

## The Genus *Lipaleyrodes* Takahashi, a Junior Synonym of *Bemisia* Quaintance and Baker (Hemiptera: Aleyrodidae): A Revision Based on Morphology

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**Anil Kumar Dubey, Chiun-Cheng Ko, and Baliah Vasantharaj David (2009)** The genus *Lipaleyrodes* Takahashi, a junior synonym of *Bemisia* Quaintance and Baker (Hemiptera: Aleyrodidae): a revision based on morphology. *Zoological Studies* 48(4): 539-557. As a result of comparative studies of puparial and adult characters of the species of the genus *Lipaleyrodes* (Takahashi 1962) and *Bemisia* Quaintance and Baker (1914), the genus *Lipaleyrodes* is regarded as a junior synonym of the genus *Bemisia*. Based on examination of the type specimens and other determined material of all 9 species of *Lipaleyrodes* so far known, *Lipaleyrodes* was synonymized with *Bemisia*. *Bemisia leguminicola* (Takahashi) is considered to be a junior synonym of *B. breyniae* (Singh). Eight new combinations are proposed. *Bemisia euphorbiae* (David and Subramaniam) is a new record for Malaysia. Puparial diagnostic characteristics of *Bemisia* are indicated. Intraspecific variations and similarities among puparia and adults are documented. <http://zoolstud.sinica.edu.tw/Journals/48.4/539.pdf>

**Key words:** Aleyrodidae, *Bemisia*, *Lipaleyrodes*, Lipaleyroдини.

The morphological characters of the puparia and adults of species in the genus *Lipaleyrodes* (Takahashi 1962) were critically evaluated against the generic characters of *Bemisia* Quaintance and Baker. Eight valid species are known in *Lipaleyrodes*; 4 from the Oriental Region, and 1 each from the African, Australasian, Malaysian, and Palearctic Regions (Corbett 1935, David and Thenmozhi 1995, Mound and Halsey 1978, Martin 1999, Chen and Ko 2006). Takahashi (1962) established the genus *Lipaleyrodes* with *L. phyllanthi* Takahashi as the type species. He characterized the genus as having a "shortened seventh... caudal ridges". David and Thenmozhi (1995) and Martin (1999) added to or better-defined the morphological characters used to distinguish the genus which have overshadowed those used by Takahashi (1962). Earlier workers

gave either partial or complete treatment of the morphology of adults in 6 of the species in the genus *Lipaleyrodes*.

### MATERIAL AND METHODS

This study is based on an examination of the type specimens and other determined specimens taken on loan from the depositories: The Natural History Museum (BMNH), London, UK; Indian Agricultural Research Institute (IARI), New Delhi, India; personal collection of Prof. B.V. David (IDAV), Chennai, India; and National Taiwan University (NTU), Taipei, Taiwan. Micro-measurements, micrographs, and camera lucida drawings were made using an Olympus (Tokyo, Japan) BX51 microscope.

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## RESULTS AND DISCUSSION

Several affinities in puparial morphology of these genera were evaluated: (1) the 7th abdominal segment is much reduced in median length, hence only 7 segments are visible, (2) wax plates/wax plate-like structures are present, (3) submarginal tiny setae are usually present, at least posteriorly, (4) a caudal furrow or ridges are usually present, (5) the transverse molting suture does not reach the true margin, (6) the thoracic tracheal pores or clefts are lacking, (7) the lingula is exposed, usually not reaching beyond the posterior end of the orifice, (8) there is an irregular crenulate margin, and (9) the vasiform orifice is triangular.

The original description of *Lipaleyrodes* by Takahashi (1962), amendments made thereafter by workers, and the present contribution suggest that the reduction of abdominal segment VII in *Lipaleyrodes* species is similar to that of *B. tabaci* (Gennadius). Manzari and Quick (2006) noted that the range of reduction of abdominal segment VII in most taxa has not been reported. Both *Bemisia* and *Lipaleyrodes* possess a slightly to extremely reduced abdominal segment VII.

A comparison of female antennae of *L. breyniae*, *L. euphorbiae*, and *B. tabaci* was made. In these species, the basal region of the 3rd antennal segment has a small sensorium that is difficult to see (Figs. 1A-E, 2A-C). The distance between the sensorial cone and the 1st primary sensoria seems to be useful in discriminating the adults of a few species. The observations revealed that (1) in all 3 species, the sensorial cone apex does not reach the base of the 1st primary sensoria, (2) on antennal segment III, the length of the 1st sensorial cone, and the distance between the 1st sensorial cone and 1st primary sensoria are always less than those of females (Table 1), and (3) in *B. tabaci*, the mean length of the 1st sensorial cone and the gap between the 1st sensorial cone and primary sensoria are smaller in both sexes than those of *L. breyniae* and *L. euphorbiae* (Table 1).

The morphology of the female antennae of these species is similar. However, *Lipaleyrodes* exhibits intraspecific variations. The male antennae of *Bemisia* (*B. tabaci*) were compared to those of *L. breyniae* and *L. euphorbiae*. In a few adults of *L. euphorbiae*, the male antennal segments V and VI are fused (Fig. 1B) which results in the occurrence of 1 sensorial cone and sensoria on 1 segment (V+VI); antennal segment IV

lacks sensoria and sensorial cones as observed in 7 segmented antennae. Further, in a few males of *B. tabaci*, antennal segments IV and V are fused, and 1 sensorium is present subapically (Fig. 1C). In *B. tabaci*, the male antennal segment IV lacks sensoria or sensorial cones, and segment VI has 1 sensorial cone (Fig. 1E). Antennal segment III has 2 primary subapical sensoria, and segment VI has 1 sensorial cone. This feature is common to both 7 segmented and fused 7 segmented antennae. The total number and position of sensoria and sensorial cones are similar on 7 segmented antennae of *L. breyniae* (Fig. 1A), *L. euphorbiae* (Fig. 1D), and *B. tabaci* (Fig. 1E), however, 1 was 6 segmented and other 7 segmented in a single male individual of *L. breyniae*.

The male genitalia of adults of *L. breyniae*, *L. euphorbiae*, and *B. tabaci* were compared. The inflatable sac on the paramere of *B. tabaci* (Fig. 2F) was found to be similar to those of *B. breyniae* (Fig. 2D) and *L. euphorbiae* (Fig. 2E).

Huldén (1986) regarded the number of ommatidia connecting the upper and lower lobes as an important character. Gill (1990) noted that pigmentation is useful in distinguishing some genera and/or species groups. It was seen that the upper and lower compound eyes are joined by a single ommatidium in *L. breyniae* (Fig. 3A), *L. euphorbiae*, and *B. tabaci* (Fig. 3B), and pigmentation in the lower eye was similar.

In an examination and evaluation of the adult morphology of the species of *Lipaleyrodes* and *B. tabaci*, it was observed that the number and position of the sensorial cones on antennal segments III, VI, and VII and the sensoria on segments III, V, and VII are similar; the upper and lower compound eyes are joined by a single ommatidium; and the number of setae in the metatibial brush and comb are similar.

In puparium, we noticed that the submarginal wax plate-like structures are also present in *B. tabaci* as in species known under *Lipaleyrodes* (Fig. 3C). Such structures are highly variable within the population or species.

Given these puparial and adult morphological affinities, it was concluded that the genus *Lipaleyrodes* is a junior synonym of *Bemisia*.

The subfamily Aleyrodinae Westwood consists of 13 tribes (David 1990); however, many genera remain unassigned to appropriate tribes. David (1990) stated that the tribe Lipaleyroдини possesses thoracic and caudal tracheal combs, clefts, pores or furrows, and clusters of wax plates arranged in a row on the submargin. Martin

(1999) observed that the tracheal openings are not modified at the margin, which contradicts the observations of David (1990) on which, along with other characters, the tribe Lipaleyroдини was based. In as much as *Lipaleyrodes* is herein synonymized with *Bemisia*, the tribe Lipaleyroдини naturally gets synonymized with the tribe Bemisini David.

In view of synonymizing the genus *Lipaleyrodes* Takahashi with *Bemisia* Quaintance and Baker the generic characteristic features of the genus *Bemisia* are redefined here, and the new combinations indicated.

### ***Bemisia* Quaintance and Baker, 1914**

*Bemisia* Quaintance and Baker 1914: 99.

