GRAINAGE ACTIVITIES FOR NON MULBERRY SILKWORMS

Dr.H.B.Mahesha, Yuvaraja's College, University of Mysore

Grainage is the most important aspect of sericulture industry. Success of rearing largely depends on careful grainage operations. Systematic and methodical grainage not only minimizes disease mortality but also results in vigorous progenies. The grainage operations consists of selection, storage and preservation of seed cocoons. Besides, preparation of disease free layings, their disinfection and
incubation are its other important aspect.

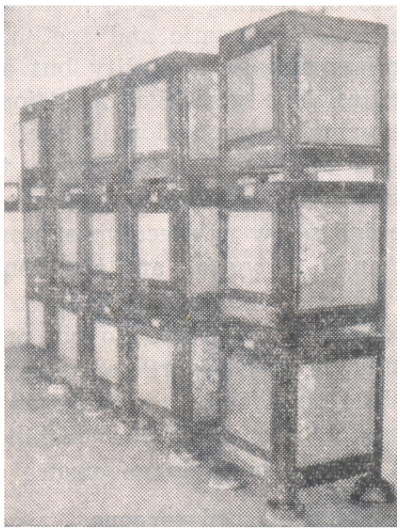
Grainage Activities for Tasar Silkworm - *A. mylitta*

Leaving behind a few wild ecotypes, most of the races of *A. mylitta,* and *A. proylei* are semi-domesticated *i.e*., except the larval stage the maintenance of other stages is carried indoor. The wild races do not respond well in captivity particularly with regard to emergence and pairing aptitudes. The semi-domesticated forms too at times behave abnormally. However, the techniques evolved during the last decadein grainage ensure a stable crop.

Selection and storage of seed cocoons

After harvest the tasar cocoons are graded visually. The flimsy, deformed, inferior, pest infested, diseased and dead cocoons are rejected while the healthy, well formed and tough cocoons are sorted. For seed purpose, sample microscopic examination is followed to ensure healthier seed. The rejected cocoons are utilised for- reeling or spinning.

The selected cocoons are stored in rat proof and well ventilated rooms in hanging condition in the form of garlands to provide natural disposition. The village practice consists in dumping or hanging the cocoon garlands in poorly ventilated, damp and dark rooms, which is highly injurious to the health of the insect. For experimental purpose when purity of stock is required to be maintained the cocoons are stored in cages fitted with wire mesh. The cages can be arranged in tier for economy of space. The four legs of the lower most cage rest on ant-wells.



Outdoor preservation of cocoons in moderate climate

Fig. Cages for tasar cocoon storage.

Coupling

The males are more active than females and can fly for longer distance. The male and female moths are confined in bigger bamboo baskets for pairing. For experimental purpose when specific crosses are required, the desired moths are kept in *manias* (bamboo basket) of 6" x 6" x 4" size. This method of coupling is more effective than the other methods such as swinging basket, mechanical coupling by means of hands and open coupling on net-covered bush. Mating takes place in 3-6 hrof emergence. The moths generally prefer darkness with comparatively lower temperature (26-28°C) and high relative humidity (70-80%) for coupling. Cool air blast (20-22°C) by means of air cooler for 30 min to 1 hr is quite helpful in achieving high coupling percentage (80-90%). The treatment, if continued for 2hr or more, reduces the coupling frequency since the females start depositing eggs. Pre-coupling flight of male moths for short duration (30 min) helps in achieving higher coupling rate, while the longer flights (1 hr or more) give poorer results. The coupling in captivity is more difficult in *A. roylei* and in nature grown Sal crops of *A. mylitta.* In these cases outdoor pairing is practiced by tying the female moths on a bush and releasing the male moths, after sun set. The paired moths are collected early in the morning to avoid damage by birds.

Nylon-net for enhancing coupling efficiency

A special type of tubular coupling cage made of netted cloth is used for preparing interspecific crosses, when there is lack of coupling aptitude between the two species (Fig). The cage is partitioned into two compartments. The males and females of two different species are introduced into the compartment, one of which ismeant .for cross and the other for reciprocal. The males being excited by the sex pheromone emitted by its female counterpart in the other chamber mate with its sister species. This may also be used for inter-regional crosses.

