

## SYSTEMATICS, MORPHOLOGY AND PHYSIOLOGY

Synonymy of *Plotococcus* Miller & Denno with *Leptococcus* Reyne, and Description of a New Species from Colombia (Hemiptera: Pseudococcidae)

TAKUMASA KONDO AND PENNY J. GULLAN

Dept. Entomology, University of California, 1 Shields Avenue, Davis, CA 95616-8584, USA  
 takumasa.kondo@gmail.com, pjgullan@ucdavis.edu

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Sinonímia de *Plotococcus* Miller & Denno com *Leptococcus* Reyne, e Descrição de uma Nova Espécie da Colombia (Hemiptera: Pseudococcidae)

RESUMO - *Plotococcus* Miller & Denno é sinonimizado com *Leptococcus* Reyne. O gênero é rediagnosticado é a espécie tipo, *L. metroxyli* Reyne, é diagnosticada e ilustrada. Todas as espécies até agora incluídas em *Plotococcus* são transferidas a *Leptococcus* como: *L. capixaba* (Kondo), comb. nov., *L. eugeniae* (Miller & Denno) comb. nov., *L. hambletoni* (Kondo) comb. nov., *L. minutus* (Hempel) comb. nov., é *L. neotropicus* (Williams & Granara de Willink) comb. nov. Uma nova espécie de *Leptococcus*, *L. rodmani* Kondo sp. n., coletada nas folhas do *Guarea guidonia* (Meliaceae) na Colômbia, é descrita e ilustrada com base na fêmea adulta. Uma chave revisada para todas as espécies no gênero é fornecida.

PALAVRAS-CHAVE: *Guarea guidonia*, Meliaceae, praga, chave taxonômica

ABSTRACT - *Plotococcus* Miller & Denno is synonymized with *Leptococcus* Reyne (Coccoidea: Pseudococcidae). The genus is redescribed and the adult female of the type species, *L. metroxyli* Reyne, is redescribed and illustrated. All species hitherto included in *Plotococcus* are transferred to *Leptococcus* as *L. capixaba* (Kondo) comb. nov., *L. eugeniae* (Miller & Denno) comb. nov., *L. hambletoni* (Kondo) comb. nov., *L. minutus* (Hempel) comb. nov., and *L. neotropicus* (Williams & Granara de Willink) comb. nov. A new species of *Leptococcus*, *L. rodmani* Kondo sp. n., from leaves of *Guarea guidonia* (Meliaceae) from Colombia, is described and illustrated based on the adult female. A revised key to adult females of all species in the genus is provided.

KEY WORDS: *Guarea guidonia*, Meliaceae, pest, taxonomic key

A mealybug species recently collected in Cali, Colombia, on *Guarea guidonia* (L.) Sleumer (Meliaceae) by the first author was identified as an undescribed species in the genus *Plotococcus* Miller & Denno using the keys to mealybugs of Central and South America by Williams & Granara de Willink (1992). During the identification process, all available specimens and descriptions of morphologically similar genera and species were examined.

There were no consistent morphological features by which the genus *Plotococcus*, hitherto known from five species in the New World (Miller & Denno 1977, Williams & Granara de Willink 1992, Kondo *et al.* 2005), could be distinguished from the genus *Leptococcus* Reyne, known from four species in New Guinea, Fiji and southern Asia (Williams & Watson 1988, Williams 2004). The adult females of both genera have unusually long antennae and legs relative to their body size and live on the surfaces of leaves. Nymphs and adult females are very active when disturbed and there are no records of honeydew production or of ant attendance, suggesting that they may be parenchyma rather than phloem feeders (Williams 2004, Kondo *et al.* 2005).

When erecting the genus *Plotococcus* for *P. eugeniae* Miller & Denno from Florida, U.S.A., Miller & Denno (1977) discussed the relationship of *P. eugeniae* with two morphologically similar species, *Leptococcus metroxyli* Reyne from Papua New Guinea and *Macrocephalococcus loranthei* Morrison from Guyana. They distinguished *Plotococcus* from *Leptococcus* by the presence of anterior ostioles on the adult female of the type species of *Leptococcus*, *L. metroxyli*, and their absence in *P. eugeniae*. They differentiated the adult females of *P. eugeniae* and *L. metroxyli* from that of *M. loranthei* by the presence in the latter of cerarii with trilocular pores closely appressed to cerarian setae forming a basal plate (trilocular pores loosely associated with cerarii in *P. eugeniae* and *L. metroxyli*). After comparing the nymphs, adult females and adult males of the three species, they concluded that these species were not closely related and that their similar external morphology was probably a result of convergent evolution. After studying the adult males, Miller & Denno (1977) concluded that *P. eugeniae* was closer to *L. metroxyli* than to *M. loranthei*, with *M. loranthei* being quite different from the other two species, by having one-segmented tarsi

