

***Planococcus bendovi* Williams (Hemiptera: Coccoomorpha: Pseudococcidae), a First
Record of Mealybug in Southeast Asia**

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ABSTRACT

Planococcus bendovi Williams (Hemiptera: Coccoomorpha: Pseudococcidae) is a mealybug species that holotype and paratypes specimens were only recorded from India as a single slide. Recently a series of surveys have been set up randomly in Bengkulu province, Indonesia in 2021 and recorded occurrence of *P. bendovi*. The species was found on the leaves, trunks, and branches of a semi-parasitic plant, *Loranthus pentandrus* L. (Loranthaceae) within 20-40% of incidence rate. This is the first report of *P. bendovi* in Indonesia as well as Southeast Asia regions. Morphological data and pictures of the species are also provided.

Key words: Biodiversity, host plant, insect pest, mealybug, taxonomy.

INTRODUCTION

Mealybugs of the genera *Planococcus* Ferris was revised in great detail by Cox (1989) and now comprises about 49 extant species worldwide (Garcia et al., 2016). It is an important genus of Pseudococcidae in which morphologically the adult female body is conspicuous by the anal lobe bars and 18 pair's cerarii (Danzig & Gavrilov, 2010). All cerarii with two conical setae which is sometimes cerarii on the head with 3 conical setae and additional flagellate setae present in C18. Even though some specimens of *Planococcus* are still difficult to identify it has 8-segmented antennae, well developed legs; coxae, tibiae and sometimes femora of hind legs with translucent pores, circulus usually present. Spiracles are well developed. Multilocular pores are numerous on ventral parts of abdominal segments. Tubular ducts are present on both body sides; usually dorsal ducts larger and sometimes with collars.

Some species of the genus *Planococcus*, *Planococcus citri* (Risso), *Planococcus minor* (Maskell), *Planococcus ficus* (Signoret) and *Planococcus lilacinus* (Cockerell) are well-known as important insect pests of agricultural and horticultural crops worldwide. The species are sap-sucking insects that attack all parts of herbaceous plant organs and causing chlorosis, growth stagnation, drying of needles and branches, and even of entire plants under heavy infestation. Additionally, the scale mostly produces large quantities of honeydew, a good nutrient for developing sooty mold, affecting reducing photosynthesis, and causing faster plant deterioration. It is also potent to transmit some plant viruses (Franco et al., 2009, Daane et al., 2012). Many of this genus are polyphagous species that feed on over a hundred different host plants (Garcia et al., 2016), but some of them are oligophagous (Francardi and Covassi, 1992) and even monophagous that only feed on native plants (Ben-Dov, 1994).

In Indonesia, six *Planococcus* species are found viz; *P. angkorensis* (Takahashi), *P. citri* (Risso), *P. dischidiae* (Takahashi), *P. lilacinus* (Cockerell), *P. minor* (Maskell), and *P. sulawesi* Cox. From these, *P. dischidiae* and *P. sulawesi* are native species of Indonesia in which holotype species were collected from Kalimantan and Sulawesi island, respectively (Williams, 2004; Garcia et al., 2016). The remaining species are cosmopolitans and polyphagous that spread over the world.

In this work, *Planococcus bendovi* Williams from Indonesia is revealed. The only holotype and paratypes specimens were recorded from India as a single slide that was collected at Natural History Museum, UK-London (Williams, 2004). Here we report as a new record for the fauna of Indonesia as well as the first record of Southeast Asia.

MATERIALS AND METHODS

A series of surveys were done in Bengkulu province in the year 2021. Specimens were collected on a semi-parasitic plant, *Loranthus pentandrus* L. (Loranthaceae) lives on some plants, namely avocado (*Persea americana* Mill), cacao (*Theobroma cacao* L.), and cucumber tree (*Averrhoa bilimbi* L.) growth spreading in Bengkulu city and Seluma district, a part of southern Sumatra (Figure1).