Though the coupling continues for 10-12 hr, duration of 1-2 hr is quite sufficient without affecting fecundity and fertility. The coupling duration has no directrelation with the pre-oviposition period which in tasar moths varies from 30 min to 45 hr. In case of necessity the male and female moths can be refrigerated for 2-3 days. The refrigeration of female moths has been found more effective than the male. The male moths can be used twice for mating.

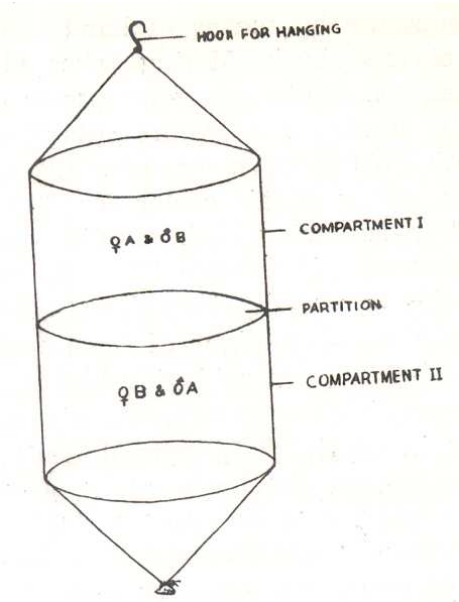


Fig. Coupling cage for interspecific cross.

Egg laying

Usually after 10-12 hr of coupling the moths are decoupled by hand and the abdomen of female moths are slightly pressed for urine discharge which facilitates better egg laying. The female moths are then placed individually in monias covered by muslin cloth for egg laying in a room having a temperature range of 26-28°C and 70-80%RH. In commercial grainage bigger bamboo baskets are used instead of monias and the females are kept collectively for egg laying. It has been observed that elimination of wings does not interfere with egg laying efficiency. This in turn helps to accommodate more female moths in the basket. The moth generally prefers a vertical posture for oviposition. The eggs are laid in batches of 5-10 together with a gummy substance discharged by collecterial glands which helps them to stick on to the surface where they are laid. The moth prefers darkness for egg laying. Most of the females start laying eggs within 24 hr in darkness but under illumination the egg laying is delayed. The egg laying capacity of the moths emerging from diapausing pupae is less than that of the non-diapausing pupae. The female which continues to lay eggs for 6-7 days deposits about 86.5% of their total eggs within 72 hr. The egg laying capacity during first to fifth day is 45.6, 32.7, 8.2, 8.8 and 7.2% respectively. In general 2-3% of the eggs remain unlaid. For rearing the eggs laid with- in 72 hr are considered.

Examination of mother moth

After egg laying the abdominal portion of the mother moth is smeared and thesuspension is examined under microscope at 10 x 40X. The eggs of the moths revealing pathogens are rejected. The pathogens include virus, bacteria, fungus and sporozoa. Special attention is given for sporozoan infection because it is transmitted from mother to the offsprings, In case of scarcity of seed cocoons, the eggs of the mothers having mild viral, bacterial and fungal infections may be used for rearing.

However, this consideration is not applicable to the sprozoan infection. The infected mother moths and their layings are destroyed immediately by burning and burying them at a distant place.

The improved technology ensures removal of outer maconium layer.

Disinfection of eggs

After moth examination the disease free eggs are washed usually with 5% formalin solution for 5 min for surface sterilization. Contamination of the egg surface results in disease since the larva feeds its egg shell on hatching. After the treatment the eggs are thoroughly washed in plain water and dried in shade.

Storage and incubation of eggs

The disinfected eggs are kept in specially designed egg boxes having transparent top to permit light and perforated sides for aeration (Fig). In village, the eggs are stored in leaf o cups of Kendu Plant.

