Eduved
International Journal of Interdisciplinary Research
ISSN 2348-6775 (Online)
2349-5480 (Print)

STUDY OF SOME IMPORTANT EXTERNAL MORPHOLOGICAL CHARACTERS OF SILKWORM *BOMBYX MORI*

Geeta Saxena	**Department of Zoology, R.B.S. College, Agra**
R.K. Verma	**Department of Zoology, R.B.S. College, Agra**
H.N. Sharma	**Department of Zoology, SLS, Khandari campus, Agra**

ABSTRACT

India produces about 25,000 tons of cocoon. Besides mulberru cocoon, she harvests tassar cocoons, eri cocoons and muga cocoons. The production of mulberry silk is 1600 tons. 90% of silk worm varieties are polyvoltine. But at present the mulberry silk production is suffering on account of low production. However the Indian sericulture industry has taken good stride during recent years, but intensive research is essential on basic problem for further improving the quality of mulberry silkworm. It is mandatory to explore the external morphological characteristics of silk worm.

INTRODUCTION

Indian sericulture in the past has been characterized by either poor cocoon crop yield or even total loss on certain occasions until 1970, the average yield of coons for 100 disease free laying, comprising roughly about 4000 eggs was of the order 20-25Kgs as against 60-65Kgs in temperate regions like Japan, Korea, USSR etc. Further, one out of every three or four crops used to result in total loss for the sericulturists and analysis of the poor cocoon crop result in India indicated low value for the two important components that go to make the yield, namely the member of coons harvested per laying and the average weight of the cocoon. It can go still higher, if the number of cocoon harvested from a laying could be stepped up further beyond 75%.

Thus the key to bumper cocoon harvest lies the skill of management of silk worm rearing aimed at achieving higher value for the above two components namely, increasing number of cocoon from laying and higher cocoon weight. Dr. Krishnaswamy 1978 initiated serious research to tackle this important problem at Central Sericultural station Berhampore and later at Central Sericulture Research & Training institute Mysore. Based on the result achieved, the Ist paper 'Some aspects of improved' technique of rearing of mulberry silkworm was published in 'Indian Silk' in 1971. This improved technique has been since popularized on a large scale during the lost years in South India. As a result, it has been possible for the sericulturists adopting the new technique to step up the average yield from the earlier level of 20-25Kgs to 30-40kgs.

Although, to a large extent, the new technique has been fairly under stood and practiced by a good number of sericultureists today, need still exists to educate them further and also other who are

ISSN 2348-6775 (Online)
2349-5480 (Print)

yet to take to it, so that the average crop yield could be further improved. With this object in 1978 paper on "New Technology of Silkworm Rearing: is being published by Dr. Krishnaswamy as 'Bulletin No.2' of Central Sericultureal Research and Training Institute, Mysore. These recommendation as given in the paper when followed systematically will ensure optimal cocoon yield practically in all seasons. The insect producing mulberry silk is a domesticated variety of silkworm which has been exploited for over 4000 years. All the strains reared at present belong to the species *Bombyx mori* which is believed to have been derived from the original Mandarina silkworm, namely *Bombyx mandarin moore*.

The mulberry silkworm may be further classified and identified as of Japanese, Chinese, European or Indian origin based on geographical distribution or as univoltine, bivoltine and multivoltine depending upon the number of generation produced in a year under natural conditions or as trimolters, tetramoulters and pentamolters according to the member of moult during larval growth of finally even as a pure strain and as hybrid which may be either monohybrid when two strain are involved or polyhybrid when more than two strains are involved in the hybrid. ***Bombyx mori*** produce cocoon with continuous silk filament and therefore can be industrially reeled to produce silk. Silk worms belong to the class Insecta, Phylum Arthropoda, which comprise by for the largest number of animals in the world. The insects are characterized by the division of body into three distinct divisions namely head, thorax and abdomen. They are segmented in their body structure, a typical insect having six segments in the head, three in the thorax and eleven in the abdomen. They may or may not carry jointed appendages and also one or tow pairs of membranous wings. The class insect is divided into two sub classes namely Apterygota and Pterygota. The order Lepidoptera included all the insects known as moths and butterflies, including the silkworm moth. The different kinds of silkworms fall under the super family Drapenoidea according Essig.

MATERIALS AND METHODS

The mulberry silkworm for the morphological investigation are collected during the month of July, August and September from Sericulture Station at Artoni, Agra district. After careful collection the silkworm are reared in ordinary breeding cages in laboratory conditions. Fresh foliages of mulberry are provided from the mulberry plantation collected from near the side of Bichpuri Canal, Agra. The mulberry silkworm are killed by chloroform vapours or benzene fumes and then preserved in formalin in different stages.

