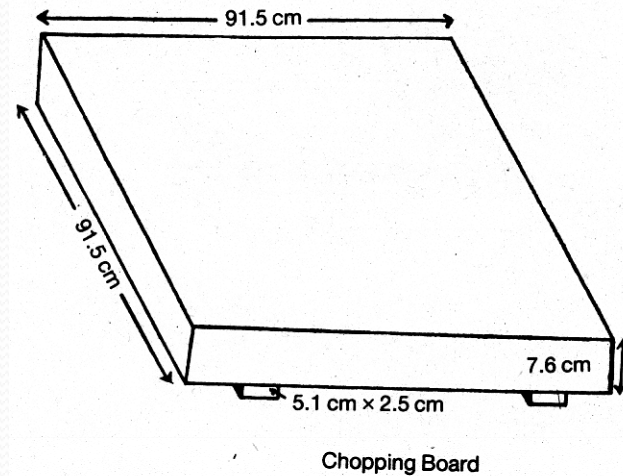
**These re small wooden stands 0.9 m high used for holding The trays during feeding and cleaning**

## Leaf Storage Bins/Leaf Chambers



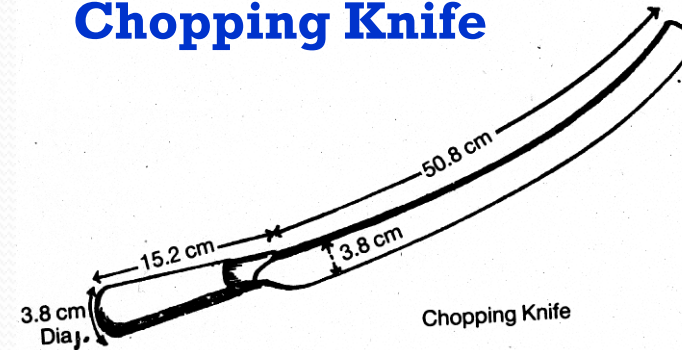
**Mulberry leaves harvested from the field are stored and Preserved fresh for feeding the worms at set intervals during the day. The leaves are stored in cool rooms, or in underground masonry pits or in rooms in heaps covered with cloth or polythene sheets. They also be stored in convenient leaf chambers as shown in the picture. The chamber is covered on all the sides with gunny cloth which is kept wet.**

## Chopping Board

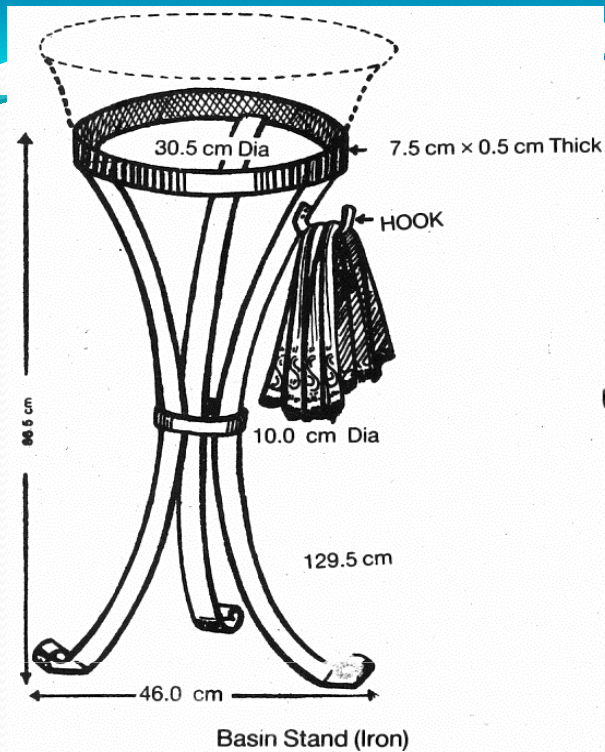


**This is made of soft wood and is used for cutting the leaf to the suitable sizes required for feeding the worms in the different instars. The dimensions are given in the picture.**

## Chopping Knife

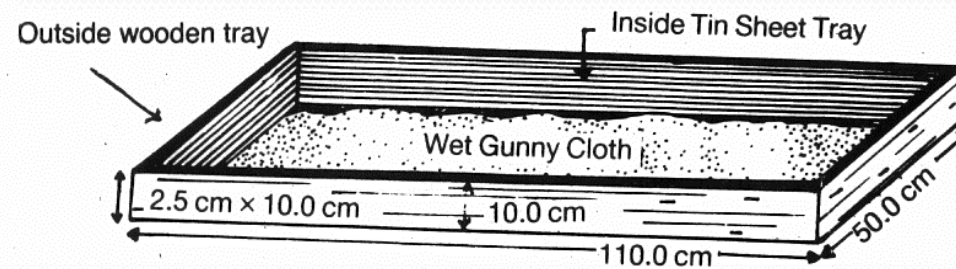


**Chopping knives are used for cutting the mulberry leaves.**



### •Basin Stand

These are made of metal and are intended to hold a basin containing formalin or any other disinfectant. This is used for disinfection of hands while entering the rearing room.



### •Foot Cleaning Tray

This is made of metal containing gunny cloth moistened with disinfectant for disinfection of feet while entering the rearing room.

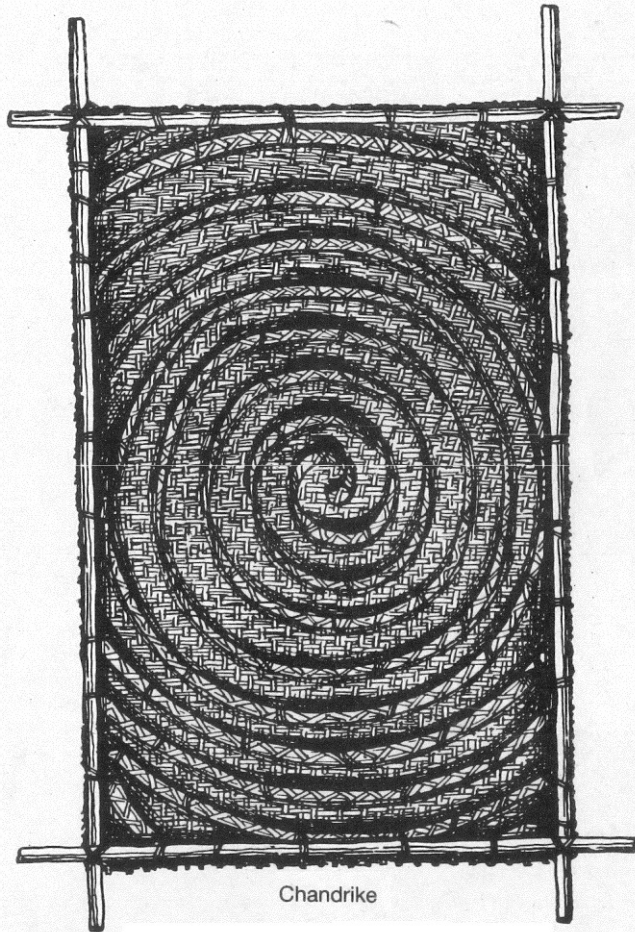


•**Hygrometer:** It is used in recording atmospheric humidity. The atmospheric humidity is expressed in percentage. In rearing room it is used in the rearing trays in particular to monitor atmospheric humidity.



•**Dry and Wet bulb thermometer:** It is used to record dry as well as wet temperature. By consulting the chart given with the Instrument any one can calculate relative humidity of that particular place. In rearing room, it is used in rearing rooms to monitor both dry temperature and relative humidity.

