Silkworm Seed Technology

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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

Quality silkworm seed may be defined as one which

- **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**

Silkworm Seed Organization

Constitutes the maintenance of breeders stock and its multiplication for the ultimate production of adequate quantity of industrial hybrid seed

The main constituents of a sound silkworm seed organization and seed production are

1. **A scientific programme of maintaining the vigour (**strength and good health) **of the silkworm stocks and their organised multiplucation.**
2. **Production of healthy and vigorous parent seed cocoons.**
3. **An organised programme of continuous supply of quality silkworm seed cocoons to the industrial grainages.**

- **Silk productivity depends on the vigorous of the pure races/breeds used.**
- **Inbreeding is the only way to maintain a pure breed/race. However, inbreeding depression leads to deterioration of the pure breed.**
- **To avoid inbreeding depression or deterioration of the economically important characters the sericulturally advanced countries have adopted the "Three Tier multiplication of Parental Stocks".**
- **In India (Karnataka) different institutions have been organised for maintenance and multiplication of these stocks. These are called as P1, P2 and P3 stations/centers.**

Silkworm Seed Organization

P4 Station: Research Institutes eg. CSR&TI (CSB), KSSR&DI, Universities, etc.,

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Breeding (evolving) of new strains and maintenance

Releases small quantity of seeds whenever P3 center demands

P3 Station: Basic Seed forms maintained by Govt. eg. Thandavapura, B R Hills etc.,

↓

Maintain the breeds with cellular rearing or 1 DFL

Release stocks to main stream of seed production

P2 Station: Maintained by Govt. eg. B R Hills, Kollegala, etc.,

↓

First stage of mass multiplication taken up with in batches of 2 DFLs.

P1 Station: Seed Areas - Mass multiplication taken up by the seed rearers (Farmers)

↓

Govt. and Private Grainages for Hybrid Preparation

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Hybrid seeds distributed to farmers for commercial silk production

Silkworm Seed Organization … continued

P4 Station

This is generally Research oriented Institutes
eg. CSR&TI (CSB), KSSR&DI, Universities, *etc*.,

Here the silkworm breeders are continuously engaged in evolving new high yielding silkworm breeds. After successful evolution, they are tested with other breeds for heterosis.

1. **Breeding (evolving) of new strains and maintenance**

2. **Releases small quantity of seeds whenever P3 center demands**

Silkworm Seed Organization … continued

P3 Station

These are also called as Basic Seed Forms

Basic Seed forms are maintained by Govt. eg. Thandavapura, B R Hills etc.,
Have Specific Roles

1. **Have to maintain the silkworm breeds released by research Institutes. The defined characters are maintained by careful selection.**
2. **Have to release the silkworm stocks at required intervals to the main stream of the seed Production,**

SELECTION CRITERIA FOR BATCHES IN P_3 FARMS:

	BIVOLTINE	MULTIVOLTINE
1. Egg/dfls not less than	500	450
2. Hatching on 1st day	90%	90%
3. Effective rate of rearing (E.R.R) (Cocoon with live pupae)	90%	80%
4. Cocoon yield for 100 dfls By number:	40000	32000
By Weight (Kgs)	70.00	32.00
5. Average Cocoon weight (grms)	1.8 ± 0.2	1.1 ± 0.1
6. Average shell weight (grms)	0.38 ± 0.02	0.14 ± 0.01
7. Shell percentage	21%	13%

Silkworm Seed Organization … continued

P2 Station/Farm

Maintained by Govt. eg. B R Hills, Kollegala, etc.,

First stage of mass multiplication taken up with in batches of 2 DFLs.

Rearing of large number of dfls is takenup in P2 farms to meet the requirement of parent seed cocoons for industrial seed programme.

The fundamental differences between a P3 Centre and P2 Centre is that individual cocoon analysis is practices for maintenence of stocks inP3 centre.

P2 Centre can prepare every fornoght about 6000-8000 DFLs (for two races) and 2 lakh DFLs per year.

THE NORMS FOLLOWED FOR A P2 REARING IS GIVEN BELOW

CHARACTER	BIVOLTINE	MULTIVOLTINE
1. Egg laying not less than	450	400
2. % of hatching	90%	90%
3. Effective rate of rearing	75%	75%
4. Individual cocoon weight(gms) Not less than	1.5	1.0
5. Shell ratio	20%	13%
6. Pupation ratio	90%	90%

Silkworm Seed Organization … coninued

P1 Station

This is the last stage of multiplication of parent stocks in 3 tier silkworm seed multiplication programme.

The P1 seeds from P2 station are reproduced in large number to meet requirements of F1 grainages.

Trained farmers can rear P1 seeds with hygienic conditions. Cocoons selected by these selected and trained farmers are once again subjected to selection, while purchasing them for grainages.

Rearing of P1 seed is practiced in a seed area established by legislation and by rained selected seed rearers in commercial cocoon production zone.

THE NORMS FOLLOWED FOR A P_1 REARING IS GIVEN BELOW :

CHARACTERS	BIVOLTINE	MULTIVOLTINE
1. Eggs/laying not less than	400	300
2. Hatching %	85%	90%
3. Effective rate of rearing	60%	65%
4. Pupation rate	90%	90%
5. Single cocoon weight	1.4g	1.0g
6. Shell ratio	18%	12%

Silkworm Seed Organization and Three Tier Silkworm Seed Multiplication

P4 Station: Research Institutes eg. CSR&TI (CSB), KSSR&DI, Universities, etc.,

↓

Breeding (evolving) of new strains and maintenance

Releases small quantity of seeds whenever P3 center demands

P3 Station: Basic Seed forms maintained by Govt. eg. Thandavapura, B R Hills etc.,

↓

Maintain the breeds with cellular rearing or 1 DFL

Release stocks to main stream of seed production

P2 Station: Maintained by Govt. eg. B R Hills, Kollegala, etc.,

↓

First stage of mass multiplication taken up with in batches of 2 DFLs.