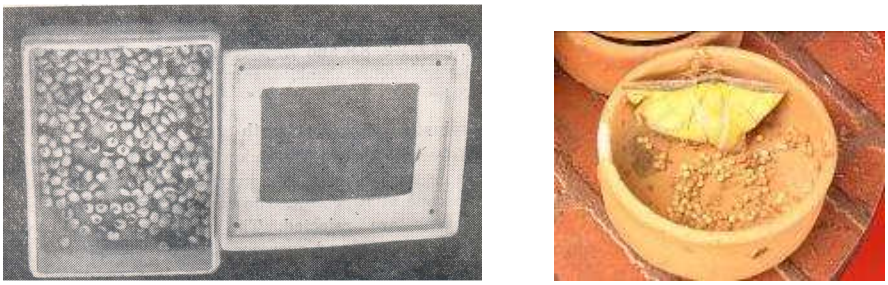


Fig. Egg laying box.

The egg boxes are kept in incubation room. The eggs are usually incubated at 2S-30°C. However, the best incubation treatment is the ascending temperature of10°C (one day) -+ 25"C (4 days) 30°C (rest of the period).

The eggs must not be kept in heaps or in thick layers. During incubation relative humidity between 70-80% is desirable. In low humidity the hatching percentage is poor and the hatched out worms are weak in health.

Refrigeration of eggs

In case of necessity the hatching can be delayed for few days by refrigerating the eggs at 8-10°C. Lower temperatures of 2-5°C are unsafe. Refrigeration is advised at two stages, one within 48 hr and the other after 120 hr of egg deposition. Refrigeration between these two periods is harmful. It

has been seen that the refrigeration is more effective during the first period. The refrigeration duration should not exceed one week for normal hatching.

Hatching of eggs

In natural conditions, the eggs hatch in about 10 days and continue for 4-5 days, while under incubation the hatching takes place in 7-8 days and is completed within 3 days. The eggs laid on first and second day give better hatchability (85% and 75%) with heavier worms (8.5 and 8.2 mg), than the eggs laid on subsequent days (62% and 7.5 mg). The larvae hatched first and second days show bettersurvival (60-65 %), while those of the third and fourth day give inferior results (50-55%). The larvae mostly hatch out in the morning hours.

Preservation of seed cocoons

The term 'preservation' in tasar culture is particularly meant for the diapausing pupae. The non-diapausing pupae do not demand much attention as the pupal period hardly lasts for a month. The room temperature and humidity are also within the normal range to favour their development.

i) **Diapausing pupae:** The tasar crops are uni, bi and trivoltine. Therefore, thediapausing pupae may be observed in all the seasons depending upon the voltinism. In univoltine crops, the pupal diapause extends from August-June, while in bi and triv1tine crops the dispausing pupae pass through November-June and January-June respectively. During these periods the pupae experience extremes of temperature and humidity. Though tasar pupae can withstand a temperature and relative humidity as low as 10°C and 20% and as high as 40°C and 80-100% respectively, it is likely to affect pupal survivality, emergence, fecundity hatchability and viability of the newly hatched larvae.

Preservation of the diapausing pupae during rains and autumn is not a major problem since the normal room temperature and relative humidity during these periods vary between 20-30°C and 50-80% respectively. Contrarily, special care is required during winter, spring and summer. In winter the temperature falls down to 10°C and relative humidity up to 30%, while in spring and summer the temperature shoots up to 46°C and relative humidity comes down up to 15%. Hence care should be taken to raise the temperature during winter and to maintain 25-30°C with 45-50% RH during spring and summer. However, it is desirable to maintain temperature between 25-26°C

and relative humidity between 70-75% through-out the pupal period to ensure a better crop.

ii) Non-diapausing pupae: The non-diapausing pupae are found during July-Augustin bivoltine crops and during July-August and September-November in trivoltine crops. The normal room temperature and relative humidity in July-August (25-30°C and 70-80% RH) and September- November (20-28°C and 50-80% RH) are suitable for preservation of non-diapausing pupae.

