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Taxonomy of *Fulgoraecia melanoleuca* (Fletcher, 1939), (Lepidoptera: Epipyropidae) in India, a biological control agent of *Pyrilla perpusilla* (Walker) (Hemiptera: Lophopidae)

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Abstract

The parasitic lepidopteran insect, *Fulgoraecia melanoleuca* (Fletcher) has been reported as an ectoparasitoid of *Pyrilla perpusilla* (Walker) from the Indian subcontinent. For the first time, the complete morphology, field biology, egg laying behavior, larval pupal, and adult morphology, including male and female gentialic features, are described and illustrated.

Key words: Ectoparasite, *F. melanoleuca*, parasitism, morphology, genitalic structures

Introduction

The leafhopper, *Pyrilla perpusilla* (Walker, 1851) (Hemiptera: Lophopidae) is one of the most destructive pests of sugarcane. *Fulgoraecia melanoleuca* (Fletcher, 1939) (Lepidoptera: Epipyropidae) is an ectoparasitoid on nymphs and adults of *P. perpusilla* in India, and it is used extensively for biocontrol programs against this pest. Fletcher (1939) reported for the first time *F. melanoleuca* as an ectoprasitoid of *P. perpusilla* from India. In India and Pakistan considerable work is expended for biological control agents for the control of *P. perpusilla* (Gupta 1940; Rahman & Nath 1940; Khan & Khan 1966; Mohyuddin *et al*. 1982; Khan & Kanhaya 1988; Patel *et al*. 1988; Ansari *et al*. 1989; Joshi & Sharma 1989; Qureshi *et al*. 1993).

The biology of *F. melanoleuca* has been reported by previous researchers *i.e.,* Fletcher (1939), Gupta (1940), Iqbal *et al*. (1985), and Misra & Krishna (1986). However, little information is available on the morphology and taxonomic characters of *F. melanoleuca*. In this manuscript, the detailed morphology of all life stages, with illustrations, is presented.

Material and methods

The present study was conducted at the Indian Agricultural Research Institute, New Delhi during 2008–2010. Field collected eggs were reared under laboratory conditions. Samples of all life stages were preserved for morphological studies. Voucher specimens have been deposited at the National Pusa Collection, Division of Entomology, Indian Agricultural Research Institute, New Delhi, India.

Larval instars were collected and relaxed in warm water and preserved in 70% ethanol. The larvae were boiled in 10% KOH for 1hr at 90 °C, and afterwards cleared and slide mounted in glycerol (Hinton, 1946; Peterson, 1962).

For genitalic study, abdomens were removed and boiled in 10% KOH for 20 min at 90 °C in Dry Block

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Heizgerät-28000, then transferred to glacial acetic acid for 5 minutes for cleaning and processed using standard procedures according to Holloway & Bradley (1987) and stored in ethanol.

Photographs were taken with a Leica DFC-290 camera mounted on a Leica MZ16A microscope using software Leica Application Suitever. 2.8.2. Comstock-Needham (1898) and Kallies (2004) were followed for terminology. Illustrations were made by using a drawing tube attached to a Nikon SMZ10 Stereo Zoom microscope. The final plates were prepared using Adobe Photoshop Elements 2.0. For field photography a Sony DSC R1 10.3 megapixel camera was used.

Fulgoraecia melanoleuca (Fletcher)

Epipyrops melanoleuca Fletcher, 1939: 293; Kato, 1940: 79.
Epiricania melanoleuca (Fletcher); Misra & Krishna, 1987; Khan & Kanhaya, 1988; Ansari et al., 1989; Joshi & Sharma, 1989. See Nomenclatural note below.
Fulgoraecia melanoleuca (Fletcher); Beccaloni *et al*., 2003.

