# TASAR REARING

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Outdoor rearing exposes tropical tasar silkworms to unfavorable weather conditions and attack by pests and predators. These account for losses of 50-55%, mainly during the early instars. Besides, the improper handling of larvae and the faulty selection of rearing site and plantation, for example, cause severe harm to the health and vigour of the population, which is reflected in a higher-rate of mortality from disease (35-40%). Losses can be substantially decreased by a more rational approach to rearing.

**Rearing operations**

The fate of the crop largely depends on choice of rearing site and food plants, brushing, supervision and maintenance of larval population and other rearing operations. Slackness in any of the operations adversely affects the yield. The following discussion of rearing operations points out the merits and demerits of various improved and traditional methods.

**Selection of rearing site and food plants:** The traditional tasar rearers usually utilize the sparsely distributed food plants on the bunds of paddy fields. Water logging in the fields during rains raises the relative humidity. Also, excreta and dead larvae which have fallen into the water putrify and pollute the environment. During the dry winter months the scattered plants fail to maintain the atmospheric humidity at the desired level. All these conditions promote the outbreak of diseases.

It is desirable to avoid low-lying areas. Fairly thick patches of food plants of 3.0-3.5 m tall are ideal. The bushes must not be utilized for two successive crops in a year.

**Rearing preparations:** Before the onset of rearing, the site and the surrounding area should be cleared of weeds, which might otherwise induce pest and predator attacks. Apart from removing the unsuitable foliage, care should be taken to free the bushes of insects, particularly ants nests. A band of straw with a little ash should be tied around the trunk to check the downward movement of larvae. The trunk base should be encircled with a thin band of gammexane to prevent attack by ants and other insects.

**Quality of leaf:** Quality of foliage in relation to larval age is a major determinant of health and vigour. The younger larvae thrive on juicy, tender leaves, while reddish or pale green foliage is harmful. The latter instars require medium to mature leaves. Outdoor rearing cannot ensure provision of the proper

quality of leaves during the different instars. Nevertheless, this can be achieved to a degree through various cultural operations and selective utilization of food plants.

**Brushing:** Brushing is the placing of the hatching larvae on the leaves. The traditional cultivators tie the leaf cups containing the eggs on the bushes for hatching. Both the developing embryo and the newly hatched larvae are thereby exposed to fluctuating temperature and humidity heavy rain, storms and other hazards. This results in poor hatchability and heavy losses of larvae.



A small twig should be placed over each of the newly hatched larvae, which are then tied on the bushes in a uniform distribution. This operation should not be carried out in strong sunlight, heavy rain or other incelement conditions.

**Supervision and maintenance of larval** population: Outdoor rearing calls for dawn-to-dusk vigilance against pests and predators. Traditional cultivators brush the larval population too densely without regard to the quantity of foliage. This high density decreases effective yield owing to the higher disease mortality and also adversely affects the economic character of the cocoon.

Frequent direct handling of the larvae causes considerable injury to their health and contaminates the population. It is therefore desirable to transfer the larvae only once or twice by cutting off the small branches bearing larvae and attaching them to unused food plants. A secondary advantage of this system is light pruning of the plants.

Moulting and spinning larvae also need special attention; the former should not be disturbed, and the latter require enough foliage to form the hammock properly.

Dead larvae hanging on the bush or fallen to the ground should be collected every morning and evening. A sample of the dead larvae should be examined for microsporidiosis. All the dead worms should be buried outside the rearing site.

Larvae showing symptoms of microsporidiosis as well as the foliage should be destroyed. Those manifesting other diseases should be reared separately. The rearing appliances and the hands of field workers should be disinfected with Dettol water after every contact.

The cocoons should be harvested after six or seven days. The branches are cut and the cocoons are pulled off the twig by breaking it near the ring. The adhering leaves are removed, and the cocoons are graded.