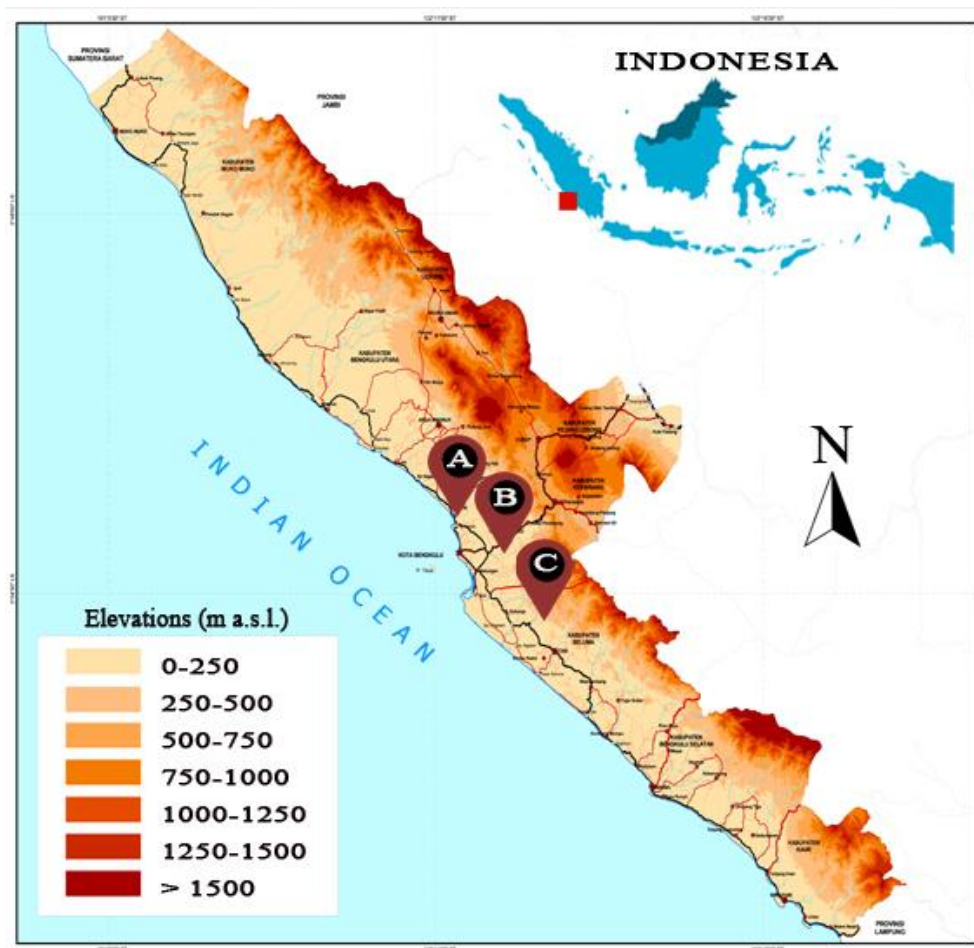


Figure 1. Sampling locations of *Planococcus bendovi* Williams: A, Muara Bangkahulu, Bengkulu city (03°45'36.1"S 102°16'00.5"E, 30 m a.s.l.); B, Slebar, Bengkulu city (03°49'25.3"S 102°19'08.3"E, 20 m a.s.l.); C, Air Periukan, Seluma regency (04°00'46.2"S 102°25'44.3"E, 40 m a.s.l.).

Mealybug populations were identified based on morphological characters. All the individuals sequenced were preserved in 70% ethanol and stored at 20°C. Individuals were posteriorly mounted on slides as described by Kosztarab and Kozár (1988) with a few modifications. The specimen was heated at 100°C -50°C in 10% KOH changed regularly for each 30 min in 2-3 hours and then washed in 70% ethanol for 30 min. It was stained with a staining solution (15 ml Essig's Aphid Solution with a 2% aqueous solution of 20 drops acid

fuchsin, 20 drops lignin pink and 20 drops of erythrosine). Specimens were then transferred to pure ethanol for a half hour and immersed in clove oil for an additional two hours. Finally, the specimens were mounted on a slide in Canada balsam and covered with a coverslip. Slides were then heated at 30°C for 48h. Specimens were identified principally with the keys of Hodgson (1994) and Williams (2004). For nymph voucher specimen identification, some species for which immature instars have never been described were identified to genus level only. The slide-mounted specimens of *P. bendovi* females and nymphs are available from the mini scale insects Museum, Plant Protection Department, Faculty of Agriculture, University of Bengkulu (Sumatra-Indonesia) with slide number series: AZ400-404.