and lacking tail-forming pore clusters and multilocular derm pores (features present in *P. eugeniae* and *L. metroxyli*). However, Miller & Denno (1977) also concluded that *P. eugeniae* and *L. metroxyli* were not closely related, and that according to the adult male morphology, *P. eugeniae* belonged to the "Planococcus group" and *Leptococcus* to the "Pseudococcus group" following a classification based on adult males proposed by Afifi & Kosztarab (1967) and Afifi (1968). They could not place *Macrocepicoccus* into any male-based mealybug group.

In contrast to the above hypothesis of relationships based on the adult males, molecular studies of the genes 18S, 28S, and EF1 $\alpha$  have shown a sister relationship between *P. eugeniae* and *M. loranthe* (N.B. Hardy & P.J. Gullan, unpublished data). Thus, if *Plotococcus* and *Macrocepicoccus* are closely related, then *Leptococcus* almost certainly is related to *Plotococcus*. Furthermore, the presence or absence of anterior ostioles, that distinguishes adult females of the type species of *Leptococcus* and *Plotococcus*, does not consistently distinguish other species in these genera; all four *Leptococcus* species possess anterior ostioles but two of the six known New World species do as well.

Here we follow a hypothesis of relationship based on adult females and synonymize *Plotococcus* with the older name *Leptococcus*. We provide a revised generic description for *Leptococcus* to include the morphological variation of both New World and Old World species. We include a key to all species, diagnose and illustrate the adult female of the type species *L. metroxyli* and describe and illustrate the adult female of the new *Leptococcus* species from Colombia.

## Materials and Methods

The description of the new species was based on multiple specimens mounted on glass slides. Material studied is listed as the number of glass slides with the total number of specimens and the growth stage in parentheses, e.g., one slide with two specimens, of which one is an adult female and one is an immature insect is represented as follows: 1 (2: 1 adult female + 1 immature). This is followed by the collection data and the depositories in parentheses. The growth stage is not specified when all specimens on the slide(s) are adult females. Measurements were made using an ocular micrometer in a compound microscope. The drawing shows the venter depicted on the right side and the dorsum shown on the left side of the illustration. Important features of the specimen are enlarged to the side of the illustration, however they are not drawn in proportion to each other. The terms used to describe these pseudococcids largely follow those of Williams and Granara de Willink (1992). The plant host of *Leptococcus* sp. n. was kindly identified by Dr. Alba Marina Torres from Universidad del Valle, Cali, Colombia.

All specimens studied have been deposited in one of the following institutions: BME: the Bohart Museum of Entomology, Department of Entomology, University of California, Davis, California; MNHN: Museum National d'Histoire Naturelle, Paris, France; UNCB: Coleccion de Insectos, Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá D.C., Colombia; USNM:

United States National Museum of Natural History Coccoidea Collection, Beltsville, Maryland, U.S.A.; UVCO: Universidad del Valle, Cali, Colombia.

## Taxonomy of *Leptococcus* Reyne

Type species: *L. metroxyli* Reyne, by monotypy and original designation.

*Leptococcus* Reyne, 1961: 145. Morrison & Morrison 1966, Miller & Denno 1977, Williams & Watson 1988, Ben-Dov 1994, Williams 2004.

*Plotococcus* Miller & Denno, 1977: 146. Type species: *Plotococcus eugeniae* Miller and Denno, by original designation. Williams & Granara de Willink 1992, Kondo *et al.* 2005.

