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Studies on mealybugs (Hemiptera: Pseudococcidae) in Indonesia, with description of a new species and three new country records

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Abstract

Pseudococcid mealybugs (Hemiptera: Coccomorpha: Pseudococcidae) include economically important insect pests worldwide; however, little is known about the species present in Indonesia. Samples were collected and identified from wild and cultivated plants in several regions of southern Sumatra, Indonesia between 2018 and 2020. Eighteen species of Pseudococcidae in 8 genera were identified, including one undescribed species and new host plants. *Dysmicoccus zeynepae* Zarkani & Kaydan **sp. n.** is described and illustrated based on the morphology of the adult female, and a key is provided for the identification of all 18 species. Furthermore, *Dysmicoccus arachidis* Williams, *D. carens* Williams and *Pseudococcus leptotrichotus* Williams are recorded for the first time from Indonesia; new locality and host-plant data are given for these species.

Key words: Biodiversity, host plant, pests, Sternorrhyncha, taxonomy

Introduction

As presently understood, the scale insects (Hemiptera: Coccomorpha) include three families of mealybugs: Pseudococcidae, Rhizoecidae and Xenococcidae (Choi & Lee 2022). The pseudococcid mealybugs (Pseudococcidae) include many important sap-sucking insect pests of woody and herbaceous plants. The insects not only damage their host plants directly, by mechanical injury and extraction of sap, but often also indirectly by promoting sooty mold growth on their sugary honeydew waste and sometimes by facilitating the transmission of plant virus diseases (Franco *et al.* 2009, Daane *et al.* 2012).

The Pseudococcidae, with 2041 species in 259 genera, is the second largest scale insect family after the Diaspididae, which contains about 2693 species in 418 genera (García Morales *et al.* 2016). In the Indonesian archipelago, 108 species of Pseudococcidae in 31 genera have been recorded so far, the second-largest family after the Diaspididae, which has 118 species in 46 genera recorded (García Morales *et al.* 2016). In the family Pseudococcidae, the most species-rich and damaging genera in Indonesia are: *Rastrococcus* Ferris (15 species), *Pseudococcus* Westwood (13 species), *Paraputo* Laing (13 species), *Dysmicoccus* Ferris (9 species), and *Planococcus* Ferris (7 species) (Williams 2004; García Morales *et al.* 2016).

As a tropical country located along major sea lanes connecting East Asia, South Asia and Oceania, it is not surprising that Indonesia has a very large number of indigenous plants, vertebrates and invertebrates including great insect biodiversity (McNeely *et al.* 1990; CBD Secretariat 2021). The first documentation of Indonesian insect diversity, including mealybugs in Indonesia began in the British, Dutch and Japanese colonial eras and has continued to the present, resulted in the description of many new Indonesian native species and several additional records to the scale insect fauna (Dammerman 1929; Reyne 1954, 1957, 1961, 1965; Wirjati 1958, 1959; Kalshoven 1981; Muniappan *et al.* 2008, 2011, 2012; Sartiami *et al.* 2015, 2016; Gavrilov-Zimin 2013, 2016, 2017, 2019, 2020,

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Abstract

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As a tropical country located along major sea lanes connecting East Asia, South Asia and Oceania, it is not surprising that Indonesia has a very large number of indigenous plants, vertebrates and invertebrates including great insect biodiversity (McNeely *et al.* 1990; CBD Secretariat 2021). The first documentation of Indonesian insect diversity, including mealybugs in Indonesia began in the British, Dutch and Japanese colonial eras and has continued to the present, resulted in the description of many new Indonesian native species and several additional records to the scale insect fauna (Dammerman 1929; Reyne 1954, 1957, 1961, 1965; Wirjati 1958, 1959; Kalshoven 1981; Muniappan *et al.* 2008, 2011, 2012; Sartiami *et al.* 2015, 2016; Gavrilov-Zimin 2013, 2016, 2017, 2019, 2020,

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2021; and Zarkani *et al.* 2020, 2021a, b). However, the only comprehensive review of mealybugs recorded from Indonesia is in the monograph by Williams (2004). In the last 16 years the number of described scale insect species recorded in Indonesia has increased by 53 species (García Morales *et al.* 2016) but the knowledge of Indonesian scale insect species is still patchy and incomplete.

The present paper covers a new species and three new country records of Pseudococcidae from Indonesia. Identification keys to genera and *Dysmicoccus* species, and new locality records for the currently known Pseudococcidae species, are provided and discussed.

Materials and methods

Mealybugs (nymphs and adult females) were collected from tropical plants in several regions of southern Sumatra, Indonesia between April 2018 and October 2020. Infested plant parts were cut, bagged, labeled and taken to the Laboratory of Plant Protection, University of Bengkulu for examination. For species determination, nymphs were reared on the relevant plant material (at 25 ± 1 °C, ~70% relative humidity and of 16:8 h light: dark photoperiod) until they reached the adult stage. A binocular dissection microscope, Leica EZ4HD, was used to sort specimens for preservation and slide mounting. Specimens were killed, labled and stored in 70% ethyl alcohol.

Adult female specimens were slide-mounted using the method of Kosztarab and Kozár (1988) with some modifications (using distilled water after KOH and cleaning the specimens using a fine brush). They were identified by light microscopy using a phase-contrast compound microscope (Olympus BX41) and were identified using the keys in Cox and Ben-Dov (1986), Williams (2004), Granara de Willink and Szumik (2007), Granara de Willink (2009), and Kaydan and Gullan (2012).

For description of the new species, the main taxonomic characters of the adult females were evaluated and quantified under a compound light microscope. The morphological terms used are those used by Williams and Granara de Willink (1992) and Williams (2004). All the measurements given are for the maximum dimensions (e.g., body width was recorded at the widest part) and are expressed as ranges. Tarsal length excludes the claw. Setal length includes the setal base. Cerarii are numbered with cerarius C_1 on the head, anterior to the antenna, and cerarius C_{17} being on abdominal segment VIII. A taxonomic illustration is provided for new species, and is based on the holotype used for the description. The illustration is split longitudinally, with the left half representing the dorsum and the right half, the venter. Structural details are shown as enlargements around the central drawing, and are not all drawn to the same scale. The translucent pores on the hind legs are mostly found on the dorsal surface, but they are illustrated ventrally on the main figure for convenience.

Type specimens of the new species described are deposited in the Mealybugs Museum, Department of Plant Protection, Faculty of Agriculture, University of Bengkulu, Bengkulu, Indonesia (MMUB). In Material examined, the holotype data is listed as it is written on the slide label, with "/" used to indicate line breaks on the slide labels).-

Results and discussion

Since Williams (2004) provided a key to the mealybug genera of southern Asia, an additional genus (*Komodesia* Gavrilov-Zimin) has been described from Indonesia (Gavrilov-Zimin 2016). A key to the 31 mealybug genera found in Indonesia is therefore provided below.