P1 Station: Seed Areas - Mass multiplication taken up by the seed rearers (Farmers)

↓

Parent Seed Cocoons

Govt. and Private Grainages for Hybrid Preparation

↓

Commercial Hybrid Seeds

Hybrid seeds distributed to farmers for commercial silk production

Seed Areas

Certain areas have been notified exclusively for multiplication of pure races for production of seed cocoons and supply them to industrial grainages.

Here they are allowed to rear only pure races as per law. Such areas are declared by government as SEED AREA. In these areas all farmers are enlisted as seed cocoon growers.

The seed cocoon growers have to rear only pure races approved by the government

- **Intern the government helps the in the form of special subsidies, loans on soft rate of interest.**
- **Government has also many obligations to these farmers. It is the responsibility of the government to ensure supply of only P1 seeds from P2 farms, provide technical assistance by the government staff by visiting the rearers house periodically**
- **Government also ensures all the cocoons produced by them are purchased at high rate, if they are according to norms of seed cocoons fixed from time to time, supply of disinfectants at free of cost and disinfect the rearers house before rearng commences**

Selection Criteria for a seed area are

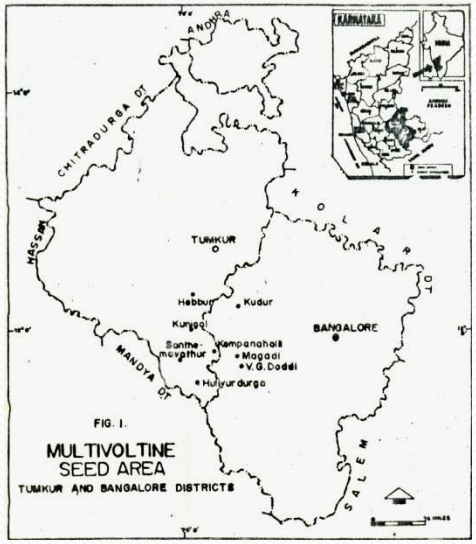
- **Generally areas where groups of farmers are scattered and land holding is limited are selected as seed areas.**
- **This helps to control diseases before it occurs as an epidemic form.**

Seed Areas

Are of two types:

a. Multivoltine Seed area:

Magadi, Kunigal & Hebbur taluks of Tumkur district



b. Bivoltine Seed Area :

Anekal taluk of Bangalore dist, K R pet taluk of Mandya dist and certain parts of Hassan, Sirsi, certain parts of western Ghats.

In addition selected seed rearers can also rear seed crops.

Selected Seed Rearers/Adopted Seed Rearers

- **Only for Bivoltines**
- **These farmers need not be in seed areas**
- **These rearers are selected considering**
  - **i. Mulberry garden for growimg god quality leaf**
  - **ii. Good rearing house with equipments**
  - **iii. Technical knowledge to rear pure breeds**
- **In turn government**
  - **i. Supply P1 seeds**
  - **ii. Assure to purchase cocoons at higher price**
  - **iii. Periodic visit by officers for technical guidance and supervision**

SEED ACT

The salient features of the "THE KARNATAKA SILKWORM SEED, COCOON AND YARN (REGULATION OF PRODUCTION, DISTRIBUTION, SUPPLY AND SALE) ACT 1959" (http://dpal.kar.nic.in/pdf_files/5%20of%201960%20(E).pdf)

It is obligatory, to ensure supply of DFLs, to provide facilities for training and to ensure fair trade of reeling cocoons and silk yarns.

- **The Mysore silkworm disease control Act 1943.**
- **The Mysore Silkworm seed (control and Distribution) Act 1952.**
- **The Mysore Silkworm seed and cocoon (Regulation of Production, supply and Distribution) Act 1959.**
- **Later these Acts, mended as The Karnataka Silkworm seed, Cocoon and yarn (Regulation of Production, Supply, Distribution and sale) Act 1959.**

THE KARNATAKA SILKWORM SEED, COCOON AND SILK YARN (REGULATION OF PRODUCTION, SUPPLY DISTRIBUTION AND SALE) ACT, 1959 (5 of 1960) has been amended by the following Acts, namely:-

Amendments (Chronological)

SL. NO.	ACT NO. AND YEAR	SECTIONS AMENDED	REMARKS
1	5 OF 1960	1(3)	Sections 10 and 19 came into force w.e.f. 25.2.1960 in the entire State Of Karnataka and the rest of the provisions of the Act came into force w.e.f. 25.2.1960 in the old Mysore Area. All other sections except sections 10 and 19 came into force on different dates by several notifications mentioned at the end of the Act.
2	29 OF 1969	4,6,7,11(1), 12(1), (2), 12(2A), 12(3), (4), 12A, 12B, 15(2)	w.e.f. 22.12.1969 By notification No. NIL dated 12/16.12.1969
3	KAL ORDER 1973	Preamble, 1(1), (2) (3), 10(2), 11(1), 14, 19	w.e.f. 1.11.1973
4	33 OF 1979	Preamble, 1(1), (2), 5A, 8A, 10(1), 10A, 11(1), 12(2B), (4), 12(5), 12B, 13, 17A, 18(2)	w.e.f. 6.11.1979
5	12 OF 1980	8A(1), 8A(2), 10A(3), 18(2)	w.e.f. 6.11.1979
6	6 OF 1981	10(1), 10A(1), 18(2)	w.e.f. 25.2.1960
7	20 OF 1984	16A, 18(2A)	w.e.f. 2.12.1983
8	30 OF 1994	2, 5A(1), 10B, 11(1), 12(2A), (4), 12(2B), 13(1)	w.e.f. 3.10.1994
9	12 OF 1997	2, 5A(1), (2), 8A(1)(3) , 12(1), 12(2B), 12(3), (4), 13(1)	w.e.f. 6.1.1997
10	22 OF 2000	1(3)	w.e.f. 25.2.1960

The salient features continued

1. **This act extends to the whole of the Karnataka State.**
2. **Regulates transactions relating to sale / purchase of cocoons for reeling/seed.**
3. **Provision for the constitution of Market Committee.**
4. **Allowed to establishment of development and price stabilization fund.**

Cocoon Markets

Market is a regular gathering of people for the purchase and sale of provisions, livestock, and other commodities.

A Cocoon market is a place where the buyers and sellers are required to transact Cocoons by open auction under the regulations of law.