## Mountages



**These are used as supports for the silkworms to spin cocoons. They are made of bamboo. They are also called chandrike.**

**Other different types of mountages like, Plastic corrugated, rotary, bottle brush, grass etc., are also used.**



# Disinfection

# Disinfection

**The process that is used to destroy, inactivate, or significantly reduce the concentration of pathogenic agents (such as bacteria, viruses, and fungi)**

**Or**

**The process of cleansing or purifying a room, items, etc., of germs that cause disease**



## **1. 1% Bleaching power:**

**1% i.e., 1kg/100 lts. @ 225 ml/sq.mt**

**Or**

## **2. Chlorine dioxide 500ppm**

## **3. 2% Formaldehyde Solution/Formalin**

**In addition to the above, workers should also be maintained personal hygiene before entering in to the grainage building by washing hands in 2% formalin and legs cleaned with foot mats soaked with 2% formalin.**

# Preparation of 2% Formalin

To prepare required concentration of formalin may be prepared by using following formula

Parts of water to be added to each part of formalin =  $\frac{\text{Original Strength of the Formalin} - \text{Required Concentration}}{\text{Required Concentration}}$

$$\text{i.e., } \frac{40\% - 2\%}{2\%} = 19$$

**i.e., For every liter of formalin 19 litres of water is added to get a solution of 2%**

**If the previous batch was contaminated then double strength i.e., 4% formalin may be used**

# Calculation for Required Quantity of 2% Formalin in a Rearing House

The requirement of 2% formalin solution for disinfection of 100 square meter area may be calculated by the following formula

1. **Floor Area** = **Length x Breadth**
2. **Area of two walls** = **Length x Height of each wall x 2**
3. **Area of two other walls** = **Breadth x Height of each wall x 2**
4. **Roof of terrace** = **Length x Breadth**

**Add up to get the area to be disinfected**

# Calculation for Required Quantity of 2% Formalin in a Rearing House continued

**The requirement of 2% formalin solution for disinfection may be calculated by the following formula**

- 1. Floor Area** =  $6.1 \text{ mts} \times 9.1 \text{ mts} = 55.51 \text{ mts}^2$  or  $20' \times 30' = 600 \text{ sq. ft.}$
- 2. Area of two walls** =  $6.1 \text{ mts} \times 3.05 \times 2 = 37.2 \text{ mts}^2$  or  $20' \times 10 \times 2 = 400 \text{ sq. mt.}$
- 3. Area of two other walls** =  $9.1 \text{ mts} \times 3.05 \times 2 = 55.51 \text{ mts}^2$  or  $30' \times 10' \times 2 = 600 \text{ sq. mt.}$
- 4. Roof of terrace** =  $6.1 \text{ mts} \times 9.1 \text{ mts} = 55.51 \text{ mts}^2$  or  $20' \times 30' = 600 \text{ sq. ft.}$

**Total Area 203.74 sq. mts = 2200 sq. ft**

$$\begin{aligned} \text{Requirement of 2\% Formalin Solution} &= \frac{203.74 \times 8.61}{100} \text{ (required to disinfect 100 sq.mt)} \\ &= 17.5 \text{ litres} \end{aligned}$$

**Add equal quantity for spraying equipments  
i.e., total requirement of 2% formalin is 35 litres**

To get 35 litres  
of 2% formalin =  $\frac{35}{19}$  = 1.84 litres

**About 1.84 litres of commercial formaldehyde is required to disinfect equipments and rearing house of size of 20' x 30' or 6.1 mts x 9.1 mts with terraced roof**

**So 1.84 liters of formalin should be mixed with 33.16 liters of water to get 35 liters of 2% formalin**



**Lime is also added to 2% formalin solution for effective killing of Cytoplasmic Polyhedrosis Virus**

**Fresh lime @ 5 gms / 1000 ml of 2% formalin solution**

**The turbid solution after mixing with fresh lime must be used for disinfection**

# Precautions During Disinfection

- **Area should be cleaned thoroughly.**
- **It is advisable to use power sprayers.**
- **Before spraying the holes and crevices should be closed.**
- **Spraying should be conducted when the room temperature is at 25°C.**
- **Laborer should always use gas masks as formalin irritates the soft skin.**
- **After disinfection the room should be sealed off for 24 hours.**
- **Spray area must be kept wet for at least 30 min to have good disinfection.**

# Fumigation

**The process of disinfecting an area with the fumes of certain chemicals**

- 1. Fumigation of Formalin is suggested for compact seed production unit.**
- 2. For this purpose , formalin kept in an iron pan is placed over a hot oven and allowed to evaporate for 4-5 hours.**
- 3. Care should be taken to keep only just sufficient fire to evaporate formalin, otherwise it may lead to fire hazards.**





# **Silkworm Seed Technology**

**Dr. Mahesha H B**  
**Professor and Head**  
**Department of Sericulture**  
**Yuvaraja's College**  
**University of Mysore, Mysuru, India.**



## **Sericulture Industry**

- **Production of Mulberry leaves**
- **Rearing of silkworms & Cocoon production**
- **Silk reeling, processing and textile manufacture**

**Quality seed is the backbone of sericulture industry**

# Quality seed

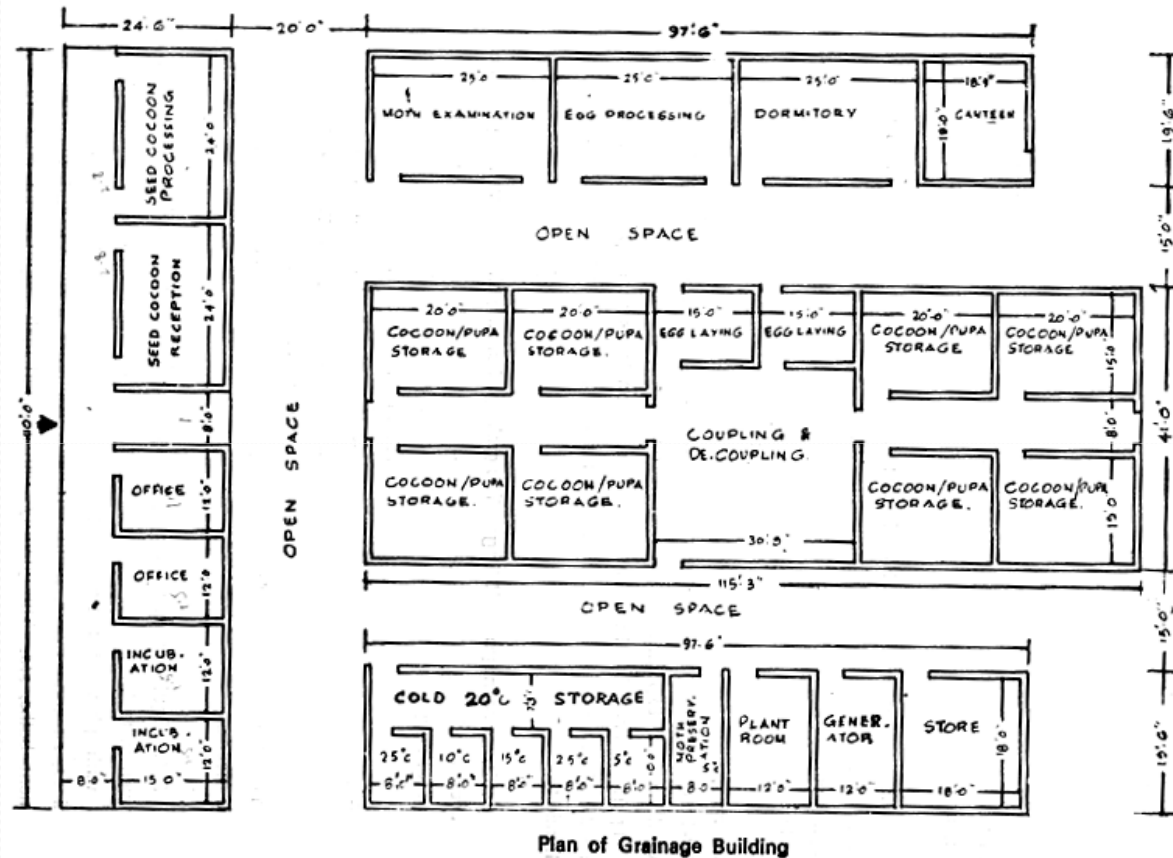
- **Is free from diseases**
- **Has maximum number of viable eggs**
- **Gives good uniform hatching**
- **Is prepared from healthy and robust parents**
- **Assures a stable and successful cocoon crop**



