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RESEARCH ARTICLE

Anatomy of the Mature Larva of *Athaliya proxima* Klug. (Mustard Sawfly)

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ABSTRACT

Athalia proxima Klug is the pest of cruciferi crop mustered (Brassica compestris) and radish (Raphanu sativus). The Athalia proxima Klug ***(****Mustard Sawfly****)*** *was collected and studies during October 2003 to February 2007 at Agra and Etawah. From the cruciferi field specially mustard and radish. For the study of anatomy of the mature larva. It is elongated, cylindrical and greenish black in colour with distinct segmentation and annulations. On removing the fat body, the alimentary canal with the glandular ducts of silk and salivary gland becomes clear. The malpighian tubules occupy the sides in the posterior region. Removal of the alimentary canal with the gland and malpighian tubules exposes the nervous system. In the thoracic region the nerve cord and the ganglia are more clear. The posterior most region of the body accommodates only the hind gut, the rest of the anatomical portions being absent in this region.*

Key words: *Mustard Sawfly, Anatomy, larvae*

INTRODUCTION

Mustard Sawfly *Athalia proxima Klug* (hymenoptera: Tenthredinidae) is the pest of cruciferi crop mustard (*Brassica compestris*) and radish (*Raphanu sativus*). Lefroy (1906) recorded the pest of Indian. While Lefroy and Ghost (1908), Bagawat (1967), Dillon (1966), Srivastva (1972), Tripathi (1963) and Verma (1991). Work out the Morphology, Anatomy and Biological detailed and feeding habits of the immature stage. *Athalia proxima Klug* is the important pest of the cruciferi vegetable causing heavy losses. *Athalia proxima Klug* has got only winter season activity, there being one or two (at the most three) generations during the cold weather and passing the reaming position of the year in reasting condition. This is in confirmation to Tripathi (1963).

METERIAL AND METHODS

Works out the life history of the vegetable pest under investigation the pest were collected from the various field groves around the Agra and Etawah, during infested and breeding season. *Athalia proxima Klug* (mustard sawfly) larvae collected during October to February from cruciferi crop mustard (*Brassica compestris*) and radish (*Raphanu sativus*) the insect was friested studied at room temperature in the laboratory of department of Agra College Agra and the later the result were cofermend by observation in the field under mature condition . Small potted host plants were kept in the muslin covered glass jars (8" x10" and 6" x 8") and a pair of insect were introduced in jars. The *Athalia proxima Klug* were feed on sugar solution kept along with potted host plant in the glass gars. Micro dissections were performed under a lens with a spot light for studying the anatomy of the mature larvae. As far as possible fresh specimen were used for dissection following the technique of Hagmann (1940), Panten (1948) For studying the nervous system only, specimen preserved in 80% alcohol were employed or the fresh specimen were dept in 90% for 24 hours before dissection.

RESULT AND DISCUTION

On first opening the mature larva of *Athalia proxima* K. from the dorsal side, the body cavity is seen flooded with fat body. The latter is represented in two forms. The upper layer is jelly like cloudy mass, light yellow in colour and looks like spherical granules bounded in a transparent covering (as the ovary of earthworm), while the deeper or inner layer is almost similar less granular but white in colour. On removing the fat body, the alimentary canal with the glandular ducts of silk and salivary gland becomes clear (Fig. 1). The malpighian tubules occupy the sides in the posterior region. This portion of the body is narrow hence the internal organs are crowded and remain in close vicinity. The malpighian tubules and the fine tracheae hold the various organs with one another. Removal of the alimentary canal with the gland and malpighian tubules exposes the nervous system. In the thoracic region the nerve cord and the ganglia are more clear. The posterior most region of the body accommodates only the hind gut, the rest of the anatomical portions being absent in this region.