Nomenclatural note. Several authors have used the combination *Epiricania melanoleuca* (see above). Yet we have been unable to find any published reference where the transfer of *melanoleuca* to *Epiricania* was formally done. Kato (1940: 79) described the genus *Epiricania*, but on page 83 of the same work he listed *melanoleuca* under *Epipyrops*. Davis (1983: 67) treated *Epipyrops* Bowring, 1876 as a junior synonym of *Fulgoraecia* Newman, 1851. But according to Nye & Fletcher (1991), because the senior name has not been used since it was established, the existing usage of the junior name should be maintained and the case referred to the International Commission of Zoological Nomenclature. Here we follow the online Lepindex (Beccaloni *et al*. 2003) in using the combination *Fulgoraecia melanoleuca*.

Morphology. Adults (Fig. 1, 7–8): Both males and females can be easily distinguished as adults. In the male the outer margin of the forewing is off white and the hindwing off white, while in female the forewing is grey black and the hindwing dark grey. The antennae are bipectinate in both sexes and the wing expanse is 9–12 mm in the male and 10–13 mm in the female. The newly emerged female does not fly well whereas males are active and fly rapidly in search of females for coupling. The coupling time noted under field conditions is 10–15 minutes.

Eggs (Fig. 2): The female begins oviposition immediately and lays upto 234–450 eggs. The eggs are light brown in color (Fig. 2) and are mostly laid on the leaf margin near to the cocoon. After hatching, only three larval instars develop.

Larva (Figs. 3-5, 9–13): Larvae possess a proboscis-like structure (Fig. 11), which functions in sucking fluid from the abdomen of the host's abdomen (*P. perpusilla*). Four pairs of abdominal and one pair of anal prolegs are present. Abdominal prolegs have uniordinal, uniserial crochets. Anal proleg with crochets uniserial but in a half circle, which help to attach to the abdomen of the host (Davis 1987). The body of larvae is covered with white waxy material.

Cocoons (Figs. 6, 14–21) : Cocoons are constructed on the leaf, and are pure white, elongate, flattened, convex anteriorly and concave posteriorly. Male and female pupae are light brown. Male pupae have a short abdomen and the male genital scar is present on the 9th sternum. Female pupae are larger than male pupae and with a larger abdomen. Eight and 9th sternum are fused and a female genital pore is present on the fused sternum. The anus is present on the 10th sternum in both male and female pupa. Dark brown color patches are present on the dorsal surface of female pupal abdominal segments, and fewer light brown patches are present on all dorsal surfaces of male pupal abdominal segments.

Taxonomic description (Figs. 22–38). ***Alar expanse*: Male** 9–12 mm, **Female** 10–13 mm.

***Male*:** Head small, rounded, roughly covered with blackish scales with white tips; bases of antennae and spaces between them with large white scales; eyes small somewhat projecting laterally, with white scales anteriorly and with long, narrow white scales posteriroly; spaces between eyes broadly trapezoidal, turned approximately ventrally, measuring a little less than twice diameter of eye. Mouth parts reduced and no part is visible among dense scaling. Antenna 13-segmented, including the two basal segments, bipectinate, extending slightly more than one-third of costa of forewing; scape stout, rounded, with pecten of short scales; pedicellus smaller, shaft bifid at apex, with 11 pairs of long, ciliated branches, the longest branch being four times longer than the segment from which it arises; shaft white-scaled dorsally, spotted with fuscous above the base of each branch; branches dark

brown, also white scaled, spotted with fuscous. Thorax covered with blackish grey scales. Abdomen rather short and slender, densely covered with short, broad, fuscous and blackish scales with whitish tips; anal tuft small, ochreous. Legs fuscous, irrorate with whitish tips on most scales; tarsi narrowly lined with white; foreleg with broad coxa; tibia without epiphysis; mid and hind legs without spurs and spines.

Mouth parts entirely reduced and not rough-scaled; covered with large blackish scales; eyes small, but projecting slightly, space between eyes approximately more than twice diameter of eye as seen from this aspect; haustellum absent; labial palpi three segmented, small; antenna short, covered with hairs, shaft bifid at apex, bipectinate; pecten long, ciliated; thorax blackish with long scales; abdomen short and slender, not reaching tornus of hindwing, blackish; posterior margins of segments narrowly white; legs fuscous, tarsi lined with white; foreleg without epiphysis; mid and hind leg without tibial spurs; forewings covered with white scales upto discal cell and half of the wing covered with blackish grey scales; hindwings covered with white scales; both the wings smaller in size.

