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First record and redescription of *Eurema hecabe simulata* M. (Lepidoptera: Pieridae) from Sanghar, Sindh, Pakistan

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Abstract

Eurema hecabe simulata Moore (1881) belongs to the genus *Eurema* Hübner (1819). The size of species is medium and commonly called “grass yellow”, because its body colour is yellow with outer border dark black. This species is re-described here on basis of external morphology, especially colouration of wings, structure of mouthparts, antennal structure, segments, thoracic segments, wing structure, veinations, leg structure, abdomen segments, internal male genitalia (uncus, tegumen, vinculum, saccus and valvae) and female genitalia (papillae analis, ductus bursae and corpus bursae). A general description of *Eurema hecabe simulata* M. is also given. This species of butterflies is a new record from district Sanghar, Sindh, Pakistan.

Keywords: First record, Redescription, *Eurema hecabe simulata* M., Sanghar, Sindh.

1. Introduction

Eurema Hübner (1819) belonging to family Pieridae (Rhopalocera: Lepidoptera) are small to medium sized butterflies with pale to yellow wings with black, mostly on the upper side of the wings. The underside of the wings is paler than the upperside, and marked with many black or brown markings. From Siam, five species of genus *Eurema* reported namely *E. hecabe hecabe*, *E. blanda davidsoni*, *E. lacteola lacteola*, *E. laeta* and *E. laeta pseudolaeta*. After E. J. Godfrey seven more species were included in this genus namely *E. sodalis* (Godfrey 1930), *E. andersoni* and *E. simulatrix inouei* (Shirôzu and Yata, 1973), *E. jordarni* (Pinratana, 1983) *E. andersoni jordani* (Yata, 1989) *E. nicevillei nicevillei* and *E. novapallida* (Yata, 1992) ^[1]. *E. hecabe simulata* M. commonly called “Grass Yellow” is distributed almost all over the Australian, Oriental, as well as Afro tropical biogeographic regions, and extends to the cool-temperate zone of the Eastern Palaearctic ^[2]. It was recently documented that *E. hecabe* consists of two sibling species called yellow type and brown type, which are unique in various biological and genetic traits. Yata reported that the clear identification of the species and subspecies of the genus is based on structure of male and female genitalia, because most of the species are morphologically similar ^[3]. The aim of present study was to illustrate the variations in the morphological characters, male and female genitalia of *E. hecabe simulata*. This study will be helpful to understand the species or subspecies of *E. hecabe* that is widely distributed throughout the world.

2. Materials and Methods

The specimens of *E. hecabe simulata* M. were collected from the Sanghar such as Sinjhor, Shahdadpur, Tando Adam and Khipro during September 2013. The specimens were sacrificed in killing jar, then stretched on the stretching board and kept in that position for 24 hours, after that preserved in the insect box. Terminology of external characters used of Talbot ^[4] and veinations nomenclature followed of Miller ^[5]. Dissection of genitalia was made by standard technique Kaminski ^[6]. The abdomens of the specimens were exised at the base and then boiled in 10% Potassium Hydroxide (KOH) for five minutes. Genital material was removed from the abdomen with the help of fine forceps, washed with tap water and observed under the dissecting microscope. Genital material was preserved in micro vial with a drop of Glycerin and pinned with a drop of Glycerin and pinned with specimen. Figures were drawn with the help of ocular micrograph on graph paper and then traced on tracing paper with the help of rotering pointers with size (0.5 and 0.2). Genitalic terminology of male

and female used that is given by Klotsk ^[7] and Winter ^[8].

3. Results

Eurema hecabe simulata (MOORE 1881) (Fig.1)

(The common Grass Yellow)

Terias simulate, Moore 1881: 119. *Terias aesiope*, Butler 1883: 150. *Terias hecabe*, Butler 1883: 150. *Terias asphodelus*, Butler 1883: 151. *Terias curiosa*, Swinhoe 1884: 508. *Terias suava*, Butler 1886: 371. *Terias swinhoei*, Butler 1886: 216. *Terias hecabe*, Moore 1906: 52. *Terias hecabe simulate*, Bingham 1907: 253. *Terias hecabe* f. *asphodelus*, Bingham 1907: 253. *Terias sari ab. Curiosus*, Bingham 1907: 256. *Terias hecabe swinhoei*, Fruhstorfer 1910: 167. *Eurema hecabe simulate* Talbot 1939: 530; Woodhouse 1949: 161; Roberts 2001: 64.