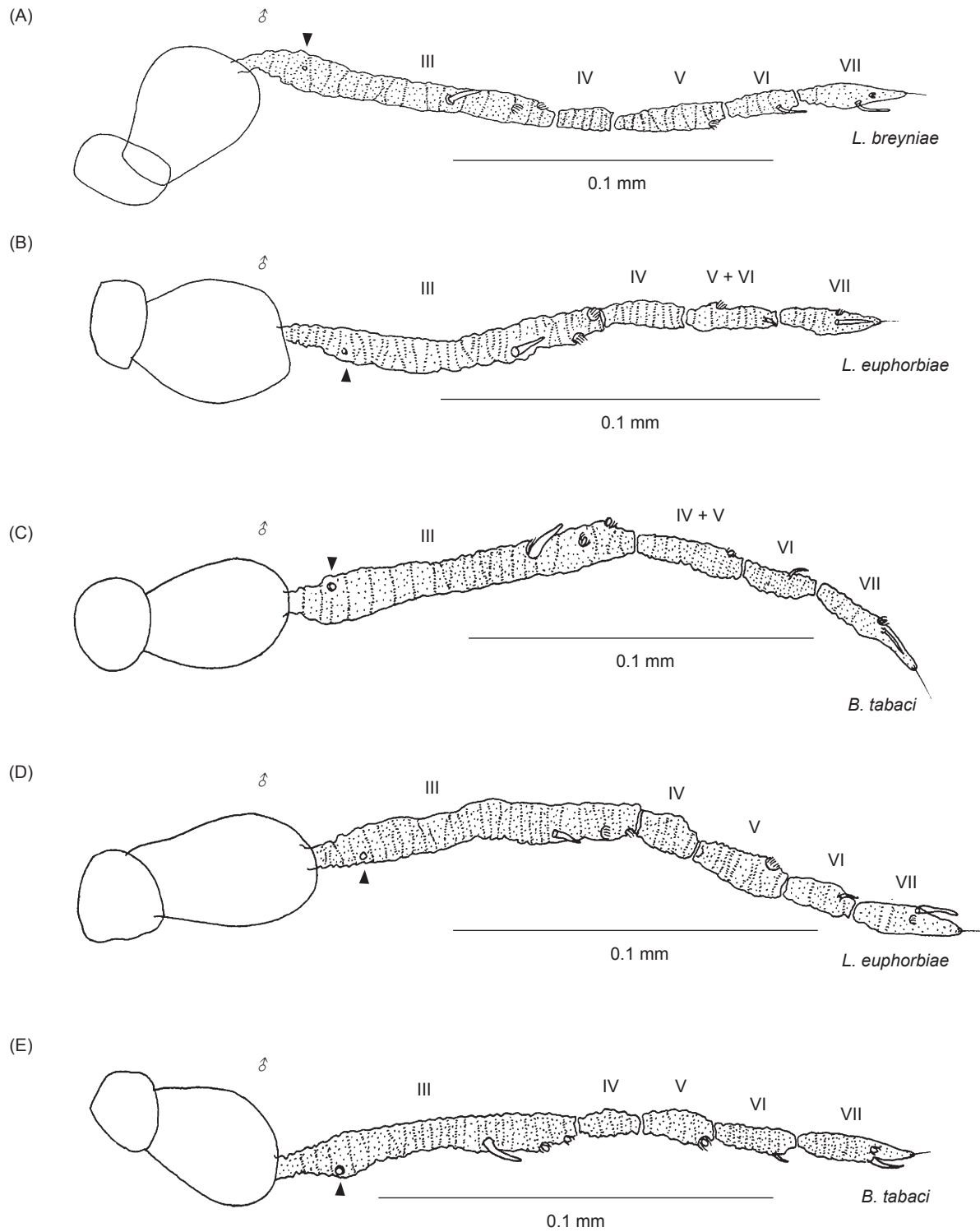
Type species: *Aleurodes inconspicua* Quaintance 1900: 28-29.

*Lipaleyrodes* Takahashi 1962: 100. Type species. *Lipaleyrodes phyllanthi* Takahashi 1962: 100, by monotypy. syn. nov.

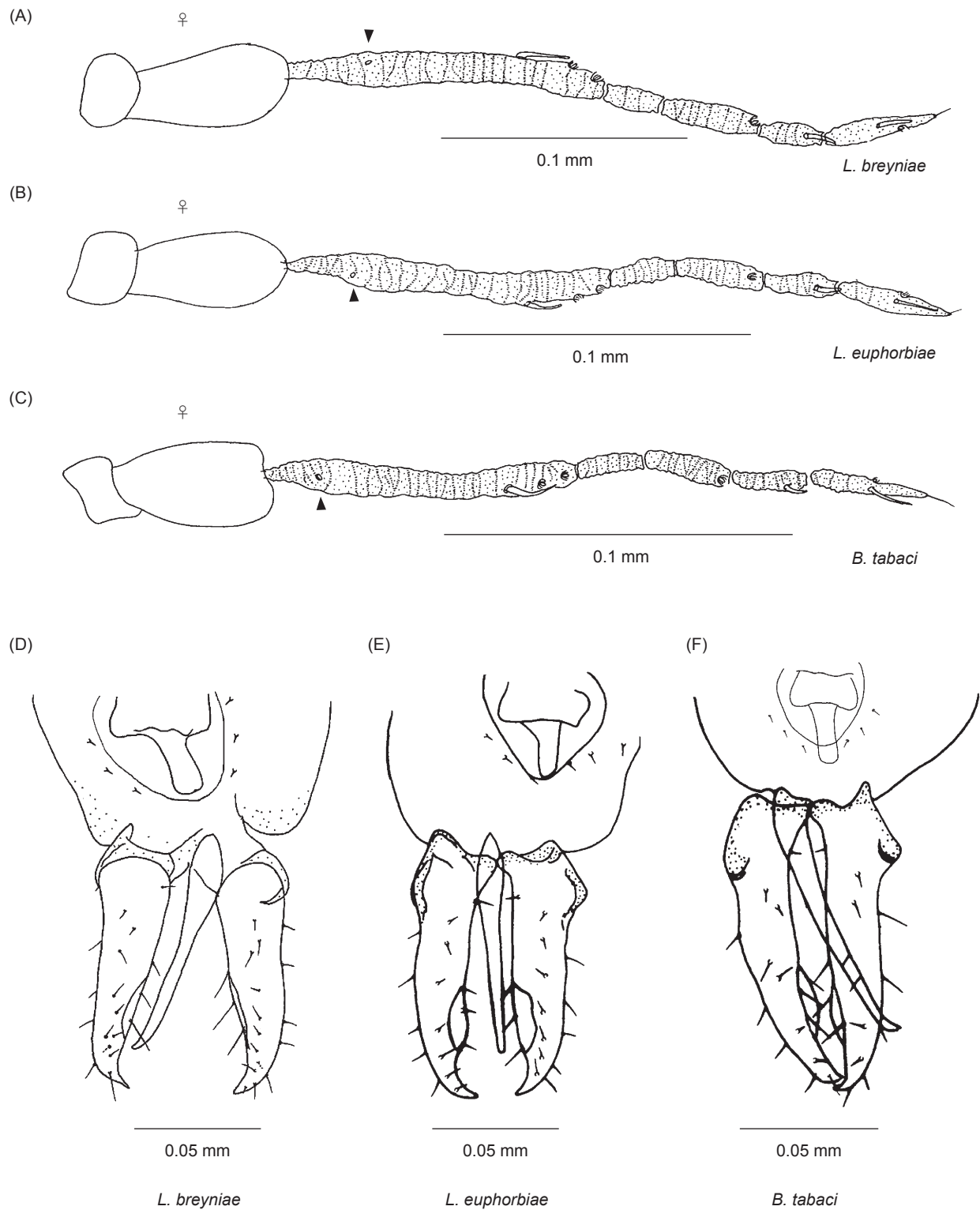
**Diagnosis:** In life, puparia may have mealy wax on margin, cuticle usually pale, sometimes with brownish pigmentation. Margin shallowly and irregularly crenulate, usually modified at thoracic tracheal openings and sometimes indicated as a comb of fine teeth, margin shallowly indented at these points. Submargin usually demarcated by

**Table. 1.** Comparison of antennae of male and female (all the measurements are in  $\mu\text{m}$ ; n1-n5- denotes individuals)

Species name	♂ , antennal segments (length)							♂ , 1st sensorial cone length	♂ , gap between 1st sensorial cone & 1st sensorium	♀ , antennal segments (length)							♀ , 1st sensorial cone length	♀ , gap between 1st sensorial cone & 1st sensorium
	I	II	III	IV	V	VI	VII			I	II	III	IV	V	VI	VII		
<i>L. breyniae</i>																		
n1	20.0	52.5	102.5	25.0	26.2	21.2	37.5	8.70	16.2	17.5	57.5	115.0	21.2	35.0	32.5	41.2	10.0	15.0
n2	17.5	53.7	115.0	21.2	30.0	26.2	35.0	8.70	15.0	20.0	52.5	103.7	21.2	30.0	26.2	35.0	10.0	15.0
n3	17.5	60.0	115.0	18.7	35.0	31.2	40.0	8.70	17.5	20.0	55.0	120.0	15.0	33.7	28.7	40.0	8.70	21.2
n4	15.0	57.5	117.5	23.7	26.2	18.7	37.5	8.70	16.2	20.0	45.0	107.5	20.0	36.2	25.0	40.0	8.70	16.2
n5	15.0	50.0	106.2	17.5	30.0	21.2	38.7	10.0	15.0	20.0	55.0	110.0	22.5	32.5	31.2	40.0	10.0	15.6
Total	85.0	273.7	556.2	106.1	147.4	118.5	188.7	44.8	79.9	97.5	265.0	556.2	99.9	167.4	143.6	196.2	47.4	83.0
Mean	17.0	54.7	111.2	21.2	29.4	23.7	37.7	8.90	15.9	19.5	53.0	111.2	19.9	33.4	28.7	39.2	9.40	16.6
<i>L. euphorbiae</i>																		
n1	27.5	52.5	97.5	17.5	20.0	22.5	27.5	10.0	16.8	17.5	52.5	105.0	20.0	28.7	22.5	38.7	11.2	15.6
n2	16.2	50.0	102.5	15.0	26.8	20.0	28.7	10.6	15.0	17.5	51.2	107.5	17.5	26.2	21.2	37.5	11.2	15.0
n3	23.7	45.0	100.0	20.0	22.5	16.2	28.7	10.0	13.7	17.5	55.0	112.5	20.0	30.0	23.7	36.8	11.2	16.2
n4	25.0	47.5	100.0	18.7	26.2	17.5	27.5	93.0	15.0	28.7	55.0	111.2	19.3	21.8	21.8	37.5	10.0	16.2
n5	17.5	50.0	98.7	16.2	23.7	22.3	32.5	10.0	16.2	17.5	52.5	110.0	21.2	25.0	23.7	37.5	10.0	16.2
Total	109.9	245.0	498.7	87.4	119.2	98.5	144.9	49.9	76.7	98.7	266.2	546.2	98.0	131.7	112.9	188.0	53.6	79.2
Mean	21.9	49.0	99.7	17.4	23.8	19.7	28.9	9.90	15.3	19.7	53.2	109.2	19.6	26.3	22.5	37.6	10.7	15.8
<i>B. tabaci</i>																		
n1	20.0	40.0	93.7	18.7	22.5	25.0	35.0	5.0	13.7	11.2	52.5	110.0	25.0	30.0	25.0	41.2	5.00	7.5
n2	20.0	47.5	117.5	17.5	27.5	16.8	40.0	5.0	17.5	12.5	50.0	112.5	21.2	28.7	27.5	37.5	7.50	16.2
n3	15.0	50.0	108.7	22.5	30.0	27.5	35.0	5.0	11.2	20.0	50.0	105.0	23.7	30.0	26.2	45.0	10.6	12.5
n4	15.0	52.5	92.5	20.0	27.5	21.8	33.7	7.5	11.2	15.0	50.0	110.0	22.5	32.5	27.5	37.5	10.0	15.0
n5	20.0	45.0	105.0	25.0	33.7	23.7	36.2	5.0	7.5	17.5	52.5	110.0	20.0	32.5	25.0	45.0	10.0	10.6
Total	90.0	235.0	517.4	103.7	141.2	114.8	179.9	27.5	61.1	76.2	255.0	547.5	112.4	153.7	131.2	206.2	43.1	61.8
Mean	18.0	47.0	103.4	20.7	28.2	22.9	35.9	5.5	12.2	15.2	51.0	109.5	22.4	30.7	26.2	41.2	8.6	12.3