RESULTS AND DISCUSSIONS

Planococcus bendovi Williams, 2004

Material examined. Bengkulu province: 3 ♀♀, Muara Bangkahulu, Bengkulu city, *L. pentandrus* living on cucumber tree, 30 m a.s.l., 03°45'36.1"S 102°16'00.5"E, 10.iv.2020, Coll. A. Zarkani, (AZ400); 6 ♀♀, Slebar, Bengkulu city, *L. pentandrus* living on avocado tree, 20 m a.s.l., 03°49'25.3"S 102°19'08.3"E, 10.ii.2020, Coll. A. Zarkani (AZ401-402); 6 ♀♀, Air Periukan, Seluma district, *L. pentandrus* living on cacao tree, 40 m a.s.l., 04°00'46.2"S 102°25'44.3"E, 12.vi.2020, Coll. A. Zarkani (AZ403-404).

Diagnosis. Alive specimen (after Williams, 2004), the body of the adult female is covered white wax secretion. The species of *P. bendovi* live on the leaf, flower, and fruit of the host plants and it commonly symbioses with ants (Figure 2.a-c). In slide-mounted specimens, the body of the adult female is oval, about 2.50 mm long and 1.70 mm wide. Antennae with 8 segments each about 300 µm. Legs well developed, short and slender. Claw stout about 30 µm long, with a denticle. Circulus about 170 µm wide divided by intersegmental line with a wrinkled surface. Ostiole well developed represented by posterior and anterior pair, with inner edges of lips sclerotized, each lip with a few trilocular pores. Anal ring bearing 6 setae, each about 115 µm long. Anal lobe cerarii each containing 2 conical setae and a few

trilocular pores but apparently no auxiliary setae. Multilocular disc pores are numerous on the abdomen (Figure 3.a). Anal lobe bars present (Figure 3.b). Dorsal surface with short and almost stiff setae, whilst ventral surface with normal flagellate setae. Cerarii always conspicuous, each bearing 2 or 3 truncate-conical setae, each cerarian setae sometimes curve at the apex (Figure 3.c). Cerarii numbering 18 pairs, each situated on a weak sclerotized base, mostly each smaller in area than the anal ring. Trilocular pores abundant, present in a regular arrangement, less numerous than on dorsum. A single pore sometimes occurring near lateral margin of abdomen, and 1 or 2 also present on head and thorax. Oral collar tubular ducts present considerably on head, thorax and abdomen of 2 main sizes; large type and slender type (Figure 3.d). A scientific drawing of a female *P. bendovi* specimen from Indonesia can be seen in Figure 4.

Comments. The species was listed tentatively as *Crisicoccus ? dischidae* (Takahashi) by Varshney (1992) and as *Crisicoccus* sp. by Ganguli & Ghosh (1964). It is a bit difficult to identify *P. bendovi* due to some similarities with *P. nilgircus*. However, they differ in the distribution of the tubular ducts and the number of multilocular disc pores. In *P. nilgircus*, ventral oral collar tubular ducts absent from the margin of the head and thorax, represented by single ducts only near abdominal margins. In *P. bendovi*, multilocular disc pores are numerous on the abdomen, and tubular ducts are abundant around the margin including on the thorax and head. The species possess dorsal setae often varying in thickness, and abundant oral collar tubular ducts around the ventral margins; the micro ducts, although minute, are noticeable even under normal magnification.

Williams (2004) reported that *P. bendovi* attacked *Arachis hypogaea* L. (Fabaceae) in Tripura and Orissa, India. However, in Indonesia, we did not find the species live on *A. hypogaea*. The species lives abundantly on a semi-parasitic plant, *L. pentandrus* living on avocado, cacao, citrus, and cucumber tree. The species invested on *L. pentandrus* up to 20-40% of

incidence, but rarely invaded the host trees of the semi-parasitic plant. It seems that *P. bendovi* has coevolved with *L. pentandrus*.

There is no information on how *P. bendovi* arrived in Indonesia, but it is probably unintentionally introduced here by international transportation and trade from India to Indonesia. This speculation is similar to some new record of mealybug's occurrence reported by Zarkani. et al. (2020; 2021). Furthermore, it might occur probably reversely considering that in the past, like India, Bengkulu was also British colony, and as such, transportation activities between both places might be high. In addition, the species was probably also introduced some years before its report since the abundance of *P. bendovi* in some plants in the different territories with various infestation outbreak levels has occurred. Historically, at the beginning of the ice age, the western part of Indonesia such as Bali, Java, Kalimantan, and Sumatra merged with the Asian continent, while the eastern part of Indonesia (the Sahul Plain) was integrated with the Australian continent (Lohman et al., 2011).