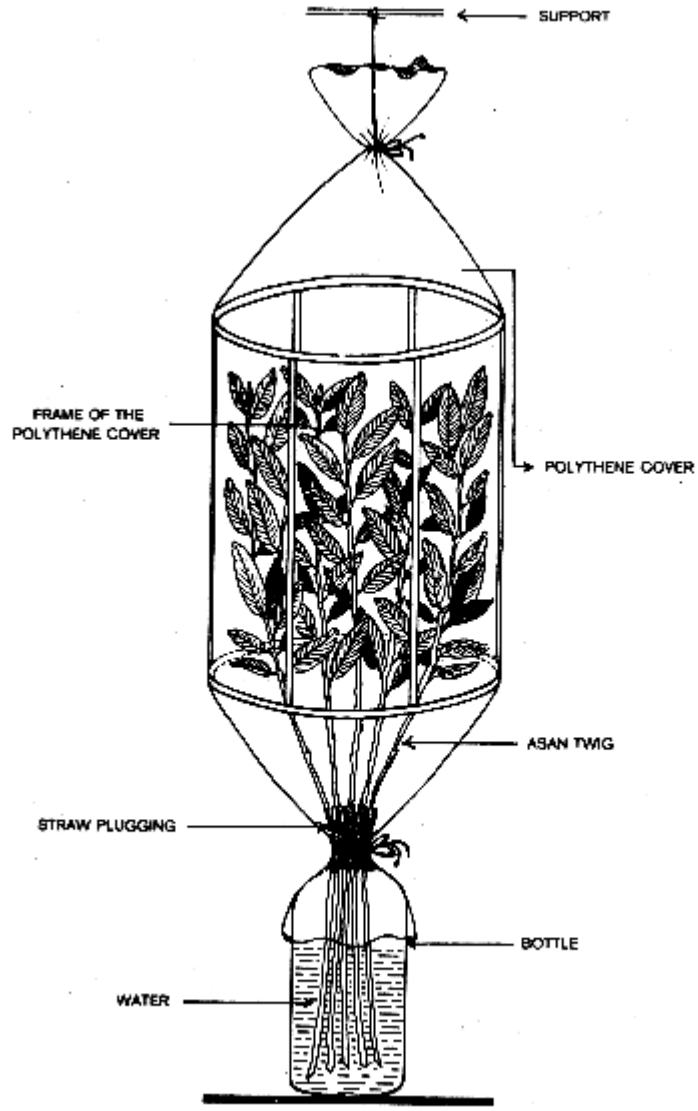
**Improved rearing techniques**

There is a very heavy population loss, particularly during the first instar, due to outdoor rearing. Attempts at total indoor rearing have so far not been successful; however, controlled rearing techniques have been developed to protect the early stages.

**Controlled rearing:** Until the first moult the larvae are reared indoors. The essential equipment and the rearing technique are described in the following paragraphs.

**Rearing set:** It consists of a water filled bottle holding 3 to 5 twigs (about 60 cm long) with quality foliage and a cylindrical polythene enclosure with a split-bamboo frame (Figure). The cut end of the twigs is inserted well under water. This arrangement keeps the foliage turgid for 3 to 4 days feeding. Proper clustering of the foliage to form a nest at the centre of the set prevents the larvae from crawling onto the polythene. The mouth of the bottle is plugged, not to protect the larvae from drowning, but also to check an increase in humidity due to gradual evaporation of the water. The rearing capacity of the set can be increased considerably by using a big earthern pot or tin container.