Types Cocoon Markets

There are two types

1. **Seed Area Cocoon Markets**

2. **Commercial Area Cocoon Markets**

COCOON MARKETS IN KARNATAKA

1. Seed area markets:

a. Multivoltine seed area markets.

b. Bivoltine area seed markets.

COCOON MARKETS IN KARNATAKA

a. Multivoltine Seed area Markets:

The transaction is in between the Seed rearers and seed producers of private and government sector.

There are 8 markets in this seed area.

***Eg*., Kunigal, Magadi *etc.*,**

b. Bivoltine Seed Area Markets:

Here the transaction of Bivoltine seed Cocoons take place between the seed rearers and LSP's and government organizations.

***Eg*., Attibele & Anekal.**

Mode of Transaction of Seed Cocoons

Each seed cocoon grower will be issued a Fitness Certificate by the state Government officer for marketing purpose before maketing

Immediately after entry into the market, every rearer will be issued a market receipt in triplicate

In the M V C market each lot will be analysed for

i. Cocoon lot should be free from pebrine so Pupa Test will be done followed by determination of Melting %

ii. Cocoon lot weight should be minimum 35 kg/100dfls brushed.

If it is less than 30 kg/100 dfls - rejected for seed purpose.

iii. Cocoon number should be less than 800/kg.

If it is more than 1000 cocoons/kg lot is rejected for seed purpose.

Mode of Transaction of Seed Cocoons continued

In the B V C market each lot will be analysed for

i. Cocoon lot should be free from pebrine with less melting %.

ii. Cocoon lot weight should be 50 kg/100dfls.

iii. Cocoon number should be less than 700/kg.

Price Fixation:

Based on the demand and supply price will be fixed in the presence of both rearers and RSP (LSP).

For cocoons sent for seed, the rearer will get fixed price plus Rs70/-.

For quality seed cocoons sent for reeling will be open auctioned and rearer will get bid amount from the reeler plus Rs. 70/- plus Rs 170/- as supportive price.

Second Grade *i.e.*, 32 kgs/100dfls and more than 800 cocoons will get only bid amount from the reeler plus Rs. 170/- as supportive price.

For rejected cocoons (above 1000 cocoons/kg and below 30kgs/100dfls): Rearer will only get bid amount.

After completion of transaction 1% market fee will be collected from the rearer only.

Normally market fee is 2%, and 1% from rearer and 1% from RSPs/LSPs should be collected

However, RSPs/LSPs requested the government to wave off/discount/ignore the same. So only 1% market fee will be collected from rearers

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

1. **Chlorine dioxide**

2. **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 = $\frac{\text{Original Strength of the Formalin - Required Concentration}}{\text{Required Concentration}}$

***i.e.*, $\frac{40\ \% - 2\ \%}{2\ \%} = 16$**

***i.e.*, For every liter of formalin 16 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

Another Method of Calculation

$$\text{Quantity of Formalin Required} = \frac{\text{Required concentration x Required quantity of solution}}{\text{Original Concentration}}$$

E.g., $\frac{2\ \% \times 1000\ ml}{40\ \%} = 50$

i.e., **50 ml of formalin to be added to 950 ml of water to get 1000 ml of 2% formalin**

Calculation for Required Quantity of 2% Formalin in a Seed Production Unit

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 Seed Production Unit continued

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

1. **Floor Area** = 6.1 mts x 9.1 mts = 55.51 mts2 or 20' x 30 ' = 600 sq. ft.
2. **Area of two walls** = 6.1 mts x 3.05 x 2 = 37.2 mts2 or 20' x 10' 2 = 400 sq. mt.
3. **Area of two other walls** = 9.1 mts x 3.05 x 2 = 55.51 mts2 or 30' x 10' x 2 = 600 sq. mt.
4. **Roof of terrace** = 6.1 mts x 9.1 mts = 55.51 mts2 or 20' x 30' = 600 sq. ft.

Total Area 203.74 sq. mts = 2200 sq. ft

Requirement of 2% Formalin Solution = $\frac{203.74 \times 8.61}{100}$ (required to disinfect 100 sq.mt)

= 17.5 litres

Add equal quantity for spraying equipments

***i.e.*, total requirement of 2% formalin is 35 litres**

To get 2 % formalin solution, calculate using following formula

$$\frac{\text{Original Concentration} - \text{Required Concentration}}{\text{Required Concentration}} = \text{Number of parts of water to be mixed with one litre of formalin}$$

Eg., $\frac{40\% - 2\%}{2\ \%} = \frac{36}{2} = 18$

***i.e.*, One litre of commercial formaldehyde is to be added to 18 litres of water to get 19 litres of 2% formalin**

To get 35 litres of 2% formalin $= \frac{35}{18} = 1.94$ litres

About 1.94 litres of commercial formaldehyde is required to disinfect equipments and seed production unit of size of 20' x 30' or 6.1 mts x 9.1 mts with terraced roof

So 1.94 or 2 liters of formalin should be mixed with 33 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 sift 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 or purifying 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 betaken to taken to keep only just sufficient fire or cinders to evaporate formalin, otherwise it may lead to fire hazards**

Seed Production Centers (Grainages)

Grainages are the centers where silkworm seeds are produced in large scale

Or

Grainages are the centers where silkworm seeds are produced in large scale on scientific lines

Graineur: Seed Producer /Grainage Fellow

Types of Grainages

- **Commercial Grainages - Located in out side the seed areas and prepare commercial multivoltine and bivoltine pure breeds and hybrids of multi x multi, multi x bi and bi x bi voltines depending upon the need.**

- **Reproductive Grainages – Located only in seed areas and prepare approved pure breeds of both multivoltine and bivoltines.**

Organisation and Functions of Grainages

- **Grainages are one of the components of Silkworm Seed Organisation and located at terminal end in silkworm seed organization. Organised all over Karnataka as per seed act.**

- **Grainages Functions – Prepare DFLs in seed areas, commercial areas based on the approval by the Government, they supply incubated seeds as required by the rearer, technical support, *etc*.,**

Grainage Building

The building should have adequate facilities to accommodating the

- **Cocoons/pupae of different sexes on separate rooms**
- **Coupling and oviposition (egg laying) should be separate**