Key to adult females of mealybug genera occurring in Indonesia

(adapted from Williams and Watson (1988), Williams and Granara de Willink (1992) and Williams (2004). The genera mentioned below all belong to the Pseudococcidae unless otherwise indicated).

1(0) Legs present 4
- Legs absent. 2
2(1) Anal ring normally situated on body surface or at base of very short tube, bearing at least 6 setae. Venter with duct-like pores in a group posterior to each second spiracle. Ventral disc-like pores absent from abdomen . . . . . *Chaetococcus* Haskell
- Anal ring situated at base of anal tube, normally bearing 6 setae (rarely without setae). Venter without duct-like pores posterior

to each second spiracle, but disc-like pores or very short, button-like microtubular ducts present in this position, sometimes also in a wider distribution on submedian to submarginal areas of abdomen 3

3(2) Circuli numbering 5. Very short, button-like microtubular ducts present posterior to each second spiracle; disc-like pores absent from this position . . . . . *Komodesia* Gavrilov-Zimin

- Circuli numbering 0–1. Disc-like pores present behind each second spiracle; short, button-like microtubular ducts absent from this position, sometimes also in a wider distribution on submedian to submarginal areas of abdomen . . . . . *Antonina* Signoret

4(3) Claw digitules each expanded widely, either from proximal end or nearer to distal end 5

- Claw digitules either setose or only minutely dilated distally 8

5(4) Antennae each with 8 segments . . . . . *Archeomyrmococcus* Williams

- Antennae each with 6 or 7 segments 6

6(5) Constriction present between head and thorax. Head sclerotized at anterior end, at least on venter. Each anterior ostiole with posterior lip larger than anterior lip, usually semi-circular and flap like, often bearing a few short setae . . . . . *Malaicoccus* Takahashi

- Constriction absent from between head and thorax. Head membranous on venter, except sometimes for small areas of sclerotization around basal antennal segments. Each anterior ostiole with posterior and anterior lips about same size, without any setae 7

7(6) Posterior of abdomen fork-like, with anal lobes prominent and elongate . . . . . *Dicranococcus* Williams

- Posterior of abdomen pointed; anal lobes poorly developed, recognisable by presence of apical setae . . *Hippeococcus* Reyne

8(4) Dorsal tubular ducts large, each with orifice surrounded by a circular, sclerotized area containing 1 or more setae within its borders or just adjacent to the rim . . . . . *Ferrisia* Cockerell

- Dorsal tubular ducts, if present, without this combination of characters 9

9(8) Cerarii always conspicuous, each containing numerous truncate-conical cerarian setae (each seta with apex flat) . . . . . *Rastrococcus* Ferris

- Cerarii, if present, containing cerarian setae with pointed apices, setae never truncate-conical 10

10(9) Recognisable cerarii absent 11

- Recognisable cerarii present, sometimes on anal lobes only 13

11(10) Dorsal ostioles usually represented by both anterior and posterior pairs, although sometimes poorly developed . . . . . *Crisicoccus* Ferris

- Dorsal ostioles represented by posterior pair only 12

12(10) Anal ring oval or triangular, situated on venter a short distance from apex of abdomen. Cephalothorax dilated. . . . . *Leptorhizoecus* Williams (family Rhizoecidae)

- Anal ring usually circular, rarely V-shaped, situated on dorsum. Cephalothorax not dilated . . . . . *Mollicoccus* Williams

13(10) Oral rim tubular ducts present, each with well-developed rim 14

- Oral rim tubular ducts absent 16

14(13) Cerarii numbering no more than 6 pairs, present on abdomen only, except for frontal cerarii occasionally present . . . . . *Maconellicoccus* Ezzat

- Cerarii numbering 9–18 pairs; present on abdomen and at least on thorax 15

15(14) Venter of each anal lobe with anal lobe bar; auxiliary setae present in anal lobe cerarii only . *Paracoccus* Ezzat & McConnel

Venter of each anal lobe with triangular to quadrate sclerotized area occupying much of lobe, never with a slender anal lobe bar only . . . . . *Pseudococcus* Westwood

16(13) Quinquelocular pores present, at least on venter; if only few present, these situated near mouthparts only . . . . *Brevennia* Goux

- Quinquelocular pores absent 17

17(16) Anal lobe cerarii large, occupying most or all of lobe, each bearing multiple cerarian setae dispersed over entire sclerotized area. Dorsal setae, at least on abdomen, thick, conical or lanceolate, each situated on membranous cuticle . . . . . *Lanceacoccus* Williams

- Anal lobe cerarii of various sizes, each bearing 2 or more cerarian setae situated on either on membranous or sclerotized cuticle; if on sclerotized cuticle, then cerarian setae occupying either marginal area of each lobe or area near centre, not dispersed over most of lobe. Dorsal setae all either slender or conical, if conical then sometimes situated on slightly sclerotized cuticle . . 18

18(17) Venter of each anal lobe sclerotized, with inner edge of sclerotized area thick, bar-like, extending antero-medially; bar-like structure not connected to apical seta or bar seta. Cerarii numbering 16–18 pairs, each cerarius bearing multiple setae; preocular cerarii (C_2) always present . . . . . *Exallomochlus* Williams

- Venter of each anal lobe membranous or sclerotized; if sclerotized, not as above. Cerarii numbering 1–18 pairs, each cerarius bearing varying numbers of setae; preocular cerarii (C_2) present or absent. 19

19(18) Anal lobe bars present, always associated with bar setae, each bar either complete from apical seta or only present forwards from bar seta (note: occasional specimens of *Formicococcus lingnani* Ferris may lack anal lobe bars) 20

- Anal lobe bars absent. Anal lobes either membranous or variously sclerotized 21

20(19) Some or all abdominal cerarii bearing more than 2 cerarian setae each (note: occasional specimens or *Formicococcus lingnani* Ferris may lack anal lobe bars). . . . . *Formicococcus* Takahashi

- Abdominal cerarii each bearing only 2 cerarian setae . . . . . *Planococcus* Ferris

21(19) Each eye associated with sclerotized patch containing discoidal pores, these pores sometimes as large as a multilocular disc pore; other similar disc pores also present, dispersed, at least on venter. Cerarii always numbering 18 pairs . . *Hordeolicoccus*

- If eyes are associated with discoidal pores then these are few, small and inconspicuous. Cerarii numbering 1–17 pairs 22

22(21) Some or most dorsal setae enlarged, conical to lanceolate, about same size as cerarian setae 23

- Dorsal setae either flagellate or conical to lanceolate, all noticeably slenderer than cerarian setae 25