**Fig. 1.** Male antenna of (A) *Lipaleyrodes breyniae*, (B) *L. euphorbiae*, segment V and VI fused, (C) *Bemisia tabaci*, segment IV and V fused, (D) *L. euphorbiae*, and (E) *B. tabaci*.



**Fig. 2.** Adults of (A) *Lipaleyrodes breyniae*, female antenna, (B) *L. euphorbiae*, female antenna, (C) *Bemisia tabaci*, female antenna, (D) *L. breyniae*, male genitalia, (E) *L. euphorbiae*, male genitalia, and (F) *B. tabaci*, male genitalia.





**Fig. 3.** Adults of (A) *Lipaleyrodos breyniae*, compound eye, (B) *Bemisia tabaci*, compound eye, (C) *B. tabaci*, puparium, wax plate-like structures, (D) *B. tabaci*, puparium, abdominal segment VII, (E) *B. tabaci*, puparium, vasiform orifice, and (F) *L. breyniae* puparium, vasiform orifice.

an irregular crease, often with ill-defined glandular patches, which may be discrete, not visible, or absent, and sometimes coalesced into a single submarginal glandular band. Transverse molting suture not reaching margin. First abdominal setae usually present. Chaetotaxy and presence of dorsal sculpturing and tubercles may be highly variable within species, depending on physical characteristics of leaves of host plants (Mound 1963). Abdominal segment VII extremely reduced in median length, with only 7 segments discernible. Vasiform orifice triangular, often ill-defined posteroapically, may be closed posteriorly or leading to a pronounced caudal furrow; operculum occupying basal 1/2 of orifice; lingula spinulose, exposed, usually elongate triangular, often protruding beyond orifice, with a pair of long apical setae. Caudal furrow not, or little, or well marked. Ventrally, caudal and thoracic tracheal fold may be marked by fine stippling.

***Bemisia atriplex* (Froggatt) comb. nov.**  
(Figs. 4A-F, 8A-D)

*Aleurodes atriplex* Froggatt 1911: 757-758.

*Aleyrodes atriplex* Froggatt: Dumbleton 1956: 171-172.

*Lipaleyrodes atriplex* (Froggatt) Martin 1999: 83-84.

**Material examined:** Paralectotype, AUSTRALIA, *Aleurodes atriplex*, 6 puparia on a slide, Saltbush, Broken Hills, 25 May 1911, no collector (BMNH).

**Diagnosis:** This species is unique in having a crenulate lateral margin, 14 pairs of submarginal setae, and an elongate subcordate vasiform orifice with a bilobed notch at the caudal end. This species is similar to *B. euphorbiae* in having continuous rows of submarginal wax secreting glands but differs from it in having exceptionally long 1st abdominal setae. Ventrally, a group of microtubercles present at base of meso- and metalegs.

**Distribution:** Australia.

**Host plants:** *Amaranthaceae* (= *Chenopodiaceae*): *Atriplex* sp., *Ptilotus nobilis*, [*Einadia trigonos*], *Chenopodium foliosum*, *C. opulifolium*, *C. trigonum*, and *Spinacia deracea*.

***Bemisia breyniae* (Singh) comb. nov.**  
(Figs. 5A-C, 8E-G)

*rhamnoides*, India, Pusa, Bihar.

*Lipaleyrodes breyniae* (Singh) Mound and Halsey 1978: 167.  
(change of combination by Mound and Halsey, 1978).

*Bemisia leguminicola* Takahashi 1942: 169-171. syn. nov.

*Aleyrodes leguminicola* (Takahashi) Takahashi 1952: 21.

*Lipaleyrodes leguminicola* (Takahashi) Martin 1999: 83.

An examination of syntypes of *B. leguminicola* (IARI) revealed that it is *B. breyniae*. The drawings and descriptions by Singh (1931) for this species do not concur with the characteristics observed in the type specimens; this may have led Takahashi (1942) to describe it as *B. leguminicola*. It is considered to be a junior synonym of *B. breyniae*.

**Material examined:** Syntypes, INDIA, *Trialeurodes breyniae* [labeled as *breynia*], 10 complete, 1 parasitized, 2 unbleached puparia on 1 slide, on *Breynia rhamnoides*, 11 Apr. 1929, K. Singh; *T. breynia*, 4 complete, 5 parasitized puparia on 1 slide, on *B. rhamnoides*, 10 Apr. 1929, K. Singh; *T. breynia*, 8 puparia on *B. rhamnoides*, 14 Sept. 1928, K. Singh (IARI). Syntype, BANGKOK SIAM. Named *Aleyrodes leguminicola* (= *Lipaleyrodes leguminicola*), 17 complete puparia, 1 partly broken puparium on 1 slide, a legume, 31 Mar. 1940, R. Takahashi (TARI).

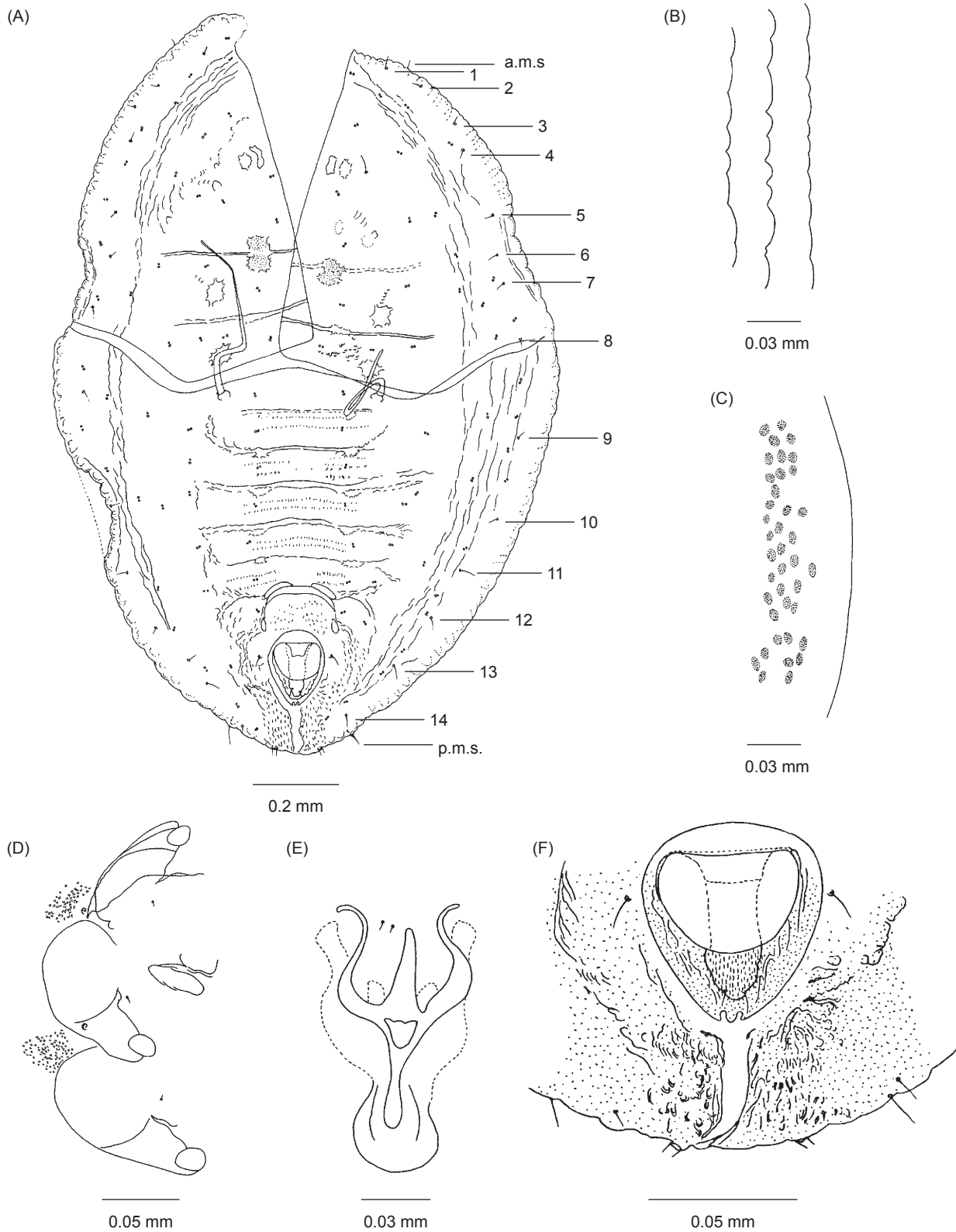
**Other material examined:** TAIWAN, Kaohsiung, Fooyin Univ., 15 puparia, 7 ♀♀, 5 ♂♂ on 8 slides, on *B. officinalis*, 11 Dec. 2005, C. H. Chen and Y. F. Chen (NTU).