Colouration

Head black covered with yellow scales, eyes brown, antennae dark brown with white scales, palpi yellow, proboscis light brown; thorax, dorsal side black covered with sparse yellow hair and scales, ventral side black densely covered with yellow scales; legs yellow, fore wings yellow, black marking under side costa, apex, termen and tornus dark black, hind wings yellow black marking under side, apex and terminal margin dark black; abdomen, abdomen black covered with yellow scales.

Structure

Head: ♂♀ (Fig. 2)

Eyes globular in frontal view (Figs. 2A-B), width is greater than height, frons quadrangular shaped in frontal view, vertex triangular in dorsal view (Fig. 2C), antennae (Fig. 2D) clavate, dicarinate, apical part spoon shaped, 9 mm length, 30 flagellomeres in both sexes, with a basal carina from the 1st flagellomere and 2nd from the 18th flagellomere, pedicel ring shaped, maxillary palpi well developed covered with large hair, equal to the length of the compound eyes, second segment is three times larger than first and third segment, proboscis large and highly coiled.

Thorax: ♂♀ (Fig. 3)

Patagia bilateral in dorsal view (Figs. 3A-B), dorsally separated by anterior region of pronotum, pronotum delimited anteriorly by patagia, posteriorly by scutum II, scutum II broad dorsally, anteriorly narrow, catapisternum broad, meron II broad, scutellum II triangular, catapisternum III anteriorly narrow, posteriorly broad, meron III posteriorly pointed, eucoxa III anteriorly broad, posteriorly narrow.

Forewings (Fig. 3C). Costa highly arched, apex rounded, termen slightly sinuated, tornus angular, dorsum straight, discal cell closed, Sc (Subcosta) originated from the base of wings, reached up to half of the costal length; R1 (Radial) curved, started from the cell next to Sc, R2 straight, started from the cell, R3 and R4

anastomosing with M1, started from the upper angle of the cell, R3 ending at the apex of the cell, R4 ending on the terminal margin, M₁ began from upper angle of the cell, M₂ started from middle of the cell, M₃ began from lower angle of the discal cell, Cu₁ and Cu₂ began separately from discal cell for an unequal distance, A₂ arised from the axillary region, separately from the distal cell up to the tornus of the wing.

Hind Wings (Fig. 3D). Oval shaped, costa arched, apex round, termen slightly sinuated, dorsum straight, discal cell closed, more than half length of the wing; veins, Sc+ R1 (Subcosta +Radial) originated from the base of the wings, Rs (Radials) arched, started from the cell, reached up to apex, M₁ began from upper angle of the discal cell, M₂ originated from middle of the discal cell, M₃ originated from lower angle of the cell, Cu₁ parallel to Cu₂, two veins A₂ and A₃ arised from the axillary of the wing, A₂ ending at the tornus of wing, A₃ ending at dorsal margin.

Legs. The prothoracic coxa I elongated, wider at proximally and narrowing gradually at distally, femur I and tibia I elongated (Fig. 3E), similar lengths, tarsus I composed of five tarsomeres with spurs, tarsomere I three times larger than others, approximately similar lengths; the mesothoracic coxa II longitudinally divided in two parts, eucoxa II anterior and meron II posterior, femur II and tibia II elongated (Fig. 3F), tarsus II composed of five tarsomeres, first tarsomere two times larger than others, with spurs; the metathoracic coxa III similar to coxa II (Fig. 3G), femur III and tibia III equal in lengths, tarsus composed of five tarsomeres, tarsomere I and II equal in lengths, and larger than others, covered with sparsely spurs.

