Andhra Pradesh J Agril. Sci : 7(3): 151-161, 2021

STUDIES ON CHAETOTAXY OF LEPIDOPTERAN POD BORER COMPLEX IN FIELD BEAN

N. CHAMUNDESWARI*, N.C. VENKATESWARLU, M.S.V. CHALAM AND G. MOHAN NAIDU

Department of Entomology, S.V. Agricultural College, ANGRAU, Tirupati-517502.

Date of Receipt: 20-05-2021 Date of Acceptance: 15-07-2021

ABSTRACT

A study was carried out at the Department of Entomology, S.V. Agricultural College, Tirupati on the larval taxonomy of pod borer complex in field bean during *rabi* 2020-21. Four lepidopteran larvae *viz., Maruca vitrata* (Geyer)*, Spodoptera litura* (Fabricius)*, Lampides boeticus* (Linnaeus) and *Etiella zinckenella* (Treitscke) were collected from field bean crop and identified. All these lepidopteran larvae were identified and described based on the morphological characters and chaetotaxy of thoracic and abdominal segments, especially 3rd abdominal segment and arrangement of crochets on the ventral prolegs. The measurements *viz.,* total length and width of the larva, length and width of head capsule, width across the compound eyes, length and width of thorax as well as abdomen were taken.

KEYWORDS: chaetotaxy, crochets, field bean, pod borer.

INTRODUCTION

Field bean [*Lablab purpureus* (L.)] is an important pulse-cum-vegetable crop in India. It is cultivated for its tender and mature pods, seeds and fodder. The young and immature green pods are cooked as vegetable (Gowda, 2006). It has rich in nutritive value, the protein content of field bean varies from 20 to 28 per cent (Schaaffhausen, 1963). It is one of the oldest legume crops known to be cultivated in dry and semi-arid regions of Asia, Africa and America (Ayyangar and Nambiar, 1935). In India, it is popularly grown in South, East and North east parts of the country. In Andhra Pradesh, field bean is grown in an area of 12.02 thousand hectares with 139,320 tonnes of total production and 16.90 M.t ha^{-1} of total productivity (National Horticulture Board, 2019-20). The productivity of field bean is low as compared to cereals. One of the main reasons for the low yield of the crop is attack by many insect-pests at various stages of the crop (Krishna *et al*., 2019).The crop has been recorded to harbour a large number of insect-pests of which *Helicoverpa armigera* (Hubner), *Adisura atkinsoni* (Moore), *M. vitrata*, *E. zinckenella*, *Sphenarches caffer* (Zeller), *Exelastis atomosa* (Walshinghan), *Callosobruchus chinensis* (Linnaeus) and *L. boeticus* are noteworthy.

The knowledge on biology and accurate identification of a pest allows formulation of the management strategies effectively. Larval stages of these lepidopterous pests are economically significant as they are the damaging stage of the insect. The destructive larval stage poses considerable difficulties in their identification. The intensive studies on chaetotaxy of different lepidopterous larvae are necessary to formulate a comprehensive account on external morphological features and to provide standard identification features which will be helpful for easy identification of larvae to the researchers and the students.

MATERIAL AND METHODS

The lepidopteran larvae of pod borer complex were (third instar larvae) collected from the field during *rabi* 2020-21, taken to the laboratory and reared upto final instar on natural diet. Some of the larvae were reared for emergence of adults. The collected larvae were killed with K.A.A.D mixture (kerosene-1 part, 95% ethyl alcohol-7 parts, dioxan-1 part and glacial acetic acid-2 parts). The killed larvae were immersed in 10 per cent solution of potassium hydroxide for maceration overnight, washed in water and passed through different grades of alcohol *viz.,* 60, 80, 95 per cent consecutively for about 10-15 minutes to facilitate dehydration. The digested soft tissues were removed with the help of a pair of blunt needles and the specimens were transferred to clove oil for clearing. A 1:1 mixture of phenol + xylol was used to retain the specimens until the slides are prepared with Canada balsam permanently. The photographs of head capsule, thorax, abdominal segments, depicting the setal formula, crochets were taken with the help of photographic

*Corresponding author, E-mail: chamucharms7373@gmail.com

attachment in Olympus trinocular stereo zoom microscope. The measurements *viz.,* width and length of the head capsule, thorax as well as abdomen of the identified larvae were taken with an Olympus trinocular stereo zoom microscope.

