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Rearing Methods for Silkworms: Enhancing Survival and Cocoon Quality

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Silkworm rearing is a highly specialized process that requires careful regulation of environmental conditions, feeding practices, and hygiene measures to ensure healthy larval growth and maximum cocoon yield. The requirements of temperature, humidity, and leaf quality vary between young age and mature larvae, making stage-specific rearing methods essential. For young age larvae, chawki rearing emphasizes high temperature (27°C), high humidity (80–85% R.H.), and feeding with tender mulberry leaves rich in moisture and nutrients. Several rearing techniques have been developed to optimize growth and reduce mortality, including paraffin paper rearing, box rearing, the new net method, and co-operative rearing, each with its own advantages in terms of leaf preservation, aeration, disease management, and labour efficiency. For mature larvae, rearing methods such as shelf rearing, floor rearing, and shoot rearing are employed, with a greater focus on ventilation, lower temperatures, and reduced humidity. These methods allow efficient handling of the higher leaf consumption and faster growth rates of older instars. Collectively, the adoption of appropriate rearing practices at each stage contributes significantly to larval health, disease prevention, labour savings, and improved cocoon quality, thereby enhancing the sustainability and profitability of sericulture.

Rearing Methods

The temperature, humidity, and quality of leaves required vary between young and older silkworm larvae. Similarly, the timing and methods of rearing practices—such as feeding, bed cleaning, and spacing—differ for each stage. Therefore, rearing techniques must be adapted according to the larval age.

Rearing of Young-Age Larvae

Newly hatched larvae are initially wet due to the residual moisture from the eggs, which gradually dries as they begin moving. At this stage, their body moisture content is lower than that of larvae that have started feeding, and they are highly sensitive to dryness. It is crucial to handle them carefully, brushing them at the right time before they dry out. Maintaining appropriate temperature and humidity is essential; otherwise, larvae may desiccate and weaken.

In chawki rearing, maintaining a higher temperature (around 27°C) and relative humidity (80–85%) is critical. The larvae are fed tender leaves that are rich in water, sugars, salts, and proteins, but low in fiber. Consuming such nutritious, succulent leaves boosts the larval water content, which supports healthy growth, as this is the period of maximum water accumulation. In contrast, water content does not increase significantly in second and third instar larvae.

Proper ventilation is also important to prevent the build-up of harmful pathogens, as young larvae are particularly vulnerable to bacteria, fungi, and viruses. During this stage, growth is extremely rapid, with larvae increasing in size approximately 15 times. To support this rapid growth, the food provided must be highly nutritious. Insufficient nutrition can increase susceptibility to disease. Ideally, a dedicated chawki plot should be used, with good irrigation, adequate sunlight, and ample organic and chemical fertilizers to ensure optimal larval health and development.

Paraffin Paper Rearing

Silkworms can be reared in standard circular or rectangular trays. To keep the leaves succulent and maintain higher temperatures, both the top and bottom of the rearing beds are covered with paraffin paper, with the paraffin side facing the bed. Wet foam rubber strips or newspaper strips are placed around the edges to help retain moisture.

Feeding is done four times a day—at 6 a.m., 11 a.m., 4 p.m., and 10 p.m. Bed cleaning schedules vary by larval stage: for the first instar, the bed is cleaned once before moulting; for the second instar, twice—once after moulting and once before the next moult; and for the third instar, three times—after moulting, midway through the instar, and just before moulting. Spacing within the tray is generally sufficient for up to 50 dfls; additional trays may only be needed from the third instar onward.

The paraffin cover is removed 30 minutes before each feeding to allow ventilation and also during moulting to provide a dry bed. This method, however, is prone to muscardine disease, so applying a thin layer of lime powder during rearing, especially during moulting, is recommended.

Since paraffin paper can be expensive or difficult to obtain, alternatives like banana leaves or bark have been used successfully. Researchers have also found polythene sheets to be an effective substitute. Using polythene has several advantages: it helps maintain bed humidity, prevents leaf drying, shortens larval duration, improves survival rates, and enhances cocoon yield and quality.

