

Silkworm, voltinism and biology of silkworm.

Silk has been under use by human beings for various purposes since ancient times. Pure silk is one of the finest and most beautiful natural fibres of the world and is said to be “the queen of fibres. One of the methods was the rearing of silkworms on large scale with great care in natural and controlled conditions. Different rearing techniques are applied in different parts of the world for large scale production of silk threads of fine quality. This is known as sericulture.

Types of Silk: Moths belonging to families Saturniidae and Bombycidae of order Lepidoptera and class Insecta produce silk of commerce. There are many species of silk-moth which can produce the silk of commerce, but only few have been exploited by man for the purpose. Mainly four types of silk have been recognised which are secreted by different species of silk worms.

(i) Mulberry Silk: This silk is supposed to be superior in quality to the other types due to its shining and creamy white colour. It is secreted by the caterpillar of *Bombyx mori* which feeds on mulberry leaves.

(ii) Tasar Silk: It is secreted by caterpillars of *Antheraea mylitta*, *A. paphia*, *A. royeli*, *A. pernyi*, *A. proyeri* etc. This silk is of coppery colour. They feed on the leaves of Arjun, Asan, Sal, Oak and various other secondary food plants.

(iii) Eri Silk: It is produced by caterpillars of *Attacus ricini* which feed on castor leaves. Its colour is also creamy white like mulberry silk, but is less shining than the latter.

(iv) Munga Silk: It is obtained from caterpillars of *Antheraea assama* which feeds on Som, Champa and Moyankuri.

Voltinism: Voltinism refers to the number of breeds raised per year. Voltinism is a genetically determined heritable character under **hormonal control**. Based on voltinism *B. mori* is divided into three type of races: univoltines, bivoltines, and poly or multi-voltines.

1. Univoltine races produce only one generation per year. The eggs laid remain in a diapausing (quiet) condition till the next spring. Larvae of univoltines are very sensitive to temperature and other environmental conditions. They are unsuitable for summer and autumn rearing by artificial breaking of egg diapause. The larval period is very long. All European races are Univoltines. The cocoons produced are commercially very superior.
2. Bivoltine races have two generations per year, the first generation adults developing from eggs hatched in spring lay non diapausing eggs. The second generation adults developing from these eggs lay eggs which remain in the dormant state till next spring. The larval duration is as long as univoltines. Larvae are robust and tolerate environmental fluctuations. They can be used for 'Summer and autumn rearing and three crops can be raised per year. The cocoons are commercially superior. Japanese and Chinese races have both uni and bivoltine varieties.

3. Multi or polyvoltines have more than three generations per year. The larval duration is short, and larvae are resistant to high temperature and high humidity. Larvae and cocoons are small in size. Commercially cocoons are of poor quality. The adults lay non-diapausing eggs.

Life cycle of tasar silkmoth

They are bivoltine i.e.; two crops in a year, one from August-October and other from October-December. It is from August to December that the tasar insects are active and for the rest of the year they are inactive i.e.; under diapause. The active and inactive phases of life of tasar insects is controlled by environmental and hormonal factors.

Biology of Tasar silk moth

Systemic position

Phylum	:	Arthropoda
Class	:	Insecta
Order	:	Lepidoptera
Family	:	Saturniidae
Genus	:	Antheraea
Species	:	mylitta (Drury)

The adult :

The tasar insect is a very large moth exhibiting sexual dimorphism. The females are bigger with a wing-span of 18 cms. The wings are grey or yellow or light brown with patterns of red, with and black (brown) lines. Each wing has an eyespot or a circular ocellus in the centre. The male are smaller with brown wing and wing span of 16 cms. The males have a narrow abdomen with broad antennae when compared with the females.

The egg :

The egg is oval, dorsomventrally flat and bilaterally symmetrical along the anteroposterior axis. It is 3 mm long and 2.5 mm in diameter. Although the egg is pale white, it appears brown due to a gummy coating. Two brown parallel lines are present along the equatorial plane.

The larva (Caterpillar) :

The larva is cruciform or polypod type, with biting and chewing type mouth parts. It is dull brown-yellowish with black-head about 7 mm long weighing 8 mg. the body turns green in 2 days. It grows and undergoes four moults and the fifth instar larva is large 13 cms long and

weights 50 gms. Shining white lareral spots appear on 3rd instar larva. The thorax is three segmented and bears 3 pairs of walking legs, one pair per segment. The terminal segment bears a anal flap and a pair of claspers. The fifth instar larva spins a cocoon.

