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Study of Physical and Chemical Properties of Silk and Methodology Of Sericulture

Nirvik Banerjee, nirvik.banerjee@yahoo.com

Introduction : Silk is the most elegant textile in the world with unparalleled grandeur, natural sheen, and inherent affinity for dyes, high absorbance, light weight, soft touch and high durability and known as the "Queen of Textiles" the world over. On the other hand, it stands for livelihood opportunity for millions owing to high employment oriented, low capital intensive and remunerative nature of its production. The very nature of this industry with its rural based on-farm and off-farm activities and enormous employment generation potential has attracted the attention of the planners and policy makers to recognize the industry among one of the most appropriate avenues for socio-economic development of a largely agrarian economy like India.

Silk is the protein secreted by the larvae of certain Lepidopteran moths. It is fibrous in nature, and widely used for the manufacture of art clothes. The silk is derived from silk moths mainly belonging to Bombycidae and Saturuidae families of lepidoptera.

Key Words : Sericulture, Mulberry , Eri , Tasar , Muga silkworm etc.

Physical and Chemical Properties of Silk:

Silk filaments are formed of an inner core of material called fibroin covered by another substance called sericin. Fibroin constitutes about 70-80% of the filament. It is an amphoteric colloidal protein of formula $\mathbf{C_{15}\ H_{22}\ N_5\ O_6}$. Fibroin when heated burns and gives the smell of burned feather. This property is used to distinguish genuine silk from artificial silk. Sericin is also a protein of albuminous nature.

The silk fibre quality and quantity depends on the size and robustness of the cocoon. It is estimated that on an average a cocoon gives silk filament of 600-1200 m. To produce 1 lb. of raw silk about 2300-2600 cocoons are required. In terms of weight about 11 kg., of cocoon'

may yield 1 kg., of raw commercial silk and 1.5 kg of waste silk for spinning. The thickness of the silk filament produced by Bombyx mori varies from 0.018 mm.

The filaments have great tensile strength (tensile strength of silk 64,000 lb/ssq. Inch and that of iron 90,000 Ib/sq. inch) and good elasticity (the silk fibre can stretch one fifth of its original length). These two properties of silk owe much of its excellence as a textile material.

Species of Silkworms:

There are four different species of moths, cocoons of which yield differing types of silk:

1. Mulberry Silk is the most common among them contributing to nearly 95% of world's silk production. It is produced from the cocoons of the moth Bombyx mori. Within the species there are many varieties, mainly differentiated according to the number of generations produced annually under natural conditions. Then, hybrids of various kinds have also been developed. Multivoltine varieties (laying eggs several times a year) have been widely propagated to push up yields, but many feel that they are more vulnerable to pests and hence risky for small farmers. The government provides DFLs of various species through its outlets.
2. Eri silkworm has two varieties – a wild one and a domesticated one bred on castor leaves. The filament is neither continuous nor uniform. Hence the moths are allowed to emerge before commencing reeling. A white or bright red silk is produced.
3. Tasar silkworms are wild. The Indian Tasar worm feeds on trees of Terminalia species and other minor host plants, while the Japanese and Chinese worms feed on oak and other allied species. Reeling can be done as with mulberry worms.
4. Muga silkworm is found only in Assam. It feeds on two local species of shrubs – Machilus bombycina and Litsae polyantha, producing a strong, golden yellow thread.

Silk production in India

India has the unique distinction of being the only country producing all the five known commercial silks, namely, mulberry, tropical tasar, oak tasar, eri and muga, of which muga with its golden yellow glitter is unique and prerogative of India.

Mulberry sericulture is mainly practised in five states namely, Karnataka, Andhra Pradesh, Assam and Bodoland, West Bengal, Jharkhand and Tamil Nadu are major silk producing

states in the country. North East has the unique distinction of being the only region producing four varieties of silk viz., Mulberry, Oak Tasar, Muga and Eri. Overall NE region contributes 18% of India's total silk production.

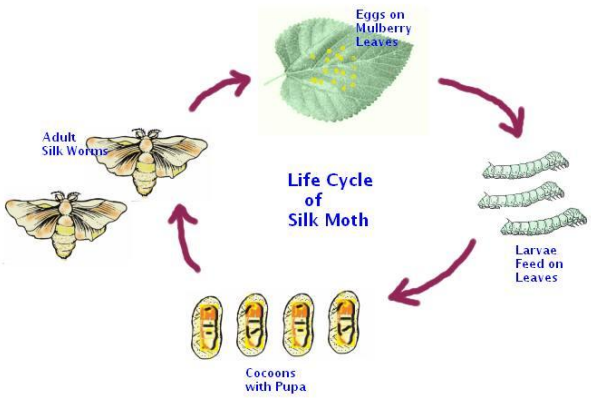
The demand for superior quality bivoltine silk is increasing in India for domestic consumption as well as value added silk products for the export market. The Ministry of Textiles Government of India and Departments of Sericulture in various states provide technical and financial assistance for enhancing the bivoltine silk production.