For the study of morphology both preserved and fresh specimens are used. Dissection of the larvae are made under high power binocular microscope, with the help of microscalpel and microneedles. Few specimens are fixed in different fixatives. The fixative used are:

a) Bovin's fluid
b) Alcoholic Bovin;s fluid
c) Zenkar's fluid

After keeping in fixative for twenty four hours, they are washed the roughly through several changes of 70% alcohol with a few drops of glycerine. For the study of mouthparts, antennal, legs and genetalia, dissection are stained in two drops of Mann's methyl blue, Endrine for differentiation of these

ISSN 2348-6775 (Online)
2349-5480 (Print)

appendages, their muscles and delicate chitinous structure which could not be ordinarily be detected in KOH preparation. Morphometric of different parts taken by microscopic scale.

RESULTS AND DISCUSSION

Morphological studies

Silkworm belongs to class *Insecta* and phylum *Arthropoda*, which is the largest phylum of the world. The class *Insecta* is divided into two sub classes namely *Apterygota* and *Pterygota*. Silkworm is a pterygota insect. The pterygotes are further divided into division and orders. The silkworm belongs to division *Endopterygota* and Order *Lepidoptera*. The silkworm included under the super family *Drapenoidea Faber*. Which are characterized by the following distinguished features (According Essig). Hind wings with Sc+R connected with cell by one cross vein or bar. Cu_2 absent from all wings, frenulum rudimentary or absent, proboscis refaced or absent, maxillary palp absent. Larvae apparently smooth or warty and with fine secondary hairs often mixed with scabs, some with tough tip hairs. Adult medium size to large moths. This superfamily includes family Bobbycidae which produce natural silk and the family Bombycidae is characterized by the following characters: Frenulum absent or if present not exceeding the front basal angle of the wing; proboscis absent; antennae bipectinate in both sexes. Medium sized robust densely hairy or scaly moths. Larvae smooth with anal horn, and pupate in thick silkon cocoon (Silk moth, Silk worm).

Classification: (According to Essig)

Class	-	Insecta
Subclass	-	Pterygota
Section	-	Endopterygota (Holometabola)
Order	-	Lepidoptera
Sub-order	-	Frenatae
Division	-	Heteroneura Filli yard
Super family	-	Thyatiridae (Bomby ciclae)
Genus	-	*Bombyx*
Species	-	*mori*

External morphology (Plate I, Plate II)

A newly hatched silkworm larvae is black or dark brown. The body of larva is divisible into: head, throax and abdomen. The entire body is covered with a thin and elastic chitinous cuticle which is capable of being extended considerably to permit rapid growth of the larva during any instar. The body of the larva consists of thirteen segments (strictly speaking fourteen segments) and has three pairs of thoracic legs, four pairs of abdominal legs, a pair of cavdal legs, a head at the anterior end of the body and a caudol horn near the posterior end of the body. On both the lateral sides of the body are present nine pairs of spiracles – one pair in the first thoracic and one pair each in the first eight abdominal segments.

ISSN 2348-6775 (Online)
2349-5480 (Print)

Skin (Plate III)

The skin of larvae is made up of two layers i.e. cuticle and hypodermis. Cuticle comprises of two layers upper one called the primary cuticle and the one lying immediately below it as the secondary cuticle. Both the cuticles – Primary and Secondary are made up of chitin. Primary cuticle is covered with a thin wax layer, modules being distributed over the parts and various kinds of markings are found. The pigment consisting the markings is included in the primary cuticle and hypodermis but not in the secondary cuticle. The hypodermis layer lies under the cuticle. The cells in this layer are full of minute granules of uric acid and putamen pigment and therefore the cuticle looks opaque. The body color of the larvae depend upon the amount of these granules, existence of pigments and the colour of the tissues under the skin. The chitinous tissues are distributed not only in the skin of the body surface, but also from the oral cavity, anus and in the surface of the head and in the tentorium. There are several trichogenous cells on some places of the hypodermis. The trichogenous cell is a big one and has a bristle on it. The external surface of the bristle is the same tissue as that of the primary cuticle, being different from the secondary cuticle

Head (Plate IV and V)

The head of the larvae is a small, sclerotized capsule joined to the thorax by a flexible membranous neck. The sclerotized head capsule is open behind and below. Its ventral margin functions as the articulating surface for the mouth parts. The sclerotic wall serves not only to protect the internal organs of the head, but it also gives attachment to the muscles of the mouth parts and the pharynx. The sutures visible on the head do not indicate the segmental limits but only the lines of apodemal inflections. The epicranial suture typically in the form of an inverted Y which is an important characteristic feature of immature insect larva.