# Grainage

**Grainages are establishments where disease free and quality seeds are produced on scientific lines.**

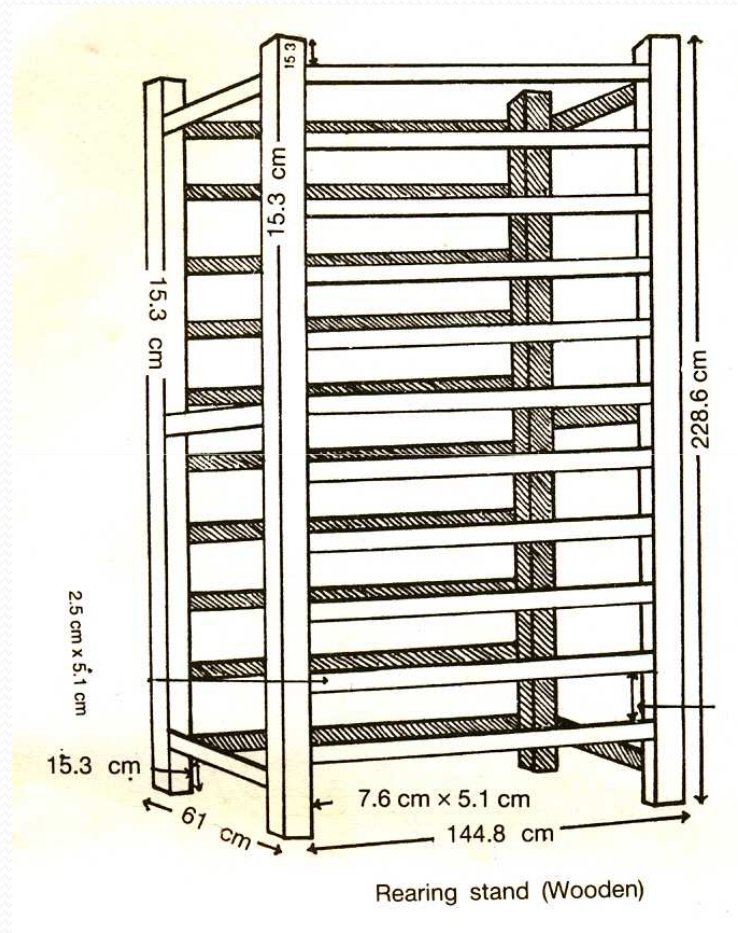
# Grainage Building Plan



## Facilities

1. Accommodating cocoons /Pupae of different strains
2. Coupling & oviposition
3. Incubation
4. Laboratory
5. Egg processing
6. Cold storage
7. Dormitory
8. Office

# Grainage Equipments



## Cocoon Preservation Rack

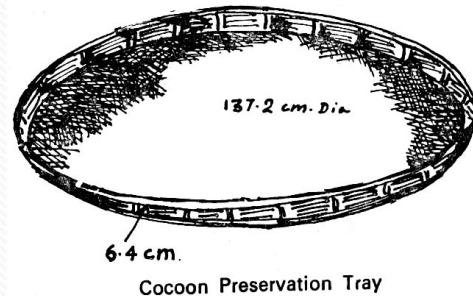
Cocoon preservation racks are made of wood or steel or bamboo and are portable.

The trays are arranged on the shelves and each stand can accommodate ten trays. These are used for keeping the trays containing cocoons and pupae of different races and sexes.

The standard length / width of the stand are given with picture. However, it can be altered depending on the requirement of the grainage.

# Grainage Equipments continued

## Cocoon Preservation Tray



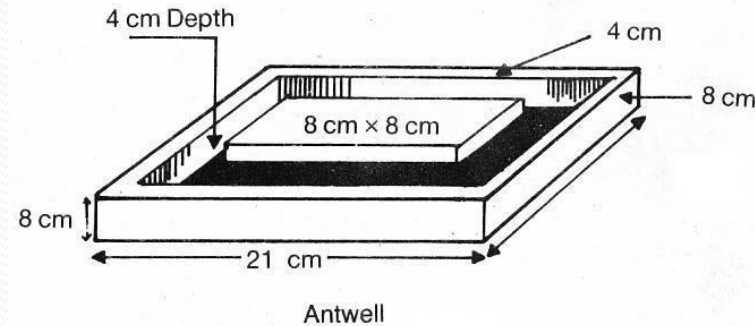
### Trays are used to Preserve Cocoons.

• **Bamboo Trays:** Are economical, light weight, easy to handle and easy for disinfection by smearing with cow dung followed by sun drying. These are very popular in both Karnataka and West Bengal. The size / diameter is varies according to the requirement and maker.

• **Wooden/PVC Tray:** The wooden trays are made of light wood and of convenient size for easy handling. However, PVC trays are more popular as they are light weight, easy handling & easy for disinfection with any chemical.

# Grainage Equipments continued

## Ant Well



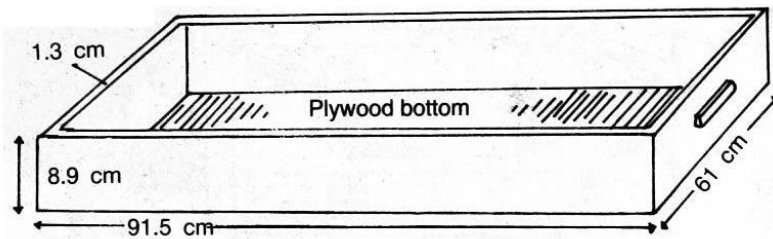
**These are made up of either cement or stone blocks or PVC material and the dimensions are given with picture.**

**The legs of the cocoon preservation stands rest on the center of the block an water is poured into the groove to stop the ants and other wingless or crawling insects climbing on to racks as they are gregarious predators.**

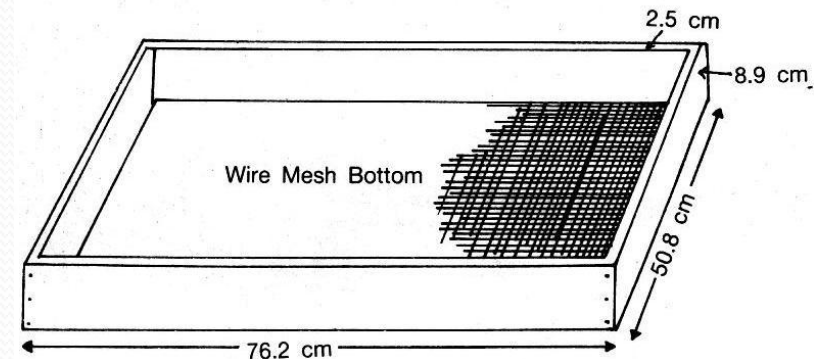
**Each stand leg must rest in a well.**



# Grainage Equipments continued



Grainage Tray (Wooden)