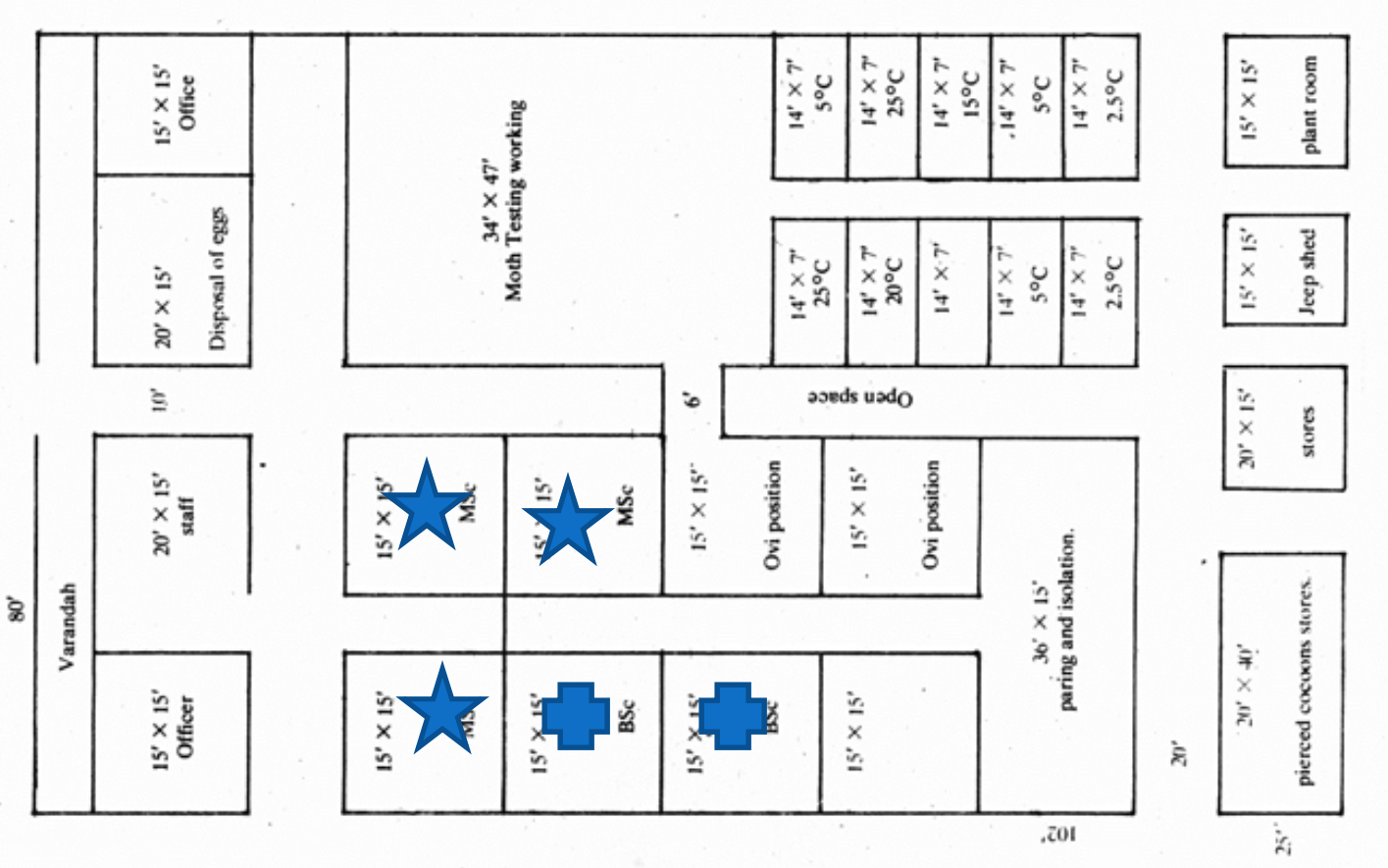
  The rooms must be provided with facilities

  to maintain temperature and humidity

  to provide darkness and light when needed

  to keep rooms ventilated & clean and for avoiding scales
- **Moth Examination Laboratory**
- **Seed Processing sections should be isolated**
- **Egg processing room with 3 tier sinks for egg washing and facilities for acid treatment of bivoltines**
- **The incubation room, cold storage for moths and eggs**
- **A dormitory will increase the efficiency of workers**