***Female*:** Head rather small, rounded, relatively rough-scaled; covered with large blackish scales; eyes small, but projecting slightly; space between eyes slightly more than twice diameter of eye.; haustellum absent; labial palpi three segmented, small; antenna short, covered with sensilla, shaft bifid at apex, bipectinate; pecten small, ciliated; thorax blackish with long scales; abdomen long and stout, extending to tornus of hindwing, blackish, posterior margins of segments blackish; legs fuscous; tarsi lined with white; foreleg without epiphysis; mid and hindlegs without tibial spurs; forewings and hindwings covered with black scales, larger in size.

***Wing venation*:** Both fore and hindwing discal cells divided into two subcells, but forewing with one more cell,*i.e.* accessory cell. **Forewing** Sc vein arising from the base of discal cell. Veins R_1, R_2, R_3, separate, but veins R_4, R_5, fused, and originating from accessory cell near apex of discal cell; veins M_1, M_2, M_3 present and originate from the discal cell separately; veins Cu_{1a}, Cu_{1b} present, separate, arising from the lower angle of discal cell; vein CuP present. 1A+2A fused and 3A not present (Fig. 30). **Hindwing** vein Sc+R_1 fused. Veins M_1, M_2, M_3 separate. Veins Cu_{1a}, Cu_{1b} originating at the lower angle of discal cell; Cu_{1b} present and originates separately; CuP present at tornal margin. 1A+2A fused and 3A not present (Fig. 31).

***Male genitalia*:** Tegumen stout, anterior margin with semicircular excavation, with large, semicircular, lateral lobes, uncus does not differentiated; gnathos represented by two strongly sclerotized, arcuate, conical processes, not fused medially, valva stout, broad, with strongly sclerotized clasper; saccus small; saccullus oval shaped, bearing small spines, aedeagus small, projecting anteriorly as a pair of bifurcated, bulbous processes, cornuti not present.

***Female genitalia*:** Anal papillae sclerotized, small, bearing minute spines; anterior apophysis short, anterior end blunt and rounded; posterior apophysis extremely short; ductus bursae short; corpus bursae rounded without signa.

Material examined. Rajesh Kumar; 100 pupae, Sorghum & Wheat, IARI, New Delhi, 05.02.2008; 50 larvae on *Pyrilla perpusilla*, Sorghum, IARI, New Delhi, 20.03.2008, leg. Rajesh Kumar and Vishal Mittal**;** 90♂, emerged in laboratory, Entomology Division, IARI, New Delhi, 20.03.2008, leg. Rajesh Kumar and Vishal Mittal**;** 40♀ emerged in laboratory, Entomology Division, IARI, New Delhi, 05.03.2008, leg. Rajesh Kumar and Vishal Mittal.

Distribution. North India, Pakistan, Sri Lanka

Host. *Pyrilla perpusilla* (Hemiptera: Lophopidae)