Grainage-wiremesh Tray

## **Grainage Tray-Plywood Bottom**

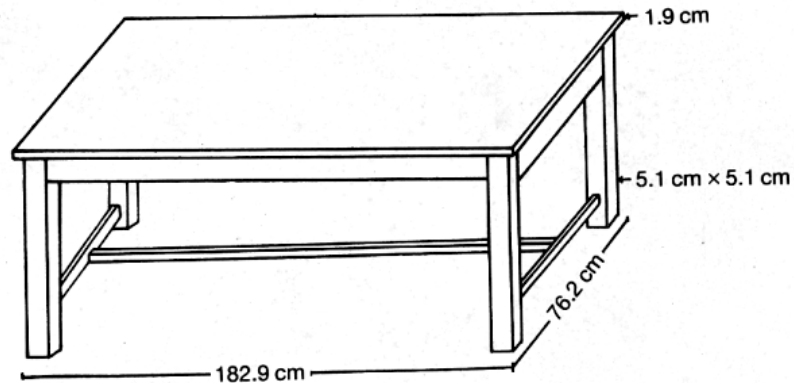
**For preservation of moths, during copulation and oviposition wooden trays with plywood bottom is generally used as it provides smooth, uniform bottom.**

## **Grainage Tray -Wire Mesh Bottom**

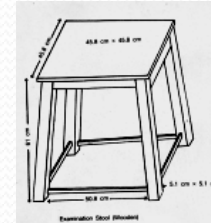
**Grainage with wire mesh bottom is used for preservation of moths as it allows draining off the last excreta / urine passed by the moths before and after copulation.**

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# Grainage Equipments continued



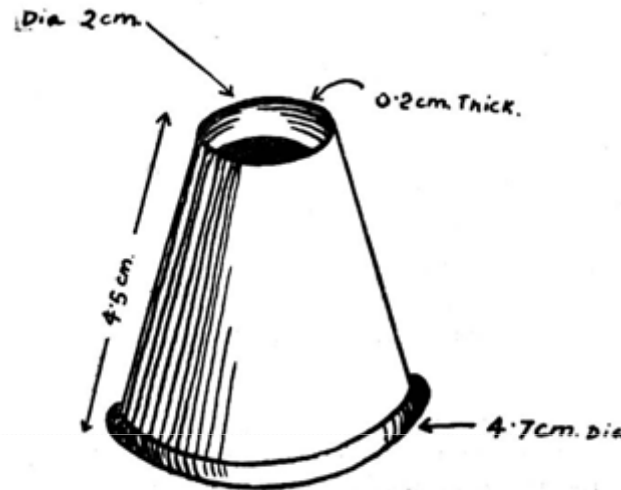
Moth Testing Table (Wooden)



## Table and Stool

**These table and stools are made up of either wooden or steel. The dimensions are given with the picture however, it may be altered depending on the requirement. These are used for preliminary examinations of the cocoons, microscopic examination of moths during pebrine inspection and also for egg processing.**

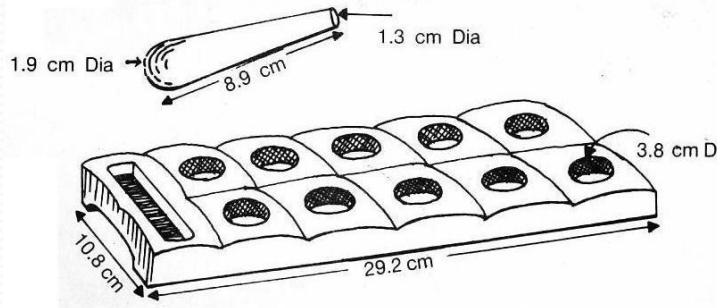
# Grainage Equipments continued



## Cellule

**This is one of the important equipments used in the grainages. It is used during pairing of male and female moths; and oviposition as it protects the moths from other unpaired / stay male moths. Also, it avoids mother moths moving from one place to another place and ensures uniform egg laying in one particular area. It is made up of PVC and black or blue in colour.**

# Grainage Equipments continued



Moth Crushing Set (Porcelain)



**Mortar and Pestle**

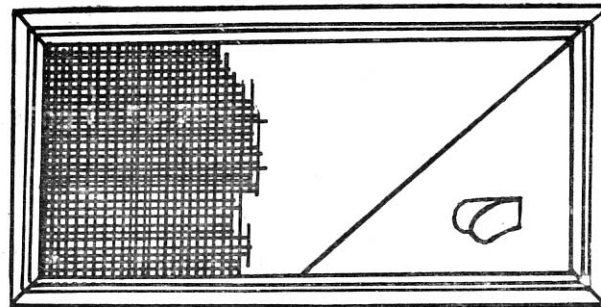
## •Moth Crushing set

Moth crushing is also made of porcelain and is used to crush the mother moths for microscopic Examination specifically for individual moth testing during the preparation of reproductive seeds at  $P_3$  and  $P_2$  stations of silkworm seed organization

## •Mortar and Pestle

Mortar and pestle is made of porcelain and used to crush the mother moths for microscopic Examination specifically sample/mass mother moth testing.

# Grainage Equipments continued

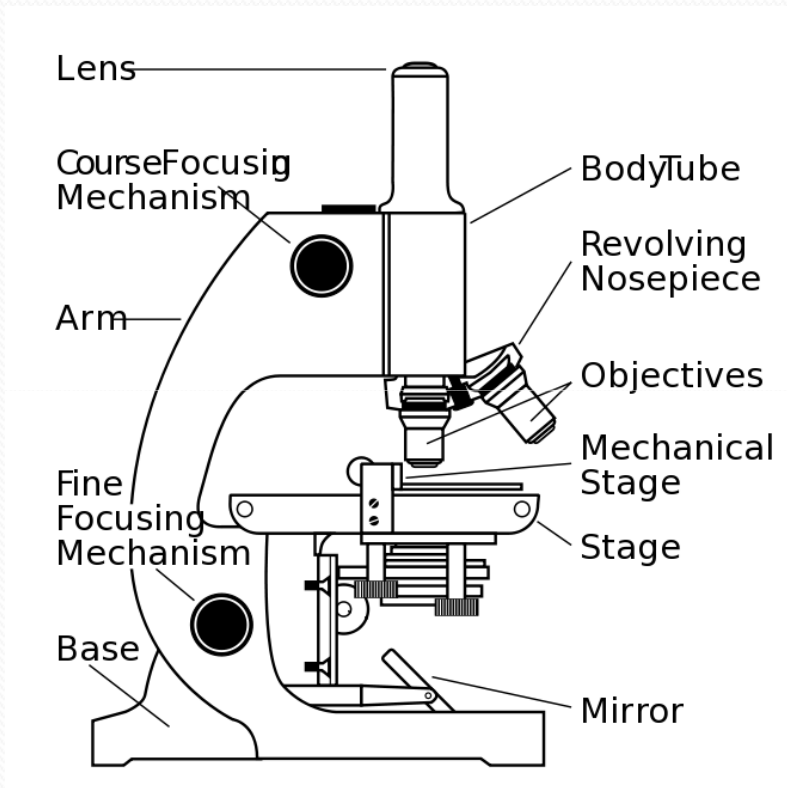


Loose Egg Container

## •Loose Egg Box

Generally silkworm seeds are available in two forms *i.e.*, layings and loose eggs. For the preparation of layings, female moths are allowed on the brown paper for laying the eggs. But in case of loose egg preparation, the eggs laid on starch coated brown paper are washed, weighed and filled in the box made up of wooden frame with muslin cloth.