RESULTS AND DISCUSSION

In the present study, four species of pod borers belonging to four genera of the order Lepidoptera *viz.,* spotted pod borer [*Maruca vitrata* (Geyer)], tobacco caterpillar [*Spodoptera litura* (Fabricius)], blue butterfly [*Lampides boeticus* (Linnaeus)] and pea pod borer [*Etiella zinckenella* (Trieitscke)] were collected, identified and described. The list of identified lepidopteran pod borer complex was given here under.

Description of Different Lepidopteran Larvae

A. Spotted Pod borer, *Maruca vitrata* (Geyer)

Family: Pyralidae Order: Lepidoptera

(Figure 1 and Plate 1)

Colouration and External Morphology: Larva is cream coloured with stout dark hairs distributed on dark brown warts of the body and hence commonly is called as spotted pod borer. The larvae were broad at the head region and tapering towards caudal end. Six rows of black spots were present on the dorsal side of the body.

Head: Head sclerotized and projected ventrad (hypognathous) with inverted "Y" shaped epicranial suture. Lateral ocelli were six in number adjacent to the base of mandibles. Antennae short, three segmented. Mandibles well developed and prominent. A distinct protruding spinneret present on the labium. Adfrontal area present and distinct.

Thorax: Thorax three segmented with three pairs of four segmented true legs. The fourth segment bears a single curved claw with a distinct arolium. One pair of spiracles present on prothorax at the junction of pro and mesothorax and another pair at the junction of meso and metathorax.

Chaetotaxy of prothorax and mesothorax

Prothorax: Prothorax bears sclerotized prothoracic shield which extends upto the ventral margin of SD2. Dorsal seta D2 is longer than dorsal seta D1. Anterior dorsal setae XD1 and XD2 are distinct. Subdorsal setae SD1 and SD2 are present. Lateral setae L1, L2 and L3 distinct and are present nearer to the spiracle. Subventral setae SV1 and SV2 present and SV1 is longer than SV2.

Mesothorax: Dorsal setae D1 and D2, Subdorsal setae SD1 and SD2 present and observable on respective pinaculi. Lateral setae L1, L2 and L3 are present. Subventral seta SV1 and ventral seta V1 are prominent.

Abdomen: Ten segmented. Abdominal legs fleshy, paired, non-segmented which are called prolegs exists on 3rd, 4th, 5th, 6th and on last segments. Eight pairs of spiracles present on 1st to 8th abdominal segments.

Chaetotaxy of 3rd abdominal segment: Dorsal setae D1 and D2 distinct. Subdorsal seta SD1 is long and present above the spiracle. Lateral setae L1 and L2 are prominent. Subventral seta SV1 is distinct.

Crochets: Crochets on abdominal prolegs are triordinal meso penellipse.

Adult: The moth is light pale brownish yellow and stout. The forewings are light brown with a white cross band The hind wings are white in colour with brown markings at the lateral edge.

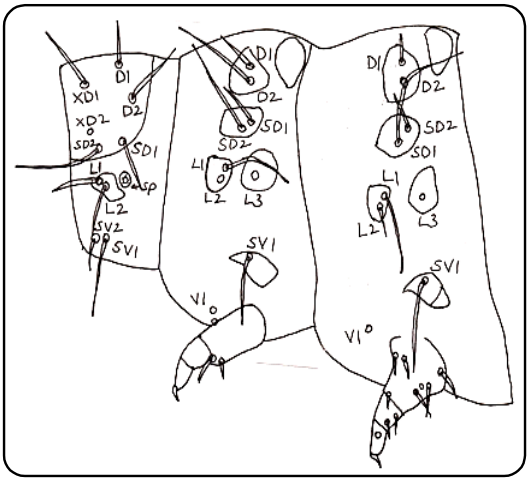
Measurements (average of 10 third instar larvae): Total length of the larva 13.76 mm, total width (maximum width) of the larva 2.11 mm, length of the head capsule 2.17 mm, width (maximum width) of the head capsule 1.87 mm, width across the compound eyes 1.56 mm, length of the thorax 5.62 mm, width (maximum width) of the thorax 1.96 mm, length of the abdomen 7.70 mm, width (maximum width) of the abdomen 2.11 mm.