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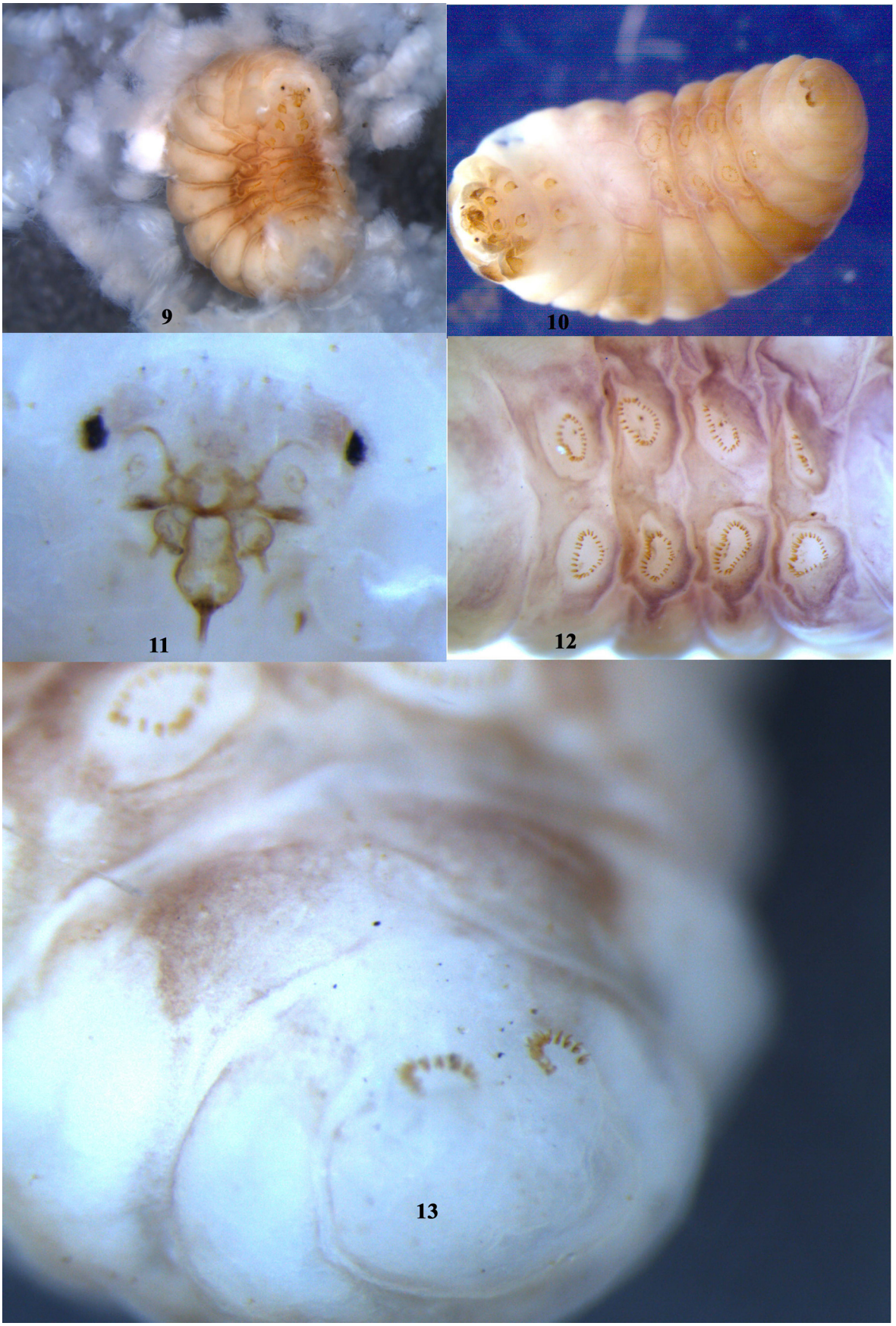
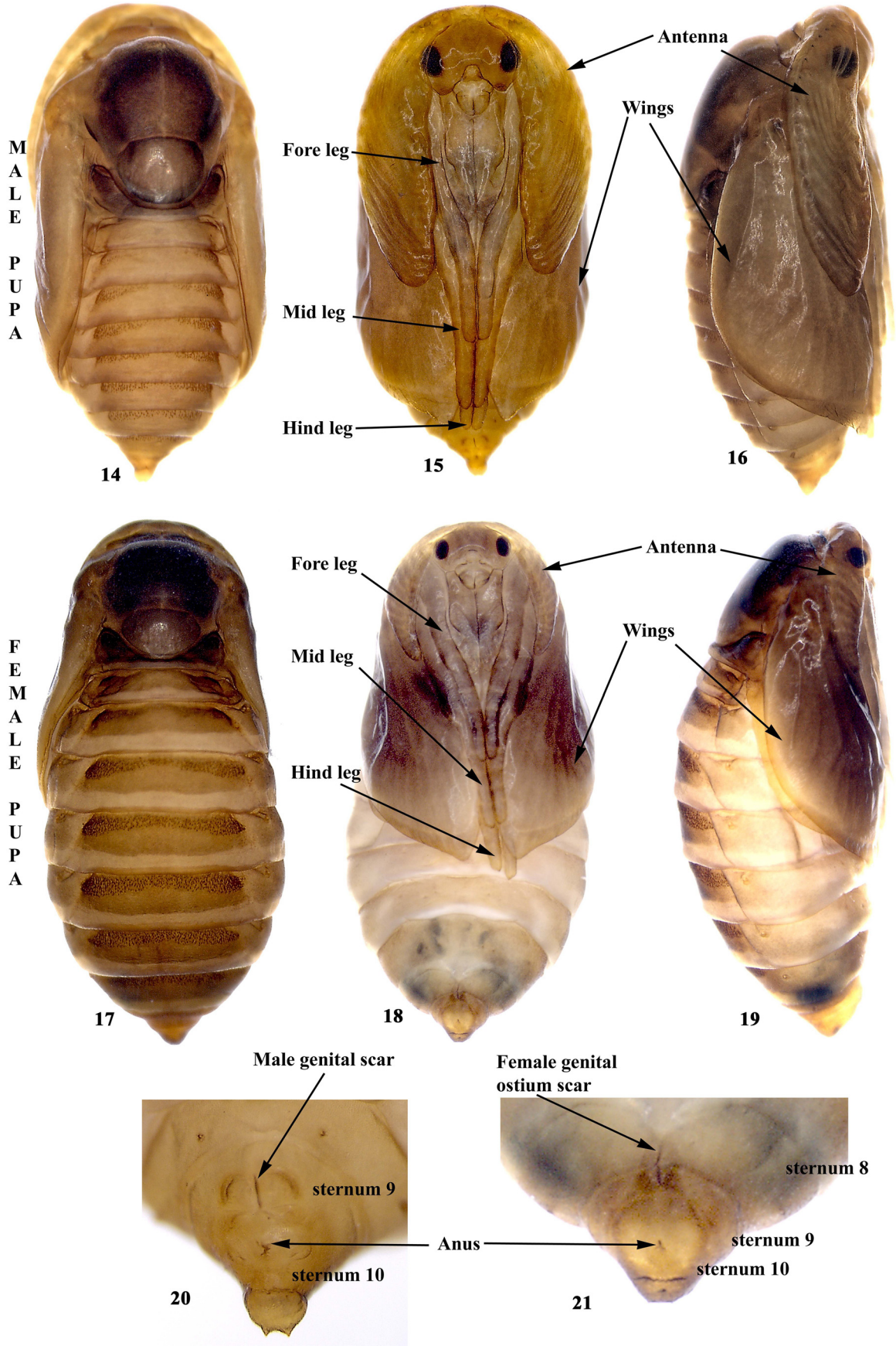
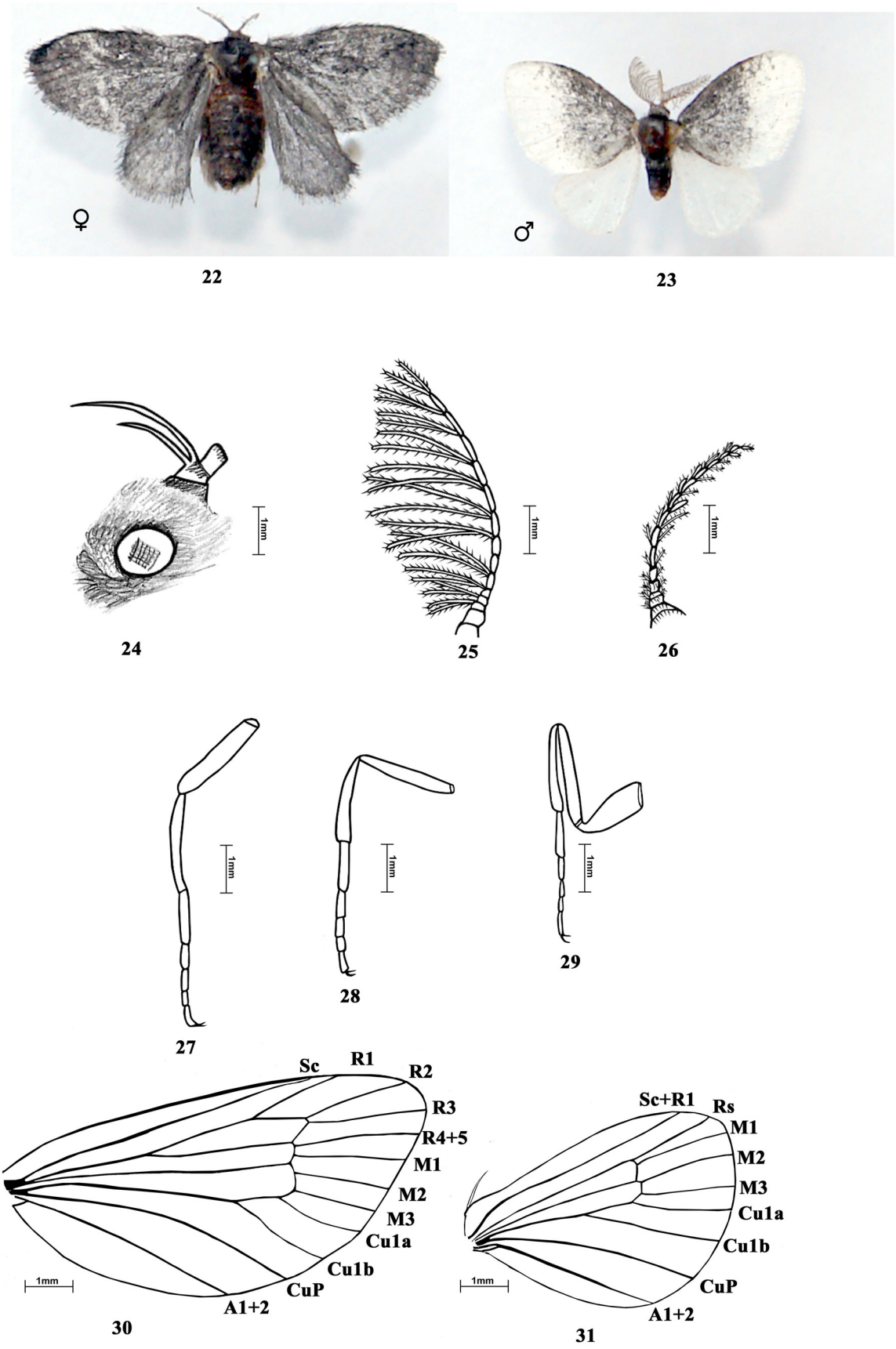
FIGURES 1–8. Life stages of *F. melanoleuca*. **1**. Male and female emerged from pupae; **2.**Eggs; **3.** Larva parasitizing on nymph of *Pyrilla perpusilla*; **4**. Larva parasitizing on adult's abdomen of *P. perpusilla*; **6.** Pupa of *F. melanoleuca*; **7.** *F. melanoleuca* adult male; **8.** *F. melanoleuca* adult male.