Emergence of moths

The entire pupal period of the diapausing pupae can be divided into two periods the period of rest (Diapause) and period of growth. The non-diapausing pupae do not have the rest period. The growth period in the diapausing pupae starts about 30 days before emergence. During the growth period the pupal-adult transformation takes place. Hence this period requires different temperature and humidity conditions; humidity being more important. Though normal emergence canbe expected at 25-30°C and 50-89% RH, to have a uniform emergence, a constant temperature of 28-30°C and relative humidity of 75-85% are desirable. Before emergence moth secretes a proteolytic enzyme which softens the peduncle end of the cocoon enabling the moth to force its way out easily. In humid conditions the anterior portion of the cocoon remains wet facilitating easy emergence, but under dry conditions quick driage of the enzyme interferes emergence and the moth dies within the cocoon. The wings which are moist, soft and folded at emergence get dry and fully stretched in 2-3 hr. Bulk of the emergence takes place from mid-night till sun rise, though stray emergence may be observed any time. The moths from different crops depending upon the voltinism start appearing from mid June, August end and early December and continue for about a month. This prolonged period of emergence can however be shortened to about a fortnight if optimum conditions as suggested are maintained.

ERI SEED PRODUCTION

Healthy *eri* silkworm seed is produced in grainages. An account of seed production is given in the following paragraphs:

The *eri* silkworm is a polyvoltine race with two different colours of cocoons, white and brick-red. Cocoons which are normal and appropriate to

the race, the shape, size, colour and weight should be selected for preparation of seed. Preference should be given to cocoons which possess a thick layer of silk. Too small or too large and abnormal size cocoons should be immediately rejected. Stained cocoons should also be rejected because the stain signifies disease.

SOURCE OF SEED

Generally, rearers obtain seed either in the form of seed cocoons or in layings. Disease free seed cocoons or layings are supplied by Government grainages or through the Government aided graineurs. Disease free seed cocoons are also obtained from a selected seed production zones or from seed raising rearersof reputed areas.

Seed cocoons selected for breeding should be well spread in a thin layer in bamboo trays. The trays should be preserved at a uniform temperature of about 75° Fwith the relative humidity at 75%. A cool dark room is the best. In spite of selection, acertain portion of seed cocoons will have to be rejected for congenital defects or, for subsequent injury.

MOTH EMERGENCE AND COUPLING

Complete metamorphosis of pupa into adult moth occurs within the cocoon. Moth emergence from cocoon takes place after about two weeks of cocoon formationin controlled room temperature of 20-22°C. The emergence of moths takes place early in the morning and continues till mid-day. In the process, male moths emerge earlier than female moths. The number of male and female moths, emerging on the same day, is seldom equal. Surplus males should, therefore, be preserved in the basket separately in a cool place for use next day. At emergence, males are more active as they flutter their wings rapidly. The females are, however, passive. The abdomen of male is narrower than that of female. The moths slowly move towards theraised border of the tray and rest for an hour or two in a vertical position till their wings are dry. Then the male moths start fluttering their wings, once again, in search of female moths yearning to mate with them. The mating is complete by evening. The males are then separated. They can, however, be used for two or three matings in case of commercial crop. For seed crop, the males are used only once for mating. Mating moths should be kept in the privacy of a slightly dark room and never be disturbed.

OVIPOSITION

The fertilized female *eri* moths are tied to a bundle of straw, known as *"kharika",* with a string passing under the shoulder joint of the right wing. If female moths are not confined, they may fly about in the evening and lay eggs all over the seed cutting house resulting in wastage of seed. Since ifl vertical position is preferred for oviposition, the *"kharikas"* with fecundated female moths are suspended from strings.

EGG LAYING

Female moths lay eggs in cluster during night and the oviposition goes on for two or three nights. Some eggs are laid during day time too. A female moth lays about 350-500 eggs but the number of eggs may increase provided the health of the moth is good. The optimum temperature in all the seasons for egg laying is between 22-24°C, with high humidity. The freshly laid eggs are white in colour. The eggs laid for the first 48 hours are selected for rearing.

DISINFECTION OF SEED

Like mulberry silkworm eggs, *eri* silkworm eggs are also disinfected with 2 % formalin and washed in cold water to remove traces of formaldehyde and they are dried under shade.

MOT EXAMINATION

For selection of best layings free from disease, moth examination is also conducted according to pasteur system. Soon after the process of egg-laying is over, all the female moths are examined individually for detection of pebrine spores, in case of reproductive seeds. In case of preparation of industrial layings, 100 % moth examination is obviously not possible. Therefore, only sample test is carried out.