23(22) Trilocular pores concentrated around setal collars of cerarian setae and enlarged dorsal setae, much smaller than trilocular pores elsewhere on body . . . . . *Pedrococcus* Mamet
- Trilocular pores all about same size 24
24(23) Enlarged dorsal setae each closely associated with trilocular pores . . . . . *Dorsocericoccus* Dong & Wu
- Enlarged dorsal setae not closely associated with trilocular pores . . . . . *Nipaecoccus* Šulc
25(22) Anterior margin of hind coxa indistinct; spiracles and leg bases situated much closer to margin than to midline . . . . . *Extanticoccus* Williams
- Anterior margin of hind coxa distinct; spiracles and leg bases situated submedially, about half way between margin and midline 26
26(25) Derm around hind coxa with numerous minute pores 27
- Derm around hind coxa without minute pores 28
27(26) Circulus large and strongly constricted, hour-glass-shaped. Derm around each hind coxa with numerous minute disc pores, in an area reaching almost as far forward as each posterior spiracle . . . . . *Saccharicoccus* Ferris
- Circulus smaller, square to oval, not strongly constricted. Derm around each hind coxa with numerous minute duct-like pores, these not extending as far forward as each posterior spiracle . . . . . *Palmicultor* Williams
28(26) Claw with denticle present . . . . . *Phenacoccus* Cockerell
- Claw without denticle. 29
29(28) Anal lobe bars present . . . . . *Mutabilicoccus* Williams
- Anal lobe bars absent 30
30(29) Cerarii numbering 8–17 pairs, always distinct, never with intermediate cerarii; preocular cerarii (C_2) always absent. Abdominal cerarii often bearing 2 conical setae each; ventral margin of penultimate abdominal segment never sclerotized. Hind tibia + tarsus usually longer than trochanter + femur. Anal ring usually situated at or near apex of abdomen. . . . . *Dysmicoccus* Ferris
- Cerarii numbering 5–18 pairs, intermediate cerarii often present or cerarii forming a continuous marginal zone; preocular cerarii (C_2) present. Abdominal cerarii often bearing more than 2 conical setae each; if with only 2 conical setae each, then ventral margin of penultimate abdominal segment always sclerotized. Hind tibia + tarsus usually shorter than trochanter + femur. Anal ring usually separated from apex of abdomen by at least its own length. . . . . *Paraputo* Laing

From 149 mealybug samples collected from southern Sumatra, Indonesia, 18 species were identified, one of which is a new to science and three are new country records for Indonesia. The identified species belong to the genera *Dysmicoccus* (5 species), *Ferrisia* (2 species), *Nipaecoccus* (1 species), *Palmicultor* (1 species), *Paracoccus* (1 species), *Planococcus* (2 species), *Pseudococcus* (3 species) and *Rastrococcus* (3 species). The species marked below with an asterisk (*) are recorded for the first time from Indonesia.

Genus *Dysmicoccus* Ferris

Type species: *Dactylopius brevipes* Cockerell by original designation.

Genus diagnosis (adapted from Williams, 2004). Body normally broadly oval, 1.65–4.20 mm long, 0.90–2.89 mm wide. Antennae each normally with 6–8 segments. Cerarii present, numbering 6–17 pairs (never 18), anal lobe cerarii each bearing either 2 cerarian setae or as many as 8, these usually conical, sometimes conical setae replaced by flagellate setae but cerarii always recognizable by concentrations of trilocular pores. Anterior cerarii each sometimes containing more than 2 setae. Circulus present or absent. Legs well developed, hind legs with translucent pores present or absent; tarsal digitules usually knobbed, occasionally setose. Claw usually stout, claw denticle absent. Anal lobes usually developed, either membranous or sclerotized, each lobe bearing a normal apical seta. Ventral margin of abdominal segments anterior to anal lobes always membranous. Anal ring normally situated at apex of abdomen (rarely a short distance from apex), usually bearing 6 setae, occasionally with more setae present. Anterior and posterior spiracles present. Dorsal setae variously shaped, often flagellate. Ventral setae flagellate. Trilocular pores present on dorsum and venter. Multilocular disc pores usually present, at least on venter. Quinquelocular pores and oral rim tubular ducts always absent. Oral collar tubular ducts usually apparent, at least on venter, sometimes present on dorsum, rarely absent entirely. Discoidal pores present, sometimes large and occasionally present next to each eye.

**Dysmicoccus arachidis* Williams

Material examined. INDONESIA, Sumatra I., Bengkulu Province, Kepahiang district, Kabawetan, on *Crassocephalum crepidioides* (Benth.) S. Moore (Asteraceae), 600 m a.s.l., 03°34′54.4″ S, 102°35′33″ E, 12.vi.2018, coll. A. Zarkani (AZ80-81), 6 ♀♀.

Comments. This species is a new country record for Indonesia, and this is the first report of it feeding on *C. crepidioides*; Williams (2004) previously recorded the mealybug from India (Tripura) on *Arachis hypogaea* L. (Fabaceae). There is very little information available on *D. arachidis*.

Dysmicoccus brevipes (Cockerell)

Material examined. INDONESIA, Sumatra I., Bengkulu Province, Bengkulu city, Slebar, on *Syzygium aqueum* Alston (Myrtaceae), 20 m a.s.l., 03°49′25.2″ S, 102°19′08.7″ E, 10.vii.2018, coll. A. Zarkani (AZ210), 3 ♀♀.

Comments. The species is polyphagous on ornamental plants and fruits belonging to 62 plant families and 147 genera. It is cosmopolitan, being found in 126 countries; in Indonesia it has been recorded from Irian Jaya (Williams & Watson 1988), Java (Betrem 1937; Ben-Dov 1994; Williams 2004) and Sumatra (Williams 2004).

**Dysmicoccus carens* Williams

Material examined. INDONESIA, Sumatra I., Bengkulu Province, Seluma district, Sukaraja, on *Psophocarpus tetragonolobus* L. (Fabaceae), 10 m a.s.l., 03°59′07″ S, 102°25′37″ E, 15.vi.2018, coll. A. Zarkani (AZ82-83), 3 ♀♀.

Comments. *Dysmicoccus carens* is a new country record for Indonesia and this is the first report of it feeding on *P. tetragonolobus*. The species had been recorded previously on species of Poaceae only, by Williams (2004).

Dysmicoccus lepelleyi (Betrem)

Material examined. INDONESIA, Sumatra I., Bengkulu Province, Bengkulu city, Slebar, on *Manilkara zapota* L. (Sapotaceae), 20 m a.s.l., 03°49′25.2″ S, 102°19′08.7″ E, 10.vii.2018, coll. A. Zarkani (AZ230), 3 ♀♀.

Comments. This is polyphagous species on ornamentals and fruits within 17 plant families: Anacardiaceae, Annonaceae, Arecaceae, Asparagaceae, Clusiaceae, Euphorbiaceae, Fagaceae, Malvaceae, Meliaceae, Moraceae, Musaceae, Myrtaceae, Rubiaceae, Rutaceae, Sapindaceae, Sapotaceae, and Zingiberaceae (García Morales *et al.* 2016). In Indonesia, it has been recorded previously from Java (Betrem 1937; Ben-Dov 1994; Williams 2004), Lombok (Williams 2004) and Sumatra (Williams 2004). It is also found in neighboring countries such as Cambodia, Malaysia, Singapore, Thailand, and Vietnam (Williams 2004).