Figure 1 Paraffin Paper Rearing

Additionally, polythene sheets are inexpensive, reusable, easy to clean, and disinfect. The sheet should not exceed 400-gauge thickness. During periods of high humidity, wet foam pads and the bottom sheet can be omitted. A gap of about 3 cm should be maintained between the sheet and the bed to prevent the weight of the covering from pressing on the larvae.

Box Rearing

In box rearing, silkworms are kept in deep trays or boxes made of wood, plastic, or galvanized iron, typically 10–15 cm deep. The preparation of the rearing bed is similar to the paraffin paper method: chopped leaves and brushed larvae are placed in the center, and a paraffin paper cover is added. Wet foam strips are arranged around the bed to retain moisture.

Box Rearing

For boxes with lids, the paraffin-covered bed is closed with the lid and placed on the rearing shelf. In boxes without lids, they are stacked one on top of the other. For second and third instar larvae, a 2–3 cm gap should be maintained between boxes by placing small sticks at each corner. Alternatively, boxes can be arranged crosswise to allow ventilation through the uncovered spaces.

Feeding, bed cleaning, spacing, and anti-muscardine measures follow the same procedures as in paraffin paper rearing.

New Net Method

The new net method was developed to address problems caused by high humidity and excessive leaf moisture in paraffin paper and box rearing, which can promote fungal growth. A wooden frame measuring approximately 2' × 2', fitted with a cotton net of 10 mm^2 mesh size, serves as the rearing bed.

After brushing, newly hatched larvae are initially fed on 0.5 cm^2 pieces of mulberry leaves in a standard rearing tray. About 30 minutes later, the net frame is placed over the bed, and a second feeding is provided by sprinkling tender leaves onto the net. The larvae crawl through the netting to reach the food, while faecal pellets fall through, effectively keeping the bed clean.

This method improves aeration, reduces heat build-up, and makes hand spacing easier. It allows the bed to remain dry, facilitates easy transfer of larvae, keeps dead or diseased worms separate, and provides an overall healthier environment for the silkworms.

Co-operative Rearing

Young silkworms are extremely small and sensitive to environmental changes and diseases. They are also prone to being lost during bed cleaning if not handled carefully. To reduce losses from missing larvae, young worms are often reared centrally by trained personnel in facilities designed to maintain optimal temperature and humidity. These centers have mulberry gardens dedicated exclusively to the feeding of young larvae. Farmers typically receive the worms after the second moult. This co-operative approach reduces labour demands and enhances overall productivity.

Co-operative rearing offers several benefits, making it both economical and efficient. It can save up to 40% of the total expenditure and reduce labour needs by about 50%, allowing workers to focus on other agricultural tasks. It also ensures consistent sericulture practices, as dedicated gardens for young larvae help produce healthier worms capable of resisting adverse conditions later in life. The main drawback is that if a co-operative rearing center fails in a given season, the entire crop in that region may be affected.

Although co-operative rearing was not widely adopted in India initially, its popularity is increasing. Both central and state governments have established chawki rearing centers across the country. These centers maintain special gardens for feeding young larvae and provide controlled environments where temperature and humidity are carefully regulated. They supply fresh, succulent leaves from specific positions on the mulberry branch according to the needs of each instar. Such centers have contributed significantly to the recent increase in cocoon production in India.

Rearing of Mature Larvae

As larvae mature, their growth rate and leaf consumption increase, demanding more labour, leaves, and equipment during rearing. Mature larvae are less tolerant of high temperature and humidity, so conditions must be carefully controlled: around 25°C for fourth instar and 23–24°C for fifth instar larvae. Adequate ventilation is necessary to keep humidity at safe levels.

