

Studies on the Meliaceae shoot borer *Hypsipyla robusta* Moore^{1/}. I. External morphology and distinguishing characters of male and female pupae*

KRISHAN K. SHARMA**, PRATAP SINGH**

COMPENDIO

Se presentan la morfología externa de las pupas de *Hypsipyla robusta* y los caracteres distintivos de las pupas machos y hembras. Hay muchos caracteres sobre la base de los cuales se pueden distinguir estas pupas. Las más importantes son la presencia de una apertura parecida a una rendija sobre el ventro-meson del noveno segmento y un tubérculo distintamente elevado en cada lado de él en el macho, y una rendija mediana comparativamente corta, que casi toca el margen cefálico del octavo segmento y que bisecta el noveno segmento en la hembra.

Introduction

THE Meliaceae shoot borer *Hypsipyla robusta* is an important pest of Meliaceae shoot in the Old World tropics. Beeson (1) has studied its biology, life history and external morphology. During our investigations in connection with the bio-assay of the sex pheromone of the pest it was necessary to separate the pupae into male and female before the emergence of adults. Sexing of pupae was also required in controlling laboratory cultures of the insect. The authors have given a detailed description of external morphology and distinguishing characters of male and female pupae in the following pages. Thirty six male and 36 female pupae were examined for the purpose. Insects used in the study were collected from toon, *Toona ciliata* growing in New Forest. Terminology of Mosher (2) has been followed.

External Morphology

Shape and colour. Freshly formed pupa is bluish green in colour with light brown proleg scars, gradually changing into dark brown dorsally and yellowish brown ventrally. Shape elongate, cylindrical, rounded at cephalic end and bluntly tapering towards posterior end bearing 4 pairs of cremastral setae (Fig 1, a, b, c).

Head. Median head regions, i.e. vertex + front + clypeus, not separable, no epicranial suture; frontoclypeal suture extending mesad for a short distance (less than the length of the base of the antenna).

Clypeus (cl), intermediate sclerite between front and labrum, clypeal labor suture (lcs) indistinct, there are two slit-like invaginations for the anterior arms of the tentorium (at).

Labrum (lb), corrugated, distinct along its lateral and distal margins, subcordate, acutely angulate in middle of anterior border, clypeal suture indistinct.

Pilifers (pf), caudo-lateral projections of labrum very large, easily detected by corrugated lobes which are adjacent to the caudo-lateral angles of labrum and are distinct along its proximal, distal and lateral margins, meet on the meson-caudad of it.

Antennae (a), long, extending to the level of anterior margin of the 4th abdominal segment and separated by maxillae and 2nd and 3rd pair of legs.

Genae (g), laterad of front and clypeus and mesad of eye, not easily separable from eyes except in mature pupae.

Eyes (e), not easily separable from genae except in mature pupae; glazed eye piece lunate, sculptured eye piece smaller and triangular.

Labial palpi (lp), entirely concealed by maxillae except a small quadrilateral piece just caudad of pilifers.

Maxillae (mx), broad at base but rapidly narrowing posteriorly extending up to middle of 4th abdominal segment and not reaching up to caudal margin of wings.

Maxillary palpi (mxp), polygonal area, latered of eye pieces, lying along the cephalic margins of prothoracic and mesothoracic legs reaching up to the proximo-lateral angle of each maxilla.

Thorax. Segments of thorax are distinct only along its dorsal surface because ventral and lateral surfaces are entirely concealed by appendages and wings.

^{1/} Lepidoptera, Phycitidae.

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** Respectively, Research Scholar and Senior Research Officer, Disease Insect Survey Unit, Forest Research Institute and College, P. O. New Forest, (Dehra Dun), India

Pronotum (p), transverse, slightly concave along its anterior margin and sinuate along its posterior margin, median line carinate, lateral angles obtusely rounded.

Prothoracic legs (l_1), adjacent to the maxillae at the proximal end, thence diverging and exposing a narrow fusiform portion of its femur (fl_1), later rejoining the maxillae about half the length of the later.

Prothoracic spiracle (psp), located on dorsum between prothorax and mesothorax, sunk deep in the conjunctiva between the segments with an opening adjacent to the caudo-lateral angles of the prothorax, margins elevate, caudal margin transverse.

Mesonotum (ms), nearly thrice as long as pronotum, anterior border sinuate, posterior border deeply concave, median line carinate.

Mesothoracic legs (l_2), exposed for their whole length and extending to the caudal margin of wings.

Mesothoracic wings (w_1), visible on the ventral surface extending down to 4/5th of the 4th abdominal segment where they are conjointly rounded in a broad arc.

Metanotum (mt), smaller than the pronotum, anterior border deeply concave.

Metathoracic legs (l_3), femora, tibia and tarsi are not exposed for their entire length but are concealed by other appendages except their distal end.

Metathoracic wings (w_2), entirely concealed by mesothoracic wings except for a narrow strip along their dorsal surface, extending up to middle of 3rd abdominal segment.