Dysmicoccus zeynepae Zarkani & Kaydan sp. n.

Material examined, all deposited at MMUB.

Holotype adult female, left label: AZ205 / 4.ii.2008 / Indonesia / Sumatra, Bengkulu / *Durio zibethinus* / 10238′33″ E / 0334′54.4″ S / 520 m; right label: *Dysmicoccus / zeynepae* Zarkani & Kaydan, 3 ♀♀ / coll. A. Zarkani / det. MB Kaydan. The holotype specimen is ringed with red ink on the coverslip. In MMUB.

Paratypes, 5 ♀♀, INDONESIA: (AZ205) same data as holotype; 3 ♀♀, AZ206, Sumatra, Bengkulu on *Lansium parasiticum* Corr. (Meliaceae), 0359′28.0″ S, 10225′50.4″ E, 11.ii.2018, coll. A. Zarkani; 3 ♀♀, AZ207, Sumatra, Bengkulu on *Manilkara zapota* L. (Sapotaceae), 0400′05.7″ S, 10226′52.1″ E, 12.ii.2018, coll. A. Zarkani; 3 ♀♀, AZ208, Sumatra, Bengkulu, *Coffea robusta* Lindl. ex De Will. (Rubiaceae), 0336′15.4″ S, 10236′30.8″ E, 19.ii.2018, coll. A. Zarkani. In MMUB.

Description of adult female

Appearance in life (Fig. 1). Adult females secrete a thin powdery white wax covering the dorsal surface of their bodies. Living on leaves, flowers and fruits of host plants, commonly attended by ants.

Slide-mounted adult female (based on holotype and 5 paratypes) (Fig. 2): Body oval, 1.95–2.54 mm long, 1.64–2.25 mm wide. Eyes situated on margins, each 42–45 µm wide. Antenna 8 segmented, 340–380 µm long,

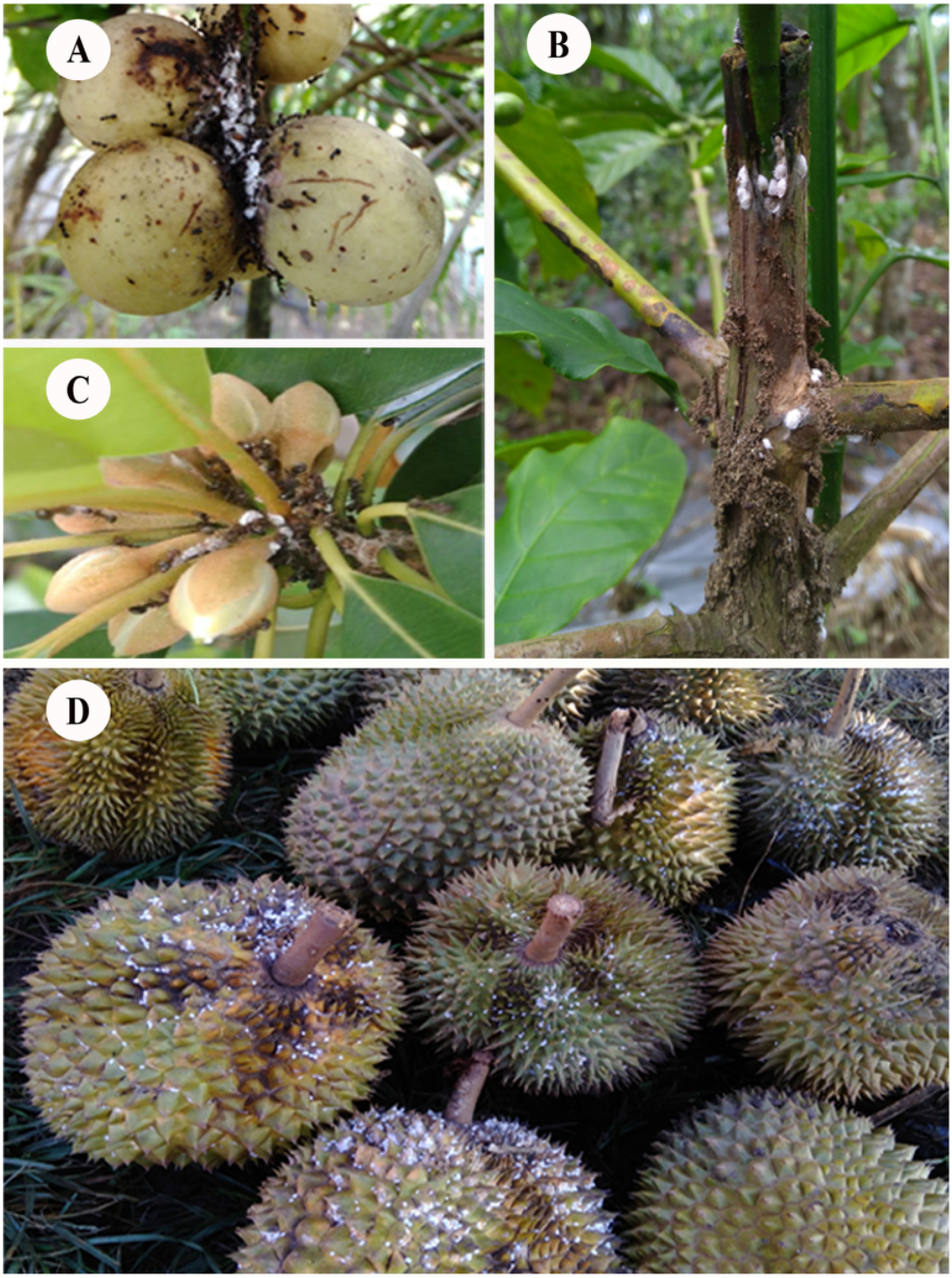

FIGURE 1. *Dysmicoccus zeynepae* Zarkani & Kaydan **sp. n.** on: (A) *Lansium parasiticum* Corr.; (B) *Coffea robusta* Lindl. ex De Will; (C) *Manilkara zapota* L.; and (D) *Durio zibethinus* Murr.