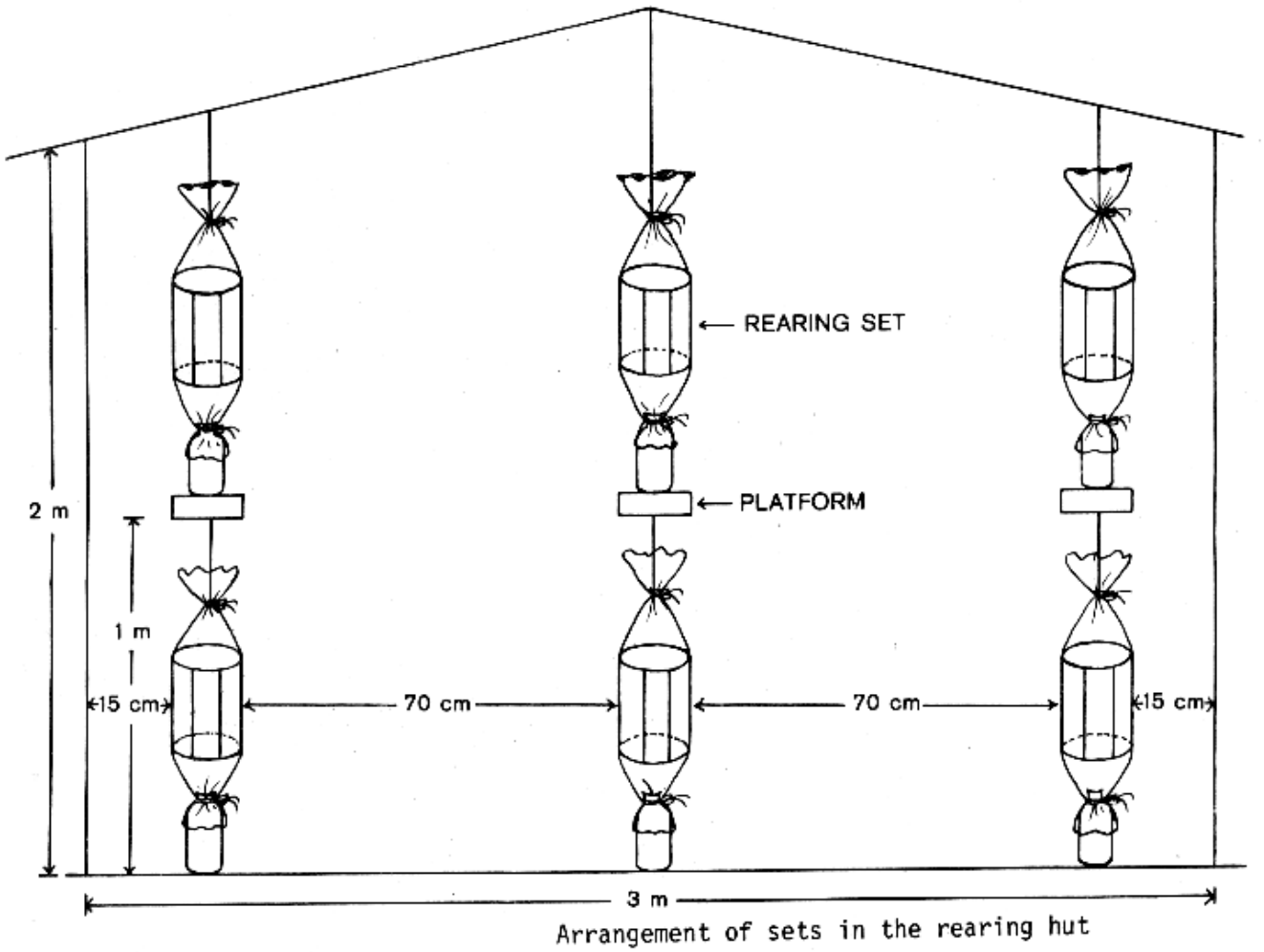
Brushing is conducted according to the improved technique of using only one day's hatchings and avoiding overcrowding. The polythene enclosure, which is tied at the bottom around the neck of the bottle and fastened at the top to a support, should be opened for about IS minutes daily for cleaning and for adequate aeration. Special care should be taken to remove the enclosure as soon as the larvae start settling to moult; otherwise the ecdysis is so difficult as to cause heavy mortality. The larvae coming out of moult are allowed to crawl onto fresh twigs and transferred outdoors, observing the precautions previously discussed.



Controlled rearing set for early-instar larvae

**Rearing huts:** The rearing sets are placed inside a hut thatched with straw or leafy branches (Figure). I t should be constructed on ground that is high enough to be free from water logging. The floor should be raised 15 cm above the ground to avert flooding by rain water. The hut should be bordered with a thin band of gammexane to keep away ants. The open side should not directly face the sun and should be closed at night and during bad weather.

A hut 6 x 3 m can accommodate about ninety rearing sets arranged in three parallel rows in two tiers. The space between the rows provides working room and the spacing of the rearing sets facilitates handling.



Arrangement of sets in the rearing hut

**Benefits of control rearing**: Under the traditional rearing method the loss in the first instar alone is generally 30%. During the remaining larval instars the losses from diseases and pests are 45 to 50% and from natural calamities 10%. Controlled rearing reduces not only the first-instar losses to as low as 5% but also disease mortality during the subsequent stages. The effective yield thereby increases to 50 to 60 cocoons per disease-free laying (dfl) against 15 to 20 with the traditional method. In India an average family of tropical tasar rearers manage 300 to 400 disease-free layings.

**Early-instar rearing centres:** The development of economic plantation of tropical tasar food plants has promoted the concept of early-instar rearing centres. The technique is a further improvement on the basic principle of controlled rearing.