**Diagnosis:** This species resembles *B. emiliae* but differs in the following: the vasiform orifice more wide posteriorly than that of *B. emiliae*; the lingula apically blunt, not acute (in *B. emiliae* lingula apex is acute), usually not reaching beyond posterior end of orifice, leaving more space between caudal end of lingula or orifice and puparial margin. Comparison of original materials of *B. breyniae* and *B. leguminicola* suggests that these 2 species are identical; hence *B. leguminicola* is considered to be a junior synonym of *B. breyniae*. Takahashi (1942) in the description of *B. leguminicola* stated "dorsum... setae on the head and on the metanotum." An examination of the 'syntypes' revealed that the setae on the metanotum were ventral setae. Submargin with 10 pairs of minute setae, 5 pairs located each on cephalothorax and abdomen.

**Distribution:** India; Taiwan; Thailand.

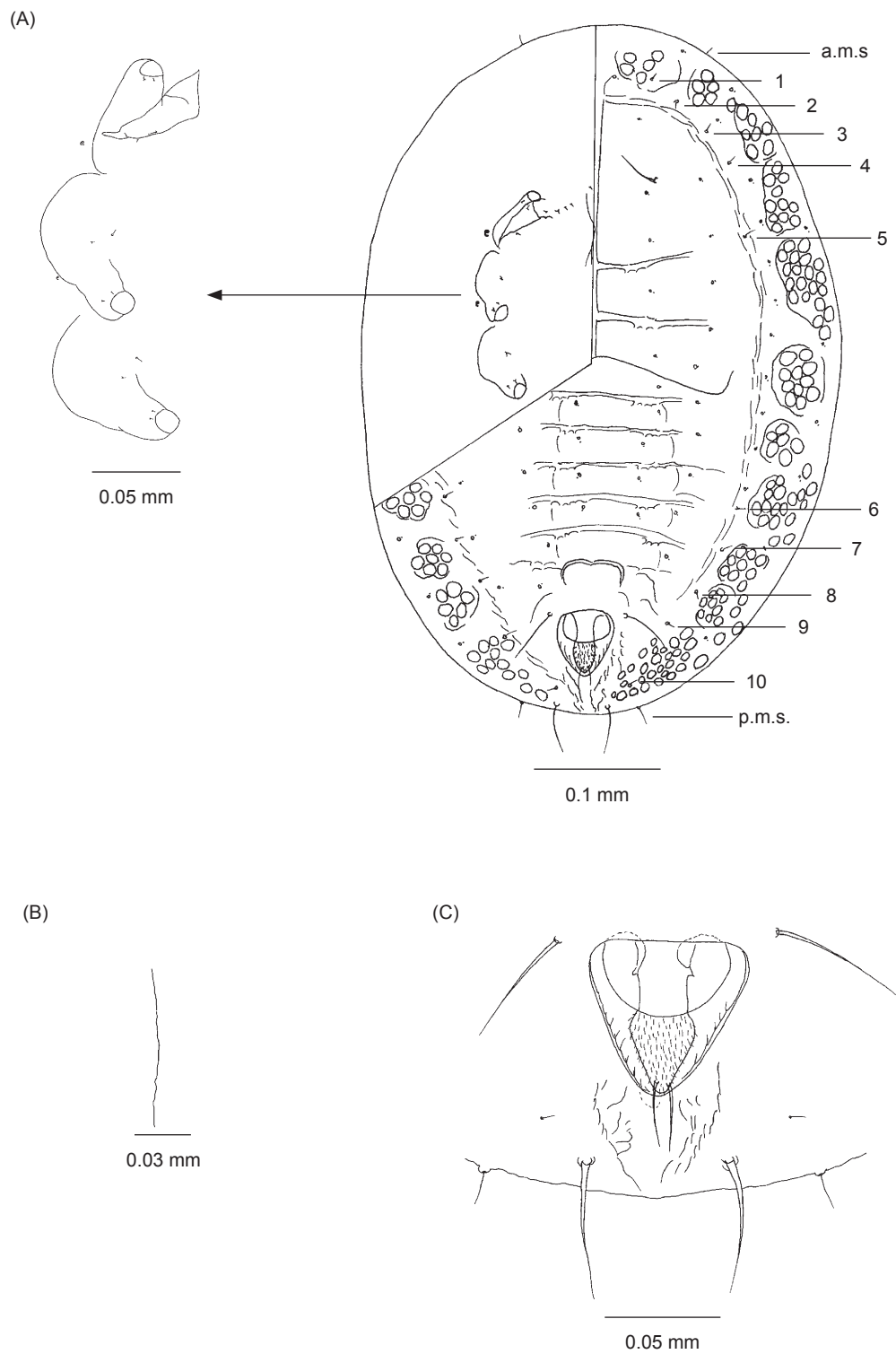
**Host plants:** *Euphorbiaceae*: *Breynia vitis-idaea* (= *B. rhamnoides*), *B. officinalis* (new record); *Leguminosae* (= *Papilionaceae*): *Indigofera cassioides*.

*Trialeurodes breyniae* Singh 1931: 49-50. Syntypes on *Breynia*



**Fig. 4.** Paralectotype puparium of *Lipaleyrodes atriplex* (A) dorsum (digits 1-14 indicating the position of the submarginal setae), (B) margin, (C) wax glands, (D) legs and antenna, (E) rostrum and setae, and (F) vasisform orifice and caudal furrow.





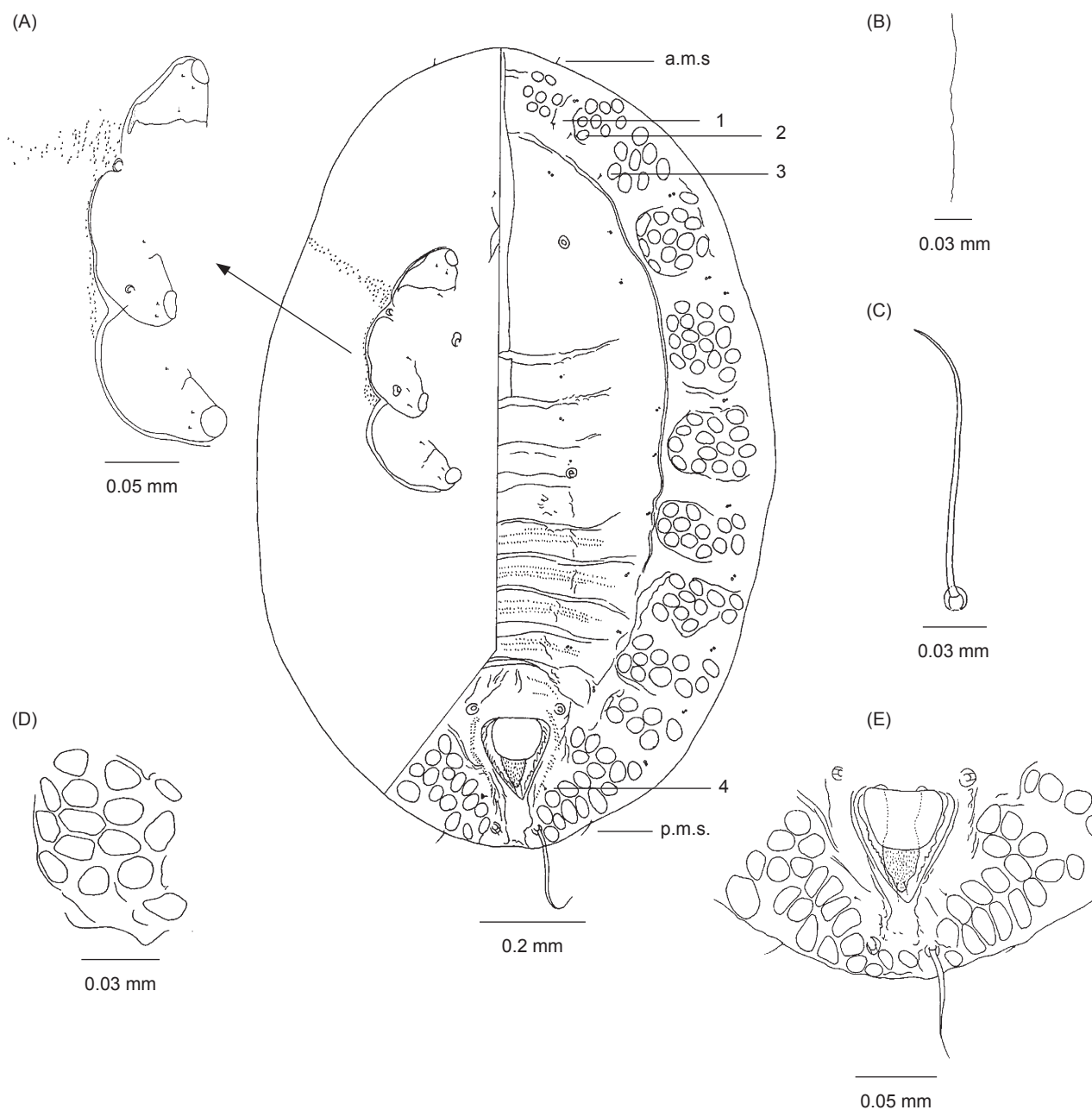
**Fig. 5.** Syntype puparium of *Lipaleyrodes breyniae* (A) dorsal and ventral view (digits 1-10 indicating the position of the submarginal setae), (B) margin, and (C) vasiform orifice and caudal furrow.