Abdomen ♂♀ (Fig. 4)

The pregenital segments tergum and sternum composed of sclerotised connected by pleura membrane, female abdomen wider dorsoventrally than male (Figs. 4A-B),

Female genitalia (Fig. 4C). Papillae anales small sub-rounded, apophysis posterior pointed smaller than anterior apophysis, anterior apophysis hair-like; ductus bursae tube-like, curved; corpus bursae bilobed, proximal lobe round with comb like cornuti, distal lobe balloon like, smaller than proximal lobe without cornuti.

Male genitalia (Figs. 4D-F) Uncus sclerotised, broad at base, gradually becoming slender to apex, slightly curved ventrally in lateral view, distal end pointed, tegumen smaller than uncus, dorsally broad; saccus long, sinuated in lateral view; valvae broad, outer side smooth with sparse setae, inner side, pointed harps present, costal margin straight up to first half, sinuated after apex, apex pointed, ventral margin convex, aedeagus long (Fig. 4F), broad at base, narrow distal end, curved ventrally conjuntival membrane present.

Table 1: Measurements of different body parts of *Eurema hecabe simulata* M.

Body parts of specimens	(Male ♂) Range (mm)	Mean (mm)	St. Dev. (mm)	(Female X) Range (mm)	Mean (mm)	St. Dev. (mm)
Length of head	(1.3-1.5)	1.4	±0.07	(1.3-1.5)	1.42	±0.08
Length of thorax	(4.0-4.2)	4.07	±0.08	(4.5-4.7)	4.57	±0.08
Length of abdomen	(8.0-8.2)	8.11	±0.07	(9.0-9.4)	9.23	±0.18
Total body length	(13.3-13.5)	13.41	±0.07	(14-14.5)	14.22	±0.19
Length of antenna	(8.8-9.0)	8.9	±0.08	(9.0-9.4)	9.13	±0.15
Span of fore wing	(17.5-18.0)	17.8	±0.15	(18.0-18.4)	18.24	±0.15
Span of hind wing	(15-15.5)	15.22	±0.10	(16.0-16.4)	16.1	±0.17

(Values represent mean and st.dev. of Ten Replicates)

Material examined

14♂ and 12♀, Sanghar, 20-27.ix.2013, collected by B. Mal. Deposited at Entomology laboratory, Department of Zoology, University of Sindh, Jamshoro, Pakistan.

4. Discussion

E. hecabe simulata (Moore 1881) is a medium sized butterfly; found flying close to the ground and in open grass and shrub habitats. It is very good pollinator, carrying pollen from flower to flower over long distance. This species was recorded from different localities of the Pakistan. Sajjad Burhan from Multan ^[9], Parveen and Ahmed from Kabal, Swat and Kohat (KPK) ^[10], Tayyab from Bahawalpur ^[11], Khan from Azad Kashmir ^[12], Zahoor from Faisalabad ^[13], T.J Roberts from different localities of Pakistan ^[14] and Abbas from Skardu region ^[15]. Previously, entomologists

documented this species from above mentioned localities and discussed about the biodiversity and abundance, without any detailed description. *E. hecabe simulata* M. has been first time recorded from the district Sanghar, Sindh, Pakistan. This study is significant in understanding the external morphology of *E. hecabe simulata* Moore. Many species of genus *Eurema* are similar in external morphology and it is thus very difficult for taxonomists to identify species or subspecies, possibly due to the lack of skilled scholars and difficulties in the observation of the sclerites and sutures, due to the scales. However, scanty reports are available on this subject. The main external morphological characters used for identification at the species level of the genus *Eurema* are head (mouthparts, antennae, maxillary palpi, palpi) thorax (thoracic segments, legs, wing veinations) and abdomen (abdomen segments, male genitalia, female genitalia).