In conducting the above examination, moths arc put in a mortar to which a small quantity of 2% caustic potash or soda solution is added and ground with a pestle. Later, the crushed juice is spread over a glass-slide covered with a cover slip and examined under microscope. If the pebrine spores are detected, the eggs laid by the concerned moth or batch of moths are rejected forthwith.

SELECTION OF LAYINGS

The best layings with the highest number of eggs laid by the healthiest moths are to be selected for propagation. Eggs laid by moths with broken or

crumpled wings and those with rubber like or scale less abdomen are rejected. Moths laying poor eggs are also set aside.

MUGA SEED PRODUCTION

Present status of muga seed organization

Non-availability of quality seed in required quantity and in the proper season, for conducting the commercial crop rearing has been attributed to be the major factor for the decline of muga silk production. Unlike in mulberry sericulture, the seed is transacted in the form of seed cocoon in muga silk industry which may be the prime factor for the prevalence of pebrine disease in muga silkworm. The crop loss due to pebrine continues unabated and every rearer prepares his layings from the cocoons he choose as seed cocoons; the mother moth after oviposition is not microscopically examined for pebrine and hence the seed prepared is not free of contamination. Thus the muga seed prepared and used by the rearers is of poor quality.

Even the departmental agencies supply only the seed cocoons to the rearers, and majority of the rearers only prefer seed cocoons and they are very reluctant to accept microscopically examined layings, possibly they are not prepared to change their age old traditional practice and adopt scientific technology. Even the seed cocoons are riot readily available to the rearers. Generally, the Upper Assam rearers conduct commercial crop rearing during spring and autumn and Lower Assam and Meghalaya rearers conduct rearings during winter and summer which are sold as seed cocoons for the succeeding spring and autumn crops respectively. However, now the picture is gradually changing. Since seed crops fetch more money and are sold at exhorbitant rate, many rearers in Upper Assam around Dibrugarh, Sephakati, Dum Duma and Tingrai region have switched over to seed crops. The seed crop rearings are conducted during unfavourable seasons' and hence the success of the seed crops is highly uncertain. However, once the cocons are produced, they are sold to commercial rearers at very high price. Often the seed cocoon price depends on the place, demand and availability. The seed cocoons are sold in numbers of hundreds, thousands etc. and prevailing rates vary from rupees four hundred to five hundred per thousand seed cocoons. It is estimated that the current requirement of seed cocoon is about five crores to

produce one crore commercial disease free layings (DFLs) as five seed cocoons are required for production of one DFL. It is assumed that there are about 6 lakhs full grown *Som* and *Soalu* trees capable of supporting 50 lakhs DFLs during every spring and autumn. Full grown *Som* and *Soalu* trees can sustain about ten and seven layings respectively. The muga silk industry is primarily in the hands of rearers and it is difficult to ascertain the exact production ofseed cocoons. However, it is estimated that the seed rearers in Assam and Meghalaya and Government farms produce about 32.5 and 7.5 lakhs seed cocoons respectively, equivalent to 8 lakhs dfls (8%) against the current demand for one crore dfls. In order -to solve the acute shortage of seed cocoon and improve the quality of seed, the Central Silk Board formulated a Muga Seed Development Project. The Project envisages four stage multiplication through establishment of parental seed farms *viz*. P4, P3, P2 at strategic locations in the wild muga tract and supply 10 lakhs P2 dfls to 10,000 selected Seed producers who will multiply and supply the seed cocoons to the commercial rearers. This project involves the State Governments at P2 stage and seed rearers at P1 stage, whereas basic seed multiplication at P4 and P3 stages rests with the Central Silk Board. Apart from the seed multiplication process, the project aims at supply of microscopically examined and, certified DFLs in order to minimize the incidence of pebrine ·disease in commercial muga crops. Silkworm seeds are produced in the grainage and therefore grainage is the first and the most important aspect which needs special attention. Success of silkworm rearing largely depends on careful grainage operation. Systematic and methodological grainage not only minimizes larval mortality due to diseases but also results in vigorous progenies. The grainage operations consist of selection, storage and preservation of seed cocoons. Besides, preparation of disease free layings, their disinfection and incubation are its other important aspects. Grainage involves four steps:

(i) Selection and preservation of seed cocoons in the grainage hall.