**Diagnosis** (adapted from Williams 2004 and Kondo *et al.* 2005). Body of adult female elongate oval to broadly oval, 0.7-3.0 mm long, 0.3-1.2 mm wide, apex of abdomen slightly protruding. Antennae and legs unusually long in relation to size of body; antennae each with eight or nine segments. Trochanter with long distal trochanteral seta. Claws long and slender without a denticle. Translucent pores present on either hind coxae or on hind tibiae only. Cerarii numbering seven to 17 pairs, either all of the complex type, or a combination of complex and simple types: (1) complex cerarii with two or three conical setae, auxiliary setae and usually numerous trilocular pores either present on all body segments or confined to anal lobes or anal lobes plus penultimate segment; (2) simple cerarii composed of one or two conical to narrowly conical to slender setae with a few trilocular pores and lacking auxiliary setae. Body setae slender, with elevated bases. Multilocular disc pores present, sometimes on venter only, often of two or three sizes. Trilocular pores present in cerarii, scattered on dorsum or associated with dorsal setae; on venter either absent or restricted to body margins. In *L. capixaba* (Kondo), *L. minutus* (Hempel), and *L. rodmani* Kondo sp. n., an additional smaller type of trilocular pore is present in one, or rarely two, small groups on each side of labium. Oral rim tubular ducts present or absent, when present of one or two sizes, sometimes with indefinite and protruding rims. Oral collar tubular ducts, simple disc pores, and circulus, present or absent. Ostioles present in one or two pairs. Anal ring apical.

### *Leptococcus metroxyli* Reyne, adult female (Fig. 1)

**Material studied.** *L. metroxyli*. One slide, one specimen, 1.80 mm long, 0.95 mm wide (BME). Netherlands New Guinea, Frederik Hendrik Island, (now Indonesia, West Papua, Pulau Yos Sudarso Island), Kalilain, iv.1957, coll. E.W. v. Heurn, No. 54, ex Sago Palm. [Although the specimen is not labeled as Type material, its collection data matches that listed in the material studied in the original description by Reyne, 1961.]

**Redescription** (adapted from Williams & Watson 1988). Body elongate, 1.80-2.20 mm long, 0.95-1.20 mm wide; anal lobes poorly developed, each with apical seta up to 105