B. Tobacco caterpillar, *Spodoptera litura* (Fabricius)

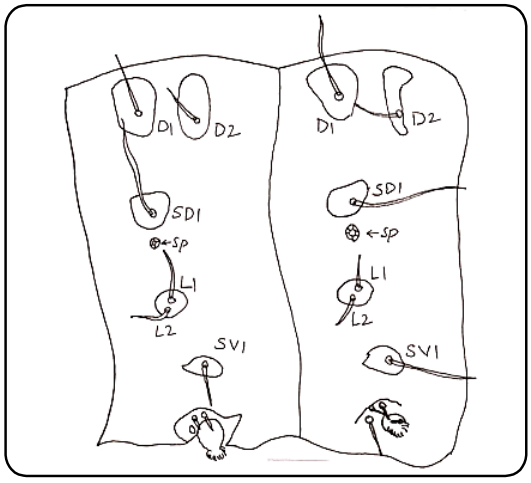
Family: Noctuidae Order: Lepidoptera

(Figure 2 and Plate 2)

Colouration and External Morphology: Caterpillar is stout, cylindrical and brownish with dorsal, subdorsal, sub spiracular and supra spiracular stripes of different colours. The general colour of the larvae is brown or sometimes greenish. Larvae often have a bright yellow or orange middorsal line, but also possess a less conspicuous subdorsal line marked by yellow or orange spots or dashes. The spiracular line often has a yellowish or orange-pink reticulate colouration with more intense orange or yellow accents.

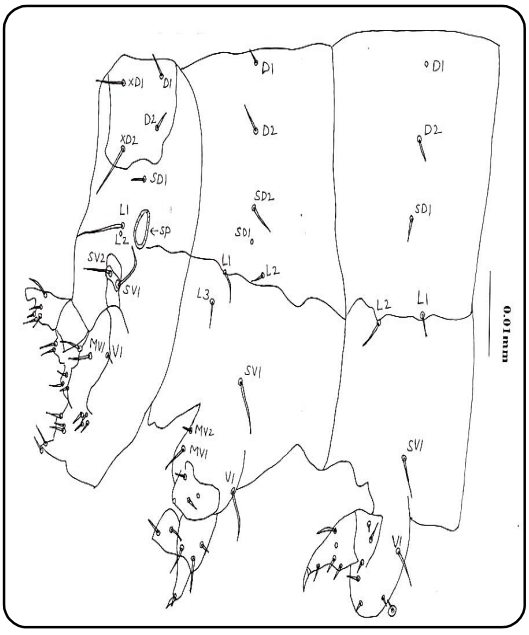


a. Thoracic segments

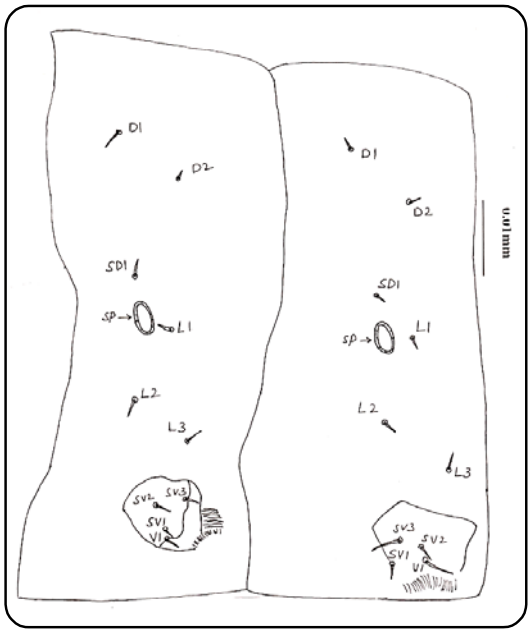


b. Abdominal segments

Figure 1. Chaetotaxy of *Maruca vitrata* (Geyer)