The areas demarcated by the different sutures of the head are:

(1) The fronto-clypeal (2) the parietal (3) the occipital (4) the postoccipital (5) the subenol

The fronto-clypeal area lies between the frontal sutures and the base of labrum. The epistomal suture divides it into frons and a clypius. The parietals bound the side of the head and are enclosed by a frontal suture in front and the occipital suture behind. The parietal area bears the antenna, the lateral ocelus and the compound eye. The two parietals forms dorsally the vertex of the head. The gena is the lateral part of the parietal area, beneath the compound eye. The narrow marginal areas, below the subgenal sutures on the sides is the subgenal area that bears the gnathal appendages. The pleurostoma is the part of the subgenal area that is above the mandible and the hypostoma behind. The labrum is typically a broad, flat lobe, movably attached to the anterior margin of the clypius. The head is thus continuously sclerotized in front, above behind and at the sides so as to form a head capsule or craium. Ventrally the head is extended by the mouth parts with the labrum forming the upper lip anteriorly, mandible and maxilla laterally and the labium the lower lip posteriorly. These appendages enclose a cavity the preoral cavity with the mouth on its upper end. Behind the mouth is the hypopharyx, the proximal membranous part of which is continuous with the pharynx. The lower ends of proocciput fuse and extends towards to form a median ventral plate the gula, which may be a continuous sclerotization with the labium.

ISSN 2348-6775 (Online)
2349-5480 (Print)

Optic organs

Six ocelli are located on the gena, on either side right and left. Five ocelli are arranged in a line and one of them is located at the foot of antennae while the other some what behind. The ocelus consists of an outer portion called the cornea which is derived from the skin and is in the form so a convex lens being transparent. The skin surroundings the ocellus has blackish brown pigment in circular form. Three corneaqgan cells are present just under the cornea cells adjacent to cornea, are transparent and colourless. But other parts of the cells have plentiful of pigment and accordingly these cells are called pigment cells. Inside the corneagen cells, three crystal bodies are found which are transparent. Retina is also found within the corneagen cells. It consists of three cells which comprises of plentiful pigment. The ends of retina cells unite with each other, forming a transparent membrane covering crystalline bodies. This part is called vitreous body. But some times the transparent and colourless part of corneagen cells (pigment/cells) is Also called viterous body.

Antenna (Plate VI)

Antenna exists on both sides (right and left) of the mouth parts making a pair and consisting of four segments. The antenna consists of a basal scape, a petical and a flagellum. The scape is inserted into a membranous region of the head wall and pivoted on a single marginal point, the antennaria (antinnifer), so it is free to move in all directions. The surface area of the pectinate antenna of a male *Bombyx mori* is 29.0mm^2 (Schneider, 1964). The partial significance of this is probably to permit the presence of more sensilla. Sensory hairs are present on a short terminal sensory projection.

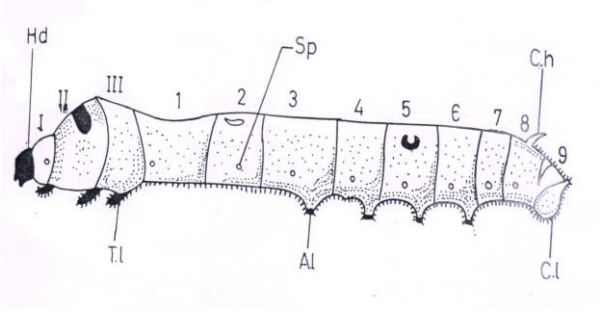
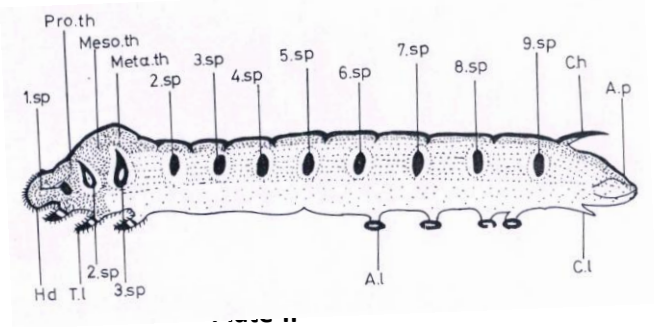