Abdomen. Abdomen consists of 10 segments ($a_1 - a_{10}$), segments 1-3 and 7-10 are fixed and 4th, 5th and 6th movable in both sexes. A visible suture is present in between segments 9 and 10 dorsally but furrow not present (characteristic feature of sub-family Phycitinae) (2).

Proleg scars (pls), scars of 3rd and 4th abdominal prolegs of larvae visible on 5th and 6th segments of pupae on their ventral surface in the form of short pits connected by transverse interrupted strips.

Abdominal spiracles (abs), present in segments 2-8, 1st pair is covered by the wings, uniform elliptical, margins elevate, 8th linear margin not clear.

Genital openings (go) (Fig. 1, d_1 and d_2), in the male, the genital opening is situated on the ventro-meson of the 9th segment. It is slit-like opening and has a distinctly elevated tubercle on each side.

Female genital aperture is a single short median slit almost to the cephalic margin of the 8th abdominal segment. The caudal margin of the 8th segment is bisected by the genital opening which also divides the 9th segment into its entirety.

Cremaster (cr), not well developed, represented by 8 small rugosities at the apex of the 10th segment from which arise 8 cuphooked setae (cs); four close together in a row and at either end one slightly posterolateral and one more distant, anterolateral.

Setae. Inconspicuous (visible under microscope), minute and whitish. On the head three pairs; on the metathorax one pair, subdorsal; on 1-8 abdominal segments 2 pairs, near the cephalic margin, subdorsal, supra-spiracular; on segments 4-8 one pair subspiracular; on segments 5-8 one pair ventral; on segment 9 one pair subdorsal, one pair subspiracular.

Variation. In six pupae (out of first 36 pupae studied) tibia and tarsi of metathoracic legs are not visible because distal end of maxillae in these pupae is reaching up to distal margin of 4th abdominal segment and in four pupae distal end of maxillae reaching up to anterior margin of 4th abdominal segment; in two pupae distal end of antennae is reaching up to middle of 4th segment and in two pupae it is reaching up to anterior margin of 4th abdominal segment and in two pupae it is reaching up to distal margin of 4th segment. According to Beeson (1), in one case (within first hundred examined) the 2nd pair of legs extended to the anterior margin, an antennae to the middle of the 4th abdominal segment.