A. DIGESTIVE SYSTEM:

The alimentary canal in the mature larva of *Athalia proxima* K. is comparatively simpler. It is represented as a straight tube of varying diameter running through the entire length of the larva (Fig. 1-B). The length of the alimentary canal is 1 of the body length in this larva. The alimentary canal is roughly differentiated into fore, mid and hind gut. It is white in unfed and dirty green in the wel-fed larvae.

(i) Foregut: The foregut is about 4.0mm. In length and constitute roughly 1/5 of the total length of the alimentary canal. Anteriorly it is bent down (vertical) as the larvae is hypognathous) and posteriorly it is horizontal. It extends up to the half of the second thoracic segment in the large. The fore gut can be distinguished into pharynx and oesophagus only. The mouth parts being of biting and chewing type, a temporary preoral cavity is formed when the larva is actually feeding.

(a) Pharynx: The pharynx starts as a narrow muscular tube from the posterior limits of the preoral cavity (Fig. 1-B, POC). It is white in muscle bands over sit. It is narrow anteriorly and a little wider posteriorly. The circumoesophageal commissure marks the termination of pharynx and initiation of oesophagus.

(b) Oesophagus: It is an elongated pear-shade structure (Fig. 1-A&B, OE). It is again narrow anteriorly and circular muscle bands can be indistinctly seen over it. No longitudinal bands are however present. Posteriorly the oesophagus joins the midgut. The joint is clearly marked by a deep constriction but there is not valvular arrangement inside. The external appearance of both the oesophagus and pharynx being widely different they are clearly marked from one another.

(ii) Midgut: The midgut is the largest (longest and the widest) part of the alimentary canal. It measures 10.5mm. By 2.3mm. in a mature wel-fed larva (Fig. 1-B, MG). It starts from the second thoracic segment and extends upto the seventh abdominal segment and is dirty greenish in colour.

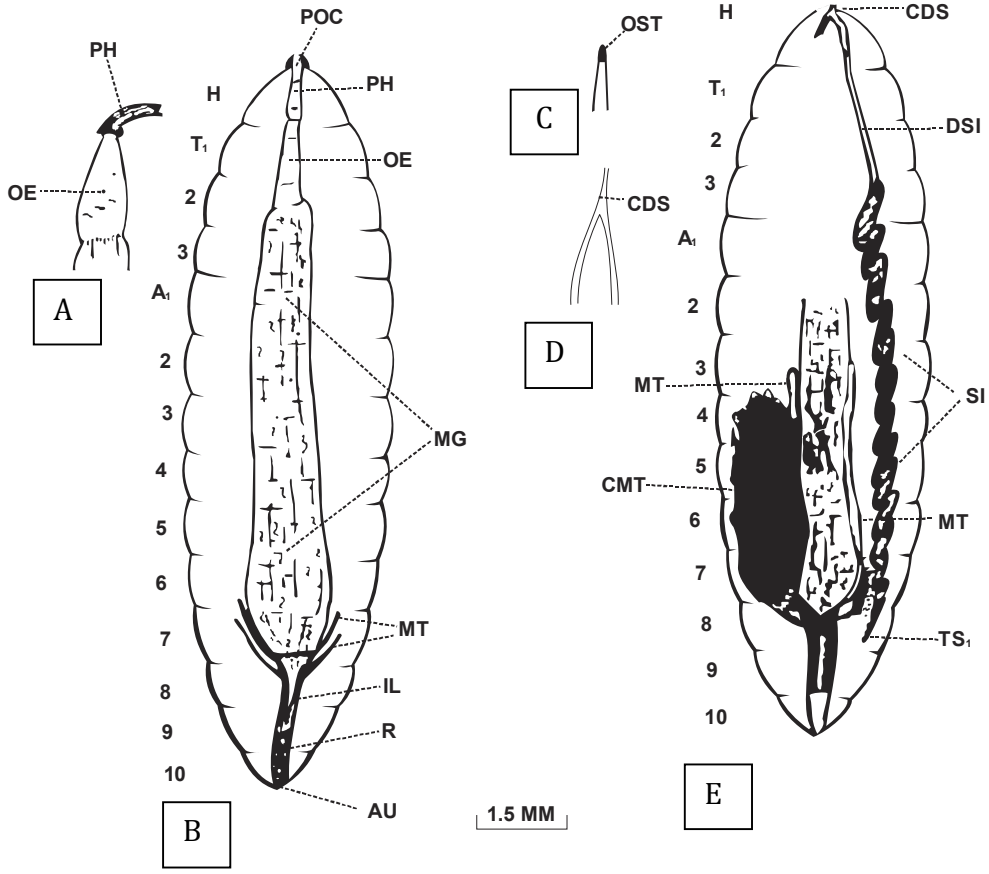
(iii) Hindgut: The joint of the mid and hindgut is marked by the origin of the malpighian tubules in the eighth abdominal segment. It is almost equal to the foregut in length but is a little wider. (Fig. 1-B). The hindgut is externally differentiated into two portions. The anterior portion, representing the ileum runs upto the ninth abdominal segment and is a thin walled bag-like chamber. The malphian tubules may be seen opposed to the wall till the next portion (Fig. 1-B, IL and R).