***Bemisia crossandrae* (David and Subramaniam)  
comb. nov.**

(Figs. 6A-E, 8H-J)

*Lipaleyrodes crossandrae* David and Subramaniam 1976:  
201-202.

**Material examined:** Holotype, INDIA, Coimbatore, *Lipaleyrodes crossandrae*, 3 complete, 3 partly broken puparia on 1 slide, on *Crossandra undulaefolia*, 15 Nov. 1966, B.V. David. Paratypes, INDIA, Coimbatore, 10 puparia on 10 slides, *Blepharis maderaspatensis*, 5 Aug. 1993, K. Thenmozhi; Padappai, 5 puparia on 5 slides,



**Fig. 6.** Holotype puparium of *Lipaleyrodes crossandrae* (A) dorsal and ventral view (digits 1-4 indicating the position of the submarginal setae), (B) margin, (C) 1st abdominal seta, (D) wax glands, and (E) vasiform orifice and caudal furrow.

unidentified plant, 7 June 1993, K. Thenmozhi; 3 puparia on 3 slides, *Achyranthes aspera*, 28 July 1992, K. Thenmozhi (IDAV).

**Diagnosis:** This species differs from other *Bemisia* species in that the cephalic and 1st abdominal setae arise from large cup-like bases (Fig. 1H), and apical ends of setae blunt; sutures of cephalothoracic and abdominal segments widely separated; and vasiform orifice acutely pointed posteriorly.

**Distribution:** India.

**Host plants:** Amaranthaceae: *Achyranthes aspera*, *Blepharhis maderaspatensis*, and *Crossandra undulaefolia*.

***Bemisia emiliae* (Chen and Ko) comb. nov.**

(Figs. 7A-D, 8K-M)

*Lipaleyrodes emiliae* Chen and Ko 2006: 31-54.

**Material examined:** Holotype, TAIWAN, Renwu, *Lipaleyrodes emiliae*, puparium on *Emilia sonchifolia*, 6 July 2003, C.H. Hsieh. Paratypes. TAIWAN. Taipei Co., Yunggho, 137 pupal cases, 73 ♀♀, 10 ♂♂ on 36 slides, on *Emilia sonchifolia*, 21 July 2003, C.C. Ko (NTU).

**Diagnosis:** Fundamentally, this species resembles *B. breyniae*. Martin (pers. comm.) diagnosed this species as differing from *B. breyniae* in having a posteriorly narrow vasiform orifice, an acute apex of lingula, extending far behind posterior margin of orifice leaving very little space between lingula apex and puparial margin.

**Notes:** 5 pairs of submarginal setae are located on cephalothorax and abdomen.

**Distribution:** Taiwan; Hong Kong.

**Host plant:** Asteraceae: *Emilia sonchifolia*.

***Bemisia euphorbiae* (David and Subramaniam) comb. nov.**

(Figs. 9A-E, 13A-C)

*Lipaleyrodes euphorbiae* David and Subramaniam 1976: 202-203.

**Material examined:** Holotype, INDIA, Madurai, *Lipaleyrodes euphorbiae*, 5 complete, 2 parasitized puparia on 1 slide, *Euphorbia prostrata*, 28 Jan. 1967, B.V. David. Paratypes. INDIA. Padappai, 2 puparia on 2 slides, *Phyllanthus amarus*, 1 July 1992, K. Thenmozhi; 3 complete, 1 broken puparia

on 4 slides, *P. acidus*, 8 Mar. 1993, K. Thenmozhi; 4 puparia on 4 slides, *P. maderaspatensis*, 1 July 1992, K. Thenmozhi; INDIA. Port Blair, 3 puparia on 2 slides, *Phyllanthus* sp., 11 Jan. 1990, C.R. Ramesh (IDAV).

**Other material examined:** MALAYSIA, Serdang, Selangor, 14 ♀♀, 8 ♂♂, 370 pupal cases, 15 1st instars, 9 2nd instars, and 4 3rd instars on 51 slides on *P. acidus*, 16 Apr. 2007, M. Hamifah (NTU).

**Diagnosis:** This species resembles *B. atriplex* but differs from it in having short 1st abdominal setae compared to cephalic, 8th abdominal, and caudal setae, a triangular vasiform orifice, and lack of a notch at caudal end of the orifice. Martin (1999) observed variations in submarginal gland groups and the presence or absence of the 1st abdominal setae. The material from *P. acidus* showed variations in the length of and in the presence or absence of the cephalic setae.

**Distribution:** Australia; Kenya; Sudan; India; Malaysia (new record).

**Host plants:** Euphorbiaceae: a weed plant, *Euphorbia cyanthophora*, *E. hirta*, *E. prostrata*, *P. abnormis*, *P. acidus*, *P. amarus* (= *niruri*), *P. fraternus*, and *P. maderaspatensis*.

***Bemisia hargreavesi* (Corbett) comb. nov.**

(Figs. 10A-D, 13D-F)

*Trialeurodes hargreavesi* Corbett 1935: 243.

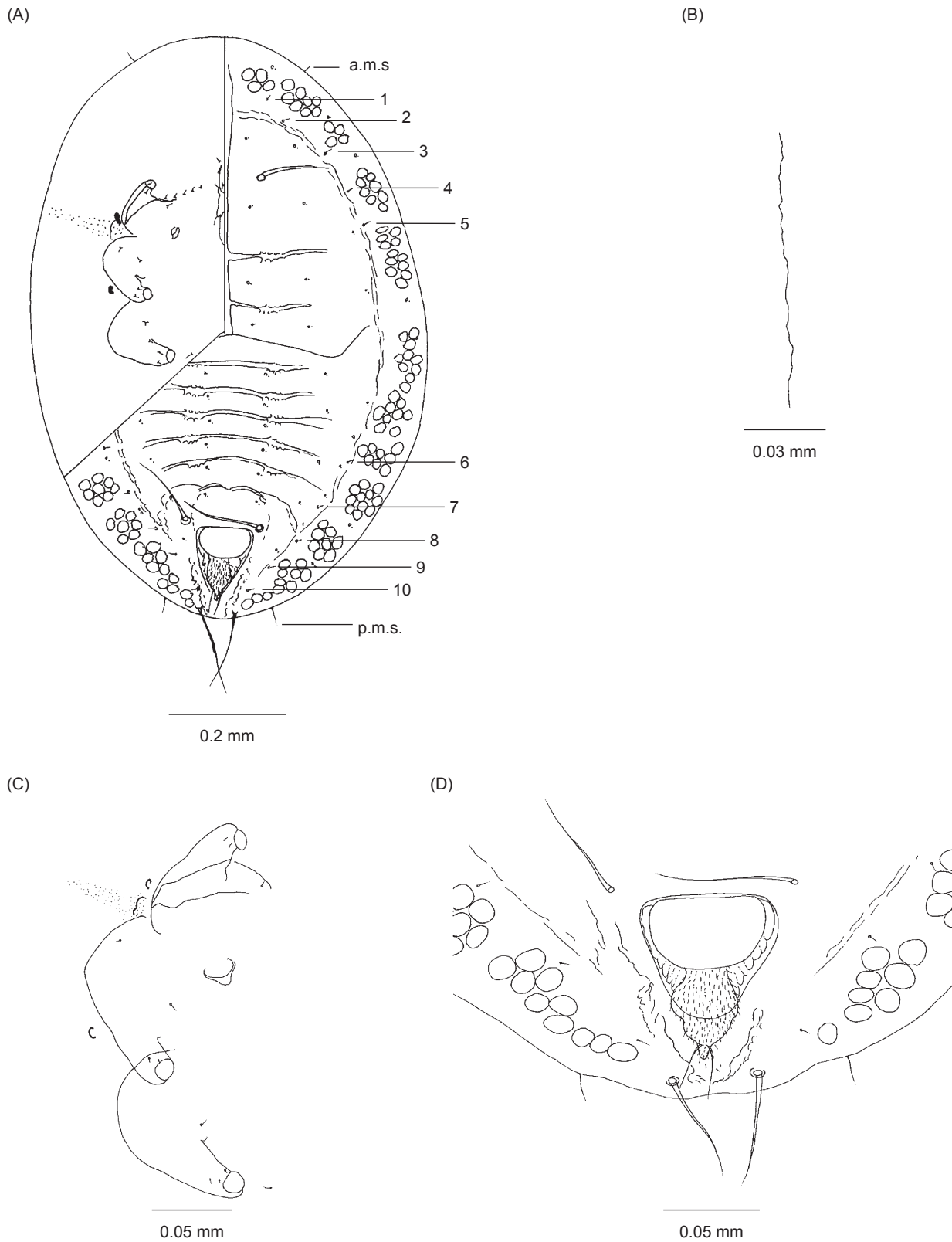
*Lipaleyrodes hargreavesi* (Corbett) Mound 1965: 158.