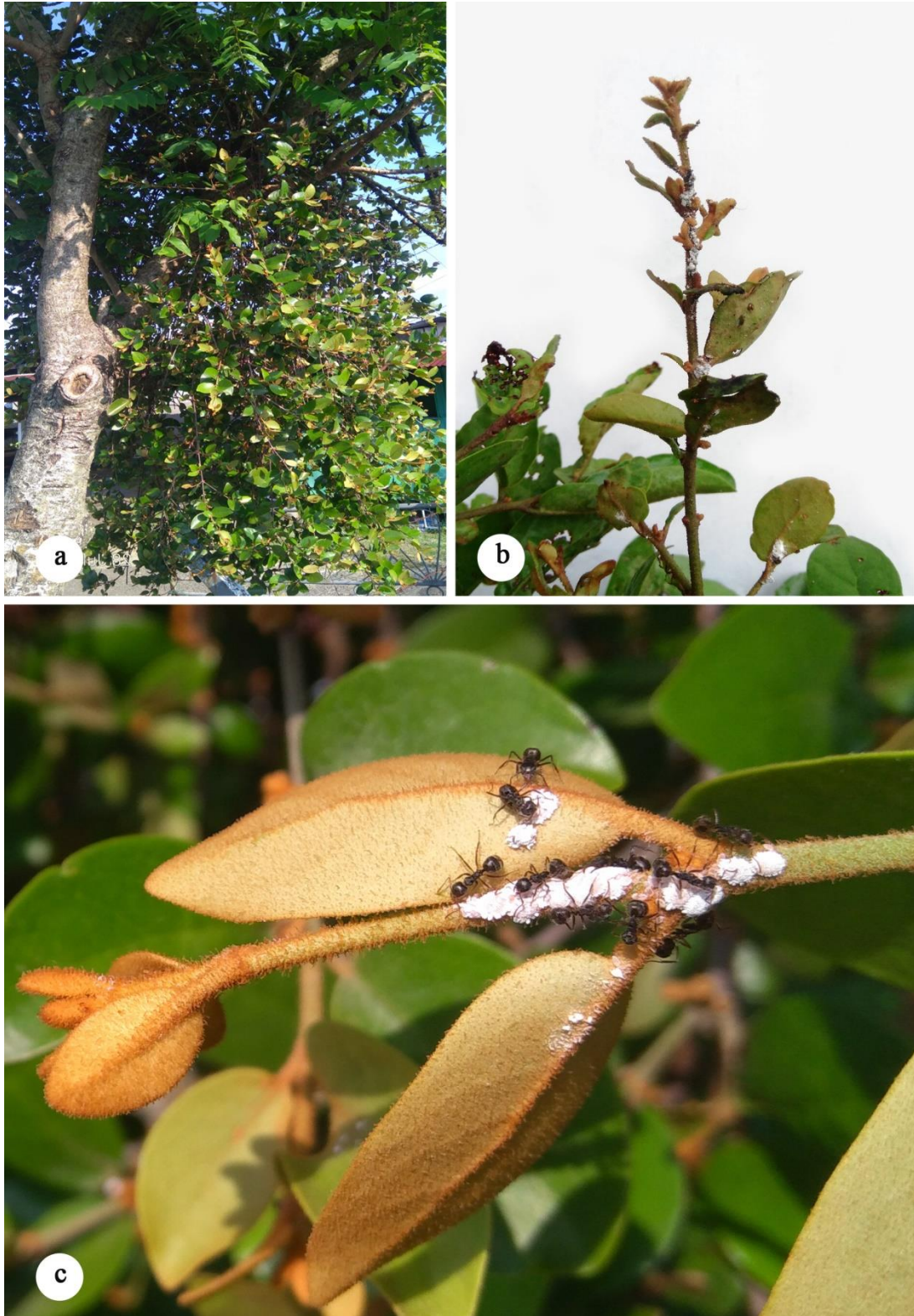


Figure 2. Nymphs and adults of *Planococcus bendovi* Williams attack a semi-parasitic plant, *Loranthus pentandrus* L. (Loranthaceae): a. Living tree of *L. pentandrus*; b. A colony of *P. bendovi* lives on *L. pentandrus*; c. Symbioses among ants and *P. bendovi*.