Plate-I



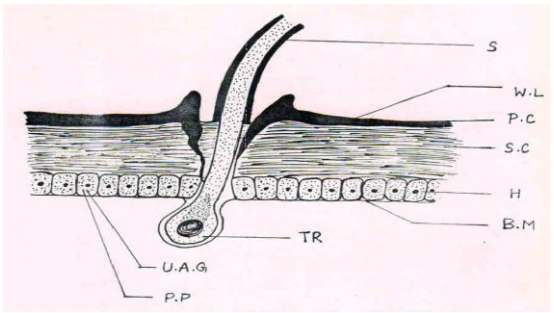


Plate-III

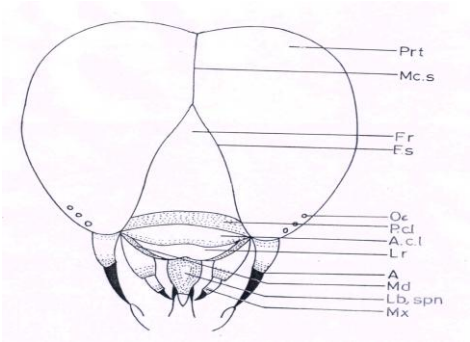


Plate-IV

ISSN 2348-6775 (Online)
2349-5480 (Print)

Crampton (1921) has observed the nature of this suture but neither he nor any other succeeding worker attached any importance to it. However, De Porte for the first time, not only recognized its importance but also clearly pointed out that the so called epicranial suture is not a suture, but the line along which the head cuticle of all the immature insects splits at ecdysis and consequently termed it as the ecdysial suture or line. In the silkworm *Bombyx mori* larvae, there is no sign of the ventral ecdysial line, it seems logical to term the so called ecdysial cleavage line as the epicranial suture as pointed in the present work. Piley (1923) in his account of embryonic development of the head of the *Bombyx mori* larvae has put forward that the 'Y' shaped epicranial suture. On the insect head is embryonic origin. The 'Y' shaped epicranial suture of the head, Piley claims, results from the dorsal closure between the protocephalon (pre-oral lobe) and the cephalic lobes.

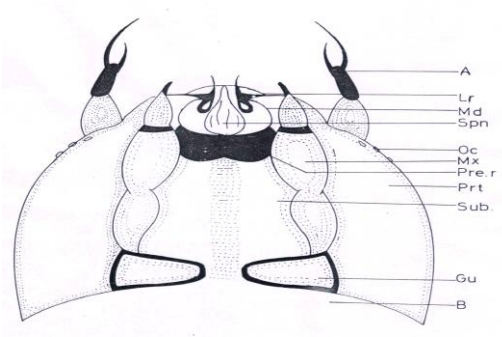


Plate-V

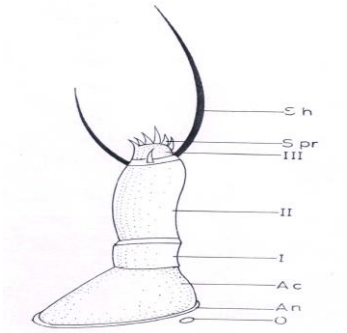


Plate-VI

REFERENCES

- Anonymous (1984). Silk in India – Statistical Biennial 1984 Central Silk Board Bangalore P. 101.
- Arora, Askari, Sami, Sharan, R.K. (1982). Studies on the effect of feeding leaves of varying maturity on the development stages of *Bombyx mori*. J. Adv. Zool. 3 (2): 90-94.
- Atwal, A.S., Verma, A.N. (1961). Rearing of more than one generation of univoltine silkworm. Curr. Sci. **30**: 435.
- Crampton, G.C. (1917). The nature of the Veric or Neck region in Insects. Ann. Ent. Amer, 10.
- Du Porte, E.M. (1946). Observations on the morphology of face in insects. Jour morphol. 79 (3): 371-403.
- Giordana, Barbara, Francsa V. Sacchi and Ciorgio, M. Honozet (1982). Intestinal amino acid absorption in lepidopteran larvae. (Philosamia Cynthia and *Bombyx mori*). Biochem. Biphys. Acta **692**(1): 81-88.
- Horie, Y. and K. Watanabe (1969). Energy requirements by larvae of the silkworm *Bombyx mori* L. reared on mulberry leaves and artificial diet. J. Seric. Sci. Jpn. **38**: 377-385.
- Imms, A.D. (1934). A General Text book of Entomology. Methuen & Co. London.