**Material examined:** Paratype, SIERRA LEONE, puparium on slide, labeled *Trialeurodes hargreavesi*, det. G.H. Corbett, on *Lindernia diffusa*, 19 Dec. 1932, Sialo and Hargreaves; Mar. 1965, remounted by L. Mound (BMNH).

**Diagnosis:** This species is typical in having the following combination of characters: an elliptical puparium, a vasiform orifice as long as wide, lingula not triangular, subapical end of lingula nearly equal to its base in width, and transverse molting suture not curving anteriorly.

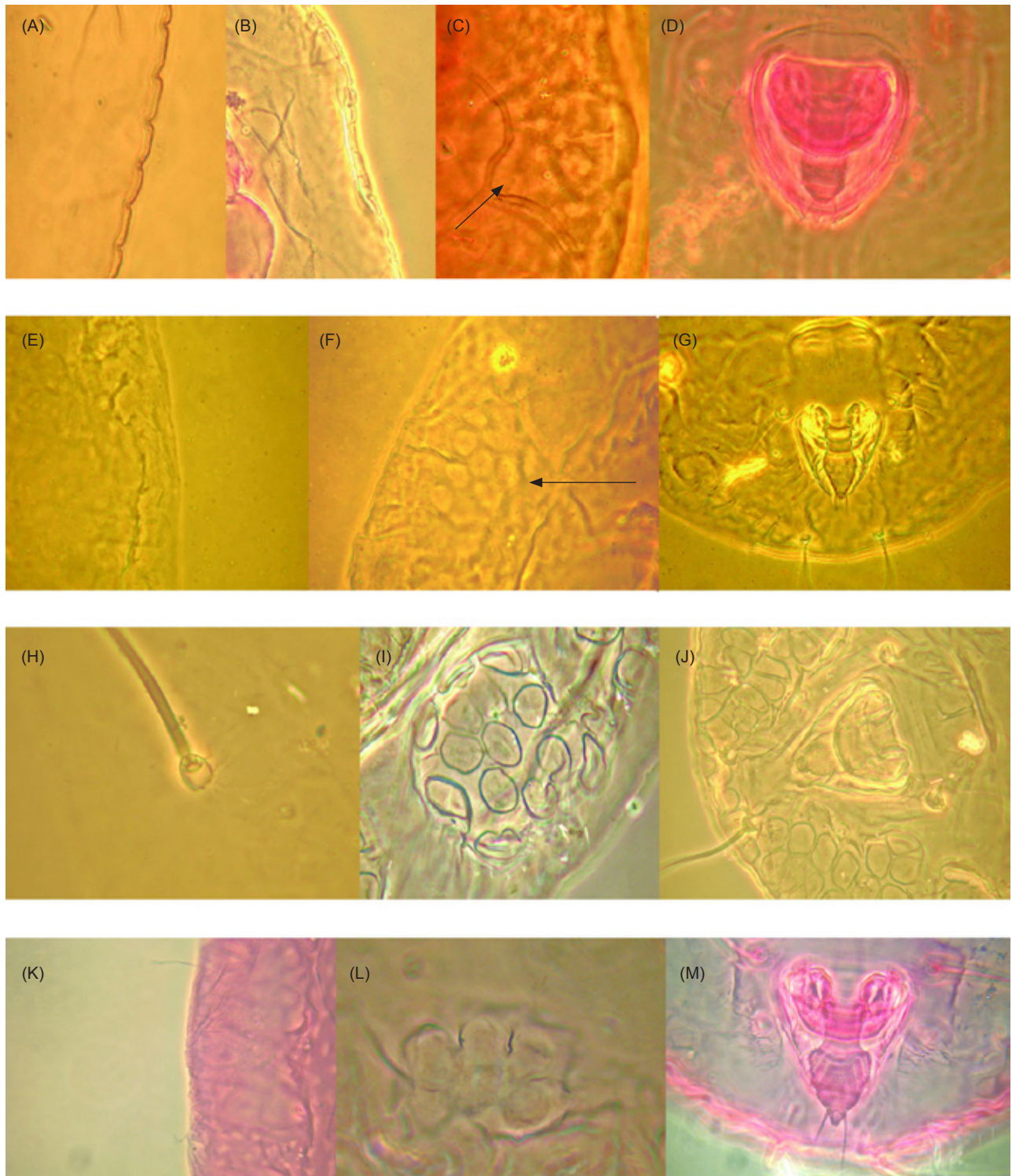
**Distribution:** Sierra Leone.

**Host plant:** Scrophulariaceae: *Lindernia diffusa*.



**Fig. 7.** Paratype puparium of *Lipaleyrodes emiliae* (A) dorsal and ventral view (digits 1-10 indicating the position of the submarginal setae), (B) margin, (C) legs and antenna, and (D) vasiform orifice and caudal furrow.





**Fig. 8.** Puparium of (A) Paralectotype, *Lipaleyrodes atriplex*, margin, (B) thoracic tracheal pore, (C) wax plates, (D) vasiform orifice, (E) syntype, *L. breyniae*, margin, (F) wax plates, (G) vasiform orifice, (H) holotype, *L. crossandrae*, 1st abdominal seta, (I) wax plates, (J) vasiform orifice, (K) paratype, *L. emiliae*, margin, (L) wax plates, and (M) vasiform orifice.

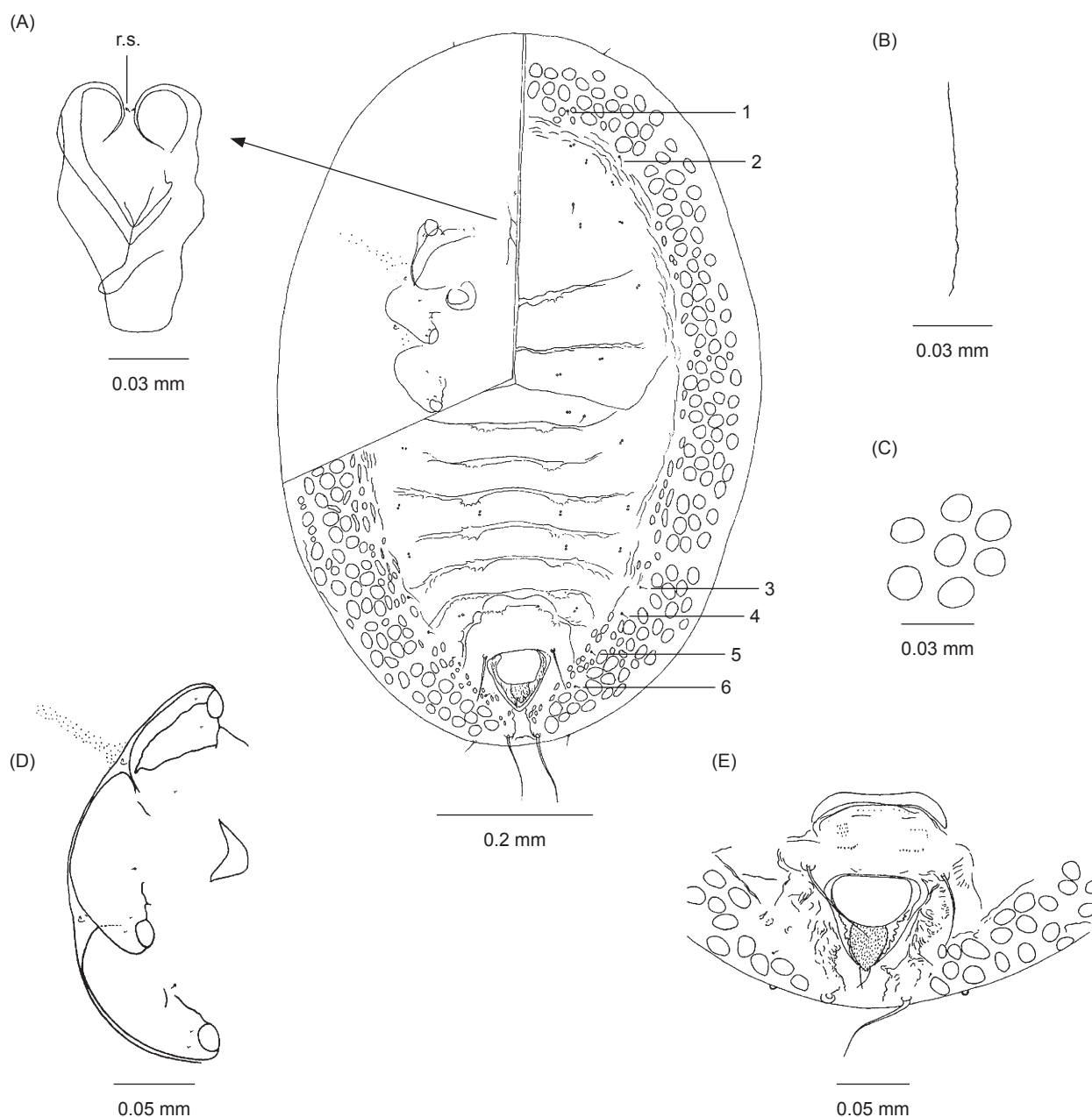
***Bemisia phyllanthi* (Takahashi) comb. nov.**  
(Figs. 11A-D, 13G-J)

*Lipaleyrodes phyllanthi* Takahashi 1962: 100.