Grainage Building continued

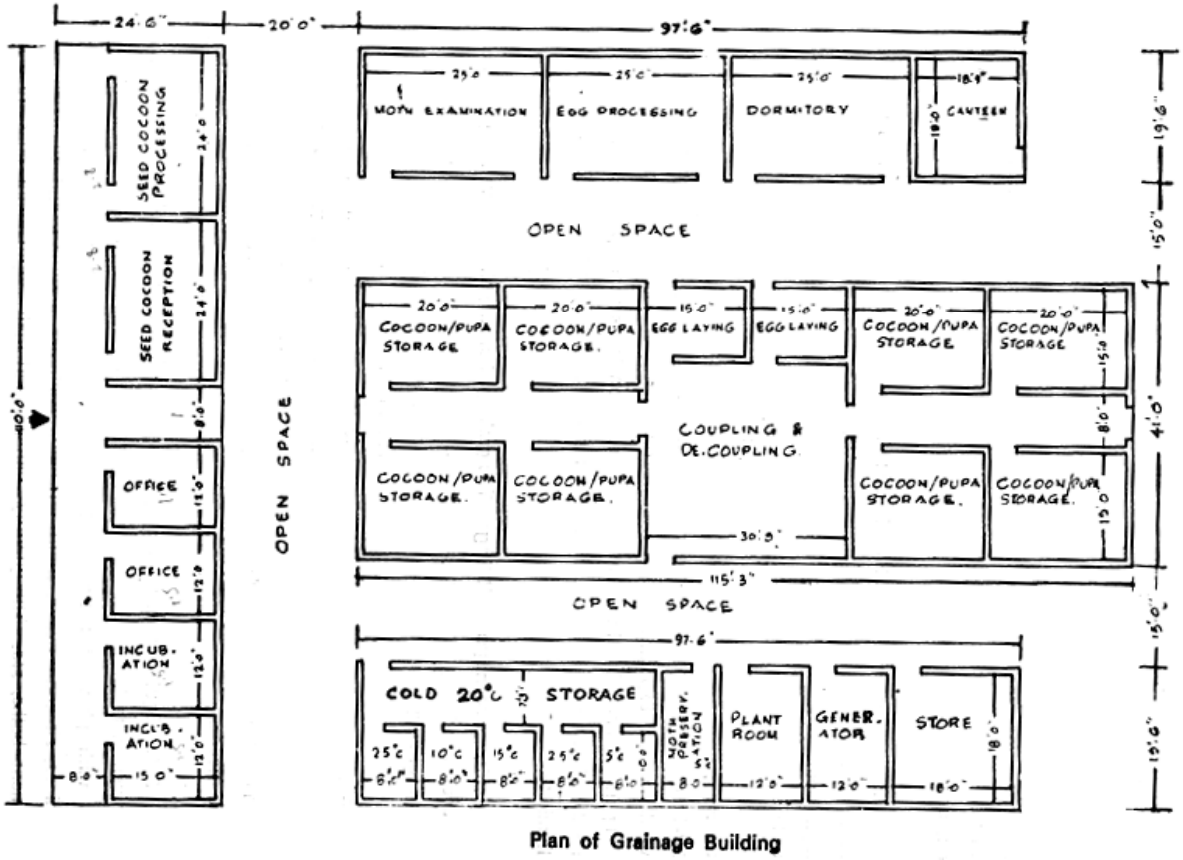


Model Grainage Building Plan (15-20 Lakhs DFLs/Annum)

MSc- Pure Mysore Seed Cocoon; BSc- Bivoltine Seed Cocoon

Grainage

Another Model Plan for Bivoltine Gainage Building. The dimensions could be altered according to the needs

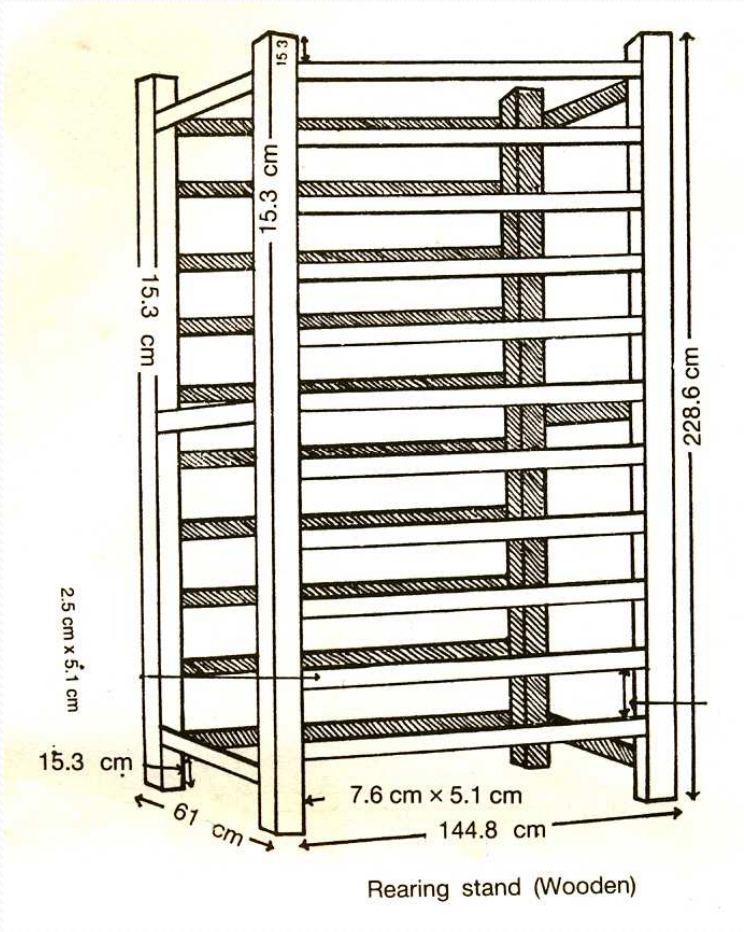


Plan of Grainage Building

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 continued



Rearing stand (Wooden)

Cocoon Preservation Rack

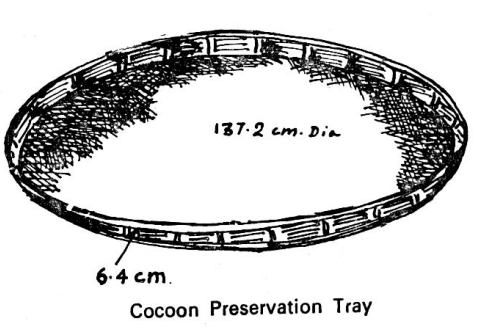
Cocoon preservation racks are made of wood or steel or bamboo and are portable.