# Grainage Equipments continued



**Light microscope / compound**

**Microscope is used in Pebrine test with 40-45 x objective lens and 10-15 x eye piece lens. However, 600 x magnification is ideal for Pebrine detection.**

# Grainage Equipments continued

**Hygrometer**

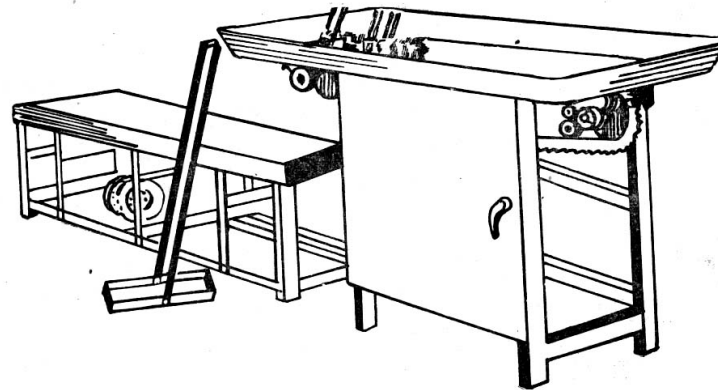


**Dry and Web bulb thermometer**



- Hygrometer:** It is used in recording atmospheric humidity. The atmospheric humidity is expressed in percentage. In grainages it is used in the cocoon / pupae / moth preservation rooms in general and trays in particular to monitor atmospheric humidity.
- Dry and Wet bulb thermometer:** It is used to record dry as well as wet temperature. By consulting the chart given with the Instrument any one can calculate relative humidity of that particular place. In grainages, it is used in cocoon / pupae / moth preservation rooms to monitor both dry temperature and relative humidity.

# Grainage Equipments continued



Cocoon Cutting Machine

## **Cocoon Cutting Machine**

**After deflossing, the bivoltine / hard cocoons are subjected to cutting for collection of pupae and sex separation. Otherwise the bivoltine moth emergence percentage will be reduced due to hard shell.**

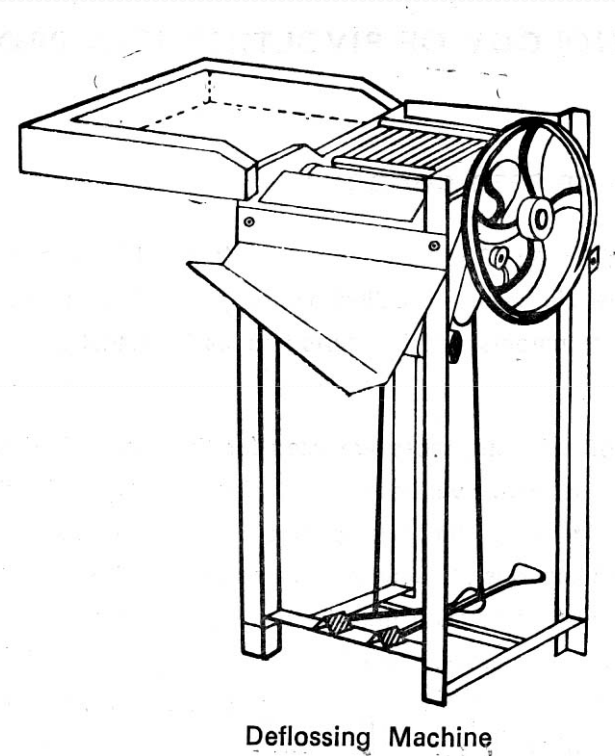


# Grainage Equipments continued

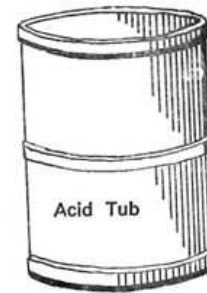
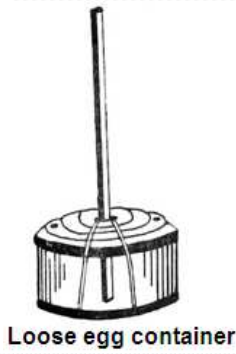
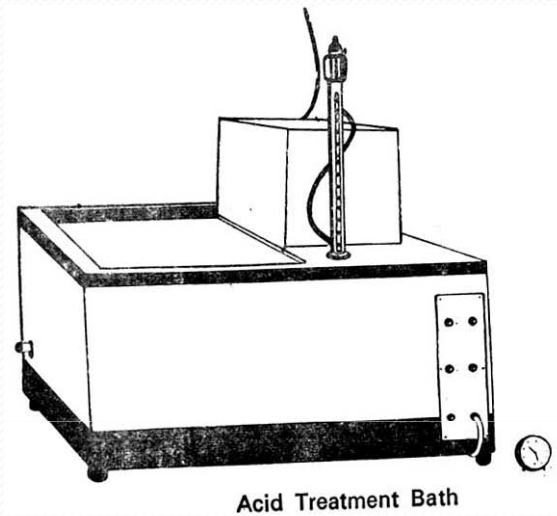
## **Cocoon Deflossing Machine**

**It is used to defloss the seed cocoons in grainages.**

**During preparation of hybrids, both sexes of required component breeds should be preserved separately to avoid selfing or inbreeding. For this purpose cocoons should be cut open and collect the pupae for preservation. Therefore before cocoon cutting bivoltine cocoons should be deflossed.**



# Grainage Equipments continued



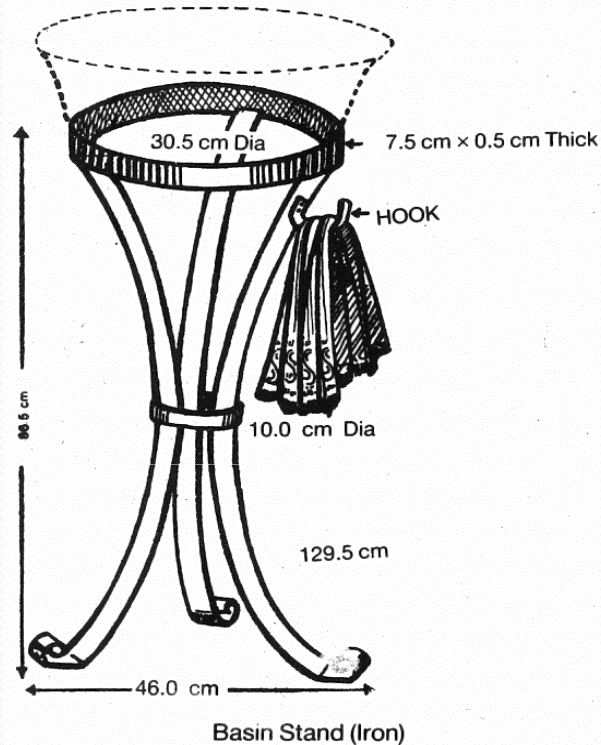
Thermometer



**Acid Treatment bath is used for acid treatment of bivoltine eggs. Acid Tub is used to hold the hydrochloric acid during acid treatment and it is made up of non reactive material to HCl. Thermometer is used to set the temperature of acid, the required temperature is 46.1 C. Hydrometer is used to set the specific gravity of the acid and the required specific gravity of the acid is 1.075 for 4-5 minutes.**

# Grainage Equipments continued

## Basin Stand



**These are made of metal and are intended to hold a basin containing formalin or any other disinfectant. This is used for disinfection of hands while entering the grainage.**