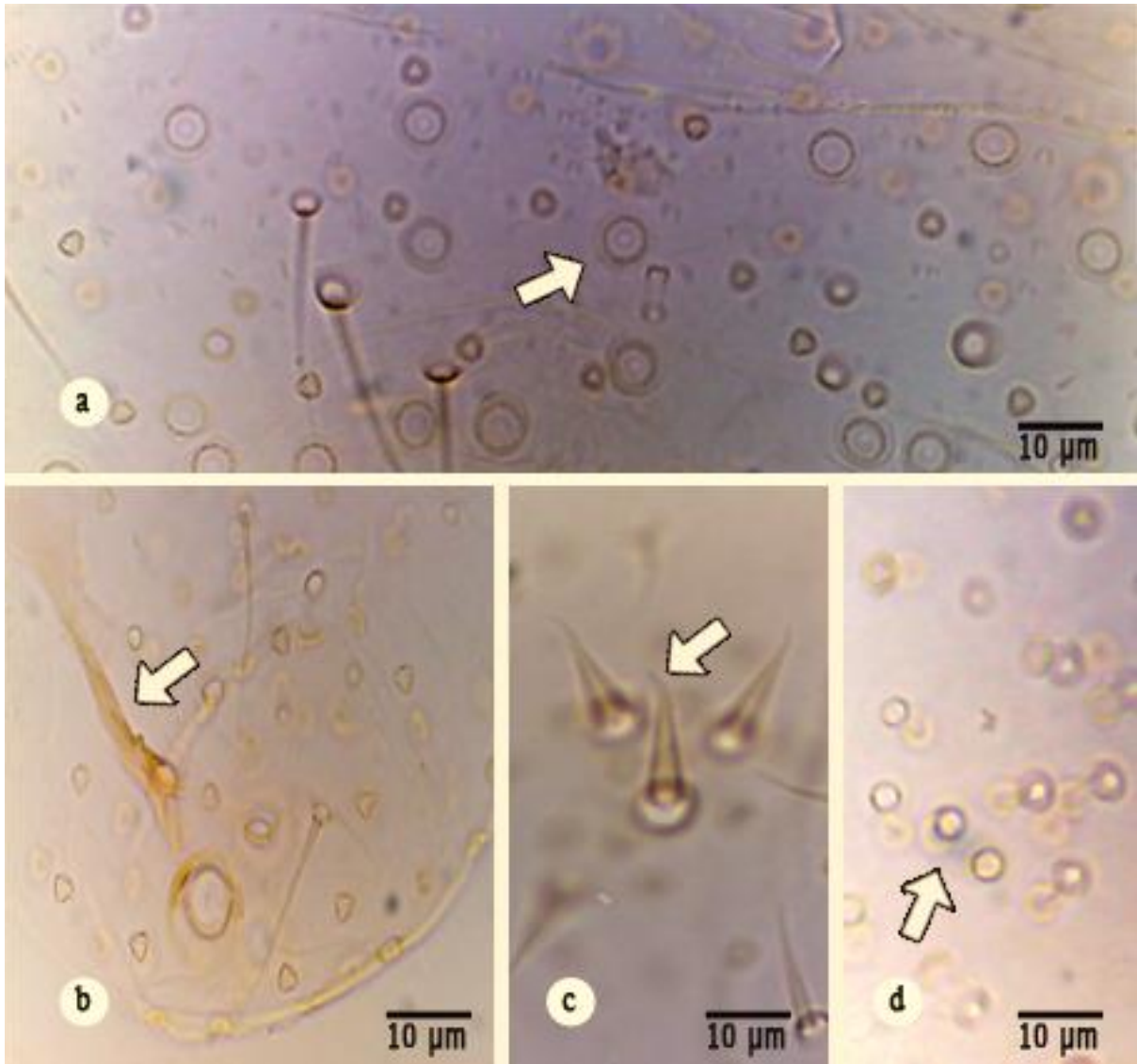


Figure 3. Morphological characters of *Planococcus bendovi* Williams: a. Numerous multilocular pores on ventral of the abdomen; b. Anal lobe bars; c. Truncate-conical setae, sometimes curve at the apex; d. Oral collar tubular ducts present considerably on head, thorax and abdomen.