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



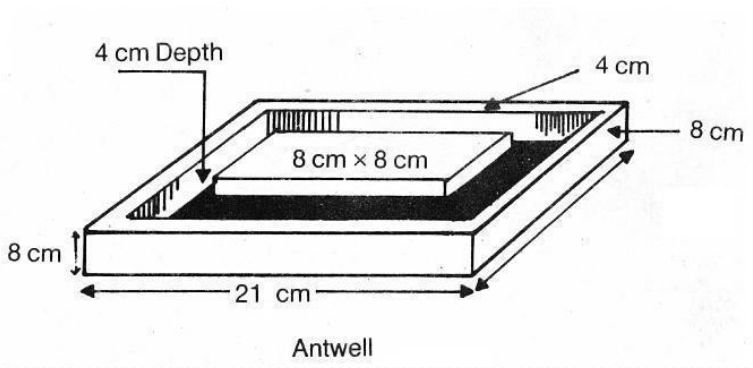
Cocoon Preservation Tray

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



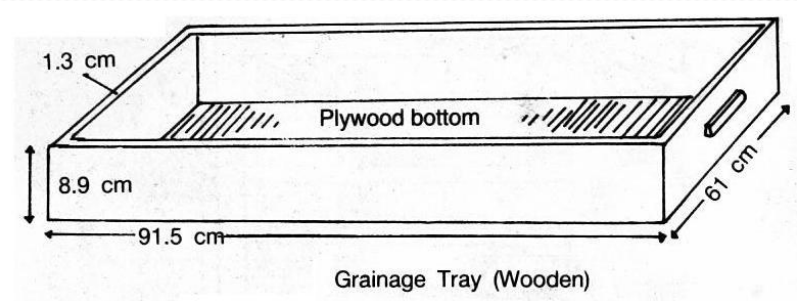
Antwell

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

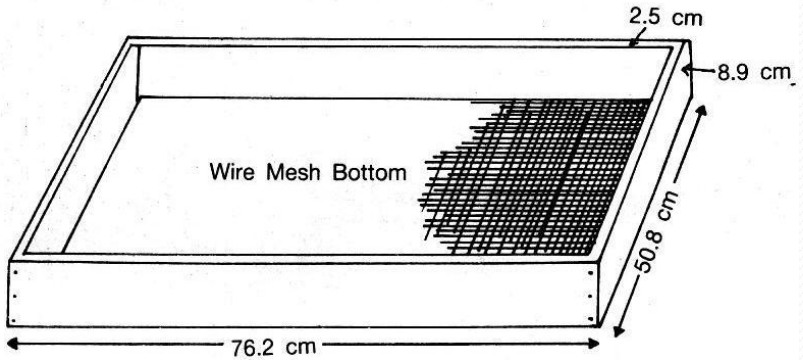
The legs of the cocoon preservation stands rest on the center of the block an water is poured into the groove to stop the ants and other wingless or crawling insects climbing on to racks as they are gregarious predators.

Each stand leg must rest in a well.

Grainage Equipments continued



Grainage Tray (Wooden)



Grainage-wiremesh Tray

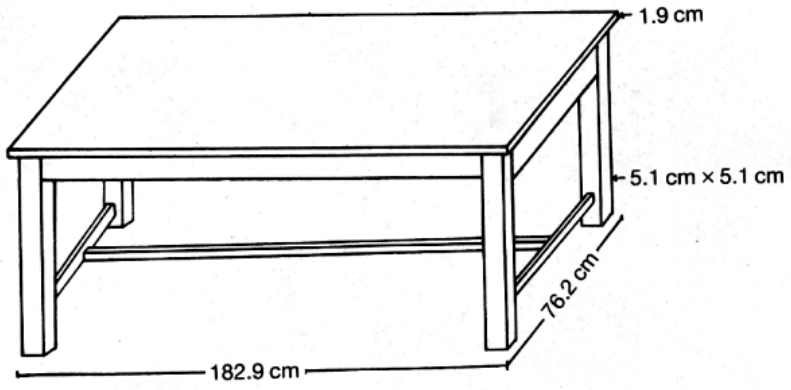
Grainage Tray-Plywood Bottom

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.

Grainage Equipments continued



Moth Testing Table (Wooden)

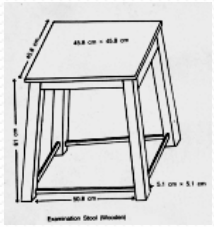
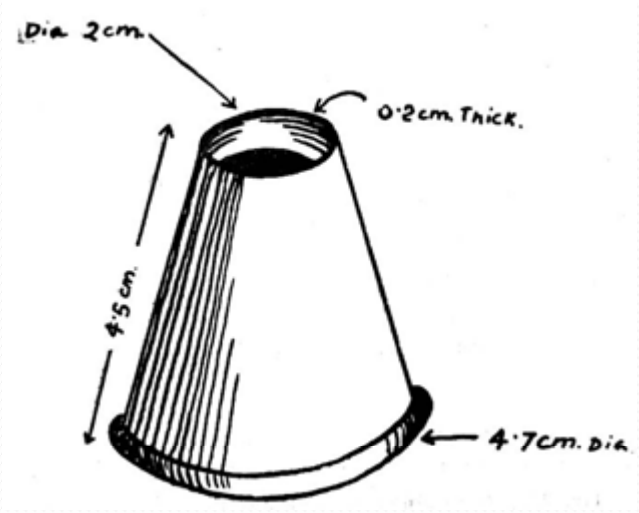


Table and Stool

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.