**Material examined:** Syntype, MADAGASCAR, Massif de l'Tremo, 1700 m, *Lipaleyrodes phyllanthi*, 9 puparia, 1 immature nymph, and 1

emerging male on a slide, on *Phyllanthus* sp., date unknown, J. Bosser (BMNH).

**Diagnosis:** This species is unique in having the following combination of characters: 1st abdominal setae absent, longitudinal molting suture not reaching margin, transverse molting suture not curved anteriorly, and 7th abdominal segment reduced (nearly 33% of abdominal



**Fig. 9.** Holotype puparium of *Lipaleyrodes euphorbiae* (A) dorsal and ventral view (digits 1-6 indicating the position of the submarginal setae), (B) margin, (C) wax glands, (D) legs and antenna, and (E) vasoform orifice and caudal furrow.

segment VI).

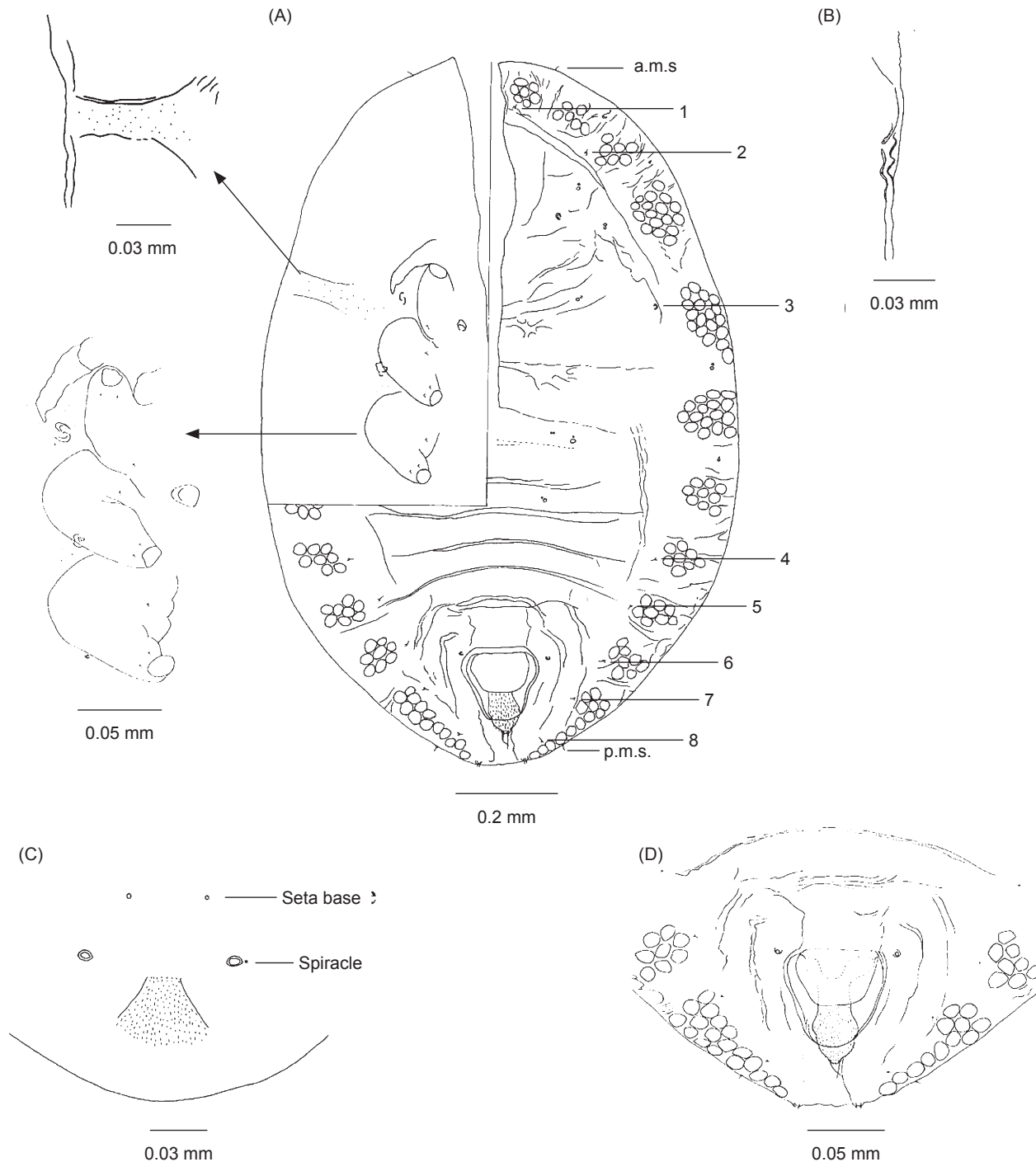
*Distribution*: Madagascar.

*Host plant*: Euphorbiaceae: *Phyllanthus* sp.

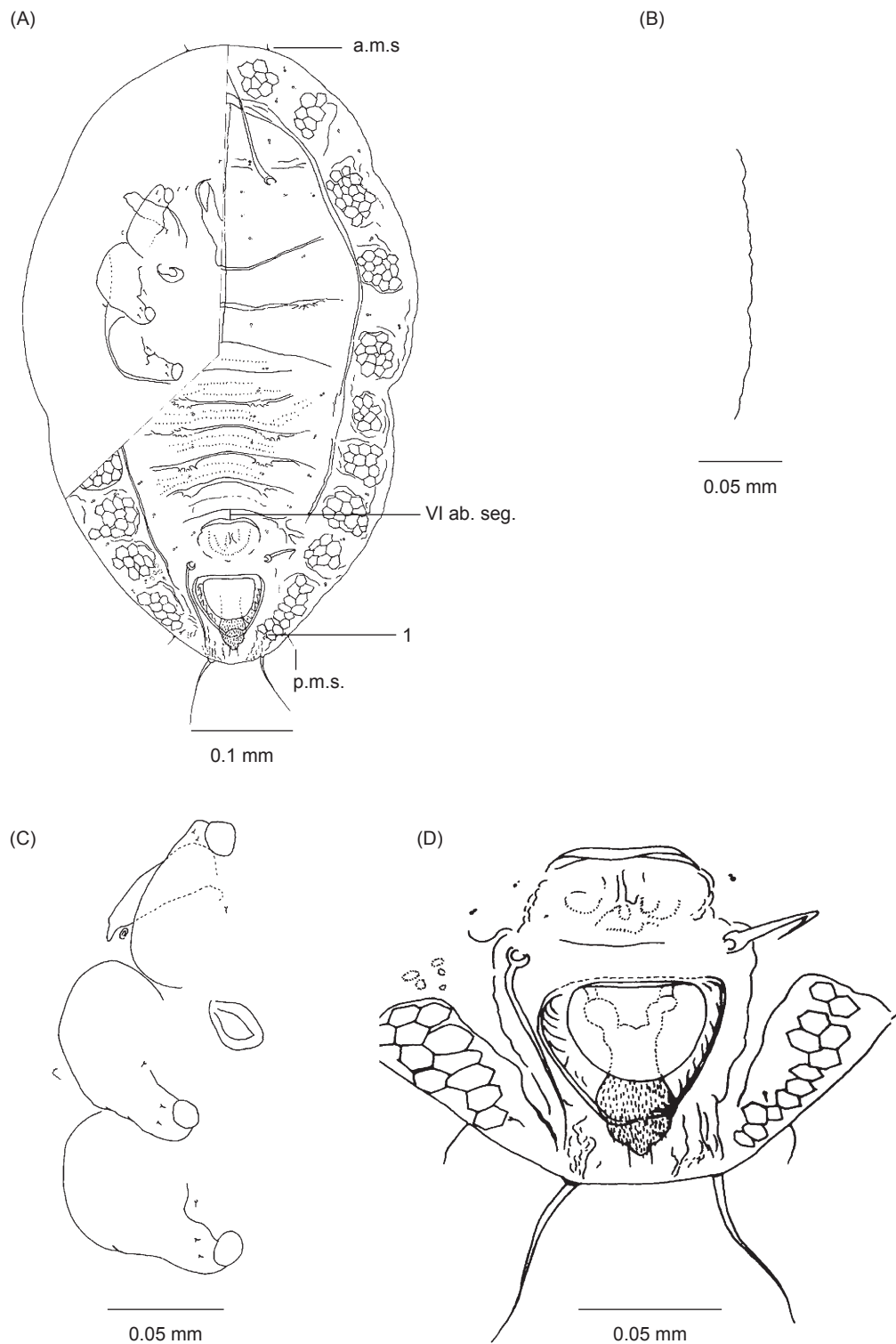
***Bemisia tabaci* (Gennadius)**

*Aleyrodes tabaci* Gennadius 1889: 1-3.

*Bemisia tabaci* (Gennadius) Takahashi 1936: 110.