B. GLANDS:

Labial or salivary gland is only present in this larva. The author, however, could not get the trace of the mandibular gland.

(i) Silk gland: A pair of labial gland is present in the mature larva of *Athalia proxima* K. Symmetrically on either side of the alimentary canal. They start as delicate, thin whitish ducts in the cephalic region. In the thoracic region they widen till in the abdominal region, they become the thickest (2.2 mm. wide). The glands are highly convoluted and zig zag throughout their course. Although they glands are loosely placed but the surface is smooth and stretched (not wrinkled). The glands proper occupy most of the body cavity on either side from first to the eighth abdominal segment (Fig. 1, E, SI).

Fig. 1: Mature Larva of *Athaliya proxima* Klug.: A. Anterior Forgut, B. Digestive system, C. Terminal Portion of the Spinneret, D. Common Duct of the Silk Gland, E. Malpighian Tubules (Right) and the left Silk Gland

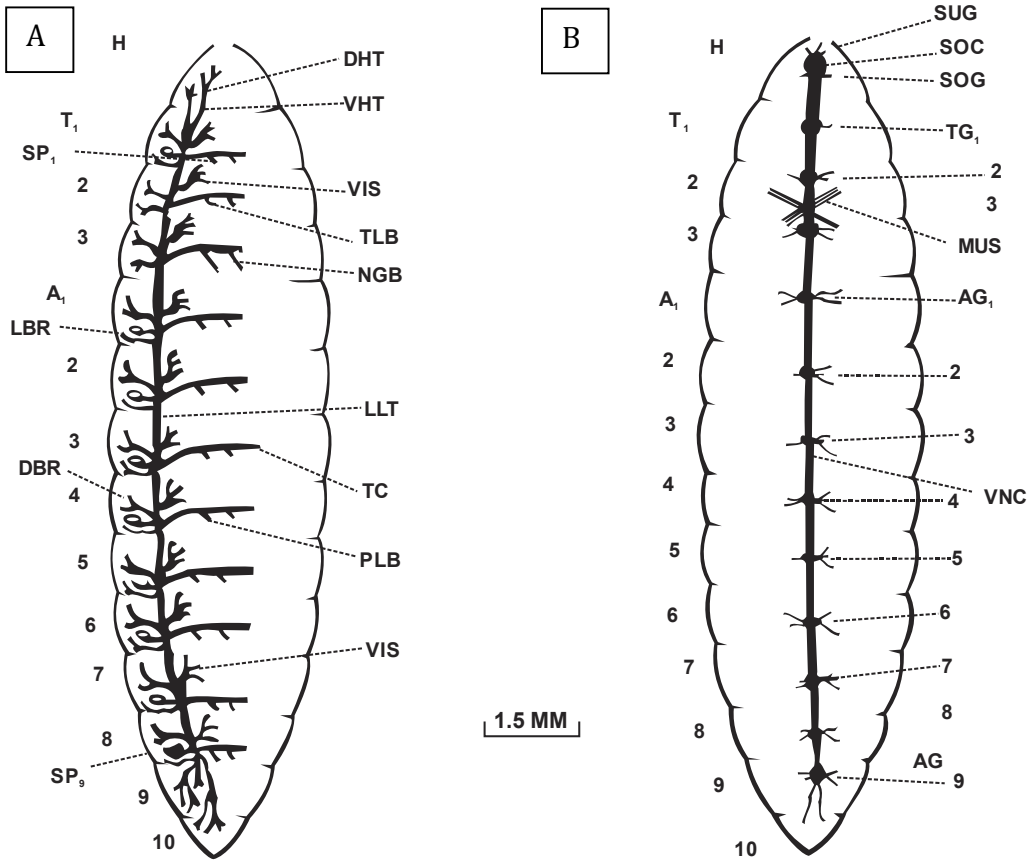


C. EXCRETORY SYSTEM:

The excretory system consist of two pairs of fine convoluted malpighian tubules emerging from the joint of mid and hind gut in the eighth abdominal segment. Anteriorly they run upto the third abdominal segment. The malpighian tubules have free ends, and do not form the cryptonephroidal system. The mid-gut narrows down posteriorly in the eighth abdominal segment abruptly and thereafter maintains a uniform diameter. This narrow joint marks the union of the mid and hind gut externally. At this joint the malpighian tubules take their origin in the eighth abdominal segment. The malpighian tubules take their origin symmetrically i.e. there is a dorso lateral pair and a ventrolateral pair (Fig. 1-B, MT). Immediately after their origin they take an independent path each. Unlike the Lepidoptera or hemiptera young, Snodgrass (1935), they lie free in the coelon. The

malpighian tubules travel up and remain studded with the fat body and the traches. They are not pressed against the wall of alimentary canal but remain suspended in the body cavity. The descending arms of the malpighian tubules are not regular at all, but are coiled and convoluted, interwoven along with the fat body, trachea and other organs. It is too difficult to isolate and straighten a single tube. They are uniform in thickness, about 0.3mm. in diameter and approximately 13cm. in length. The tubes end blind and separately within the crowd in the posterior region of the body (Fig. 1, E, CMT).