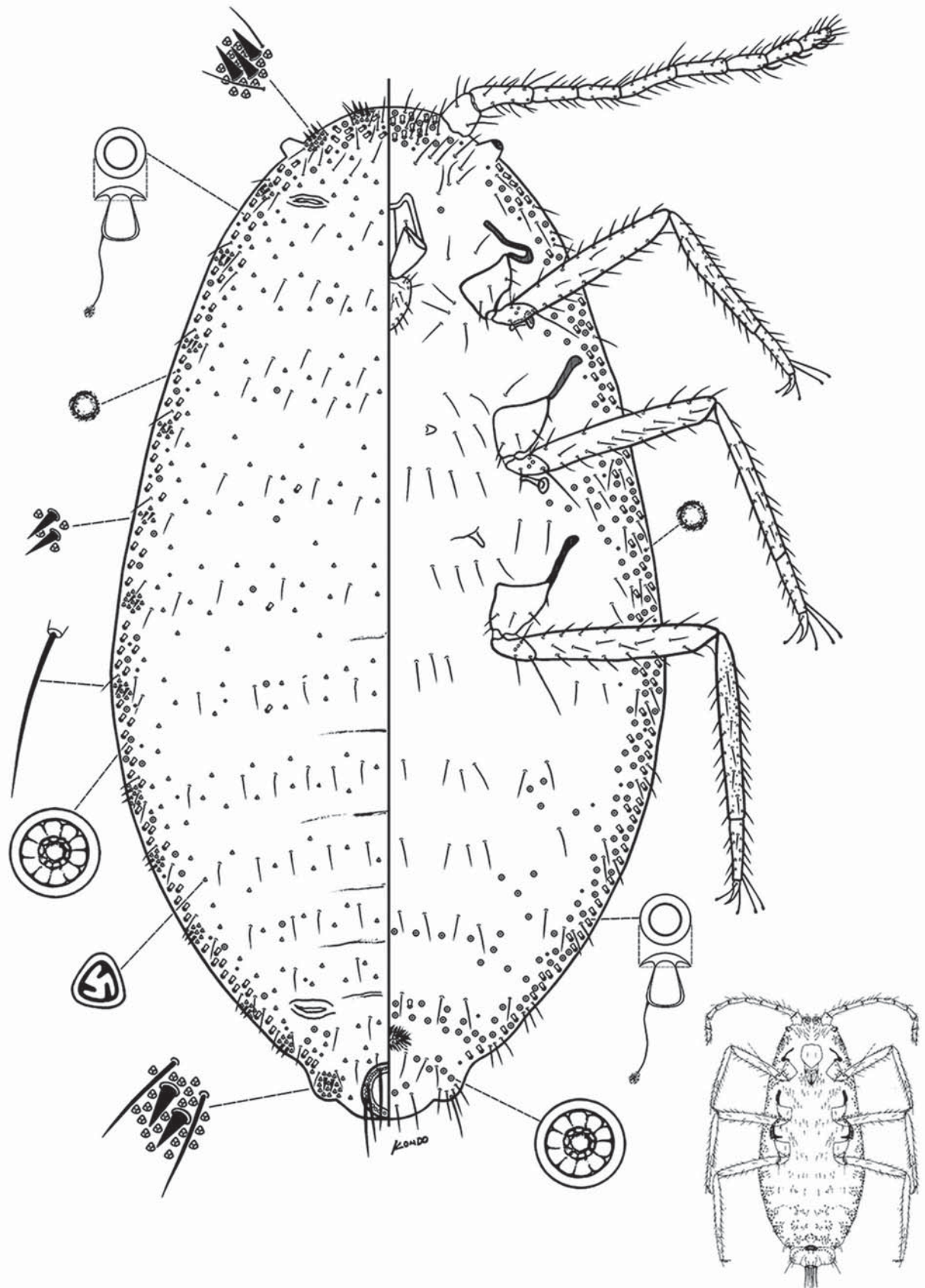


Fig. 1. *Leptococcus metroxyli* Reyne, adult female. Inset showing ventral side of a young adult female (adapted from Williams & Watson 1988).



µm long. Antennae each with nine segments, usually long. Legs slender, long in comparison to size of body. Hind tibia with translucent pores. All tarsal and claw digitules knobbed, subequal in length. Labium shorter than clypeolabral shield. Circulus absent. Anterior and posterior ostioles present, without setae on lips and with only occasional trilocular pores. Cerarii numbering 14-16 pairs, each mostly with two conical setae, 2-4 auxiliary setae and a few trilocular pores, all on a slightly sclerotized area; some cerarii on head with three conical setae and others on thorax may be reduced to one conical seta, with a single auxiliary seta and very few trilocular pores. Dorsal surface with flagellate setae. Trilocular pores in an even distribution, but absent from intersegmental areas. Multilocular pores few, present around margins and occasionally on submarginal and submedial areas. Discoidal pores minute, present around margins. Tubular ducts of a modified oral rim type, each with the rim flat and inconspicuous, present on margins and forming submedian lines on head, thorax and anterior abdominal segments. Ventral surface with normal flagellate setae. Trilocular pores absent. Multilocular disc pores on median areas of posterior abdominal segments and around margins towards head. Discoidal pores similar to those on dorsum, present on margins and submargins. Tubular ducts each with obscure rim or without rim, as on dorsum, present around margins and represented by one or two on median area of segment 7.

**Key to the Species of *Leptococcus* Based on Adult Females**  
(adapted from Williams & Watson 1988, Williams & Granara de Willink 1992, Williams 2004, Kondo *et al.* 2005)

1. Complex cerarii present only on anal lobe and or anal lobe and penultimate cerarius, rest of cerarii each with one or two conical to narrowly-conical to slender setae, with one or two trilocular pores and lacking auxiliary setae. Translucent pores present on hind coxae only.....2  
– All cerarii complex, with conical setae, auxiliary setae and usually numerous trilocular pores. Translucent pores present on hind tibiae only.....5
2. Complex cerarii present on last two abdominal segments, with those on other abdominal segments composed of single conical seta and one or two trilocular pores. Large multilocular pores with a protruding central locus.....*hambletoni* (Kondo), comb. nov.  
– Complex cerarii present only on anal lobes, rest of cerarii composed of one or two slender setae and a few trilocular pores. Large multilocular pores without a protruding central locus.....3
3. Ventral multilocular disc pores around spiracular openings about half size of other pores on thorax, ratio of width of smaller pores around spiracles to other pores on thorax 0.50-0.67. Dorsal multilocular disc pores scattered throughout dorsum and present near margin. Anterior ostioles absent.....*minutus* (Hempel), comb. nov.  
– Ventral multilocular disc pores around spiracular openings about same size as other pores on thorax or only slightly smaller, ratio of width of pores around spiracles to other pores on thorax 0.80-1.00. Dorsal multilocular disc pores rather

few, present or absent from body margin. Anterior ostioles present or absent.....4