Methodology Of Sericulture

1. Collection of eggs
2. Incubation of eggs.
3. Rearing of larvae.
4. Recovery of cocoons.
5. Reeling of cocoons.

1. Collection of Eggs:

Ripe cocoons are selected for mating and production of eggs. The cocoon meant for raising adult moths are collected, threaded together and hung from roof to within a foot of the ground. Earlier examinations are made to assess the health of the cocoon. Unhealthy or ill formed cocoons are rejected.



In the "seed station" can be observed many long strings of cocoon masses suspended on strings. Within the prescribed period the moths emerge and; they mate each other, (female moths can be identified by studying the external features). The mated females are collected in disinfected linen bags. The bags are hung on the ceiling with their mouths tied. Within a few hours the female moth lays her eggs inside the bag and dies.

This procedure carried out for large-scale production of eggs or seeds (commercial term). The eggs are collected and washed repeatedly in distilled water to remove dirt's excreta. The eggs are examined under the microscope at regular intervals for infections. It is estimated that the weight proportion of egg and silk fibre produced is in the ratio 1.250 i.e. to produce 250 lbs of silk. 1 lb of egg must be hatched and reared. The healthy and viable mass of eggs are collected and subjected for incubation.

2. Incubation of Eggs:

Eggs of the silk worms called silk-seeds are incubated to obtain the larvae. The eggs are subjected to incubation after assuring the availability of mulberry leaves. Normally incubation is resorted to when the mulberry buds are breaking into leaf.

Incubators are utilized to provide the optimum temperature and to regulate the hatching of the eggs. Further it helps in mass scale hatching of eggs simultaneously, which is highly economical. The eggs are spread evenly in a tray and placed inside the incubator set at 65 F. The temperature is then slowly by 1 or 2° daily. At 77°F the eggs hatch.

3. Rearing of Larvae:

Utmost clean lines and hygiene should be maintained while handling the larvae as they are easily vulnerable to infection. The incubator tray containing just hatched out larvae is taken and covered with perforated paper. Tender and finally cut pieces of mulberry leaves are placed over the paper.

The young larvae wriggle out through the pores on the paper and begin feeding on the leaves. Rearing is done in a special room or cabin and the temperature is maintained at 77°F. The larvae are transferred to large wire meshes covered with paper. Along with their increase in size the number of larvae in each tray is reduced to prevent overcrowding.

They feed voraciously and in 4 to 5 days their size double. The feeding phase (larval phase) lasts for about 40 days during which it passes through 4 periods of sleep alternating with 4

moulting stages. During each moulting the old skin of the larva is shed and a new one formed from beneath.

4. Production and Recovery of Cocoon:

The fully grown larva exhibits signs to indicate that it is about to begin spinning of cocoon. It lifts its front part of the body and moves it in a circular fashion. Close observation has to be maintained to notice this change. They are now transferred to spinning trays containing dry leaves, twigs and straws.

The caterpillar will release its silk secretion from the silk gland and be gains spinning the silk cocoon around itself. Here again, overcrowding must be prevented, otherwise silk threads of two nearby larvae may get entangled and spoil the fibre. In about 9-11 days the spinning will be completed and the cocoons are collected. The cocoons may be preserved immediately after the spinning is over or else, the chrysalis (pupa) moulted inside may cut the exit hole on the cocoon, which spoils the silk fibre.

The cocoons are suffocated by using steam. They are collected over porous trays and placed over a cauldron containing boiling water. The steam will percolate through the pores of the tray and kill the chrysalis inside the cocoon. The treated cocoons can be stocked for weeks in dry places. The chrysalis dead inside will dry up.

5. Spinning of Cocoons:

This is the period when the caterpillar stops feeding and starts to secrete a pasty substance from the silk gland. In this condition worms should be picked up and transferred to the spinning trays and kept in a position of slope (slanting) to the sun for a short period. Within three days spinning is over and the cocoon is formed and this is the last phase of the rearing of silkworm.

Precautions:

1. Utmost cleanliness and hygiene has to be maintained during sericulture, especially while handling eggs and larvae which are easily prone to infection.

2. Incubation of eggs has many advantages that it helps in simultaneous hatching of eggs, and completion of larval growth, and simultaneous cocoon spinning by the larvae which are useful and economical to the cultivator.

3. Food resource or availability of plant leaves must be assured before beginning the larval rearing.

4. Overcrowding of larvae must be prevented.

5. During diapause and moulting the caterpillars should not be disturbed, which otherwise may lead to death of the worms,

6. The feed leaves should always be maintained moist.

7. Constant inspection of the eggs and larvae for any microbial infection should be carried out. Infected eggs and larvae are to be immediately removed from the culture rooms.

8. Only uncut and complete cocoon shall be used for reeling silk

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