Fig. 2: Mature Larva of *Athaliya proxima* Klug.: A. Tracheal system B. Nervous System



D. RESPIRATORY SYSTEM:

The respiratory system in the mature larva of *Athalia proxima* K. is of typical peripneustic type Essig (1958). It consists of nine pairs of spiracles along with an elaborate system of minute tracheae to various organs (Fig. 2-A). The spiracles are present on the first thoracic and first eight abdominal segments, head being devoid of any. Each spiracle leads to a small spiracular trunk which in turn communicates with the lateral longitudinal structures and traverse the whole length of the body (from head to the last spiracle) and gives off segmental commissure in each segment (Fig. 2-A, TC). This gives a ladder like appearance to the main tracheation. In the various segments branches from the spiracular trunk, lateral longitudinal trunk or transverse commissure are given off that ramify over various organs to supply them (Fig. 2-A). The tracheation in this larva may be conveniently described under the following headings:

(i) Tracheation of the head (ii) Tracheation of the thorax (iii) Tracheation of the abdomen

(i) Tracheation of the head: In this larva there are no spiracles in the cephalic region. This is in confirmation to Snodgrass (1935). This region receives its entire tracheal supply from the thorax (through the extension of the lateral longitudinal trunk) (Fig. 2- A). The latter sends two cephalic branches entering the cranial cavity on either side viz. a dorsal head trunk and a ventral head trunk (Fig.2, DHT and VHT). Both are of almost same calibre but the former lies at a little upper level. Major portion of the had is tracheated by the dorsal head trunk. Soon after its entrance it sends a branch runs opposed to the brain and the commissure for some distance. Later it gives off three branches. The first is the ocellar branch supplying the ocelli and the second antennary branch supplying the antenna. A fine third branch was however also traced, supplying the dorsal aspect of the mouth parts. The Ventra head trunk supplies the lower lip and the musculature therein.