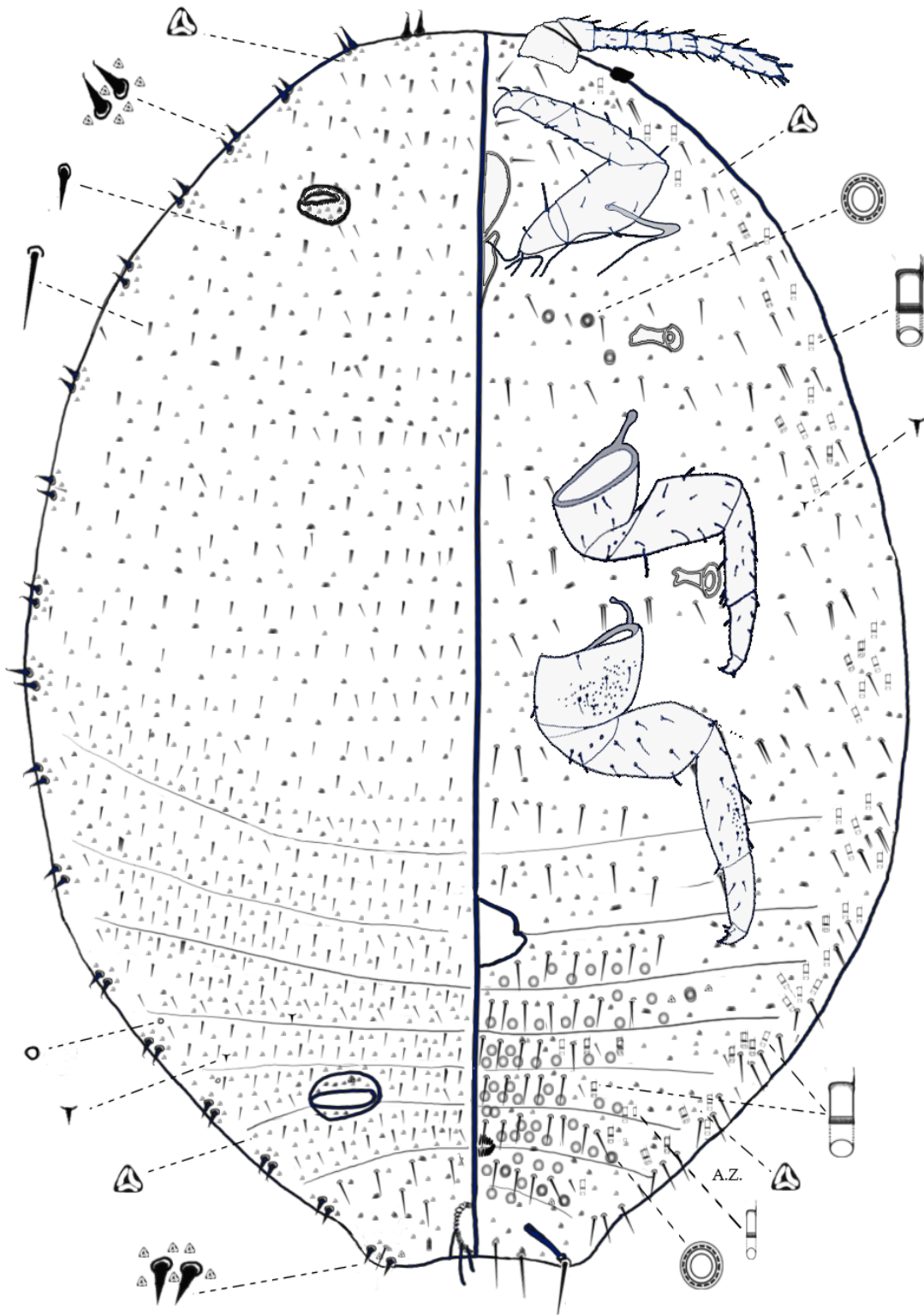


Figure 4. A female of *Planococcus bendovi* Williams. Specimen from Indonesia.

CONCLUSION

A mealybug species, *P. bendovi* has been reported for the first time from Indonesia and as well as from Southeast Asia. It was found on a semi-parasitic plant, *L. pentandrus* that lives on avocado, cacao, and cucumber tree. This semi-parasitic plant is a new host of *P. bendovi*.

ACKNOWLEDGEMENTS

This project was made possible by small grant of the Faculty of Agriculture, University of Bengkulu. Cooperative Agreement No. 12/5/2021.