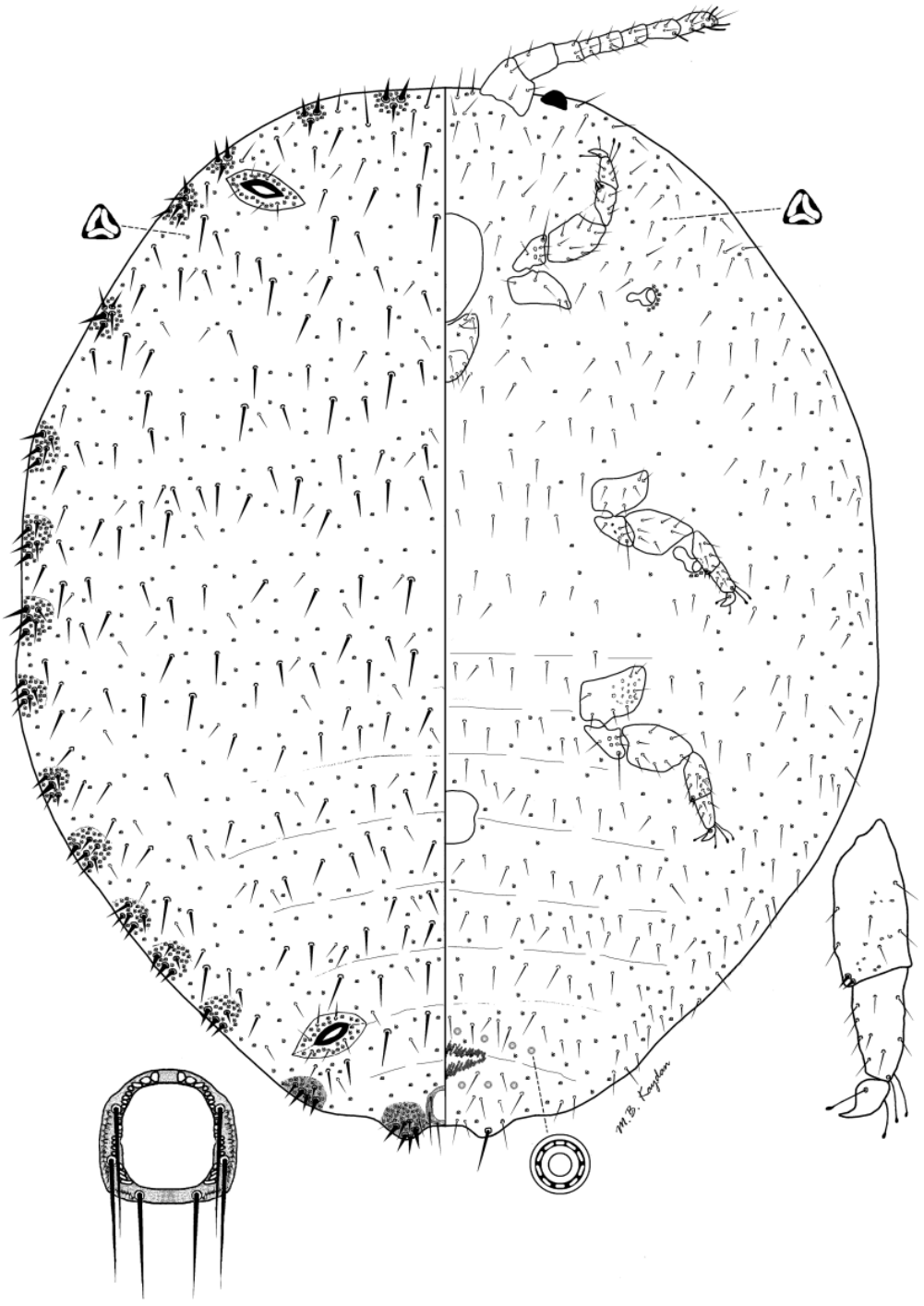

FIGURE 2. Adult female *Dysmicoccus zeynepae* Zarkani & Kaydan **sp. n.**, holotype.

with 4 fleshy setae each 22.5–25.0 µm long; apical segment 75–[illegible] µm long, 27.5–30.0 µm wide, with apical seta 30–35 µm long. Cl[illegible]peolabral shield 200–220 µm long, 175–185 µm wide. Labium 3 segmented, 110–120 µm long, 80–85 µm wide. Anterior spiracles each 85–90 µm long, 45–50 µm wide across atrium; posterior spiracles each 95.–115. µm long, 55–60 µm wide across atrium. Circulus rounded-quadrate 80–110 µm wide. Legs well developed; segment lengths for each posterior leg: coxa 160–175 µm, trochanter + femur 145–155 µm, tibia + tarsus 175–180 µm, claw 35.0–37.5 µm. Ratio of length of tibia + tarsus to trochanter + femur 1.16–1.21 : 1; ratio of length of tibia to tarsus, 1.2–1.4 : 1; ratio of length of trochanter + femur to greatest width of femur, 2.41–2.60 : 1; coxa with 30–50 translucent pores; tibia with numerous translucent pores. Tarsal digitules capitate, each 35–40 µm long. Claw digitules capitate, each about 27.5–30.0 µm long. Both pairs of ostioles present, anterior ostioles each with a total for both lips of 28–40 trilocular pores and 4–6 setae; posterior ostioles each with a total for both lips of 58–60 trilocular pores and 6–8 setae. Anal ring about 70 µm wide, bearing 6 setae, each seta 80–90 µm long.

Dorsum. Derm membranous, with 16 pairs of cerarii around body margin, each cerarius with 4–7 enlarged conical setae and 3–5 auxiliary setae. Each anal lobe cerarius set on membranous cuticle and containing 5–7 enlarged conical setae 25–35 µm long, plus 40–45 trilocular pores and 3–5 hair-like auxiliary setae. Dorsal setae flagellate, each 15–75 µm long, scattered throughout dorsum. Trilocular pores, each 3–4 µm in diameter, scattered. Multilocular disc pores and tubular ducts absent.

Venter. Setae flagellate, each 30–110 µm long, longest setae located medially on head. Apical setae on anal lobes unusually short, each 80–90 µm long. Multilocular disc pores, each 7–8 µm in diameter, present only immediately around vulva, numbering 8–10. Trilocular pores, each 2.5–3.0 µm across, scattered throughout venter. Oral collar tubular ducts absent.

Comments. *Dysmicoccus zeynepae* is most similar to *D. finitimus* in having anal lobe and other abdominal cerarii each containing a group of about 2–7 conical setae. However, *D. zeynepae* can be readily distinguished from *D. finitimus* in having: (i) no multilocular disc pores and oral collar tubular ducts on dorsum; and (ii) a few multilocular disc pores without oral collar tubular ducts on venter. It is also close to *D. lepelleyi* in having small legs and translucent pores on hind coxa and femur, but *D. zeynepae* lacks oral collar tubular ducts on both dorsum and venter. *Dysmicoccus zeynepae* is also close to *D. castanopseus* Williams in lacking oral collar tubular ducts on dorsum and venter; however, it can be readily distinguished by having (character state for *D. castanopseus* given in parentheses): (i) small, stout legs with tibia + tarsus obviously shorter than trochanter + femur (large legs with tibia + tarsus very slightly longer than trochanter + femur); and (ii) translucent pores on the hind coxa and femur (translucent pores on hind femur and tibia).

Etymology. This species is named after Zeynep Kaydan ("mother" of Kaydan's Laboratory), Zeynep Güleç and Zeynep Kaya who are good friends of the Kaydan's lab.

Host plants. *Durio zibethinus* (Malvaceae), *Lansium parasiticum* (Meliaceae), *Manilkara zapota* (Sapotaceae) and *Coffea robusta* (Rubiaceae) (Fig. 2).