a. Thoracic segments

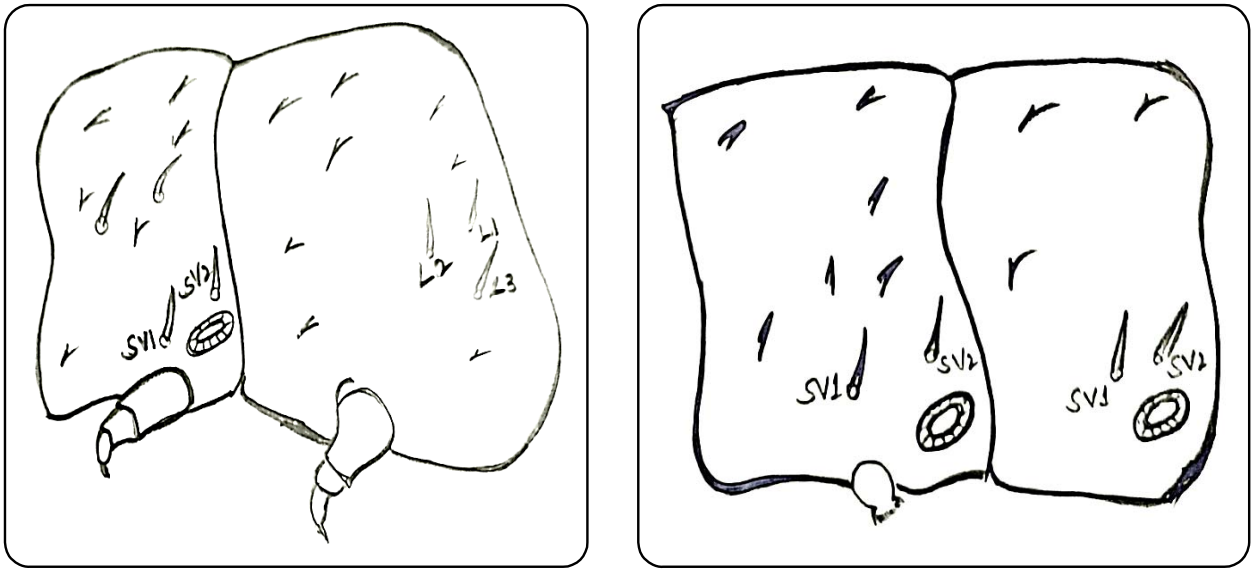


b. Abdominal segments

Figure 2. Chaetotaxy of *Spodoptera litura* (Fabrcius)

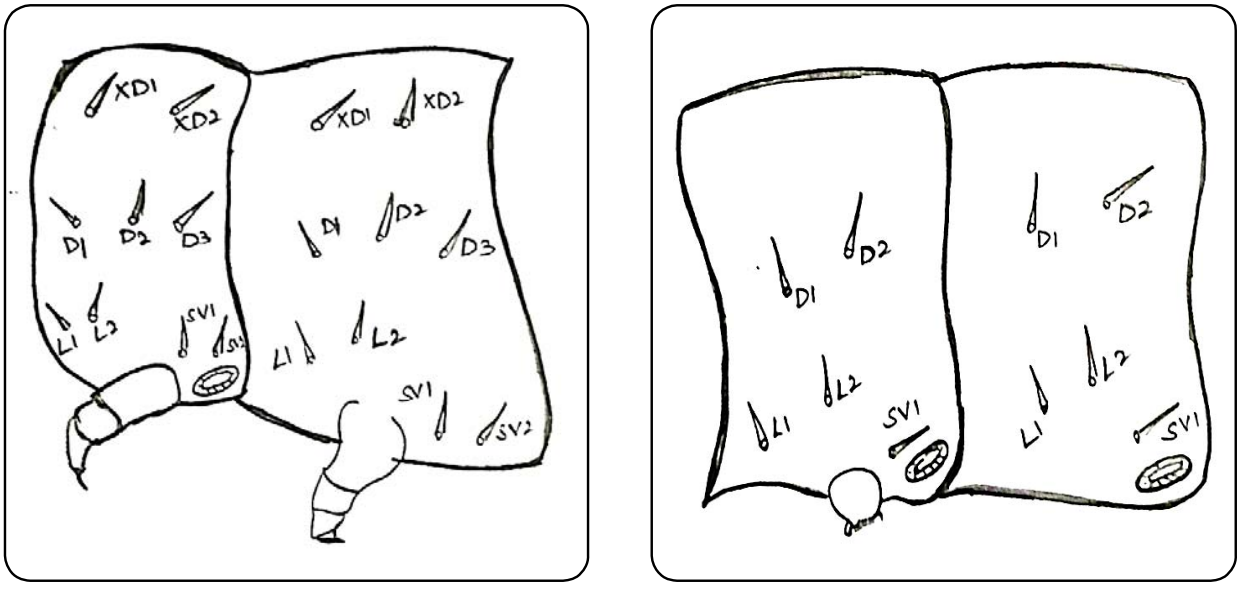
Head: The head is brown to black with a reticulate pattern on the lateral side. Head sclerotized and projected ventrad (hypognathous) with inverted "Y" shaped epicranial suture. Lateral ocelli six in number adjacent to the base of mandibles. Antennae short, three segmented. Mandibles well developed and prominent. A distinct protruding spinneret present on the labium. Adfrontal sclerites present, two in number and distinct. Adfrontal areas well developed.