In countries like Japan, mature larvae are often reared outdoors in mulberry gardens under temporary tents, vinyl rearing houses, or barracks. This approach reduces labour and simplifies the harvesting, transport, and storage of leaves. In contrast, in India, mature larvae are primarily reared indoors. The most common methods for indoor rearing include shelf rearing, floor rearing, and shoot rearing.

Shelf Rearing

Shelf rearing is the most widely used method in India. In this system, silkworms are kept in circular bamboo trays measuring 1–1.2 meters in diameter, which are stacked in tiers on shelves positioned parallel to the walls. The bottom shelf is typically placed about 20 cm above the floor, and an 80 cm gap is maintained between trays to allow ease of access. The arrangement of shelves is customized according to the room dimensions to ensure sufficient space for moving trays during feeding or bed cleaning.

Feeding is performed in the trays, using either whole leaves, chopped leaves, or shootlets, three to four times a day. Bed cleaning is carried out daily in the morning using nets, and spacing of larvae is done simultaneously with cleaning.

The primary advantage of shelf rearing is that it allows a large number of silkworms to be raised in a limited space while keeping the area clean. However, the method requires significant labour for feeding and cleaning each tray individually, and the initial cost of trays and shelves can be high.


Shelf Rearing

Floor Rearing

This method is followed traditionally in Kashmir and some parts of China wherein rearing is conducted on the floor using mulberry shoots/branches in rearing bed of 5 feet width and as long as rearing room is made on either side of the floor with an old newspaper. Before spreading the newspaper, thin layer of lime is dusted on the floor to prevent the attack from ants. Feeding is done as in shoot feeding method and no cleaning of bed is practiced. Since no rearing racks are used for rearing, it is highly economical and hygienic.


Floor Rearing

But the disadvantages are that, more floor area is required than tray and shoot rearing.

Shoot Rearing

Shoot rearing, a method developed in Japan, resembles floor rearing in that larvae are kept on fixed platforms. This approach is suitable for both indoor and outdoor rearing. The platform can be flat, sloped, or a combination of vertical and sloped surfaces. Usually, a single platform above the ground is sufficient, but multiple tiers can be set up in the same space.

In this method, entire mulberry branches or shoots are provided as feed, arranged closely to prevent wilting. Because leaves are distributed in three dimensions, aeration within the room is improved, and larvae can fully utilize the foliage. Feeding is reduced to two or three times per day, and bed cleaning is minimized to once per instar. This reduces labour costs for harvesting, chopping, feeding, and cleaning, and also decreases leaf consumption by approximately 25% during the fifth instar.

Shoot rearing is especially popular in Japan due to labour shortages. For outdoor setups, straw mats are used to shield the larvae from direct sunlight. In India, where labour is more readily available, the labour-intensive shelf rearing is more commonly used. However, some farmers have adapted the shoot rearing method successfully. For example, in Kashmir, a farmer replaced traditional platforms with thick nylon nets, which allowed excreta to fall through the mesh, reducing or even eliminating the need for bed cleaning.


Shoot Rearing

Conclusion

Effective silkworm rearing requires careful attention to the biological needs of the larvae at different stages of growth. Young age larvae demand high temperature, humidity, and nutritious tender leaves, with methods such as paraffin paper rearing, box rearing, new net rearing, and co-operative rearing designed to optimize survival, growth, and disease resistance. Mature larvae, with higher food consumption and faster growth, require lower humidity, more ventilation, and efficient feeding and cleaning practices, achieved through shelf rearing, floor rearing, or shoot rearing methods. Each rearing system has been developed to balance environmental control, labour efficiency, and larval health, ensuring maximum cocoon yield and quality. Adoption of stage-specific techniques not only enhances the survival and development of silkworms but also reduces the risk of disease, minimizes labour costs, and improves overall productivity. Therefore, understanding and implementing appropriate rearing methods at every stage is crucial for sustainable and profitable sericulture, contributing significantly to rural employment, silk production, and the economic stability of silk-growing regions.

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