4. Ventral multilocular disc pores on mid areas of abdomen abundant, in one or two rows, present in transverse rows on abdominal segments III-VIII. Anterior ostioles absent.....*capixaba* (Kondo), comb. nov.  
– Ventral multilocular disc pores on mid areas of abdomen few, totalling 0-6 on median areas of each segment, always in one row, present on abdominal segments IV-VIII or V-VIII. Anterior ostioles present, vestigial.....*rodmani* Kondo, sp. nov.

5. Antennae 8 segmented. Multilocular disc pores scarce, confined to area around vulva only.....6  
– Antennae 9 segmented. Multilocular disc pores numerous, present on head, thorax and abdomen.....7

6. Oral rim tubular ducts present on ventral margins in considerable numbers, extending to submedial areas of abdomen and submarginal areas of head and thorax. Oral collar tubular ducts absent.....*sakai* (Takahashi)  
– Oral rim tubular ducts either absent from ventral margins or present around margins only. Oral collar tubular ducts present on abdomen, few.....*tanycnemus* Williams

7. Circulus present. Ventral multilocular disc pores present on mid areas of head and thorax.....8  
– Circulus absent. Ventral multilocular disc pores scarce or absent from mid areas of head and thorax.....9

8. Multilocular disc pores present on dorsum. Cerarii numbering 17 pairs. Circulus notched at each side.....*neotropicus* (Williams & Granara de Willink), comb. nov.  
– Multilocular disc pores absent from dorsum. Cerarii numbering 13 or 14 pairs. Circulus round, not notched.....*grallator* Williams & Watson

9. Anterior ostioles present. All multilocular pores of one size class only. Multilocular disc pores and oral rim tubular ducts present on dorsum, especially around margins.....*metroxyli* Reyne  
– Anterior ostioles absent. Multilocular pores of two size classes, those on inner areas of venter smaller than those present around margins. Multilocular disc pores and oral rim tubular ducts absent from dorsum.....*eugeniae* (Miller & Denno), comb. nov.

***Leptococcus rodmani* Kondo sp. n.**

**Suggested common names.** English: Rodman's mealybug; Portuguese: cochonilha de Rodman; Spanish: cochinilla harinosa de Rodman.

**Type material.** Holotype: adult ♀, Colombia: Valle, Cali, Club Campestre Comfandi, 03°18'23.2"N, 76°32'11.9"W, 1013 mts asl, 9.ii.2007, Takumasa Kondo, ex *Guarea guidonia* (L.) Sleumer, (Meliaceae), 1(1), (USNM). Paratypes: same data as Holotype, 24(22 adult females + 14 immatures) (USNM); 2(6) (UNCB); 3(9)(BMNH); 1(6)(UVCO); 2(4) (MNH).

**Diagnosis of adult female.** Small, with relatively long legs and antennae compared to body size. Antennae 8 segmented. Anal lobe cerarii complex, with two enlarged conical setae, several auxiliary setae and a cluster of trilocular pores; rest of cerarii simple, composed of two setae (rarely one) and one or two trilocular pores; head region with a pair of cerarii located submarginally, just posterior to frontal cerarius. Multilocular pores on venter and dorsum of one size class only. Trilocular pores on dorsum scarce; those on venter different in shape and size to pores on dorsum, present in one or two small groups lateral to labium and associated with two or more setae. Anterior ostioles vestigial, membranous (often hard to detect); posterior ostioles rather well developed.

*Leptococcus rodmani* differs from other species of *Leptococcus*, by having complex cerarii in the anal lobe only, a feature only shared with *L. capixaba* and *L. minutus*. *Leptococcus rodmani* is most similar to the Brazilian species, *L. capixaba* and the two species can be easily separated from *L. minutus* by the presence of very small multilocular disc pores around the spiracles in the latter. *L. rodmani* can be separated from *L. capixaba* by the following features (character states of *L. capixaba* in parentheses): (i) much larger body size, 1.2-1.5 mm long (0.7-0.8 mm); (ii) anterior ostioles present (absent); (iii) ventral multilocular disc pores on mid areas of abdomen few, present on segments IV-VIII or V-VIII (ventral multilocular disc pores on mid areas of abdomen abundant, present on segments III-VIII); and (iv) trochanter of hind legs with smooth round apical protrusion (with rectangular to quadrate, often bifid protrusion).