Thorax: Thorax three segmented with three pairs of four segmented true legs. The fourth segment bears a single curved claw with a distinct arolium. One pair of spiracles present on prothorax at the junction of pro and mesothorax and another pair at the junction of meso and metathorax. Meso and metathoracic segments are often black with dorsal patches. The black patch on mesothoracic segment is comparatively larger; both the



a. Thoracic segments **b. Abdominal segments**

Figure 3. Chaetotaxy of *Lampides boeticus* (Linnaeus)



a. Thoracic segments **b. Abdominal segments**

Figure 4. Chaetotaxy of *Etiella zinckenella* (Treitscke)

patches, however, are smaller than the one on the first abdominal segment. Whitish or pale whitish middorsal stripe and two white dorsolateral stripes are present on prothoracic shield.

Chaetotaxy of prothorax and mesothorax

Prothorax: Prothoracic shield much chitinized, dark extended up to the margin of XD2. Anterior dorsal setae XD1 and XD2, dorsal setae D1 and D2 distinct and present on prothoracic shield. Lateral setae L1 and L2 are present. Subventral setae SV1 and SV2 distinct. Microscopic seta MV1 and ventral seta V1 present.

Mesothorax: Dorsal setae D1 and D2 and subdorsal setae SD1 and SD2 distinct. Lateral setae L1, L2 and L3 present. Subventral seta SV1, ventral seta V1 and microscopic setae MV1 and MV2 present.

a. Head capsule

b. Thoracic segments

c. Abdominal segments

d. Crochets

e. Larva

f. Adult

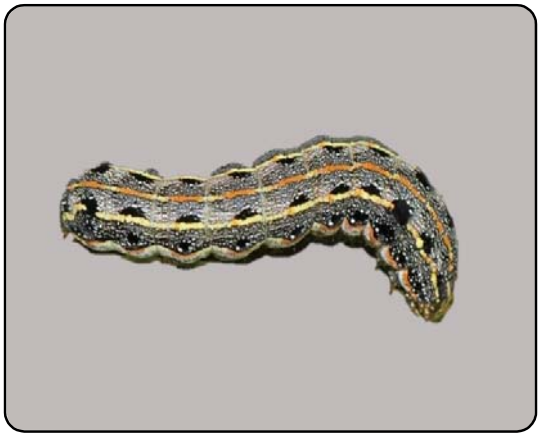
Plate 1. *Maruca vitrata* (Geyer)

a. Head capsule

b. Thoracic segments

c. Abdominal segments

d. Crochets



e. Larva

f. Adult

Plate 2. *Spodoptera litura* (Fabricius)

Abdomen: Ten segmented. Abdominal legs fleshy, paired non-segmented which are called prolegs exists on 3rd, 4th, 5th, 6th and on last segments. Dark patches are present on the dorsal side of abdominal segments 1 and 8. Eight pairs of spiracles present on 1st to 8th abdominal segments. There is a small white or light-coloured spot caudal to the spiracle on the abdominal segments.

Chaetotaxy of 3rd abdominal segment: Third abdominal segment is with dorsal setae D1 and D2. Subdorsal seta SD1 distinct. Lateral setae L1, L2 and L3 present below the spiracle. Subventral setae SV1, SV2 and SV3 and ventral seta V1 are present.

Crochets: Crochets on abdominal prolegs are uniordinal mesoseries.

Adult: The moth is stout, greyish brown in colour. The forewings are grey to reddish-brown with dark wavy white markings. The hindwings are greyish-white with grey margins, often with dark veins.

Measurements (average of 10 third instar larvae): Total length of the larva 33.42 mm, total width (maximum width) of the larva 5.47 mm, length of the head capsule 5.57 mm, width (maximum width) of the head capsule 4.14 mm, width across the compound eyes 3.21 mm, length of the thorax 11.02 mm, width (maximum width) of the thorax 5.21 mm, length of the abdomen 22.62 mm, width (maximum width) of the abdomen 5.47 mm.

C. Blue butterfly, *Lampides boeticus* (Linnaeus)

Family: Noctuidae Order: Lepidoptera

(Figure 3 and Plate 3)

Colouration and External Morphology: Larvae are slug-like caterpillars. The newly hatched larva is yellowish green in colour with faint reddish-brown bands mid-dorsally and laterally. The light green colour of the larvae changes into green colour in later instars. The dorsal line disappears at the final instar of the larvae. Fully grown larva is yellowish green to yellowish red sometimes light purple in colour, ventral surface is light green. Whole larvae are covered with small setae and are marked with irregular black markings.

Head: Head capsule is black in first instar whereas black to yellowish brown in final instar. Head sclerotized and projected ventrad (hypognathous) with inverted "Y" shaped epicranial suture. Lateral ocelli six in number adjacent to the base of mandibles. Antennae short, three segmented. Mandibles well developed and prominent. A distinct protruding spinneret present on the labium. Adfrontal area present and distinct.