Rearing up to the third instar is conducted on economic plantation, preferably under nylon netting. Although the overlapping twigs allow the larvae to crawl from one bush to the other, the medium size and regularity of the plantation not only permits more efficient management,

supervision and operation but also minimizes losses (Figure). Moreover, the larvae are more vigorous as a result of being reared under natural conditions with almost no intervention.

As soon as the larvae have passed the second or third moult, the twigs bearing them are cut and transferred to forest or block plantation for rearing in the advanced stages. To save time and labour in the transfer of early-instar population, the rearing centers should be situated as close to the forest as possible.

About 4 000 disease-free layings (dfl) can be reared up to the third instar on one hectare of economic plantation. The loss during the early instars is reduced to 5 to 6% against 40 to 50% during the corresponding period with the traditional method. Also the advanced stages are less susceptible to diseases. The technique therefore yields a stable and rich harvest of 80 to 100 cocoons/ dfl (Figure).

Furthermore, labour at the cultivator level is reduced substantially by approximately fifteen days of rearing at the centre and the consequent handling of more or less uniform populations. The centres can be organized as cooperatives of ten member rearers each.

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## MUGA REARING

Unlike tropical and temperate tasar silkworms, *A. assamensis* is polyvoltine; however, as they are reared outdoors, the various aspects of rearing more or less resemble those of tropical tasar, except for indoors cocooning.

**Rearing period**

Rearing is conducted throughout the year, yielding five or six crops annually. These crops are designated by local names based on rearing months. The larval span varies by season, mainly because of the difference in temperature. Kotia and lethua are large-scale crops for the production of reeling cocoons, whereas the remaining crops are used only for stock maintenance and seed purposes.

**Larval behavior**

The muga silkworms have a high humidity requirement, which is largely satisfied by the high annual rainfall (2000-2100 mm) throughout the rearing belt. They can sustain a very wide range of temperature; however, a temperature above 35°C combined with less than 65% R.H. makes the larvae restless and causes heavy mortality. The optimum temperature and relative humidity ranges are 24-25° C and 75-80%. The occurrence of diapause in the wild population inhabiting the foothills of the Brahmaputra valley is a consequence of the very short day and low temperatures during the winter.

Like the advanced stage larvae of *A. yamami*, the early instars of muga silkworm cut the leaves through the midrib. Like *A. proylei*, the late instars, consume the midrib and petiole, and they suck dewdrops. The larval growth rate is also more or less comparable to that of *A. proylei*.

The ripened muga larvae have the peculiar habit of moving collectively toward the trunk base at dawn for cocooning. The ripening may commence at any time of the day. The larvae have to be picked up, as otherwise they travel long distances in the grass in search of a suitable cocooning place. Cocoon formation starts in the evening and is completed within 3 to 6 days, depending on the season. As in *A. proylei* the ring and peduncle are quite weak and almost rudimentary.

**Rearing technique**

Attempts to rear even the early stages of muga silkworm under indoor conditions have not yet met with success. Mounting is carried out in the morning. The kharikas are tied with straw rings on the main trunk of the trees 1.5 - 2.0 m above the ground. It is desirable, however, to place them on small twigs, so that the newly hatched larvae are not exposed to attack by their enemies and are able to reach tender foliage immediately.

The kharikas are placed either on the eastern or the southern side of the bush for adequate sunlight. The number of layings is adjusted so as to a void transfer until third instar. Soalu is more efficacious than som for feeding the early stages.

To control the downward movement of the larvae, a few straw bands are tied in succession on the main trunk and thick lateral branches. The larvae which cross the barrier are collected and placed on a triangular bamboo sieve known as a "chaloni", which is then hung on a leafy twig by means of a bamboo stick.

For cocooning the descending mature larvae are collected in a chaloni in the evening and placed either in a pit or a bamboo basket, above which a bundle of dry leafy twigs, or jali (cocoonage),

is placed. The larvae gradualy crawl onto the jali for spinning. Moist leaves are observed to produce cocoons of inferior quality. Twigs of a singori, som, soalu, mango, jackfruit and azar, for example, are preferred for cocoonage. The glaze of the cocoons is better if singori jali is used. The size of the jali depend on the number of larvae (usually 500- 1000) to be mounted for cocooning. The jalis with spinning larvae are hung indoors on wire about 2 m above the floor, and a piece of hollow bamboo (15-20 cm) is placed at the upper end to halt the upward movement of the larvae. Cocoons are harvested on the fifth day in summer and the eighth day in winter. If a population is being raised for seed, it is desirable to separate the sexes by the genital markings on the mature worms and use separate cocoonage to facilitate grainage operations.