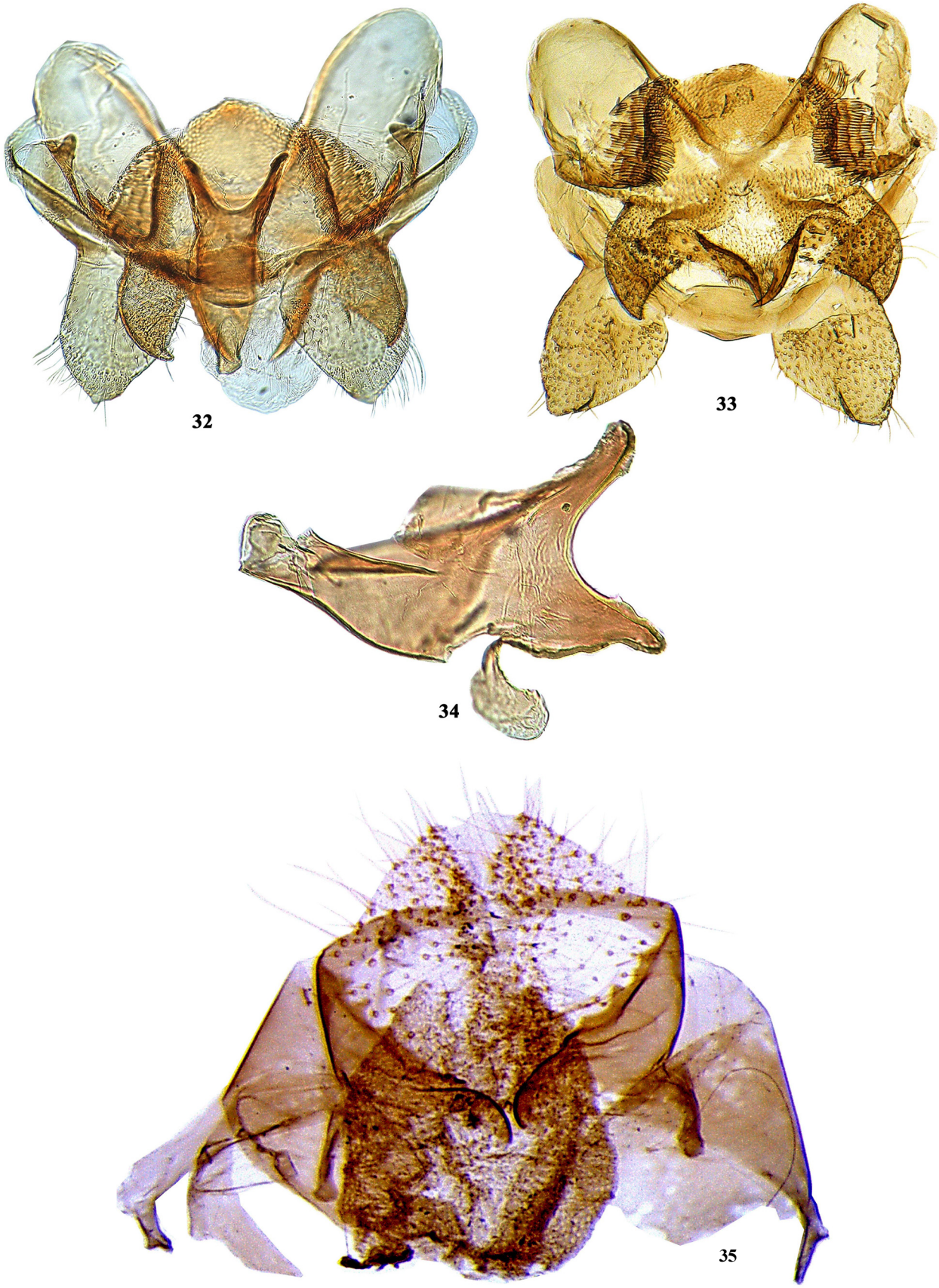
FIGURES 9–13. Larvae of *F. melanoleuca*. **9.** Larva removed from the abdomen of *P. perpusilla*; **10.** After removing waxy material from the body of the larva; **11.** Proboscis for sucking fluids from the body of the host *P. perpusilla*; **12.** Uniserial crochets on abdominal prolegs; **13.** Uniserial crochets on anal prolegs.



FIGURES 14–21. Pupae of *F. melanoleuca*. **14.** Dorsal view of male pupa;**15.**Ventral view of male pupa; **16.** Lateral view of male pupa; **17.** Dorsal view of female pupa; **18.** Ventral view of female pupa; **19.** Lateral view of male pupa; **20.** Male genital scar; **21.** Female genital ostium scar.



FIGURES 22–31. Adult structures of *F. melanoleuca*. **22.** Habitus of female; **23.** Habitus of male; **24.** Lateral view of head; **25.**Male antenna; **26.** Female antenna; **27.** Foreleg; **28.** Midleg; **29.** Hindleg; **30.** Forewing venation; **31.** Hindwing venation.



FIGURES 32–35. Genitalia of *F. melanoleuca*. **32.** Ventral view of male genitalia with aedeagus in situ; **33.** Dorsal view of male genitalia with aedeagus in situ; **34.** Aedeagus; **35.** Dorsal view of female genitalia.

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