# Grainage Equipments continued

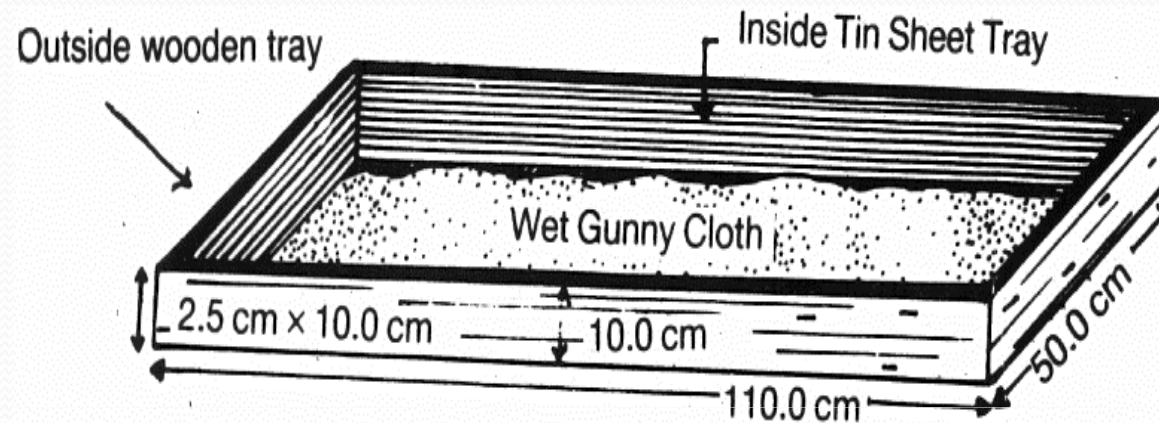
**Refrigerator is used to preserve small amount of cocoons for the purpose of synchronization of moth emergence.**

**In addition it is used to preserve female/male moths before copulation for purpose of synchronization.**

**Also, male moths after first mating and before second mating may be preserved.**



# Grainage Equipments continued



## •Foot Cleaning Tray

This is made of metal containing gunny cloth moistened with disinfectant for disinfection of feet while entering the grainage.

# Grainage Activities

## Production of silkworm seeds

The aim of a grainage is the production of quality seeds. This process involves different steps as

- **Procurement of seed cocoons**
- **In the cocoon market, the grainage authorities will purchase the required quantity of multivoltine cocoons in a cocoon market.**
- **Half quantity of the bivoltine cocoons should also purchased from bivoltine cocoon markets for the preparation of hybrid seeds.**
- **The seed cocoons are packed loosely in perforated boxes or bamboo baskets in small quantities and are transported during cooler hours of the day.**



# Grainage Activities continued

- **Preliminary Examination/Selection and sorting of cocoons**

**The seed cocoons arriving at the grainages are subjected to rigid selection. In selection only sound and uniform cocoons conforming to the characteristics of the race are selected and defective cocoons *etc.*, are rejected.**

# Grainage Activities continued

**Advance detection of pebrine disease, if any before the commencement of operation of each batch helps in averting great loss to the grainages. This is facilitated by investigations at three stages**

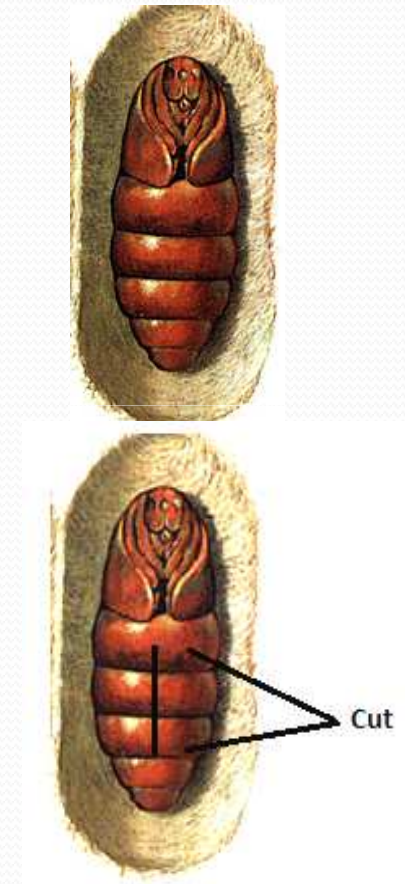
**Pupal test**

**Forced eclosion test**

**First day moth examination.**

## **Pupa Test**

**The pupa is cut ventrally just below the wing bud by a scissor by holding the pupa between thumb and for finger in left hand. After cutting the pupa is pressed gently. The midgut oozes out as a brown body from the cut portion. This midgut is collected and crushed with few drops of potassium hydroxide in a moth crushing set. The fluid is taken on the slide and examine under the microscope with 600 X magnification.**





# Grainage Activities continued

- **Preservation of seed cocoons**

**The cocoons are preserved in single layer in well ventilated rooms under natural light and dark conditions. Exhaust fans in cocoon preservation and emergence rooms are essential to expel foul gases and dust. Different component races are to be preserved in separate rooms.**

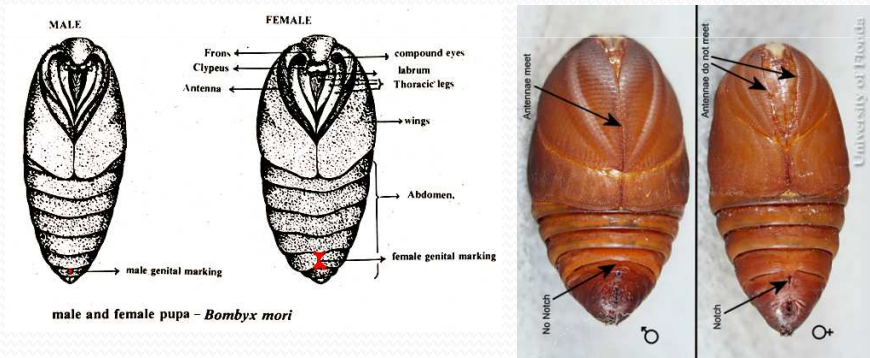


# Grainage Activities continued

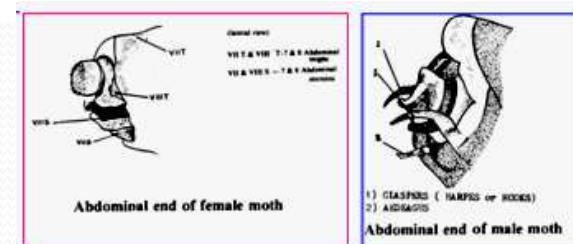
In the case of preparation of industrial **hybrid seeds**, the sexes must be separated before selfing occurs in the same parental race. This sexing may be carried out either in the larval or pupal or moth stage.

- Sex separation at Pupal and Moth stages

## Male and Female



## Female and Male



## **Grainage Activities** continued

- **Synchronization of Moth Emergence**

**Moths of the component races are made to emerge on the same day, so that male and female moths are readily available for hybridization. This is referred to as synchronization.**

**In case of synchronizing batches are not available; emergence of the earlier batches can be delayed by refrigerating the cocoons at 5-10°C. Such refrigeration should be limited to 3 days for females and 7 days for males.**

**The moths may also be refrigerated at 5°C up to 10 days in case of males and 2-3 days in case of females.**

# Grainage Activities continued

## **Coupling and Decoupling:**

**As soon as the moths emerged they start to get pair.**

**The female moths are spread in a tray and the male moths of the desirable hybrid component are evenly distributed over the females. In about 15 minutes, the male and female moths pair.**

**After the required period of coupling, the pairs are separated by holding the female moth and gently sliding the male. This facilitates easy separation without injury to the female reproductive organs.**



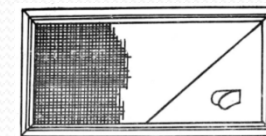
# Grainage Activities continued

- **Oviposition:** This is nothing but the process of egg laying by the female moth.