**Characteristics of muga rearing**

Muga silkworms reared on young (4 to 5 years) mejankori bushes yield glossy white rather than brown cocoons. The survival rate on mejankori is very low, as only the more vigorous and healthy worms can thrive on it. Chapa plants are also reported to yield glossy white cocoons. Mejankori and chapa silks are produced chiefly in Jorhat, Assam.

In the foothills, as has already been pointed out, muga silkworms grow vigorously and can be maintained in a wild state year round. Congenial climatic conditions and rearing on soalu promote healthy growth, and they pass the winter in a dormant state.

In the plains the weather is favourable only in autumn. The soil remains water logged in the rainy season, adversely affecting both the silkworms and the food plants; moreover, hailstorms and gusty winds during the spring, climatic fluctuations and heavy rains in summer and intense heat during August and September cause severe damage to the population. Being polyvoltine, the larvae have to withstand the unfavourable winter conditions. Also, muga silkworms are reared so far as the food plant is concerned, mainly on one food plant: som. All these factors are probably responsible for the rapid deterioration of the muga population in the plains.

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## ERI REARING

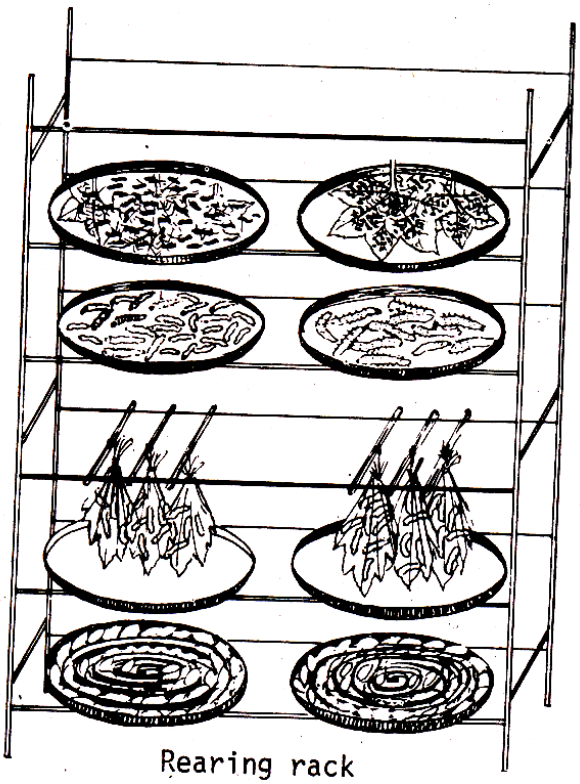
Rearing the larval population of *P. ricini* is entirely different from that of *Antheraea* silkworms. Neither the provision of foliage suitable or each larval stage nor the protection of larvae from attack by its enemies and from natural calamities is difficult.

**Rearing house**

The rearing house should be ideally located and protected against rats. It should have verandah on all the four sides and an adequate number of doors, windows and ventilators to ensure cross circulation of air and good light. Glass panes on the outside wire-mesh fitted panels on the inside effectively prevent the access of various pests and parasites. Naturally, the size of the rearing house is adjusted to the rearing capacity.

**Rearing appliances**

The important appliances are rearing racks, trays and chandrika (cocoonage). The wood or bamboo racks are about 1.8 m high, 2.1 m long and 60 cm deep with six shelves spaced 25 cm apart. The feet of the rack rest on ant wells. The rearing trays, made of split bamboo and preferably circular. should have a diameter of nearly 90 cm so that two trays can easily be accommodated on one shelf.



Rearing rack

The chandrika is made of split-bamboo tape (called "chandrika phool") about 6 cm wide with big triangular holes to allow larval movement. The tape is fixed on a rectangular or circular bamboo mat (like a rearing tray) in the form of spirals, maintaining a distance of about 4 to 5 cm between spirals.

**Rearing preparation**

The volume of rearing to be undertaken should be established according to the availability of foliage.

An average of about one metric ton of foliage is required for the rearing of 100-125 laying from hatching to ripening.