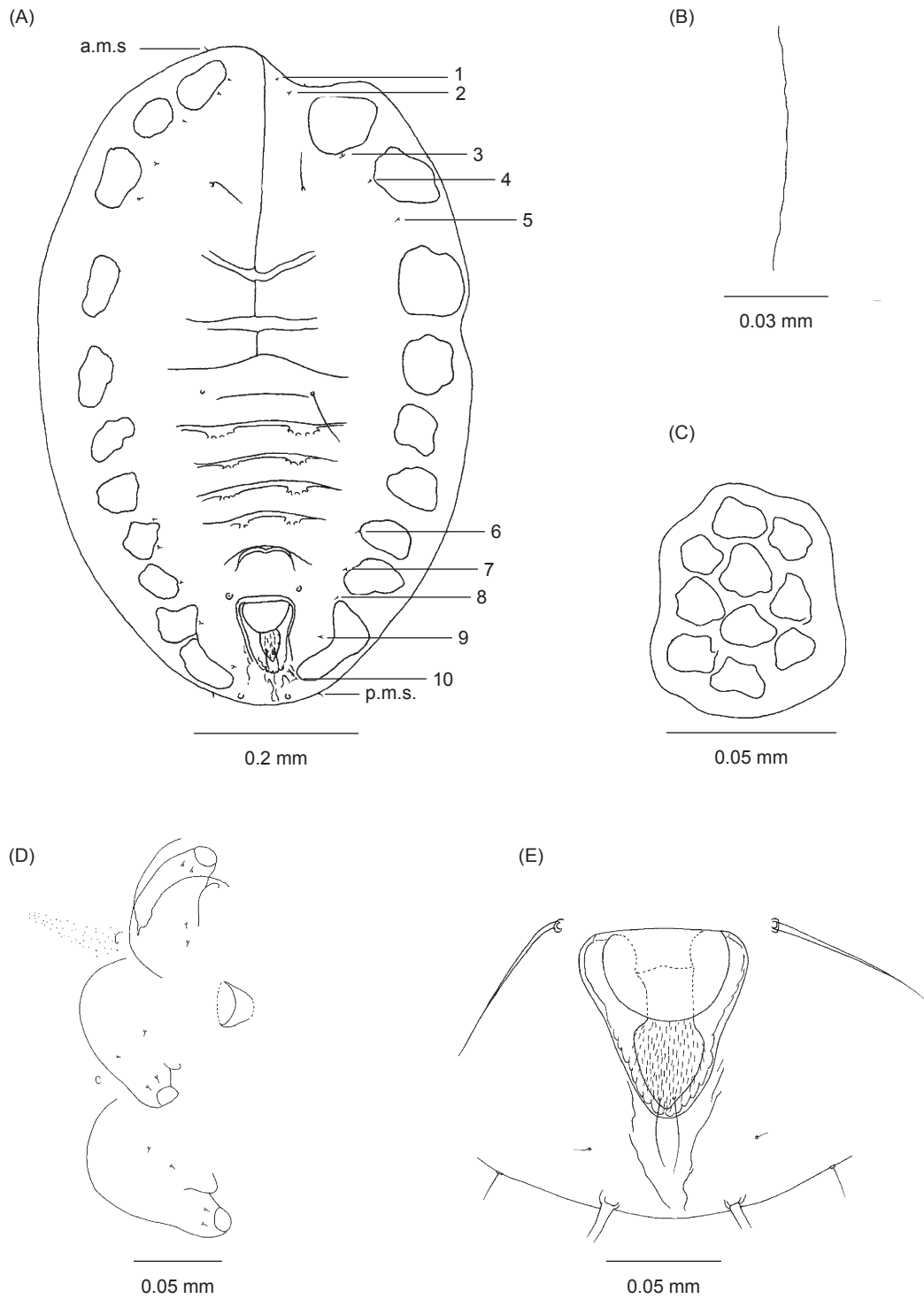


**Fig. 10.** Paratype puparium of *Lipaleyrodes hargreavesi* (A) dorsal and ventral view (digits 1-8 indicating the position of the submarginal setae), (B) margin, (C) caudal fold, and (D) vasiform orifice and puparial caudal end.

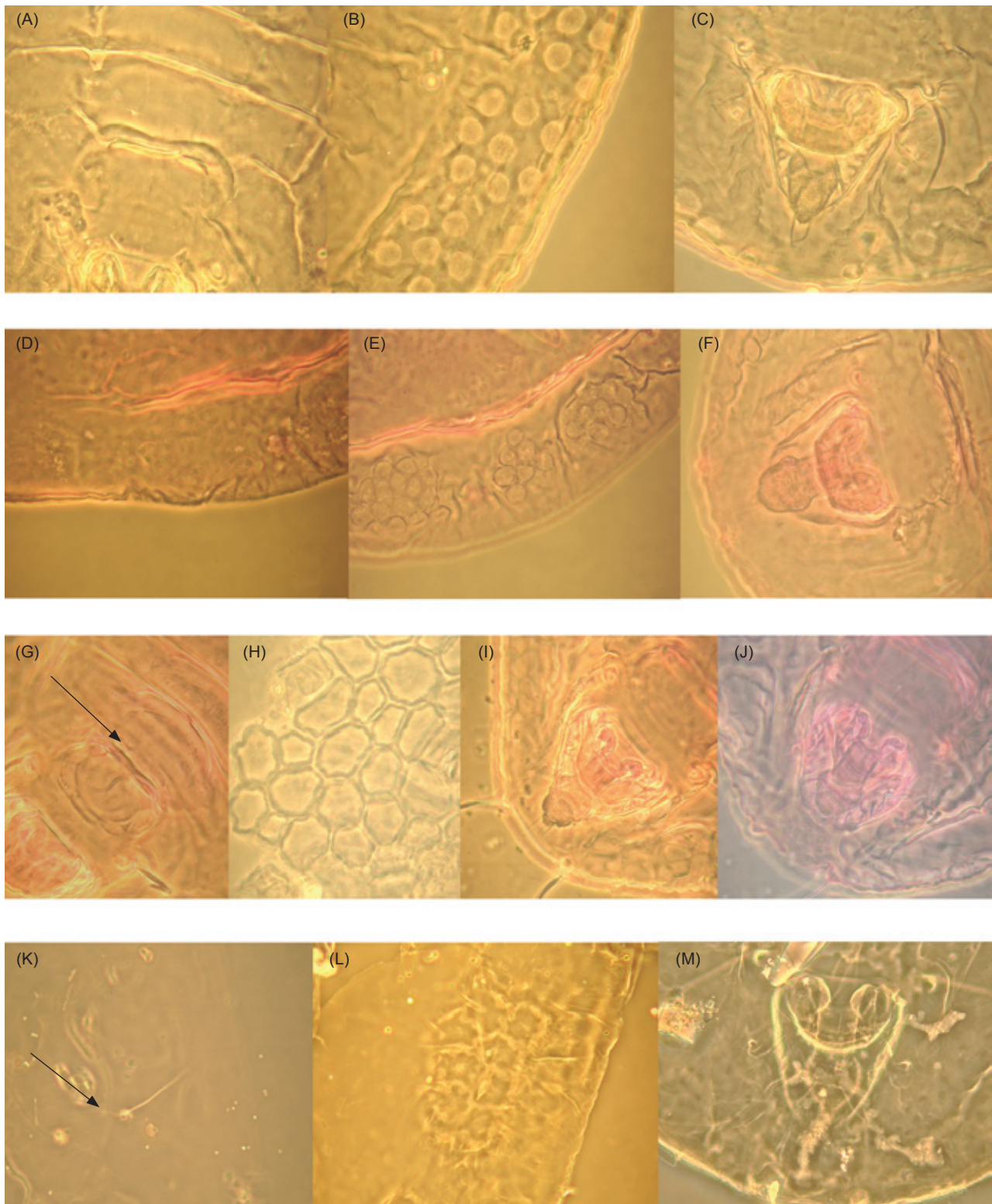


**Fig. 11.** Syntype puparium of *Lipaleyrodes phyllanthi* (A) dorsal and ventral views (digit 1 indicating the position of the submarginal setae), (B) margin, (C) legs and antenna, and (D) vasiform orifice and caudal furrow.





**Fig. 12.** Holotype puparium of *Lipaleyrodes vernoniae* (A) dorsum (digits 1-10 indicating the position of the submarginal setae), (B) margin, (C) wax plates, (D) legs and antenna, and (E) vasiform orifice and caudal furrow.



**Fig. 13.** Puparium of (A) holotype, *Lipaleyrodes euphorbiae*, 7th abdominal segment, (B) wax plates, (C) vasiform orifice, (D) paratype, *L. hargreavesi*, margin, (E) wax plates, (F) vasiform orifice, (G) syntype, *L. phyllanthi*, abdominal segment VII, (H) wax plates, (I) vasiform orifice, (J) vasiform orifice, (K) holotype, *L. vernoniae*, 1st abdominal seta, (L) wax plates, and (M) vasiform orifice.

**Comparative material examined:** TAIWAN, Tainan, 40 puparia, 12 ♀♀, 8 ♂♂ on 12 slides, on *Cucumis melon*, 25 July 2004, C.C. Ko (NTU).

***Bemisia vernoniae* (David and Thenmozhi)  
comb. nov.  
(Figs. 12A-E, 13K-M)**

*Lipaleyrodes vernoniae* David and Thenmozhi 1995: 346.

**Material examined:** Holotype, INDIA, Padappai, *Lipaleyrodes vernoniae*, 1 puparium, *Vernonia cinerea*, 21 Jan. 1993, K. Thenmozhi (IDAV). Paratypes, INDIA, Padappai, 5 puparia on 5 slides, data same as of for holotype (IDAV).

**Diagnosis:** This species resembles *B. phyllanthi* but differs from it in having 1st abdominal setae (in *B. phyllanthi*, there are no 1st abdominal setae), and a much-reduced 7th abdominal segment (in *B. phyllanthi*, the 7th abdominal segment is partially visible). It differs from *B. breyniae* by the presence of the 1st abdominal setae.

**Distribution:** India.

**Host plant:** Asteraceae (= Compositae): *Vernonia cinerea*.

**Note:** Mound and Halsey (1978) recorded *Lipaleyrodes* species from the Asteraceae (= Compositae), Euphorbiaceae, and Sapotaceae; Carver and Reid (1996) recorded it from *Euphorbia heterophylla*, *E. hirta*, *Euphorbia* sp., and *Sonchus oleraceus*.

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