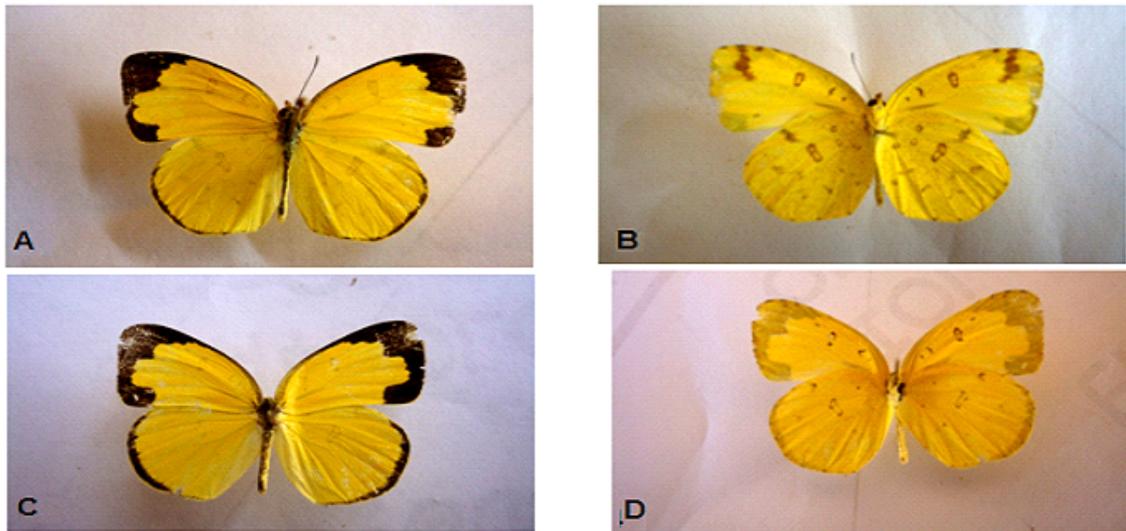


Fig 1: *Eurema hecabe simulata* Moore, A. Male dorsal side, B. Male ventral side, C. Female dorsal side, D. Female ventral side.

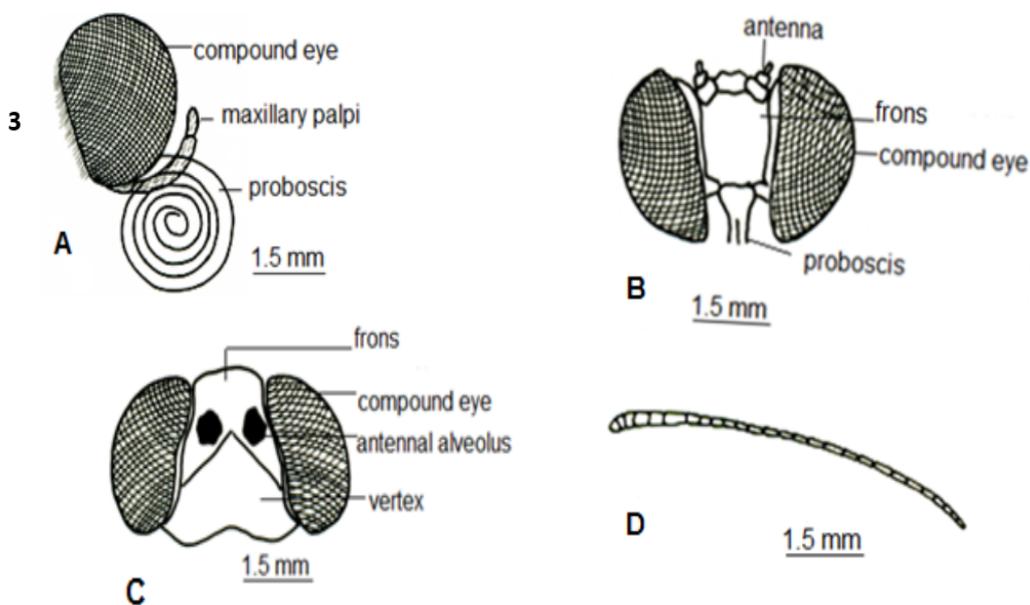


Fig 2: *Eurema hecabe simulata* Moore, Head: A. Lateral view, B. Frontal view, C. dorsal view, D. Antenna (dorsal view).