#### Description of adult female (Figs. 2A,B & 3).

**Live appearance.** Insects found on the underside of leaves, very active when disturbed; adult females intermixed with adult males and other growth stages. Adult females pink to yellowish green in color, covered in a white cottony, somewhat loose secretion, with two long waxy caudal filaments, each filament as long as or longer than the body

length. Immature insects yellow to yellowish green, generally with very little wax, but with a well-developed pair of terminal filaments.

**Slide-mounted features (n = 31).** Body small, elongate oval, 1.2-1.5 mm long, 0.5-0.6 mm wide, abdominal apex protruding, with well-developed anal lobes; segmentation pronounced on abdominal segments. Antennae each 580-650  $\mu$ m long, with eight segments; apical segment longest, 113-118  $\mu$ m long, 23-26  $\mu$ m wide. Legs long and slender; hind trochanter + femur 300-330  $\mu$ m long; hind femur 43-45  $\mu$ m wide; hind tibia + tarsus 345-370  $\mu$ m long; tarsal digitules 55-58  $\mu$ m long; claw long and slender, 25-28  $\mu$ m long, about 8  $\mu$ m wide at base, claw digitules 38-40  $\mu$ m long; claw denticle absent. Prothoracic tarsal digitules, one knobbed and the other spiniform: knobbed digitules each 50-55  $\mu$ m long, spiniform digitules each 14-18  $\mu$ m long; mesothoracic claw and tarsal digitules both knobbed, similar in length to those of metathoracic legs. Ratio of length of hind trochanter + femur to width of femur 7.00-8.25; ratio of lengths of hind tibia + tarsus to hind trochanter + femur 1.09-1.16; ratio of lengths of hind tibia to tarsus 2.5-2.6. Translucent pores present on hind coxa only. Apex of hind trochanter often with a rounded protuberance. Spine-like setae present at distal end of tibiae and on tarsi. Clypeolabral shield 105-115  $\mu$ m long, 95-105  $\mu$ m wide. Labium 3-segmented, but segmentation indistinct, 53-60  $\mu$ m long, 58-65  $\mu$ m wide; labial setae as follows: two or three pairs on basal segment, one pair on second segment, 6-7 pairs on apical segment. Spiracular peritremes 15-16  $\mu$ m wide, 30-43  $\mu$ m long. Circulus absent. Ostioles: anterior pair poorly developed, membranous and bare, often hard to detect; posterior pair represented as sclerotized slits, lacking pores and setae. Anal ring 63-75  $\mu$ m wide, with six setae, each about 113-130  $\mu$ m long. Anal lobe seta 105-118  $\mu$ m long, accompanied by 1-3 short, hair-like ventral setae. Cerarii numbering 17 pairs, including one pair located submarginally on head. Anal lobe cerarii each with two enlarged conical setae, each 23-25  $\mu$ m long, about four auxiliary setae and a