All rearing appliances and rooms are thoroughly cleaned and disinfected two or three days in advance. The chandrika is subjected to a low flame in order to remove any adhering silk filaments. The rearing room should be made as airtight as possible before spraying the disinfectant and kept closed for I5 to 20 hours afterwards.

**Larval behavior**

Eri silkworms are reared in both the plains (West Bengal, Bihar, etc.) and the hills (up to 1500m above sea level in Assam, Meghalaya, *etc*.) at temperatures ranging from 15 $^{o}$C in winter to 35 $^{o}$C in sumer and from 50% to 100% relative humidity; however, the optimum range of temperature and relative humidity is 24-26°C and 75-85%. The larval span varies from 20 days in summer to 50 days in winter.

Unlike other non-mulberry varieties, eri silk worms do not eat the empty egg shell on hatching nor the cast-off skin after moulting. Furthermore, like *A. mylitta* they do not consume the midrib and petiole. They have a very poor gripping power. The mature larvae produce a rustling sound when rolled between the fingers and have a tendency to move upward and away from the foliage.

The mature larvae search a suitable cocooning place on the chandrika and remain there 4 to 5 hours after discharging the last excreta. First the base of the cocoon is formed by moving the head to trace a horizontal figure eight. This is followed by the formation of sides and finally the upper part, but during these operations the head movement is irregular. After about 13 to I5 hours of spinning the larvae are invisible. The cocooning is completed in three days during the summer and in five days during the winter. Unlike silkworms of the *Antheraea* species, eri silkworms do not form a ring and peduncle, and because the cocoons are open at one end the filament is discontinuous.

The newly hatched larvae of *P. ricini* measure about 4 x 0.7 mm and weigh about 1.3 mg. The mature larvae are about 8.5 cm long and 1.7cm wide and weigh about 6.2 g exhibiting an increase of 21, 24 and 4770 times respectively.

**Rearing techniques**

The eggs are kept in the rearing tray on a piece of paper for 24 hours before hatching. They are covered with a few tender top leaves when they start to hatch. The larvae crawl gradually onto the underside of the leaves and remain very close together in groups. It is advisable to feed them chopped

leaves until the first moult, as they may become enclosed in the dried leaves and discarded at the time of cleaning.

Extreme care is taken to ensure that the age of the leaves is compatible with the growth stage of the larvae. They should not be fed wet, dirty, diseased, dried or ripe yellow leaves, or offered too many leaves at a time. The plucked leaves are loosely heaped and kept covered with wet gunny cloth. The density of the larval population should be properly regulated. Each larva requires, on the average, about three times the space occupied by its body throughout the larval span.

The larvae are fed on trays or on hanging leaf bundles. If fed on trays, whole or chopped leaves are spread over the larvae. Considerable time is saved, but the rearing bed becomes dirty with excreta. In any case, this method is necessary until the second moult. If the hanging-bundle method is used, eight to ten leaves are tied together and hung on a stick resting across the two parallel bars of the stand. The vertical position of leaf lamina not only facilitates almost complete consumption of the foliage, but also permits the litters to drop directly onto the tray underneath without soiling the leaves. This feeding method thus combines foliage economy and cleanliness.

Up to the third instar the larvae are given four feedings a day, and the late instars fed five times a day at regular intervals. The first feeding must be served at 5:00-6:00 and the last at 21:00-22:00 hours. Moulting larvae, however, are served only when about 85% of them have cast off their old skin.

The rearing bed should always be cleaned before noon, else the excreta starts decomposing with the rise in temperature. Not only the litters, but also the midribs, petioles, dry and unconsumed leaves as well as other waste must be removed. While cleaning, fresh leaves are put on the rearing tray to attract the larvae. Dead and infected larvae are removed as soon as they are noticed. When the batches are preparing to moult, cleaning should be conducted before they settle.

It is desirable to rear early and late instar larvae in separate rooms because of their substantially different requirements. The rearing is generally conducted under normal room conditions in all seasons, but in case of necessity the temperature and relative humidity of the rearing room can be brought to the desirable level by artificial means. As soon as the larvae mature they are placed in the chandrika for spinning.

The quality of the cocoons greatly depends on the food plant. The various eri food plants, in order of efficacy, are castor-oil payam, kesseru and tapioca. As to the seasonal effect, the cocoons produced in late spring and in late autumn are the best.

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