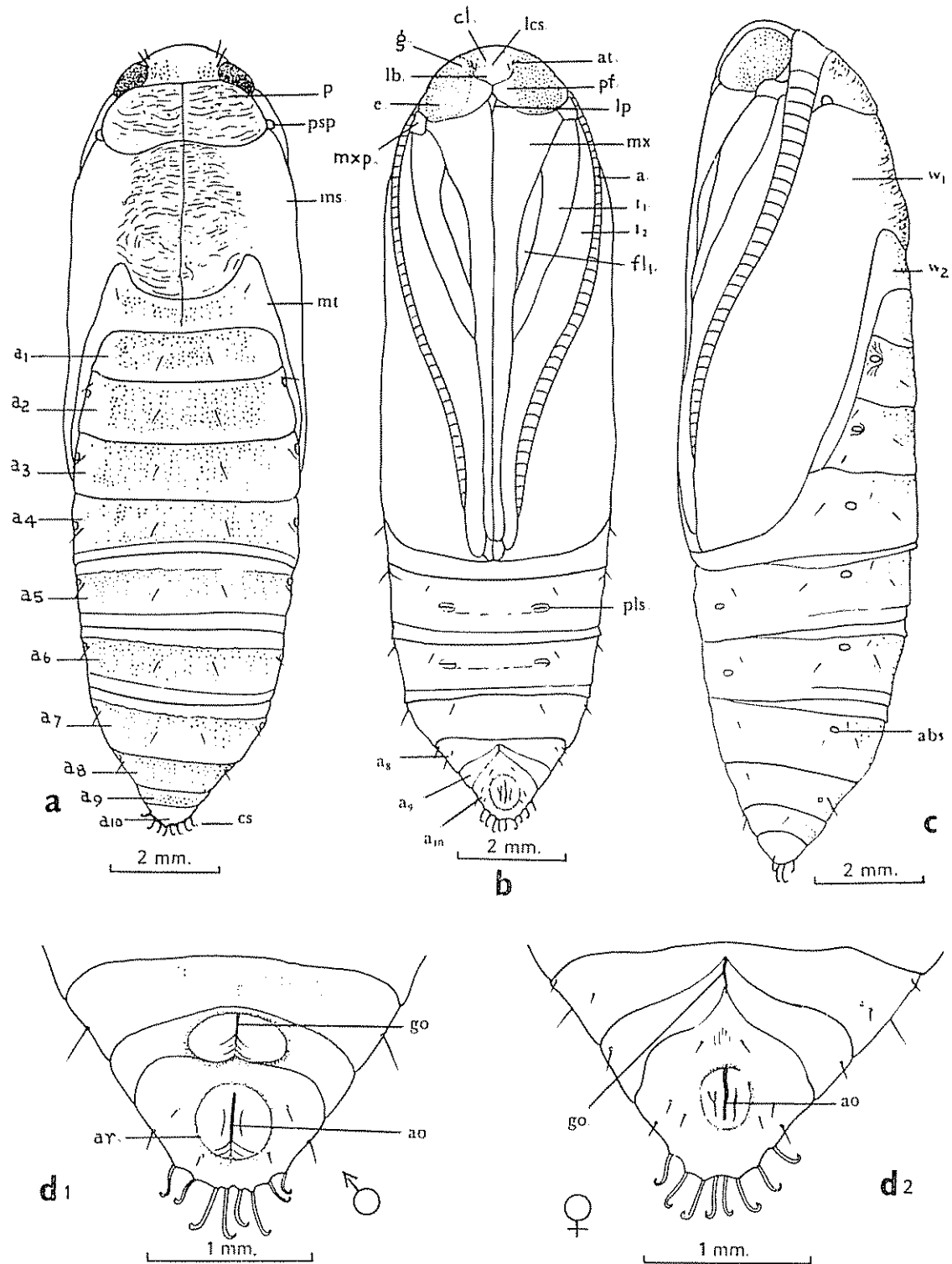
Measurements

Measurements of 30 male and 30 female pupae were taken. Average length, width and weight of pupae are given in Table I which shows that average

Table 1.—Mean S. E (standard error) values of length, width and weight of 30 male and 30 female pupae of the species.

Average length (mm)			Average width (mm)			Average weight (gm)		
Male	Female	Significance	Male	Female	Significance	Male	Female	Significance
13.92	14.41		4.56	4.75		0.101	0.125	
0.036 ± 0.033			± 0.007 ± 0.004			± 0.003 ± 0.004		
		***			***			***

*** Highly significant at 0.1% level.



PUPA OF HYPsipYLA ROBUSTA MOORE

Fig 1 — a Dorsal view; b Ventral view; c Lateral view; d₁ Segments 8-10 of male; d₂ Segments 8-10 of female

length, width and weight of female pupae is significantly higher than the average length, width and weight of male pupae.

Distinguishing characters of male and female pupae
(Fig. 1, d₁, d₂)

The male and female pupae have many characters (Table 2) on the basis of which they can be distinguished from one another. The most important distinguishing characters are shape and position of genital openings.

Sexing of *H. robusta* pupae may therefore be achieved by counting the number of tubercles on the terminal abdominal segments. These can be seen rapidly with low power of the microscope in the laboratory or with a X 10 power lens in the field. This method provided 100% accuracy in differentiating thousands of shoot borer pupae.

Table 2.—Distinguishing characters between male and female pupae.

Sl. No	Characters	Male	Female
1.	Size		
a.	Length	12.00 to 15.50 mm	13 to 17 mm
	Range	13.92 mm	14.41 mm
	Average		
b.	Width	4.00 to 5.5 mm	4 to 5 mm
	Range	4.5 mm	4.7 mm
	Average		
2.	Weight		
	Range	0.075 to 0.122 gm	0.094 to 0.178 gm
	Average	0.1013 gm	0.1253 gm
3.	Genital opening	on 9th abdominal segment ventrally	on 8th abdominal segment ventrally
i.	Shape of genital opening	Sinus impressed by elevations	slit like
5.	Caudal margin of (ventro-meson)		
a.	8th abdominal segment	not divided	divided
b.	9th abdominal segment	partially divided by genital opening	entirely divided by genital opening
6.	Rounded tubercles on each side of the genital opening	present	absent
7.	Rounded tubercles on each side of the anal opening	present	present

List of abbreviations

a	antenna
a ₁ -a ₁₀	abdominal segments 1-10
ao	anal opening
at	invaginations for the anterior arms of tentorium
cl	clypeus
cr	cremaster
cs	cremastral setae
e	eye
f	front
fl ₁	femur or prothoracic leg
g	gena
go	genital opening
l ₁	prothoracic leg
l ₂	mesothoracic leg
l ₃	labrum
lb	metathoracic leg
lcs	labro-cypeal suture
lp	labial palpi
ms	mesonotum
mt	metanotum
mx	maxilla
mxp	maxillary palpus
p	pronotum
pf	pilifers
pfs	proleg scars
w ₁	mesothoracic wings
w ₂	metathoracic wings

Summary

External morphology of pupae of *Hypsipyla robusta* and the distinguishing characters of male and female pupae are given. There are many characters on the basis of which these pupae can be distinguished from one another, the most important are the presence of slit like opening on the ventro-meson of 9th segment and distinctly elevated tubercle on each side of it in male and a comparatively short median slit, almost touching the cephalic margin of the 8th segment and bisecting the 9th segment in female.

Literature cited

1. BEESON, C. F. C. The life history of the toon shoot and fruit borer *Hypsipyla robusta* Moore (Lepidoptera: Pyralidae: Phycitinae) with suggestions for its control. *Indian Forest Records (Old Series). Entomological Series. 7: 146-216. 1919.*
2. MOSHER, E. A classification of the Lepidoptera based on characters of the pupae. *Bulletin of the Illinois State Laboratory of Natural History 12: 72-76. 1916.*