Distribution. Indonesia (Sumatra I., Bengkulu Province).

Key to adult female *Dysmicoccus* found in Indonesia

(adapted from Williams 2004).

1(0)	Cerarii numbering 7 pairs including frontal pair. Dorsal oral collar tubular ducts numerous, present in rows across most segments	*D. boninsis* (Kuwana)
-	Cerarii numbering more than 7 pairs. Dorsal oral collar tubular ducts, if present, never forming rows across segments	2
2(1)	Most cerarii without auxiliary setae	3
-	Most cerarii with auxiliary setae	4
3(2)	Ventral oral collar tubular ducts sparse, a few present in medial area of abdomen and on lateral margins of abdominal segment VI and anterior segments only, absent from head and thoracic margins	*D. carens* (Williams)
-	Ventral oral collar tubular ducts numerous, present in rows across most abdominal segments to lateral margin, and around lateral margins forward to head and thorax	*D. arachidis* Williams
4(2)	With series of large oral collar tubular ducts, each about twice as wide as a trilocular pore, present around dorsal lateral margins	*D. lepelleyi* (Betrem)
-	Without a series of large oral collar tubular ducts around dorsal lateral margins	5
5(4)	Anal lobe cerarii each containing a group of about 2–7 conical setae	6
-	Anal lobe cerarii each containing only 2 conical setae	7
6(5)	Oral collar tubular ducts absent from both dorsum and venter. Venter with a few multilocular disc pores	

		***D. zeynepae* Zarkani & Kaydan sp. n.**
-	Oral collar tubular ducts absent from dorsum but present on venter. Venter with numerous multilocular disc pores	
		D. finitimus Williams
7(5)	Abdominal cerarii anterior to anal lobe pair, each with 2 conical setae except for an occasional cerarius with only a single conical seta	8
-	Some abdominal cerarii, anterior to anal lobe pair, usually containing more than 2 conical setae	9
8(7)	Venter with marginal oral collar tubular duct present, at least as far anterior as thorax	*D. debregeasiae* (Green)
-	Venter with marginal oral collar tubular duct confined to abdomen	*D. orchidum* Williams
9(7)	Dorsal setae on abdominal segment VIII, anterior to anal ring, longer than other dorsal setae, almost as long as anal ring setae	*D. brevipes* (Cockerell)
-	Dorsal setae on abdominal segment VIII, anterior to anal ring, shorter, about same size as other dorsal setae	*D. neobrevipes* Beardsley

Ferrisia dasylirii (Cockerell)

Material examined. INDONESIA, Sumatra I., Bengkulu Province, Bengkulu city, Muara Bangkahulu, on *Solanum torvum* Swartz (Solanaceae) and *Theobroma cacao* L. (Sterculiaceae), 20 m a.s.l., 3°45′33.0″ S, 102°16′10.1″ E, 3.vii.2019, coll. A. Zarkani (AZ245–246), 6 ♀♀.

Comments. The species is polyphagous, particularly on ornamentals and fruits, and has been recorded on host plants in 23 families and 52 genera (García Morales *et al.* 2016). In Indonesia, it has been recorded previously from Sumatra (Zarkani *et al.* 2020).

Ferrisia virgata (Cockerell)

Material examined. INDONESIA, Sumatra I., Bengkulu Province, Bengkulu city, Muara Bangkahulu, on *Psidium guajava* L. (Myrtaceae), 20 m a.s.l., 03°45′33.0″ S, 102°16′10.1″ E, 5.iii.2019, coll. A. Zarkani (AZ247), 3 ♀♀.

Comments. The species is polyphagous on ornamentals and fruits, and is known from 78 plant families and 207 genera (García Morales *et al.* 2016). It is cosmopolitan, having been recorded from 101 countries (García Morales *et al.* 2016). In Indonesia, it has been recorded previously from Irian Jaya (Williams & Watson 1988; Gavrilov-Zimin 2013), Java (Keuchenius 1915; Betrem 1937; Ali 1968; Ben-Dov 1994; Williams 2004) and Sulawesi (Williams 2004).

Nipaecoccus viridis (Newstead)

Material examined. INDONESIA, Sumatra I., Bengkulu Province, Bengkulu city, Kampung Melayu, on *Citrus* sp. (Rutaceae), 10 m a.s.l., 03°54′16.5″ S, 102°19′11.7″ E, 18.ii.2018, coll. A. Zarkani (AZ211), 3 ♀♀.

Comments. The species is polyphagous on ornamentals and fruits, and has been recorded from 45 plant families and 114 genera (García Morales *et al.* 2016). It is cosmopolitan, having been reported from 63 countries (García Morales *et al.* 2016). In Indonesia, it has been recorded previously in Irian Jaya (CABI, 1983; Ben-Dov 1994), Java (CABI, 1983; Ben-Dov 1994; Williams 2004) and Sulawesi (Williams 2004).

Palmicultor cryptic species complex, species near *palmarum* (Ehrhorn)

(Fig. 3)

Material examined. INDONESIA, Sumatra I., Bengkulu Province, Seluma district, Air Periukan, on *Elaeis guineensis* Jacq (Arecaceae), 8 m a.s.l., 03°59′07″ S, 102°25′37″ E, 2.ii.2018, coll. A. Zarkani (AZ203), 3 ♀♀.

Appearance in life (Fig. 3). Body of adult female covered with fluffy white wax secretion. The mealybugs live mainly on the fruits and are attended by ants (Fig. 4).

Description of adult female (based on holotype and 2 paratypes) (Fig. 4): Body oval, 1.98–2.42 mm long, 1.38–1.48 mm wide. Eyes situated on margins, each 25–30 µm in diameter. Antenna 7 segmented, each 270–280 µm long,

FIGURE 3. *Palmicultor* cryptic species group, species near *palmarum* (Ehrhorn), attacking *Elaeis guineensis* Jacq. fruits.