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ABSTRACT

Planococcus bendovi Williams (Hemiptera: Coccoomorpha: Pseudococcidae) is a mealybug species that holotype and paratypes specimens were only recorded from India as a single slide. A series of surveys have been set up in Bengkulu province, Indonesia in 2021 and recorded the occurrence of *P. bendovi* in the country. The species was found on the leaves, trunks, and branches of a semi-parasitic plant, *Loranthus pentandrus* L. (Loranthaceae). This is the first report of *P. bendovi* in Indonesia as well as southeast Asia regions.

Key words: Biodiversity, host plant, insect pest, mealybug, taxonomy.

Dikomentari [1]: Nadrawati, Djamilah and Priyatningsih (there is not a surname) are each one author? Or are parts of an author name? Please check it

Dikomentari [AZ2]: They are author names (single name without sure name)

INTRODUCTION

Mealybugs (Hemiptera: Coccoomorpha: Pseudococcidae) of the genus *Planococcus* Ferris was revised by Cox (1989) and now comprises about 49 extant species worldwide (Garcia Morales et al., 2016). It is an important genus in which morphologically the adult female body is conspicuous by the anal lobe bars and 18 pair's cerarii (Danzig & Gavrilov, 2010). *Planococcus* are considered difficult to identify, it has 8-segmented antennae, well developed legs; with translucent pores on coxae, tibiae and sometimes on femora, circulus usually present, spiracles are well developed, multilocular disc pores numerous on ventral parts of abdominal segments and tubular ducts present on both body sides, usually dorsal ducts larger and sometimes with collars (Williams, 2004).

Some species of *Planococcus*, such as *Planococcus citri* (Risso), *Planococcus minor* (Maskell), *Planococcus ficus* (Signoret) and *Planococcus lilacinus* (Cockerell) are well-known as important insect pests of agricultural and horticultural crops worldwide. Mealybugs are sap-sucking insects that attack all parts of herbaceous plants and causing chlorosis, growth stagnation, drying of needles and branches, and even of entire plants under heavy infestation. Additionally, mealybugs mostly produces large quantities of honeydew, a good substrate for development of sooty mold, affecting photosynthesis, and causing faster plant deterioration. It is also potent to transmit some plant viruses (Franco et al., 2009, Daane et al., 2012). Many *Planococcus* species are polyphagous and may feed on over a hundred different host plants (Garcia Morales et al., 2016), but some of them are oligophagous (Francardi and Covassi, 1992) and even monophagous (Ben-Dov, 1994).

In Indonesia, six *Planococcus* species were recorded: *P. angkorensis* (Takahashi), *P. citri* (Risso), *P. dischidiae* (Takahashi), *P. lilacinus* (Cockerell), *P. minor* (Maskell), and *P. sulawesi* Cox (Garcia Morales et al., 2016). From these, *P. dischidiae* and *P. sulawesi* are native species of Indonesia in which holotype species were collected from Kalimantan and Sulawesi island, respectively (Williams, 2004; Garcia et al., 2016). The remaining species are cosmopolitans and polyphagous that spread over the world.

In this work, *Planococcus bendovi* Williams is recorded from Indonesia. In previous studies holotype and paratypes of this species were recorded from India as a single slide that was collected at Natural History Museum, UK-London (Williams, 2004). Here we report as a new record for the fauna of Indonesia as well as the first record of southeast Asia.

Dikomentari [3]: Deposited?

Dikomentari [AZ4]: Deposited (We are agree with you)

MATERIALS AND METHODS

A series of surveys were carried on in Bengkulu province in 2021. Specimens were collected on a semi-parasitic plant, *Loranthus pentandrus* L. (Loranthaceae) living on avocado (*Persea americana* Mill), cacao (*Theobroma cacao* L.), and cucumber tree (*Averrhoa bilimbi* L.) growth spreading in Bengkulu city and Seluma district, a part of southern Sumatra (Figure1).