(ii) Moth emergence and coupling.

(iii) Oviposition

(iv) Microscopic examination of mother moth and preparation of disease free laying.

Operational building for grainage hall:

Grainage building should be spacious and well ventilated for operational purposes. The size of the building depends upon the amount of seed cocoons to be utilised for grainage. The building should be centrally located and easily approachable to the technical staff and should contain three 'rooms viz. (1) for preservation of cocoons and moth emergence, (2) for coupling and egg laying, (3) for moth examination and egg processing. The grainage work for processing 10,000 seed cocoons can be conducted in a room of approximately 1200 sq. feet area (for all the activities cited above). The type of building is also an important consideration for grainage. Thatch roofing is good for grainage hall. Asbestos or G.I. sheet roofing without false ceiling is not suitable particularly during summer. The grainage building should be well ventilated, rat proof with spacious open verandah all round and with glass windows. For various 'grainage operations the grainage house should be provided with equipments like disinfectants, racks, moth , emergence cages, trays, moth crushing sets, microscope, room heater, air cooler, humidifier, incubator,sprayer etc.

Disinfection of grainage hall and equipments

In order to ensure successful grainage operation, the grainage hall and theequipments should be disinfected properly. The disinfection operation can be categorized into two stages:

(a) Washing and spraying

(b) Fumigation

(a) **Washing and spraying:** The grainage hall and its equipments at first, should be washed thoroughly with clean water and/ or bleaching powder. After 24 hours they should be sprayed with 4% formaldehyde solution and should be kept air tight for 48hours.

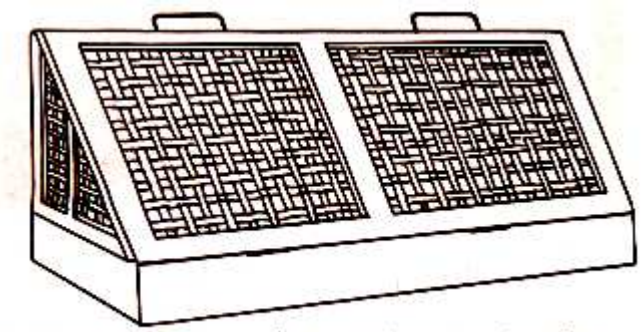
(b) **Fumigation**: After 48 hours of formalin spray, 35-40% commercial formaldehydesolution should be boiled inside the grainage hall keeping it air tight so that the vapours of formalin effectively disinfect the room. After 48 hours the hall should be opened for proper aeration and should be washed with clean water.

Collection of seed cocoons:

Foot hill areas of lower Assam, Garo hills, Naga hills and Cachar hills

are the major seed zones for muga. The traditional rearers of Upper Assam collect their seed cocoons from these areas for commercial rearing during autumn and spring. For collection of healthy seeds, the muga rearings are generally surveyed and selections made accordingly. In order to ensure disease free seeds it is necessary to make sample testing with microscope before collection. The flimsy, deformed, inferior, pest-infested cocoons, cocoons with dead pupae *etc*., should be rejected, while the healthy, well formed cocoons only should be selected. The collection of cocoons should be made preferably from the "Bharpok" stock (peak period of collection of larvae for pupation) in order to avoid erratic emergence of males and females at different times. (Bharpok in assamese means the day of major harvest of muga silkworm for cocooning).

Extreme care should be taken for transportation of seed cocoons from the production site to the place of grainage. While transporting the seed cocoons to far off places, care should be taken for their safe packing. The cocoons should be loosely packed and transported in split bamboo basket or in perforated plywood boxes. In other words, sufficient provision should be made for aeration. In no case the cocoons should be transported in the pre-pupal stage or just prior to moth emergence. They should be transported preferably during night time after 4 to 6 days of harvest from cocoonage. Immediately after transportation the cocoons should be removed from the basket and should be preserved in the grainage room. Heat, jerks, rain etc. should be avoided as far as practicable. Grainage rooms along with the implements should be disinfected and kept ready before the arrival of seed cocoons.