Thorax: Thorax three segmented with three pairs of four segmented true legs and a prominent prothoracic shield. The fourth segment bears a single curved claw with a distinct arolium. One pair of spiracles present on prothorax at the junction of pro and mesothorax and another pair at the junction of meso and metathorax.

Chaetotaxy of prothorax and mesothorax

Prothorax: Prothoracic shield is sclerotized and is distinct. Definite setal position was not observed. Anterior dorsal setae absent. Subdorsal setae SD1 and SD2 present. Lateral setae indistinct. Subventral setae SV1 and SV2 present near the spiracles and distinct.

Mesothorax: Numerous small microscopic subdorsal setae are present. Lateral setae L1, L2 and L3 are present.

Abdomen: Ten segmented. Abdominal legs fleshy, paired non-segmented which are called prolegs exists on 3rd, 4th, 5th, 6th and on last segments. Eight pairs of spiracles present on 1st to 8th abdominal segments.

Chaetotaxy of 3rd abdominal segment: Dorasl and subdorsal setae indistinct. Subventral setae SV1, SV2 are present. Numerous small microscopic subdorsal setae are present.

Crochets: Crochets on abdominal prolegs are uniordinal uniseries.

Adult: The moth is violet metallic blue to dusky blue with a small thin hair like projection (tail) on each hind wing. Prominent black spots were found near the tail of the hind wings at posterior side.

Measurements (average of 10 third instar larvae): Total length of the larva 15.32 mm, total width (maximum width) of the larva 6.67 mm, length of the head capsule 1.34, width (maximum width) of the head capsule 1.43 mm, width across the compound eyes 1.24 mm, length of the thorax 5.54 mm, width (maximum width) of the thorax 6.41 mm, length of the abdomen 9.38 mm, width (maximum width) of the abdomen 6.67 mm.

D. Pea pod borer, *Etiella zinckenella* (Treitscke)

Family: Pyralidae Order: Lepidoptera

(Figure 4 and Plate 4)

Colouration and External Morphology: Dorsal surface of the mature larva is reddish pink, while the pleural and ventral surfaces of the body are pale-green or creamy-white.

Head: Head sclerotized and projected ventrad (hypognathous) with inverted "Y" shaped epicranial suture. Lateral ocelli six in number adjacent to the base of mandibles. Antennae short, three segmented. Mandibles well developed and prominent. A distinct protruding spinneret present on the disto-meson of the labium.

Thorax: Thorax three segmented with three pairs of four segmented true legs. The fourth segment bears a single curved claw. One pair of spiracles present on prothorax at the junction of pro and mesothorax and another pair at the junction of meso and metathorax.

Chaetotaxy of prothorax and mesothorax

Prothorax: Prothoracic shield is sclerotized and is distinct. Dorsal setae XD1 and XD2, dorsal setae D1, D2 and D3 are present and distinct. Lateral setae L1 and L2 present. Subventral setae SV1 and SV2 present.

Mesothorax: Dorsal setae XD1 and XD2, dorsal setae D1, D2 and D3 are present and distinct. Lateral setae L1 and L2 present. Subventral setae SV1 and SV2 present.

Abdomen: Ten segmented. Abdominal legs fleshy, paired non-segmented which are called prolegs exists on 3rd, 4th, 5th, 6th and on last segments. Eight pairs of spiracles present on 1st to 8th abdominal segments.

Chaetotaxy of 3rd abdominal segment: Dorsal setae D1 and D2 present. Lateral setae L1 and L2 are present. Subventral seta SV1 is present.

Crochets: Crochets on abdominal prolegs are biordinal uniseries.

Adult: Greyish brown moth, distinct pale-white band along the coastal margin of the forewings, hind wings are semi-transparent and with a dark marginal line.

Measurements (average of 10 third instar larvae): Total length of the larva 12.95 mm, total width (maximum width) of the larva 3.39 mm, length of the head capsule 1.62 mm, width (maximum width) of the head capsule 1.87 mm, width across the compound eyes 1.66 mm, length of the thorax 2.95 mm, width (maximum width) of the thorax 2.76 mm, length of the abdomen 9.14 mm, width (maximum width) of the abdomen 3.39 mm.

Dionisio (1987)studied the immature stages and chaetotaxy of the anal plate and position of the setae L1 and L2 in the superfamilies Gelechioidea, and Pyraloidea of order Lepidoptera. Bustillo and Gomez (1986) provided identification, coloured photographs of eggs and larvae of last instar of the family Noctuidae. Chakravorty and Mandal (1989) studied the morphology of three jute eating Lepidopterous larvae viz., Diacrisia obliqua (Walker) (Arctiidae), Spodoptera exigua (Hubner) (Noctuidae) and Anomis sabulifera Guenee (Noctuidae). They differentiated the three final instar caterpillars based on thoracic and abdominal chaetotaxy.