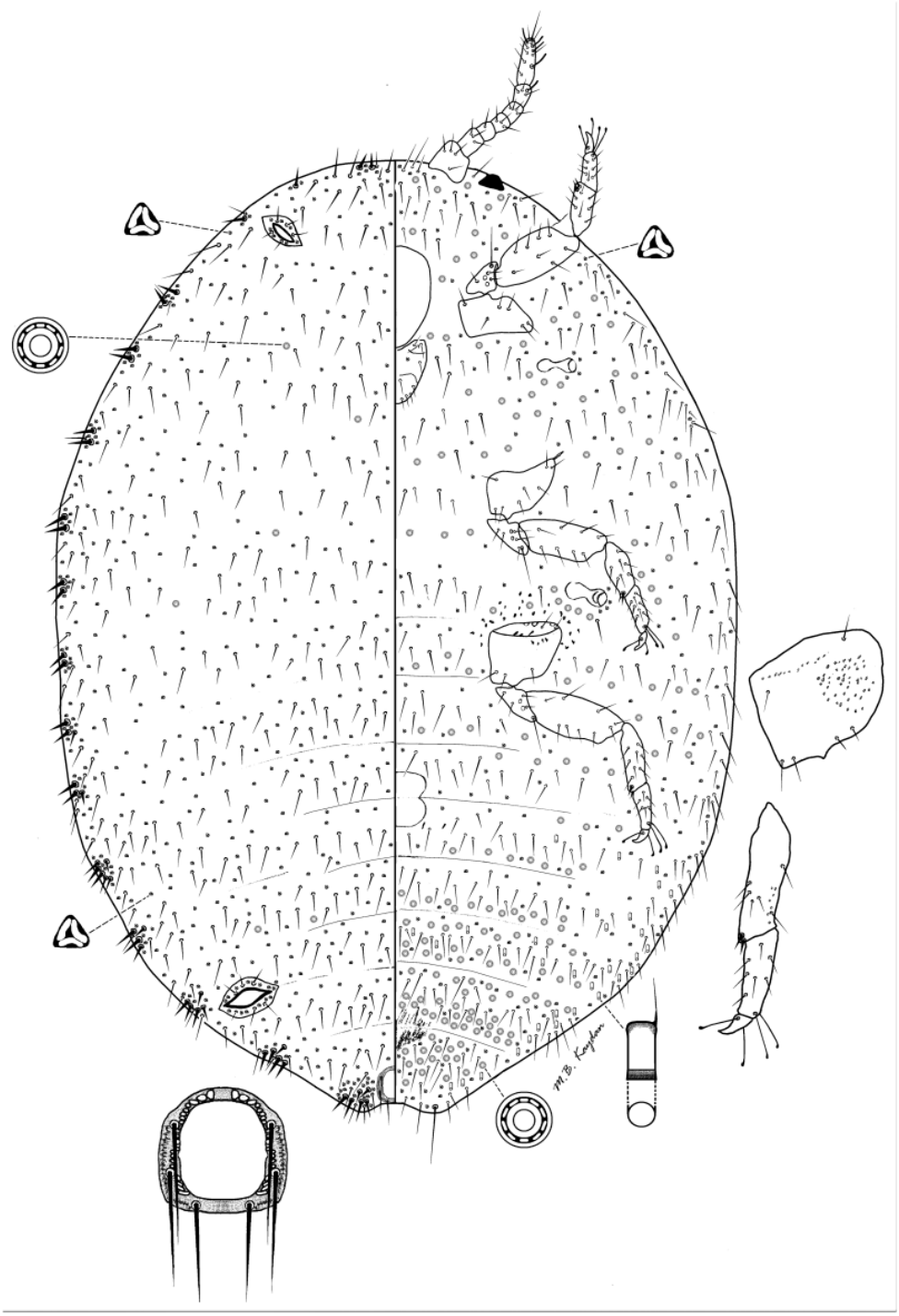

FIGURE 4. Adult female of a member of the *Palmicultor palmarum* (Ehrhorn) cryptic species group, from Indonesia, Sumatra I., Bengkulu Province, Seluma district, Air Periukan, on *Elaeis guineensis* Jacq. (Arecaceae).

with 4 fleshy setae each 22.5–30.0 µm long; apical segment 75–90 µm long, 22.5–30.0 µm wide, with apical seta 27.5–30.0 µm long. Cephalolabral shield 220–230 µm long, 175–185 µm wide. Labium 3 segmented, 110–120 µm long, 80–85 µm wide. Anterior spiracles each 60–65 µm long, 20–25 µm wide across atrium; posterior spiracles each 75–85 µm long, 40–45 µm wide across atrium. Circulus notched on each side with a strong middle constriction, 80–110 µm wide. Legs well developed; segment lengths for each posterior leg: coxa 115–135 µm, trochanter + femur 205–220 µm, tibia + tarsus 160–170 µm, claw 27.5–30.0 µm. Ratio of lengths of tibia + tarsus to trochanter + femur, 0.77–0.78 : 1; ratio of length of tibia to tarsus, 1.2–1.4 : 1; ratio of length of trochanter + femur to greatest width of femur, 3.41–3.60 : 1; derm surrounding each posterior coxa with 40–50 translucent pores; coxa with 30–50 translucent pores; tibia with numerous translucent pores. Tarsal digitules capitate, each 27.5–30.0 µm long. Claw digitules capitate, each about 22.5–25.0 µm long. Both pairs of ostioles present, anterior ostioles each with a total for both lips of 28–40 trilocular pores and 4–6 setae; posterior ostioles each with a total for both lips of 58–60 trilocular pores and 6–8 setae. Anal ring about 95 µm wide, bearing 6 setae, each seta 160–165 µm long.

Dorsum. Derm membranous, with 16 pairs of cerarii around body margin, each cerarius with 2–5 enlarged conical setae and 3–5 auxiliary setae. Each anal lobe cerarius set on membranous cuticle and containing 3–6 enlarged setae 25–30 µm long, plus 55–57 trilocular pores and 3–5 hair-like auxiliary setae. Dorsal setae short and flagellate, length 30–110 µm long, scattered throughout dorsum. Trilocular pores, each 3–4 µm in diameter, scattered. A few multilocular disc pores present on thorax and abdomen.

Venter. Setae flagellate, each 30–110 µm long, longest setae located medially on head. Apical setae on anal lobe each 125–150 µm long. Multilocular disc pores, each 7–8 µm in diameter, present throughout venter, numbers on each abdominal segment as follows: I–III each with 60–70, IV 20–24, V 38–43, VI 100–110, VII 90–98, VIII + IX 36–38 and 125–145 on thorax and head. Trilocular pores, each 2.5–3.0 µm across, scattered throughout venter. Oral collar tubular ducts each 8–10 µm long, 4–5 µm wide, present throughout, but in bands across abdominal segments, as follows: VI 21, VII 15, VIII + IX 14.

Comments. The Indonesian specimen is a member of the *P. palmarum* cryptic species complex, which was discussed by von Ellenrieder *et al*. (2021). Members of this species complex have more than 12 pairs of cerarii; the derm surrounding each posterior coxa has 40–50 duct-like pores, and each hind coxa and hind tibia have numerous translucent pores. The dorsal setae in the Indonesian specimen are up to twice as long as those recorded previously in *P. palmarum* by Williams and Watson (1988) and Williams (2004). Even though we found some differences, we believe that some further studies must be done to decipher this species complex. Further molecular studies will be useful to resolve species concepts.

Paracoccus evae Williams

Material examined. INDONESIA, Sumatra I., Bengkulu Province, Seluma district, Sukaraja, on *Melastoma malabathricum* L. (Melastomataceae), 50 m a.s.l., 03°52′00.4″ S, 102°22′51.2″ E, 23.vii.2019, coll. A. Zarkani (AZ249), 3 ♀♀.

Comments. This is the second report of *P. evae* from Indonesia, and the first record of it feeding on *M. malabathricum*; Williams (2004) recorded it from Java on *Eupatorium* sp. (Asteraceae).