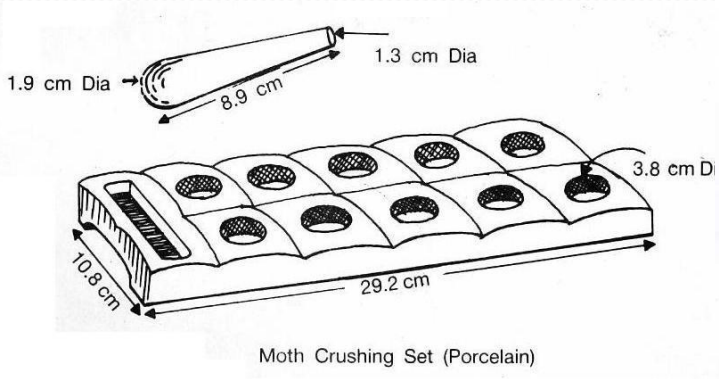
Grainage Equipments continued



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

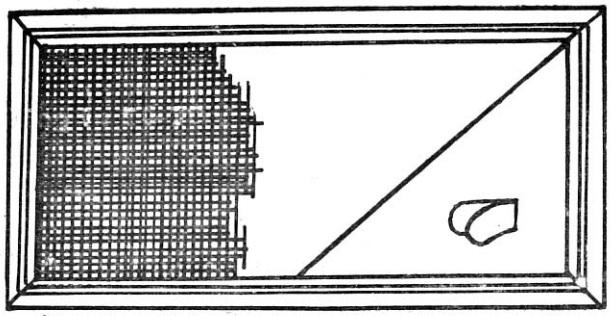
•Moth Crushing set

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

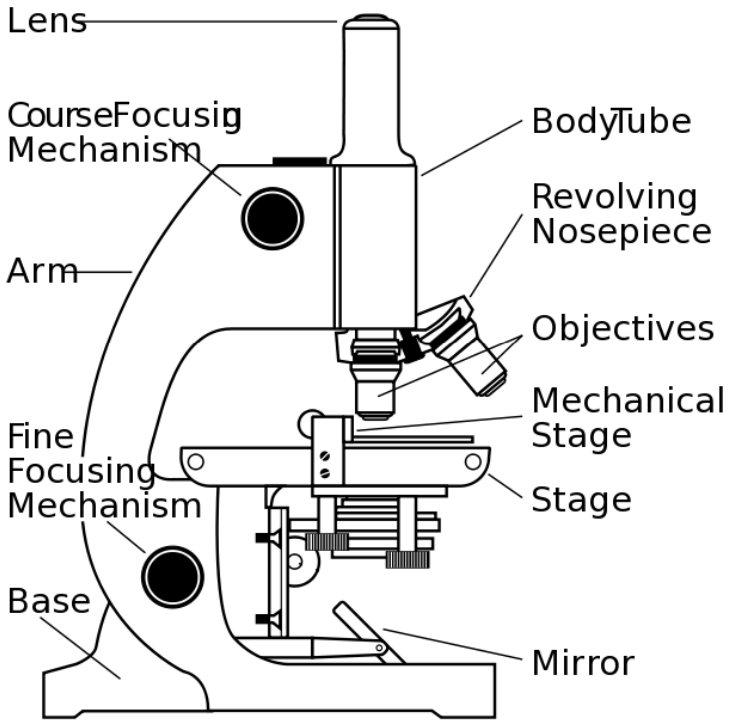


Loose Egg Container

- **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 o f 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.

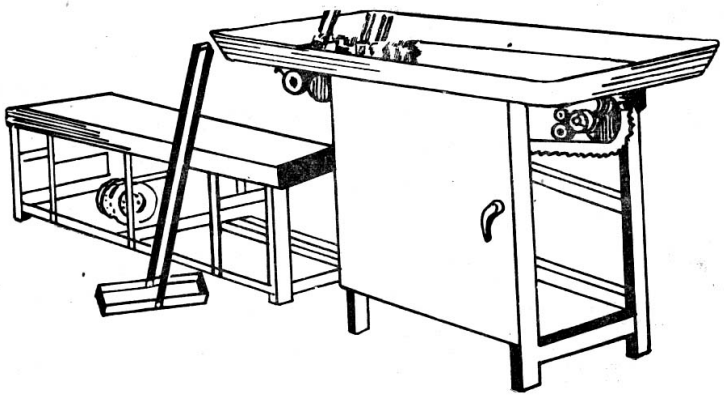
Grainage Equipments continued

Hygrometer

Dry and Web bulb thermometer

- **Hygrometer:** It is used in recoding 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

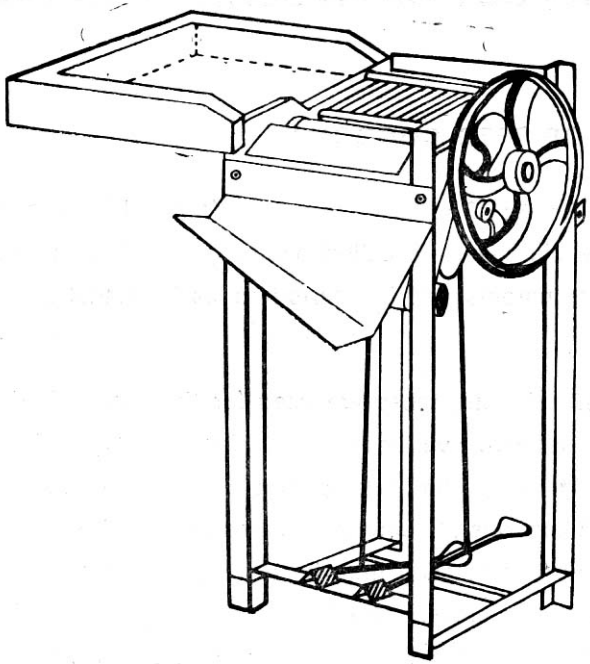
Cocoon Cutting Machine

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

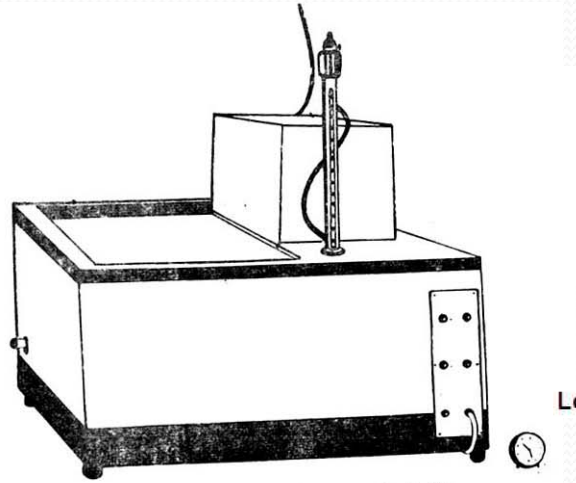
Cocoon Deflossing Machine

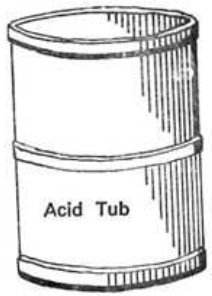
It is used to defloss the seed cocoons in grainages.
During preparation of hybrids, both sexes of required component breeds should be preserved separately to avoid selfing or inbreeding. For this purpose cocoons should be cut open and collect the pupae for preservation.
Therefore before cocoon cutting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