**When eggs are required to be laid on cards, the mated females are placed on the egg sheets and each moth is enclosed in a cellule. The cellule isolates the eggs laid by each moth, facilitate individual moth examination and elimination of eggs laid by diseased moth.**

**In case of preparation of loose eggs, a unit number of female moths are allowed to lay eggs on starched paper or cloth, with in a wooden or plastic frame. The number of moths vary from 30-200 according to the health of the batch and convenience.**

**Moths are allowed to lay eggs for 24 hours in a dark room with 25°C and 75-80% RH. Then mother moths are examined for the pebrine disease and eggs free from pebrine disease are qualified for rearing.**



Loose Egg Container

## Grainage Activities continued

# Mother moth examination

- **Individual Mother Moth Examination**
- **Sample Testing**
- **Mass examination**

## Surface Disinfection of Eggs

**After mother moth examination, the egg sheets or loose eggs in a container are dipped in 2% formalin solution.**

- 1. This helps in eliminating surface contamination.**
- 2. Formalin increases the adhesive capacity of eggs to the egg sheets.**

**Subsequently, the sheets are washed and dried under shade and preserved under optimum temperature (25°C) and RH of 80%.**

## Artificial Hatching

**Multi Voltines never undergoes diapause, but uni and Bi Voltines undergo diapause or hibernation. So to check the diapause ARTIFICIAL HATCHING is done by either**

**Cold treatment or Hydrochlorination**

**Cold treatment is nothing but refrigeration depending upon schedule *i.e.*, Hibernation Schedule**

**Hydrochlorination is hydrochloric acid treatment**

- 1. Cold acid treatment – HCl 1.1 sp.gr. 60-90 min at 24°C**
- 2. Hot acid treatment – HCl 1.075 sp.gr. 5-6 min at 46.1°C**

**Then was the eggs in running water to remove acid traces and dry under shade.**

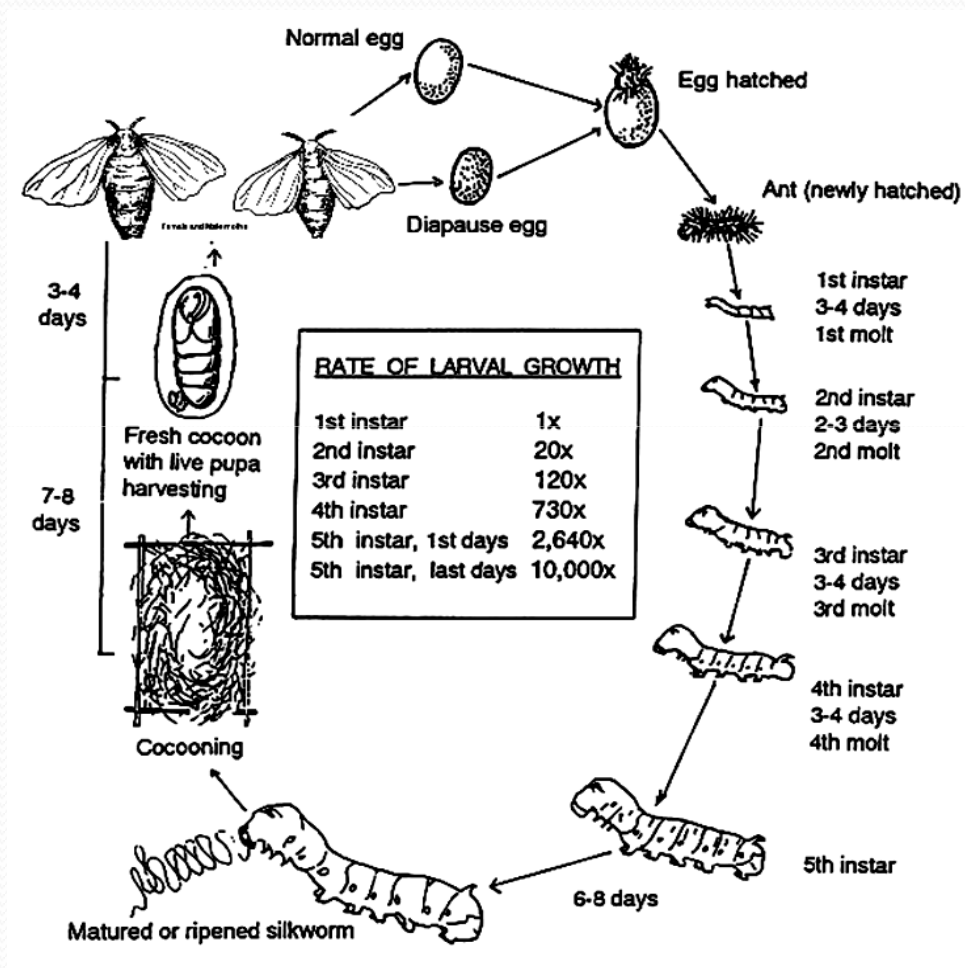
**“Now the eggs are ready for Incubation”**





# **YOUNG AGE SILKWORM REARING**

## LIFE CYCLE OF SILKWORM



**MV -----BV**

**Egg- 9-12-----11-14 days**

**Larva- 20-24--- --24-28 days**

**Pupa- 10-12---- 12-15 days**

**Moth- 3-6-----6-10 days**

## **Selection of Silkworm Races/Breeds for Rearing**

The silkworm rearing programme in a farm is determined by the following considerations.

- **Conditions of mulberry growth, yield of mulberry leaf, quality of mulberry leaves and time of availability.**
- **Availability of labour for leaf harvesting and rearing of silkworms.**
- **Facilities for rearing silkworms *i.e.*, type and size of rearing house, rearing equipments, disinfection and hygiene.**



## **Selection of Silkworm Breeds for Rearing**

**Silkworm hybrid varieties are preferred for commercial rearing to pure breeds.**

## **The Egg**

The quality of eggs to be used in rearing is very important factor determining the success of rearing. Quality silkworm seed may be defined as one which

- Is entirely free from diseases.
- Has maximum number of viable eggs
- Gives good uniform hatching
- Is prepared from healthy and robust parents
- Assures a stable and successful cocoon crop.

For details of Incubation please refer the earlier topic **INCUBATION**.

## INCUBATION

Incubation is an important process by which the activated silkworm eggs are maintained under proper environmental conditions to get hatching or preparation of eggs for hatching.

That is

Temperature-UV- 24-25 °C,

BV- 24-26 °C

MV- 21-24 °C.

Relative Humidity-75-85%.

Light Intensity- 16 hours per day light

Air flow- 0.3m/sec

### **Purpose**

- To get uniform hatching with high percentage.
- To ensure the hatching on the required day.
- **To ensure healthy and robust silkworms.**

## **Black Boxing**

Providing total darkness for a day or two before egg hatching is called **Black Boxing**.

### **Purpose**

This helps in uniform hatching in a single day. During black boxing those embryos in advanced stage of development will wait for light to hatch and developing embryos will continue their development and when exposed to light, all eggs will hatch uniformly. It helps in synchronized brushing. Simple black sheet of paper (thick craft paper) or cover, which gives total darkness, is good enough.

## Procedure for Black Boxing

Eggs are pin head stage are wrapped (25 or 50 dfls each) in a tissue paper and transferred to black boxes.

Such black boxes are placed under required humidity and temperature conditions.

The eggs are to be exposed to light between 7 and 8 AM on the expected day (10<sup>th</sup> or 11<sup>th</sup> day) to enable maximum hatching.





## **BRUSHING**

Brushing is the process of separating the newly hatched worms from the shells of their eggs, and collecting them for convenience of rearing.