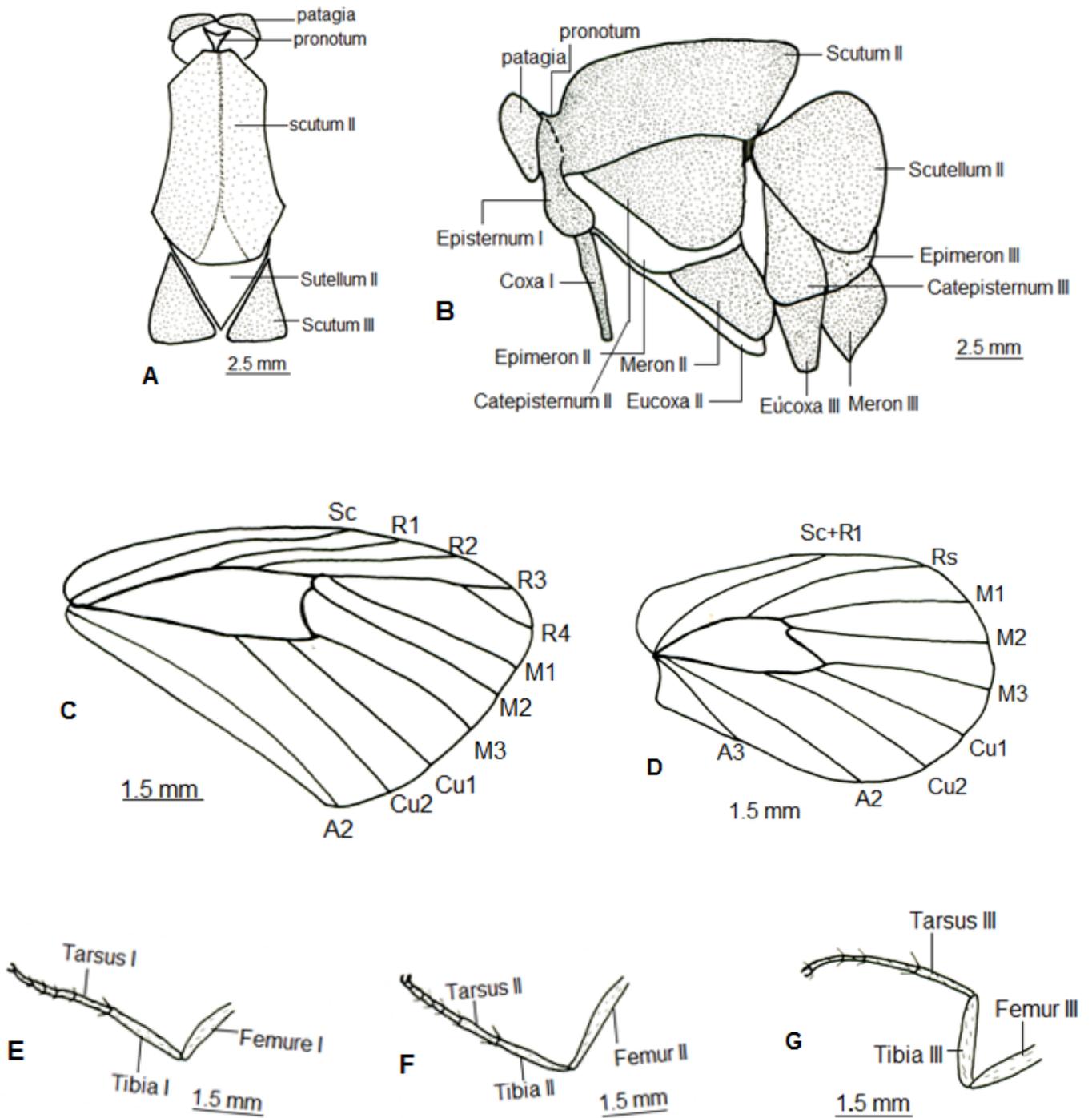


Fig 3: *Eurema hecabe simulata* Moore, Thorax: A. Dorsal view, B. Lateral view, C. Forewing, D. Hindwing, E. Prothorax leg, F. Mesothorax leg, G. Metathorax leg