Gupta (1991) published a key for the separation of 50 Lepidopterous pests on rice in India. The key is based on morphological characters like shape and structure of antennae, chaetotaxy, external colour patterns and venation of fore and hind wings of adults. Sidhu and Rose (2004) described chaetotaxy of first instar caterpillars of the families Lycaenidae and Papilionoidea of Lepidoptera. They studied the cephalic, thoracic and abdominal chaetotaxy in detail. They described cephalic chaetotaxy; prothoracic shield, XD group of setae, dorsal group of setae, sub dorsal setae, lateral group of setae, sub ventral group of setae and ventral group of setae in thoracic chaetotaxy.

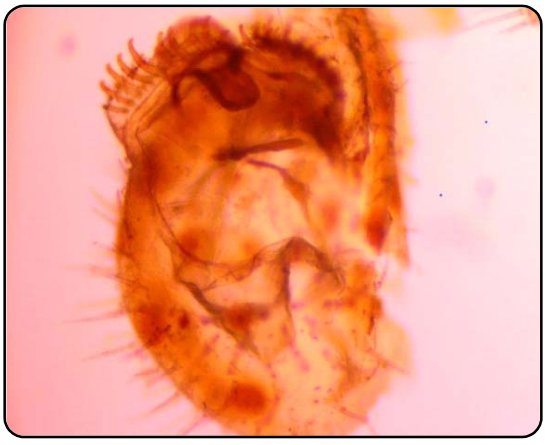
Venugopal (2005) studied ten lepidopteran larvae of rice and sugarcane crops. All these larvae were described based on different characters like colour, armature on the body, chaetotaxy of prothorax, mesothorax and 3rd abdominal segment, arrangement of crochets on abdominal and anal prolegs. An identification key for distinguishing all these lepidopteran larvae was prepared and is supplemented with the line diagrams and colour photographs for easy identification of these larvae.

Arunasri (2006) identified eighteen Lepidopteran larvae belonging to families, Noctuidae, Pyralidae, Nymphalidae, Lymantriidae, Arctiidae, Gelechiidae, Pterophoridae, Eupterotidae, Ctenuchidae (Syntomidae) and Yponomeutidae. All these Lepidopteran larvae were identified and described based on the morphological characters and chaetotaxy of thoracic and abdominal

a. Head capsule

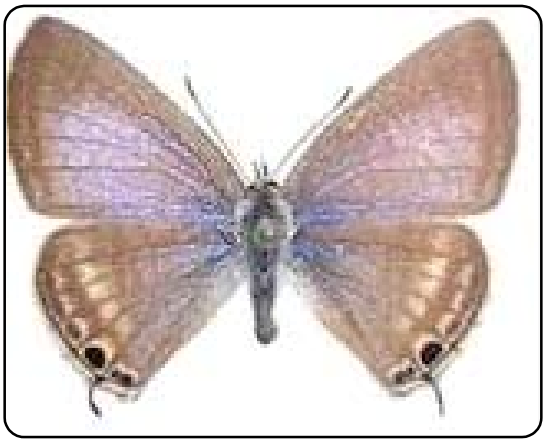
b. Thoracic segments

c. Abdominal segments



d. Crochets

e. Larva

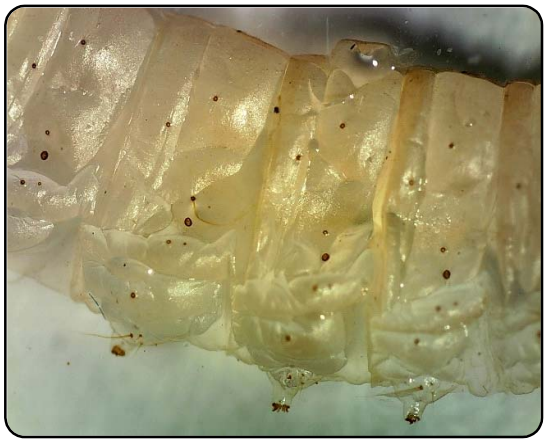


f. Adult

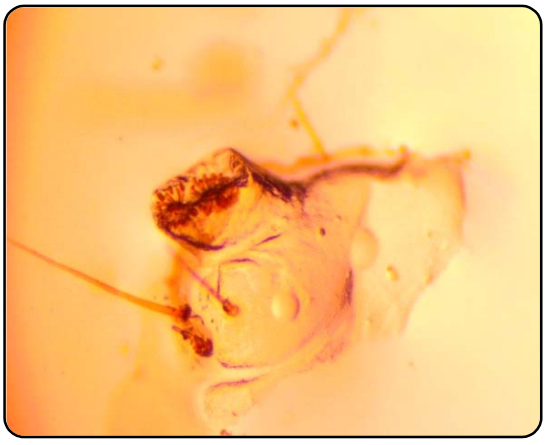
Plate 3. *Lampides boeticus* (Linnaeus)#