(ii) Tracheation of the thorax: There is a single thoracic spriracle on the prothorax. The lateral longitudinal trunk in the meso and metathorax produces nodule like swellings at the segmental pleural joint. Internally it looks like a spiracle present there but there is no trace of the same externally. From this junction, branches are given off to supply the various organs in respective segments. But for the absence of the spiracle the tracheal supply is almost identical in the three thoracic segments. Most prominent are the dorsal and the ventral branches in the thoracic region. Each thoracic segment regularly receives these two branches from the spiracular trunk or lateral longitudinal trunk (Fig. 2-A DBR & LBR). The dorsal branch gives an offshoot to ramify over the portion of alimentary canal and the main branch supplies the integument and the muscles. The ventral branch likewise ramifies at the ventral aspect of the segment. In the metathorax the transverse commissure sends two pairs of branchs the outer goes to the legs and the inner supplies the metathoracic ganglia. A stout visceral branch (Fig.2-A, VIS) also supplies the gut in each segment.

(iii) Tracheation of the abdomen: There are eight abdominal spiracles placed on the first eight abdominal segments. The last abdominal spiracle on the eighth segment is a little larger. The tracheation of the abdomen is more regular and the same plan is segmentally repeated except for few changes. Each spiracle bearing segment has a spiracular trunk, a portion of the lateral longitudinal trunk and a transverse commissure (Fig.2). In the abdominal segments the most prominent vessel is the visceral branch that remains profusely ramified over the portion of gut in that segment. It arises as a dorsolateral branch and becomes tufted soon (Fig.2-A, VIS). Like the thoracic segments there are dorsal and ventral branches here also, supplying the respective portion of the segment. The traverse commissure sends two pairs of branches in each segment. The outer supplies the pseudo legs and the inner supplies the segmental ganglia (Fig.2-A, PLB & NGB). In the posterior region the fine tracheoles are knotted and hold together the glands, malpighian tubules and the gut etc. At the last spiracle the lateral longitudinal trunk is a little extended and sends few branches on either side to supply the posterior extremity of the larva. In the last few segments neighter the arrangement is not too regular nor does the minute size allow detailed investigation.

E. NERVOUS SYSTEM:

In general the immature Hymenoptera have well developed nervous system except in the parasitic forms. The nervous system of the mature larva of *Athalia proxima* K. represents the basic plan of insectan nervous system except for minor modifications. It consists of typical brain or supraoesophageal ganglia, the suboesophageal ganglia and the ventral nerve cord with the thoracic and abdominal ganglia along with the segmental branches (Fig. 2-B). As usual the nervous system occupies a mid-ventral position (below the alimentary canal) embedded beneath the tissues here and there. The entire nervous system is exposed on removing the alimentary canal and the attached

trachea etc. The nerve cord in this larva is cloven and the two components appear as closely set longitudinal paired elements (Fig. 2-B).

(i) Innervation of the head: The brain (Fig. 2-B) is represented as a pair of white spherical mass of nervous material (comparatively larger in size), over the oesophagus, accommodated in the anterior cephalic cavity. In the head region separate optic peduncle or optic lobes are not developed as described by Snodgrass (1935) in typical insects. It is because of the absence of the compound eyes here. The supra-oesophageal ganglionic mass (Fig. 2,-B, SUG) are represented as large sub-spherical ganglia occupying an almost dorso-lateral position, giving out fine branches on either side. The oesophegeal commissures are thin and V-shaped, the gap being occupied by the oesophagus (Fig. 2,-B, SOC). The brain is anterior in position instead of being dorsal (as the larva is hypognathous). There are three pairs of minute nerves emerging from the supra oesophageal ganglia symmetrically from either side (Fig.2-B). (a) Optic nerve (b) Nervous antinnalis (c) Nervous laborfrontalis, also described by Snodgrass (1935). The first supplying the eye region, the second to the antenna and the third to the dorsal aspect of the head.