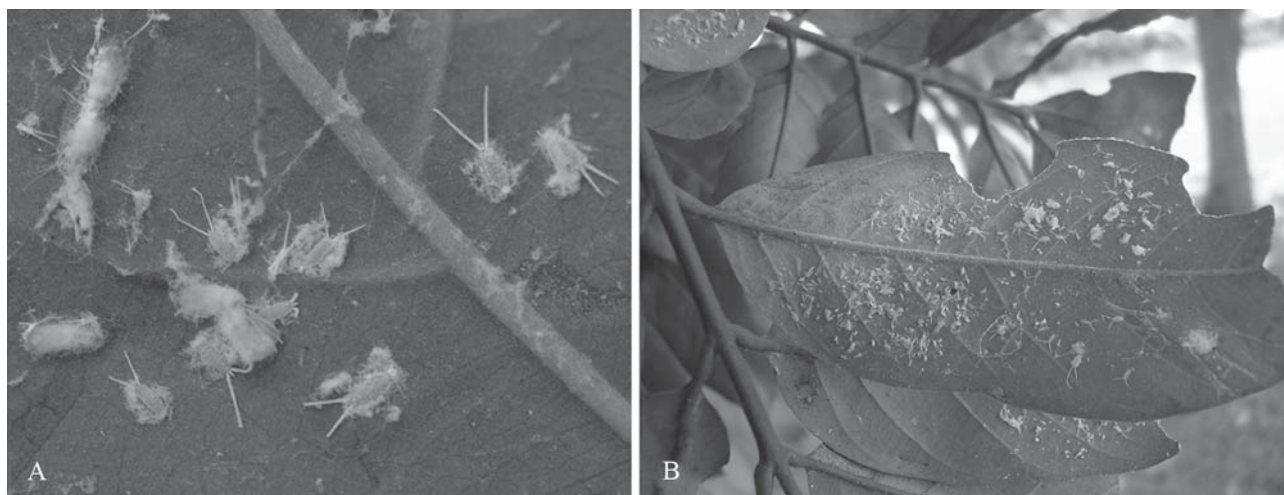


Fig. 2. A. Close-up of *L. rodmani* Kondo sp. n. showing male puparia (mostly towards left side) and several adult females (notice the two long terminal waxy filaments with a shorter median filament produced by the anal ring). B. Typical infestation of *L. rodmani* on underside of leaves of *Guarea guidonia* (photographs by T. Kondo).

Fig. 3. *Leptococcus rodmani* Kondo, adult female.



group of trilocular pores, all on an oval slightly sclerotized area. Anterior cerarii each with two small narrowly conical setae or occasionally one seta, each about 7.5-10.0  $\mu\text{m}$  long, accompanied by 1-2 trilocular pores, auxiliary setae lacking; setae of frontal cerarii and submarginal cerarii on head slightly thicker than other cerarii, 10-13  $\mu\text{m}$  long. Eyespots present on margin, each on a protuberance just posterior to antennal scape, 25-30  $\mu\text{m}$  wide at widest point.

Dorsal surface with small sharply spinose setae, each 7.5-10.0  $\mu\text{m}$  long, scattered or in irregular transverse rows on head and thorax, in a segmental transverse row on each abdominal segment. Trilocular pores scarce, scattered throughout dorsum, each pore about 3  $\mu\text{m}$  in diameter. Multilocular disc pores, each 9.0-10  $\mu\text{m}$  in diameter, few, scattered on head, in irregular rows on thorax, in more or less single rows at posterior edges of abdominal segments, absent or very few on margins and submargins. Discoidal pores not detected on dorsum. Oral collar tubular ducts small, about 2  $\mu\text{m}$  wide, 4  $\mu\text{m}$  long, present in more or less single transverse rows on abdominal and thoracic segments, scarce and scattered on head. Microtrichia present on medial to submedial area of each abdominal segment.

Ventral surface with slender setae, each seta with an elevated setal collar; setae shortest on abdomen, 17-25  $\mu\text{m}$  long; 25-50  $\mu\text{m}$  long on thorax; 50-70  $\mu\text{m}$  long on head. Derm on ventral submargin often rugose on abdomen, but smooth on some specimens. Trilocular pores absent from venter except for one, or rarely two small groups of 5-10 trilocular pores next to labium associated with 5-7 setae; each pore about 2  $\mu\text{m}$  wide, different in shape and size from trilocular pores on dorsum. Multilocular disc pores of one size class only; each 8-10  $\mu\text{m}$  in diameter, very scarce on mid-ventral areas: usually with none or one pore (rarely two pores) on segment IV, and 2-6 pores on mid areas of each of abdominal segments V-VIII; pores abundant marginally or submarginally around body. Ratio of smallest to largest multilocular disc pores 0.80. Discoidal pores few, small, each 2.0  $\mu\text{m}$  in diameter, present on marginal and submarginal areas of abdomen, with an occasional pore on margins of thorax and head. Oral collar tubular ducts, same as on dorsum, in a transverse row on each of abdominal segments III-VIII, in a submedial cluster on metathorax and abdominal segment I medial to hind leg, and in a marginal zone mingled with multilocular disc pores. Microtrichia present on medial to submedial area of each abdominal, mesothoracic and metathoracic segment.

**Etymology.** The mealybug is named after plant taxonomist Dr. James E. Rodman, former director of the systematics section of the National Science Foundation, who through

his efforts in advancing the Partnerships for Enhancing Expertise in Taxonomy (PEET) program has helped the field of coccidology.

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