Storage of muga seed cocoons in a bamboo box

Preservation of seed cocoons in the grainage hall:

Soon after the receipt of the cocoons, they should .be preserved in the grainage room. In the traditional practice the village rearers preserve the seed cocoons in bamboo cages. In the laboratory, cages made up of wire-mesh are used and they are arranged in three tier system on the wooden racks. A cage of 3'x2.5'x1.5' (LxBxH) can accommodate 250-300 Cocoons. This method is helpful in small scale grainage operation. For industrial grainage, where very large sample is utilized, cage system does not seem to be economical and hence 'garland system is considered. In this system, cocoons are stitched in the cephalic end" in the form of a garland and are hung in the room. The number of cocoons in each garland may vary from 50 to 150. The cocoons received from different areas should be served separately to avoid contamination.

Emergence of moth:

Depending upon the season, the emergence of moths commence from 14 to 55 days after spinning. The cephalic end of the emerging cocoons becomes soft and distinct from the non-emerging ones. Before emergence the moth secretes proteolytic enzyme which softens the peduncle end of the cocoon enabling the moth to pierce its way out easily. Under humid conditions the anterior portion of the cocoon remains wet facilitating easy emergence, but under dry conditions, the anterior wet portion of the cocoon dries off quickly and, therefore, the moths cannot come out easily. They die within the cocoons at times. The emergence of moths starts from dusk and continues till dawn. The period of emergence varies slightly in different seasons and is observed to take 18 to 20 hrs. The emergence of male moths is more in the early part of moth emergence span and of the females in the later part. This heterogeneity of emergence pattern leads to wastage of male moths in the early part and of female moths in later part of moth emergence period. The emergence of the moths can be synchronized by preserving the male chrysalis at 5°C to 10°C temperature for 3 to 4 days at the early pupal stage. This practice helps to synchronize the emergence of male and female moths and avoids wastage of moths and, thereby, enhances the production of disease free layings.

Immediately after emergence the moths rest for sometime on the

cocoon and stretch their Wings. As soon as the wings become completely dry and fully stretchedthe male moths usually take a' short flight.

Coupling:

Emergence is followed by .coupling. It requires sufficient time for the moths to couple naturally under room conditions. The moths which do not couple naturally are made to couple mechanically. After coupling, the fluttering of the wings of themale moth cease and the coupled moths remain still for a day.

The coupled moths are usually tied on the "Kharika" (Kharika is a thin bundle of straw for oviposition) with a string of thread and the coupled moths are left undisturbed. The hind wings of the female moths are tied to the Kharika in order to avoid stray egg laying. Under normal conditions, muga moths couple overnight, but4 to 6 hrs. coupling is quite sufficient for optimum egg laying and hatching. In the" later part of emergence span, when the male moths are less in number, a single male moth can be used successfully for a second coupling without affecting fertility and egg laying.

Oviposition:

After decoupling, the female moths start depositing eggs on the Kharika. Oviposition starts in the evening and continues till dawn. Egg laying continues for 5 to 6 days but the eggs laid upto four days are only considered for rearing. The eggs laid after fourth day are less viable and the worms become weaker and larval development is very poor.

The number of eggs laid on different days varies considerably. Maximum number of eggs is laid on the first day, then it decreases progressively on the second to the fourth day.

Seasonal factors affect the oviposition behavior of the muga silk moth. Egg laying is maximum in autumn and spring (up to 220 and 200 eggs per laying respectively) and minimum (101) during summer. A substantial number of eggs is retained in the ovary and remains unlaid in the abdomen of the female moth. Thus the number of eggs laid is considerably lower than the actual potential.