The cocoon :

The cocoon is single-shelled, yellow or grey pendent, oval, closed and reelable with a hard non-flossy grainy shell. At the anterior end there is a well formed dark brown penduncle with a ring. Female spins larger cocoon than the male. The larva transforms into the pupa inside the cocoon.

The Pupa :

The pupa is abtect, a dectious with well defined segmental body, the dark brown pupa measures about 4.5 X 2.3 cm and weight 10.3 gm.

Bombyx mori

Phylum	:	Arthropoda
Class	:	Insecta
Order	:	Lepidoptera
Family	:	Bombaycidae
Genus	:	<i>Bombyx</i>
Species	:	<i>mori</i>

Life history of mulberry silk worm, *Bombyx mori* (L) :

The adult of *Bombyx mori* is about 2.5 cm in length and pale creamy white in colour. The entire body is covered with scales. The males have longer antennae and narrow abdomen while the female has small antennae, large and flat abdomen and is less active than the male. Due to heavy body and feeble wings, flight is not possible by the moth. This moth is does not feed during its very short life period of 2-3 days.

Fertilization :

Fertilization is is internal preceded by copulation. Just after emergence male moth copulates with female for about 2-3 hours and if not separated they may die after few hours of copulating with female.

Egg laying :

Just after fertilization, female starts egg laying which is completed in 1-24 hours. One moth lays 400-500 eggs depending upon the climatic conditions and the supply of food material to the caterpillar from which the female moth is obtained. The egg is laid in form of clusters and covered with gelatinous secretion of the female moth which helps them in proper attachment.

Egg :

The eggs laid by the female moth are rounded and white in colour. The weight of the newly laid 2,000 eggs comes to about 1 gm. With the increase in time after laying. Eggs become darker. Two types of eggs are generally found viz., Diapause type and Non-Diapause type.

Hatching :

The eggs after ten days of incubation hatch into a larva called as caterpillar. Hatching is the most important phase of silk moth life. After hatching caterpillars need continuous supply of food because they are voracious feeders. If proper supply of mulberry leaf is not possible the development of caterpillar would not be in a proper course. Sometimes, due to lack of food material, young caterpillars die causing great loss to the sericulture industry.

Caterpillar :

The newly hatched caterpillar is about $\frac{1}{8}$ th of an inch in length and is pale, yellowish-white in colour. The caterpillars are provided with well developed mandibulate biting and chewing type of mouth-parts adapted to feed easily on the mulberry leaves. The caterpillar is twelve segmented and the abdominal region has ten segments having five pairs of pseudo-legs. It is also provided with a small dorsal horn on very soft leaves of mulberry plants. As they are voracious feeders, they grow rapidly which is marked by four moultings. After 1st, 2nd, 3rd and 4th moulting caterpillars get changed into 2nd, 3rd, and 4th, 5th instars respectively. It takes about 21 to 25 days after hatching. The full grown caterpillar is 7.5 cm in length. It develops salivary glands, stops feeding and undergoes pupation. The time taken for the full growth of the caterpillar from young to the well grown stage varies with regard to the temperature, humidity, food supply and type of race. The weight of the full grown caterpillar varies from 4 to 6 gm.

Pupa :

The caterpillars stop feeding and move towards corner among the leaves and secrete a sticky fluid through silk gland. The secreted fluid comes out through spinneret (a narrow pore situated on the hypopharynx) and takes the form of long fine thread of silk which hardens on exposure to the air and wrapped around the body of the caterpillar in the form of covering called as Cocoon.

Cocoon :

Cocoon is the white coloured bed of the pupa whose outer threads are irregular while the inner threads are regular. The length of continuous thread secreted by a pupa for the formation of cocoon is about 1000-1200 metres which requires 3 days to complete. The thread is wound around the cocoon in concentric manner. The binding of threads round the cocoon is

achieved by the constant round motion of the head of the pupa from one side to the other at the rate of 65 times per minute. The weight of one cocoon is about 1.8 to 2.2 gm and the weight of the cocoon shell only is 0.45 gm. The size of the thread is 2.0 to 2.8 denier. The pupal period lasts for 10 to 12 days and the pupae cut the cocoon and emerge into adult moths.

Emergence of imago :

Due to active metamorphic changes during pupation period the abdominal pseudo-legs disappear and two pairs of wings develop. The silk worm within the cocoon secretes an alkaline fluid to moisten its one end. The moistened end becomes soft where the threads are cut open by the silk.