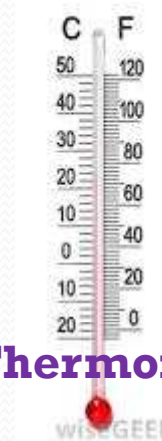


Deflossing Machine

Grainage Equipments continued







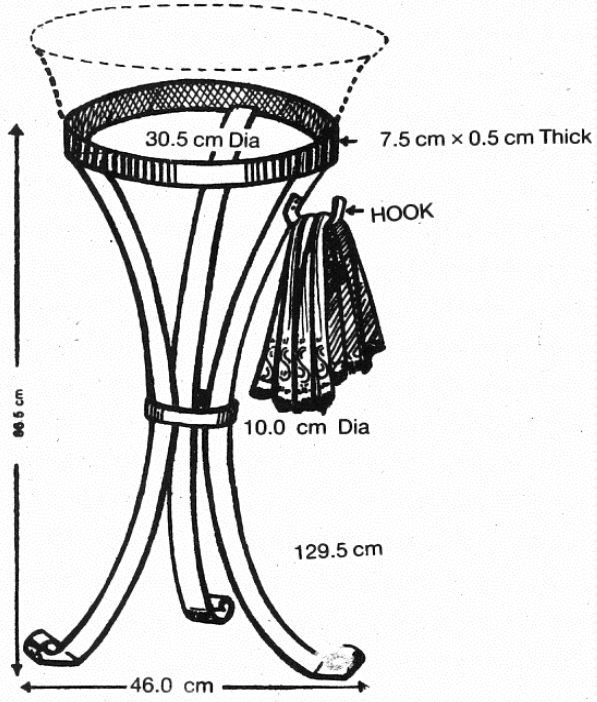
Thermometer

Hydrometer

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



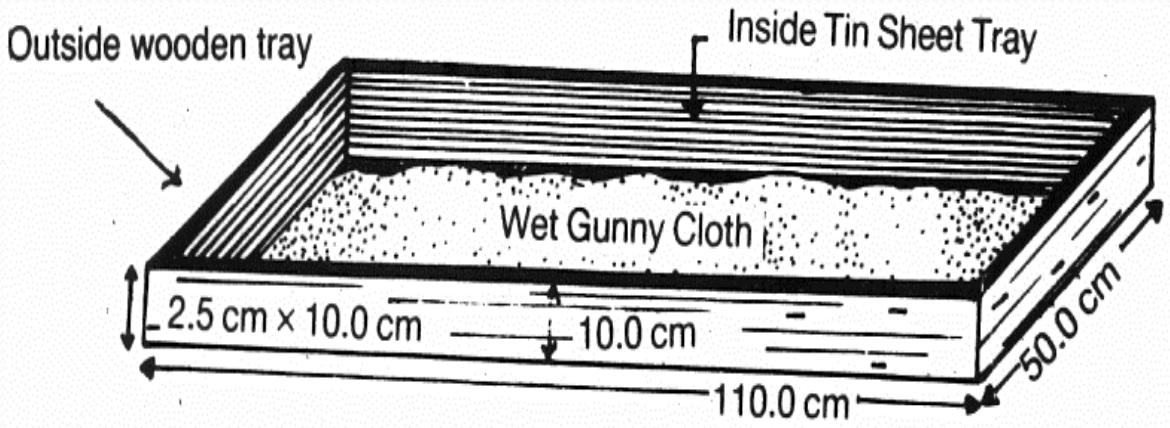
Basin Stand (Iron)

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 Equipments continued

In addition, other equipments like craft paper to preserve the pupae for emergence, working stands to keep the trays at working height, egg cabinet for keeping the eggs, hot air oven to dry the moths, zinc trays, washing equipments such as trays, basins, room heaters to raise the temperature, humidifiers for maintaining the humidity, air conditioners *etc*.

Seed Production Plan

Though the standard production is 25 lakh dfls/annum, it is not distributed uniformly throughout the year

Monsoon & Post Monsoon season demand for seeds is high in rainfed gardens (even in irrigated lands)

In winter season demand is less as mulberry growth is slow

Social Customs / Festival seasons should also be considered as it is a labour oriented field

Seed Production Plan continued

Minimum time required to produce a batch of seeds is two months from Rearing to Seed Production

Better to have three batches of production per month and the rearing of parent breed is required to be planned accordingly

A forecast of egg production is possible at the time of seed cocoon preservation and emergence approximately one kg (600 cocoons) may yield 200 dfls

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 acocoon 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.**

VIEW OF A COCOON MARKET

Grainage Activities continued

Processing of Seed Cocoons

- **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/Emergence Test

First Day Moth Examination.

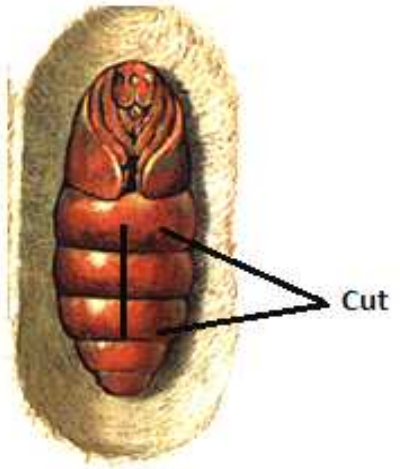
Grainage Activities continued

Pupa Test

The pupa is cut ventrally just below the wing bud with a scissor by holding the pupa between thumb and forefinger in left hand.

After cutting, 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.

Pupa Before Cut



Pupa After Cut

Forced / Accelerated Eclosion/Emergence Test

- **Sample of cocoons from each batch is subjected to high temperature of 30-32˚C**
- **From this set of cocoons, moths emergence is accelerated by one or two days, facilitating early moth examination for detection of Pebrine to avoid any further risk and wastage of material and labour**

First Day Moth Examination

- **A sample of first day emerged moth is recommended and should be done without allowing for copulation**

- **All these tests helps in forecasting the pebrine disease to avoid the possible risks and facilitate to take timely and appropriate decision about the cocoons**

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.

Sex Separation in Seed Cocoons

Sex limited breeds- it is easy for sex separation at cocoon stage if the SEX LIMITED BREEDs are used as parent.

Otherwise cocoon should be cut open, take out the pupa and examine to separate the sex. So it is explained in forthcoming slide as sex separation at pupal stage

Continued as part 2

Reference/Acknowledgements to

MANUAL ON SILKWORM EGG PRODUCTION, CENTRAL SILK BOARD, INDIA 1988.
INDUSTRIAL BIVOLTINE GRAINAGE FOR TROPICS, CENTRAL SILK BOARD, INDIA 1983.