Microscopic examination of mother moth:

After fourth day of egg laying, the abdominal portion of the mother moth

is crushed in the moth crushing set with 1 or 2 drops of 2% potassium hydroxide solution. A drop of the suspension is then taken on a clean glass slide and examined under the microscope at 15 or 40 magnification. Potassium hydroxide solution dissolves the fatty tissues and fat bodies and makes the suspension clear. The pathogens include viruses, bacteria, fungus and sporozoa and the diseases caused by them are Grasserie, Flacherie, Muscardine and Pebrine respectively. Special attention has to be given for sporozoan infection (pebrine) which is the most serious disease of muga silkworm. Pebrine disease is transmitted from the mother moth to the progeny through eggs and hence pebrinised layings should be rejected. Under the microscope the sporozoans appear as oval shining bodies, distinct from other cells. Flacherie is identifiable by the presence of numerous small rod/dot. shaped bodies in the haemocoel. The eggs of the diseased moths are rejected and are buried under the soil with formaldehyde or burnt. The layings, which are free from pebrine,are called disease free layings (dfls)/ seeds.

Disinfection of seed (dfls):

The disease free layings/ seeds are collected and soaked in 2% formaldehyde solution for five minutes, washed in water and dried to prevent contamination of germs on the surface of the egg shell. The use of high chlorine bleaching powder during loose egg preparation also serves as a disinfectant.

Preservation of dfls:

After disinfection the eggs are kept in the egg laying boxes for hatching. Over-crowding of the eggs in the laying boxes should be avoided. Otherwise the eggs may be kept as such on the Kharika itself.

Rearing Technology:

The muga silkworm is multivoltine in nature and therefore, rearing could be conducted all through the year. Unlike the domesticated species like *Bombyx mori,* the rearing of the muga larvae is conducted out-door. The out-door rearing exposesthe silkworms to unfavourable environmental conditions and attack of parasites, predators and diseases. As a result, depending upon the weather conditions and intensity of natural enemies, the effective rate of rearing varies considerably. The effective rate of rearing is generally low in the seed crops.

The fate of the crops largely depends on the choice of rearing site, disinfection measures and brushing and maintenance of the larvae. Slight carelessness in any of these factors may reduce the success of the crop to a large extent.

Pre-requisite for rearing:

The rearing of silkworms starts with the brushing of larvae. However, some pre-rearing work is to be done before the actual rearing operation.

(i) Selection of rearing site and plantation:

The rearing site should not be shady and low lying as the high humidity in such places may adversely affect the larvae. The area of plantation facing east and south directions is good for rearing the larvae. The rearing should be conducted on medium sized plants with fresh leaves. Plants heavily infested with ants, wasps, aphids and termites should be avoided for rearing; also plants with diseased leaves should not be used for muga culture.

(ii) Preparation for rearing:

The rearing spot is cleared of weeds. The green grass below the plants should not be removed completely. The plants are thoroughly freed from ant nests and other insect pests. Unsuitable leaves, such as the ripe and dry ones are plucked off. Care is taken to clear the neighboring bushes from ants and wasp's nests. Wasp nests should be burnt at night.

A band of straw with a little ash on the top is tied around the trunk of the tree at about 3 to 4 feet height from the trunk base to prevent the downward movement of larvae. Fresh banana leaves or barks are also useful for this purpose. The trunk base should be sprayed or dusted with a layer of gammexone or lime to prevent the entry of ants. Excessive application of lime however, results in the early maturation of the leaves.

(iii) Disinfection of rearing appliances:

Chaloni (bamboo sieve with a hook used' for transferring larvae), khora (bamboo basket used for collection of ripe worms), bamboo pole (for putting *Chaloni* on the tree top), spade, secateurs, basins, mug etc. which are used in rearing should be kept clean. However, *chaloni* and *khora* may be disinfected with 4% formaldehyde solution. .

(iv) Receipt and maintenance of eggs:

If grainage work is not done at the place of rearing and eggs are

received from distant places, care should be taken to avoid any damage or injury to the developing embryo while transporting the eggs. The eggs are brought in loosely packed condition with provisions for sufficient aeration. Transportation during the advanced embryonic period is detrimental. It is safe to transport the eggs on the fourth or fifth day of incubation. In case, eggs are transported on the date of hatching,small pieces of leaves of som/soalu are put in the packet to serve as food to the hatched larvae. The eggs are transported preferably during cooler hours, to prevent dehydration during the hotter period of the day. After receipt, the eggs are transferred to perforated egg boxes and kept in an aerated and disinfected room. Care should be taken to prevent entry of ants, lizards, and birds' inside the incubation room.