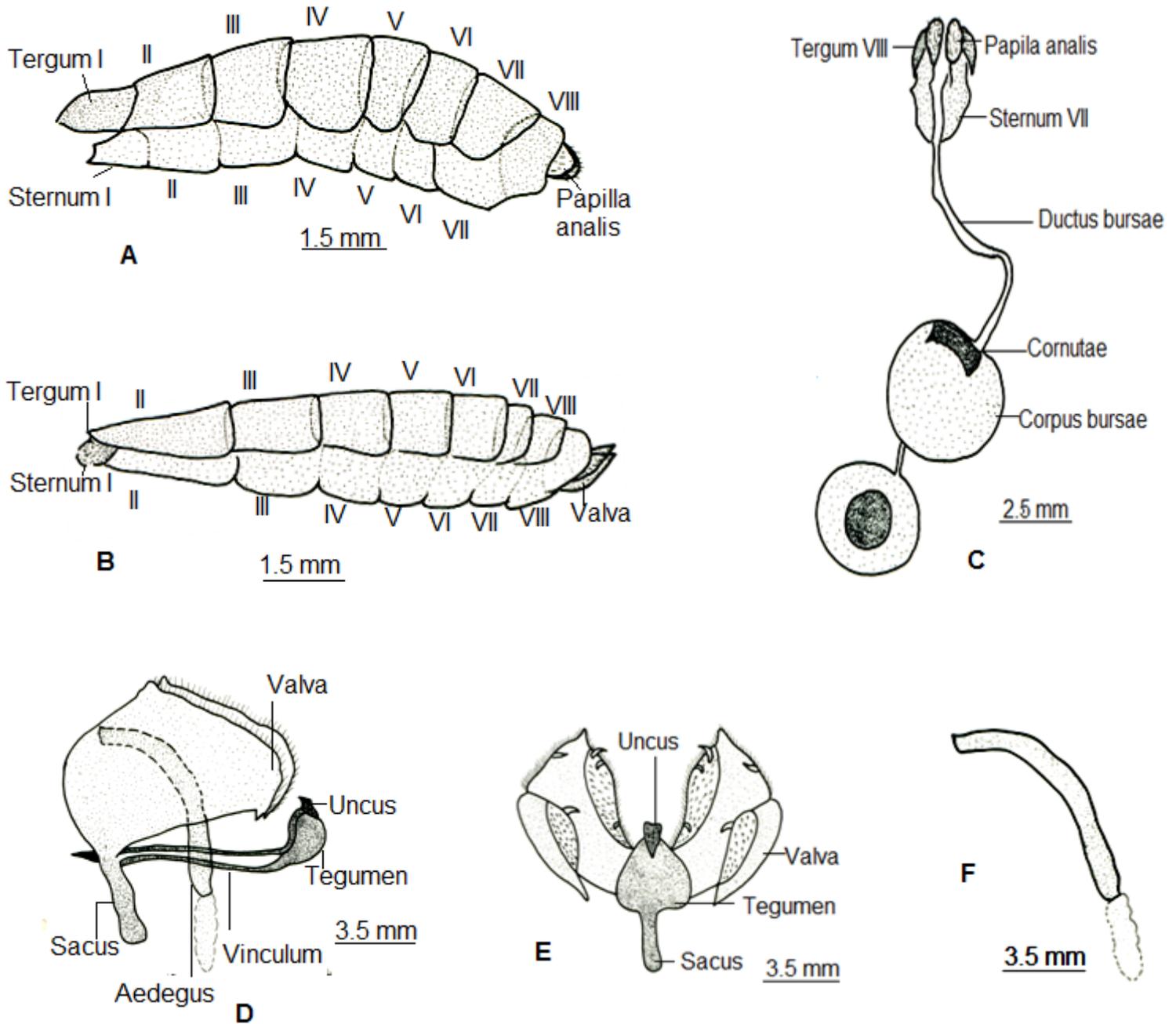


Fig 4: *Eurema hecabe simulata* Moore, Abdomen: A. Female abdomen, B. Male abdomen, C. Female genitalia, D. Male genitalia (lateral view), E. Male genitalia (ventral view), F. Aedeagus.

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