## Brushing of loose eggs

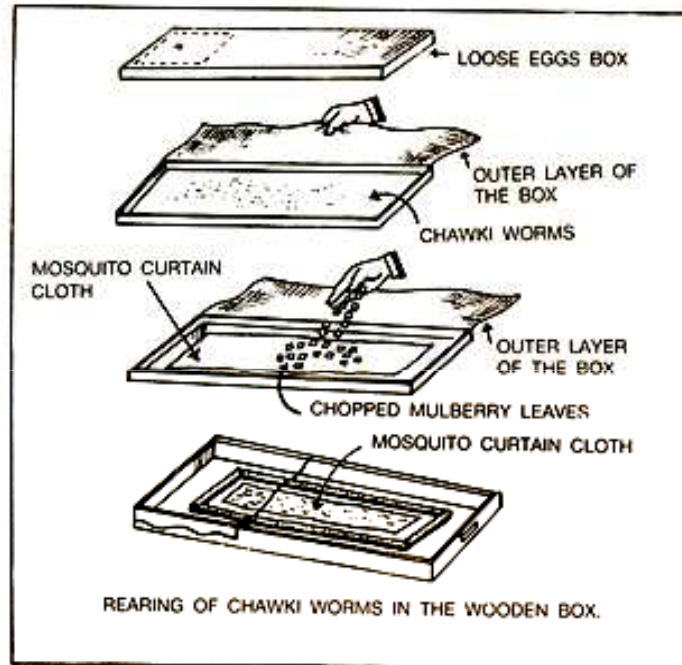


Fig-Brushing Loose Eggs

- Eggs are spread evenly in one layer in the egg box after removing the cover.
- At blue egg stage they are kept in black box or covered with black paper.
- When they change colour preparatory to hatching, black cover is removed and they are covered lightly over with a thin perforated cloth or a fine-meshed net or finely perforated thin paper (Fig.).
- Just before brushing, chopped mulberry leaves are sprinkled on the top of the net or cloth or paper-not for the worms to eat, but just to attract them to crawl on to the upper surface.
- When a sufficient number of worms have hatched out, the rearer takes out the cloth.

## **Brushing from Egg Cards**

In the case of layings, there are several methods of brushing. Most common ones are:

- (i) Brushing by husk method
- (ii) Brushing by cloth, paper or net
- (iii) Brushing by feather
- (iv) Brushing by net and feeding

## **Brushing by Husk method**

This is a very popular method of brushing is vogue in India.

In this method, charred powdered husk is spread on the newly hatched worms.

Later chopped mulberry leaves are spread on the card. The newly hatched worms crawl on to the top of the feed.

After half an hour of feeding, the silkworms are brushed off to the rearing tray with a feather.

## **Brushing by Cloth, Paper or Net**

This is only an adaptation of the method described in relation to loose eggs.

The layings are covered over with paper or net or cloth and the worms which crawl on to the underside are collected by tapping or transferring the paper with worms to the rearing tray.



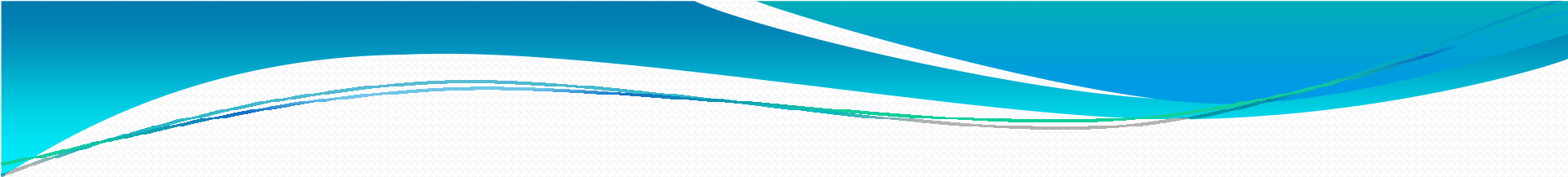
## **Brushing by Feather**

In this the egg card or paper is held vertically by one end over the rearing tray and the hatched worms are separated by gentle strokes with a feather.

This method is simple and easy but is apt to injure the worms which at this stage are tiny and delicate.

## **Brushing by Net and Feeding**

In this, instead of husk, a fine meshed net is employed. In other respects it resembles the method described above.



**After brushing the silkworms, the bed is prepared by collecting the worms and mulberry leaves together by using a feather. The bed is spread uniformly using chopsticks. After about two hours of brushing, the first formal feed is given to the silkworms. Prior to the first feeding, as a precaution against muscardine the larvae may be treated with one per cent "Dithane M<sub>45</sub>" or "Captan".**





## **REARING OF YOUNG AGE SILKWORMS**

**Different methods of rearing early age silkworms have been evolved in recent years, all of which seek to prevent the driage of mulberry leaves and also maintenance of proper temperature and humidity in the rearing beds, and thus secure vigorous and healthy development of silkworms.**

# 1. Paraffin Paper Method of Chawki Rearing

In this method, paraffin paper is used both as a **bottom layer** and also as a **cover** for the rearing beds in the usual rearing trays. The paraffin paper for this purpose should be of a good quality, without the smell of petroleum.

**Significance: To Prevent Moisture Loss**

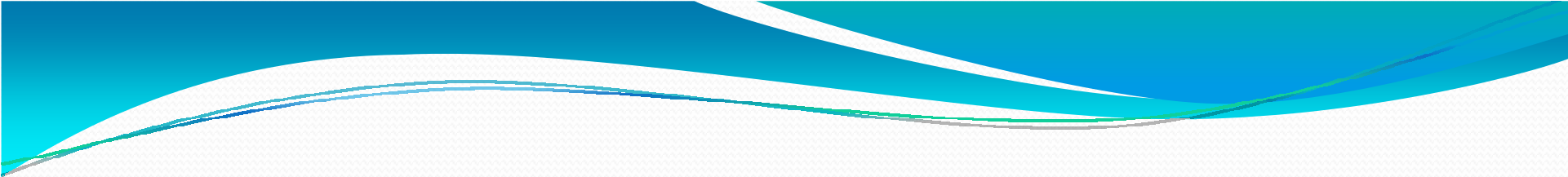
**A sheet of paraffin paper is spread on the base of the rearing tray over which the rearing bed of silkworm is formed.**

**A second sheet of paraffin paper is placed loosely over the silkworm bed.**

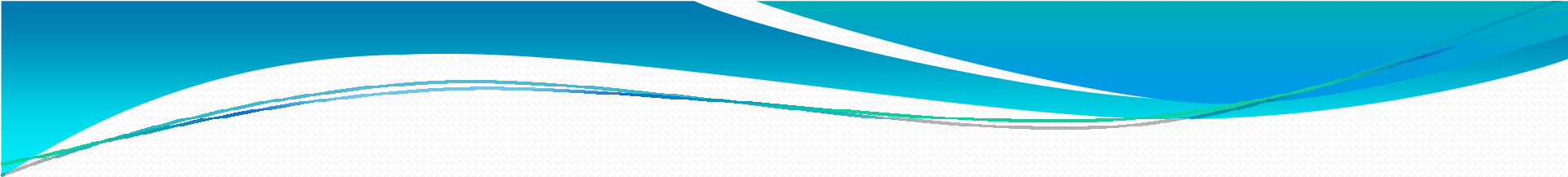
**In between the two sheets, on all four sides of the rearing bed, strips of wet foam rubber pads or ordinary newspaper folded into strips are placed to maintain the required humidity.**



Fig. Covered rearing with paraffin paper



**Care should be taken to see that the cover sheet is removed at least 30 minutes before each feed so that supply of fresh air to the silkworms is received and simultaneously the expulsion of the accumulated toxic gases on the rearing beds is also achieved.**



**In humid places, there is fear of incidence of muscardine disease. To prevent this, a thin layer of Ceresan Lime or Dithane M<sub>45</sub> or Capton-Koalin mixture is spread over the bed as a prophylactic measure at the time of hatching, at each moult and in the middle of each age**

## 2. Rearing in boxes without lids

In this case also the rearing beds are prepared as in paraffin paper method of rearing.

**The boxes are piled, on top of another for rearing first age larvae.**

**For rearing second and third age larvae a space of 2 to 3 cm is provided between each two boxes by keeping wooden strips for ventilation.**

**The boxes are kept open for at least 30 minute prior to each feeding, and completely when the larvae start to settling for moult.**

**In this method also chances of incidence of muscardine, so care should be taken as described earlier.**





# SILKWORM REARING -2



**Continued as Part 2**