a. Head capsule

b. Thoracic segments

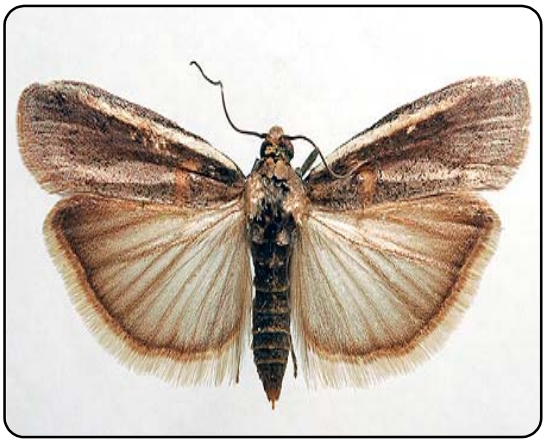


c. Abdominal segments



d. Crochets

e. Larva



f. Adult

Plate 4. *Etiella zinckenella* (Treitscke)

segments especially 3rd abdominal segment and arrangement of crochets on the ventral prolegs.

All these lepidopteran larvae *viz., M. vitrata, S. litura, L. boeticus, E. zinckenella* were identified and described based on the morphological characters and chaetotaxy of thoracic and abdominal segments, especially 3rd abdominal segment and arrangement of crochets on the ventral prolegs.

LITERATURE CITED

Arunasri, M. 2006. Taxonomic studies on the different Lepidopteran larvae of economic importance in Guntur District. *M.Sc. (Ag.) Thesis*, Acharya N.G. Ranga Agricultural University, Hyderabad.

Ayyangar, G.N.R and Nambiar, K.K.K. 1935. Studies in *Dolichos lablab* (Roxb) and (L.). The Indian field and garden bean. In: *The First Proceedings of Indian Academy of Science.* 1(12): 57-867.

Bustillo, G.M.R and Gomez, B.M.R. 1986. The immature stages of the Catocalinae of the Iberian – Balearic fauna (Lepidoptera : Noctuidae). *Boletin-de-la-Estacion-Central-de-Ecologia.* 15(29): 81-88.

Chakravorty, S and Mandal, P.K. 1989. Morphological identity of three jute leaf eating caterpillars. *Indian Journal of Entomology.* 51: 220-221.

Dionisio, M.H. 1987. Immature stages of Lepidoptera III. Chaetotaxy of the anal plate and position of the setae L1 and L2 in the last larval stage of Gelechioidea Stainton, 1854; Tortricoidea stephens, 1829 and Pyraloidea Leach, 1819. SHILAP- *Revista-de-Lepidopterologia.* 15: 49-51.

Gowda, B.M. 2006. Uses and chemical composition of Dolichos bean green pod. A report to the University of Agricultural Sciences, Bangalore, India, 8-10.

Gupta, S.L. 1991. Key for the identity of lepidopterous pests of rice in India. *Bulletin of Entomology.* 32(1-2): 56-65.

Krishna, H., Singh, A.K., Kumar, P and Kumar S. 2019. Management of pod borer complex in field pea using combinations of botanicals and insecticides. *Journal of Entomology and Zoology Studies.* 7(2): 1250-1252

National Horticulture Boards Statistics, 2019-20.

Schaaffhausen, R.V. 1963. Dolichos lablab or Hyacinth bean: Its uses for feed, food and soil improvement. *Economic Botany*. 17: 146-153.

Sidhu, A.K and Rose, H.S. 2004. Chaetotaxy of first instar caterpillar of world's smallest butterfly, *Freyria putli* (Kollar) (Lycaenidae: Papilionoidea: Lepidoptera). *Journal of Entomological Research*. 28(1): 55-61.

Venugopal, M. 2005. Taxonomic studies on the different Lepidopteran larvae infesting rice and sugarcane crops. *M. Sc. (Ag.) Thesis*, Acharya N.G. Ranga Agricultural University, Hyderabad.