The sub-oesophageal ganglia is sub-triangular united mass, resembling the supra-oesophageal ganglia in colour and texture, the former being much smaller. The ganglia seem to be united but the nerve cord takes their origin separately and remain well apart. The nerves arising from this ganglion are not too prominent. Under a lens the author could mark only two branches (Fig. 2-B). The anterior is the more stout, mandibular branch, Snodgrass (1935), while the posterior is a thin and shorter branch supplying the ventral aspect of the cranial cavity (Fig.2-B).

(ii) Innervation of the thorax: There are three thoracic ganglia, one in each thoracic segment, mid ventral in position, with the nerve cord cloven well apart (Fig. 2-B, VNC). The thoracic ganglia are larger than the sub-oesophageal or abdominal ganglia. They are broadly triangular in shape pointing downwards. Near the ganglia the nerve cord come closer but are well apart in the middle. A striking peculiarity is observed in the thoracic region, that few of the muscle bands pass above the ventral nerve cord, there being two such sets (Fig. 2-B, MUS). This is prominent between the second and third thoracic ganglia. Muscle bands are X-shaped and about four rays pass over the nerve cord. Each thoracic ganglia gives off two pairs of branches in each segment that supply the various organs in the segment including the legs.

(iii) Innervation of the abdomen: In the abdominal region there are in all nine ganglia present, one each in the first nine abdominal segments. The last abdominal segment is devoid of the ganglia. The posterior ganglia are smaller than the anterior ones. The ninth abdominal ganglia (although the posterior most) is larger than the eighth abdominal ganglia (Fig. 2-B). The counterparts of the nerve cord are also seen much closer, they are widest apart in the anterior region only. The ventral nerve cord occupies a deep mid ventral position, but no muscle bands overlap the same as in the thoracic region. In each abdominal segment two pair of nerves is given off from the segmental ganglia, to supply the organs integument and musclature. (Fig.2-B). The first branch is similar to the branch of the typical segment while the second supplied the larval pseudolegs in the segments two to nine and from the ninth the second pair of nerves go to supply the last abdominal segment. The tenth or the terminal abdominal segment has no ganglia of its own hence receives the nerves from the preceding segment.

APPENDIX

For Fig. 1:

A_{1-10}	-	First to tenth abdominal segments
AU	-	Anus
CDS	-	Common silk duct
CMT	-	Coils of malpighian tubules

DSI - Duct of the silk gland
H - Head
IL - Ileum
MG - Midgut
MT - Malpighian tubules
OE - Oesophagus
OST - Opening of the spinneret
PH - Pharynx
POC - Preoral cavity
R - Rectum
SI - Silk gland
T_{1-3} - First, second and third thoracic segment
TSI - Terminal portion of silk gland

For Fig. 2:

A_{1-10} - First to tenth abdominal segment
AG_{1-9} - First to ninth abdominal ganglia
DBR - Dorsal branch
DHT - Dorsal head trunk
H - Head
LBR - Lateral branch
LLT - Lateral longitudinal trunk
MUS - Muscle bands
NGB - Branch to nerve ganglia
PLB - Proleg branch
SOC - Circum-oesophageal commissure
SOG - Suboesophageal ganglia
SP_{1-9} - First to ninth spiracle
SUG - Supra-oesophageal ganglia
T_{1-3} - First to third thoracic segment
TC - Transverse commissure
TG_{1-3} - First to third thoracic ganglia
TLB - Thoracic leg branch
VHT - Ventral head trunk
VIS - Visceral branch
VNC - Ventral nerve cord

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