Planococcus dischidiae (Takahashi)

Material examined. INDONESIA, Sumatra I., Bengkulu Province, Kepahiang district, Kabawetan, on *Coffea robusta* (Rubiaceae), 600 m a.s.l., 03°34′54.4″ S, 102°35′33″ E, 12.vi.2018, coll. A. Zarkani (AZ235–239), 1 ♀.

Comments. *Planococcus dischidiae* was recorded from Indonesia (Sulawesi) by Cox (1989), Ben-Dov (1994) and Williams (2004); also from Malaysia by Takahashi (1951) and Ben-Dov (1994). This is the first time it has been collected on *C. robusta*; previously, it was recorded on *Dischidia* sp. (Apocynaceae) and *Epipremnum* sp. (Araceae).

***Planococcus lilacinus* (Cockerell)**

Material examined. INDONESIA, Sumatra I., Bengkulu Province, Bengkulu city, Muara Bangkahulu, on *Saraca asoca* (Roxb.) (Fabaceae), 20 m a.s.l., 03°45′33.0″ S, 102°16′10.1″ E, 10.ii.2019 and 15.iii.2020, coll. A. Zarkani (AZ313), 1 ♀.

Comments. The species is polyphagous on ornamentals and fruits, and has been recorded from 73 plant families and 196 genera (García Morales *et al.* 2016). It is cosmopolitan, having been reported from 64 countries (García Morales *et al.* 2016). In Indonesia, it has been recorded previously from Irian Jaya (Williams & Watson 1988; Ben-Dov 1994), Java (Williams 2004), Kalimantan (Cox 1989; Ben-Dov 1994), Lombok (Williams 2004), Sulawesi (Williams 2004) and Sumatra (Cox 1989; Ben-Dov 1994; Williams 2004). This is a new species complex of *S. asoca*.

***Pseudococcus jackbeardsleyi* Gimpel & Miller**

Material examined. INDONESIA, Sumatra I., Bengkulu Province, Kepahiang district, Kabawetan, on *Selenicereus undatus* (Haw.) DR Hunt (Cactaceae), 600 m a.s.l., 03°34′54.4″ S, 102°35′33″ E, 10.vii.2018, coll. A. Zarkani (AZ227), 1 ♀.

Comments. This neotropical species is polyphagous on ornamentals, fruits, vegetables and herbs; it has been reported from 52 plant families and 112 genera (García Morales *et al.* 2016). It is cosmopolitan, having been reported from 52 countries (García Morales *et al.* 2016). In Indonesia, it has been recorded previously from Flores (Gavrilov-Zimin 2017), Irian Jaya (Gavrilov-Zimin 2013) and Java (Williams 2004).

****Pseudococcus leptotrichotus* Williams**

Material examined. INDONESIA, Sumatra I., Bengkulu Province, Kepahiang district, Kabawetan, on *Coffea robusta* (Rubiaceae), 600 m a.s.l., 03°34′54.4″ S, 102°35′33″ E, 12.vi.2018, coll. A. Zarkani (AZ235–239), 12 ♀♀.

Comments. This is a new country record for Indonesia, and is the first mealybug species from Indonesia that had been previously recorded in a leaf nest of *Oecophylla* sp. ants in Malaysia (Sarawak). In Indonesia, *P. leptotrichotus* specimens was collected in a leaf nest of *Oecophylla* sp. ants on coffee leaves and within a protective carton shelter of soil made by unidentified ants on coffee berries and trees.

***Pseudococcus longispinus* (Targioni Tozzetti)**

Material examined. INDONESIA, Sumatra I., Bengkulu Province, Bengkulu city, Muara Bangkahulu, on *Theobroma cacao* L. (Sterculiaceae), 20 m a.s.l., 03°45′33.0″ S, 102°16′10.1″ E, 5.iii.2019, coll. A. Zarkani (AZ217), 3 ♀♀.

Comments. The species is polyphagous on ornamentals and fruits, and has been recorded from 84 plant families and 167 genera (García Morales *et al.* 2016). It is cosmopolitan, having been reported from 115 countries (García Morales *et al.* 2016). In Indonesia, it has been recorded previously from Irian Jaya (Williams & Watson 1988; Ben-Dov 1994), Java (Betrem 1937; Ben-Dov 1994), Lombok (Williams 2004), Sulawesi (Watson *et al.* 2014) and Sumatra (Green 1930).

***Rastrococcus chinensis* Ferris**

Material examined. INDONESIA, Sumatra I., Bengkulu Province, Bengkulu city, Singaran Pati, on *Nephelium lappaceum* L. (Sapindaceae), 20 m a.s.l., 03°48′57.9″ S, 102°18′38.9″ E, 12.vi.2018, coll. A. Zarkani (AZ168–170), 12 ♀♀.

Comments. The species was recorded previously on *Alocasia* sp. (Araceae), *Ardisia lindleyana* D. Dietr. (Primulaceae), *Melastoma malabathricum* L. (Melastomataceae), *Morinda umbellata* L., *Psychotria asiatica* L.

(Rubiaceae), *Eugenia* sp., *Syzygium* sp., *S. anomalum* Lauterb. and *S. hancei* Merr. & Perry (Myrtaceae). It has been reported previously from Brunei, China and Malaysia (García Morales *et al.* 2016). In Indonesia, it has been recorded previously from Java (Williams 1989, 2004; Ben-Dov 1994).

Rastrococcus invadens Williams

Material examined. INDONESIA, Sumatra I., Bengkulu Province, Kepahiang district, Kabawetan, on *Mangifera indica* L. (Anacardiaceae), 600 m a.s.l., 03°34′54.4″ S, 102°35′33″ E, 12.vi.2018, coll. A. Zarkani (AZ235–239), 12 ♀♀.

Comments. The species is polyphagous on ornamentals and fruits; it has been recorded from 29 plant families and 54 genera (García Morales *et al.* 2016). It is cosmopolitan, having been reported from 32 countries (García Morales *et al.* 2016). In Indonesia, it has been recorded previously from Bali and Java (Williams 1989, 2004; Ben-Dov 1994).

Rastrococcus tropicasiaticus Williams

Material examined. INDONESIA, Sumatra I., Bengkulu Province, Seluma district, Air Periukan, on *Azadirachta excelsa* (Jack) M. Jacobs (Meliaceae), 10 m a.s.l., 3°59′07.1″ S, 102°25′37.4″ E, 1.v.2019, coll. A. Zarkani, (AZ336), 1 ♀.

Comments. Zarkani *et al.* (2021) reported *R. tropicasiaticus* for the first time in Indonesia (Bengkulu) on *A. excelsa* (Meliaceae), *Cerbera manghas* L. (Apocynaceae), *Dimocarpus longan* Lour. (Sapindaceae), *Ficus* sp. (Moraceae), and *Tectona grandis* L. (Lamiaceae). It is also known to live on woody plants and wild grass in parts of southern Asia such as Malaysia, Philippines, Thailand and Vietnam (Williams 2004).

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