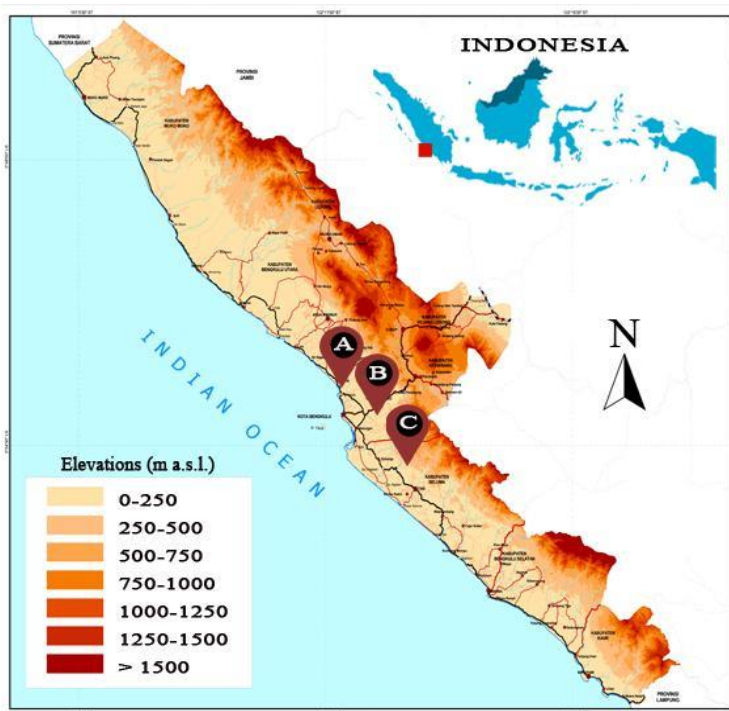


Figure 1. Sampling locations of *Planococcus bendovi* Williams: A, Muara Bangkahulu, Bengkulu city (03°45'36.1"S 102°16'00.5"E, 30 m a.s.l.); B, Slebar, Bengkulu city (03°49'25.3"S 102°19'08.3"E, 20 m a.s.l.); C, Air Periukan, Seluma regency (04°00'46.2"S 102°25'44.3"E, 40 m a.s.l.).

Mealybug populations were identified based on morphological characters. All the individuals sequenced were preserved in 70% ethanol and stored at 20°C. Individuals were slide mounted as described by Kosztarab and Kozár (1988) with a few modifications. The specimen was heated at 100°C -50°C in 10% KOH changed regularly for each 30 min in 2-3 hours and then washed in 70% ethanol for 30 min. It was stained with a staining solution (15 ml Essig's Aphid Solution with a 2% aqueous solution of 20 drops acid fuchsin, 20 drops

Dikomentari [5]: ???

Dikomentari [AZ6]: All the individuals were preserved in 70% ethanol, and then those were slide-mounted as described by Kosztarab and Kozár (1988) with a few modifications (We corrected this sentence)

lignin pink and 20 drops of erythrosine). Specimens were then transferred to pure ethanol for a half hour and immersed in clove oil for an additional two hours. Finally, the specimens were mounted on a slide in Canada balsam and covered with a coverslip. Slides were then heated at 30°C for 48h. Mealybugs were identified using the keys of Hodgson (1994) and Williams (2004). For nymph voucher specimen identification, some species for which immature instars have never been described were identified to genus level only. The slide-mounted specimens of *P. bendovi* females and nymphs are available from the mini scale insects Museum, Plant Protection Department, Faculty of Agriculture, University of Bengkulu (Sumatra-Indonesia) with slide number series: AZ400-404.

Dikomentari [7]: In the case of *Planococcus bendovi* did you identify nymphs?

Dikomentari [AZ8]: No, We did not identify the nymph. We deleted this sentence.

RESULTS AND DISCUSSIONS

Planococcus bendovi Williams, 2004

Material examined. Bengkulu province: 3 ♀♀, Muara Bangkahulu, Bengkulu city, *L. pentandrus* living on cucumber tree, 30 m a.s.l., 03°45'36.1"S 102°16'00.5"E, 10.iv.2020, Coll. A. Zarkani, (AZ400); 6 ♀♀, Slebar, Bengkulu city, *L. pentandrus* living on avocado tree, 20 m a.s.l., 03°49'25.3"S 102°19'08.3"E, 10.ii.2020, Coll. A. Zarkani (AZ401-402); 6 ♀♀, Air Periukan, Seluma district, *L. pentandrus* living on cacao tree, 40 m a.s.l., 04°00'46.2"S 102°25'44.3"E, 12.vi.2020, Coll. A. Zarkani (AZ403-404).

Diagnosis. Live specimen (after Williams, 2004), the body of the adult female is covered white wax secretion. The species of *P. bendovi* live on the leaf, flower, and fruit of the host plants and it commonly symbioses with ants (Figure 2.a-c). In slide-mounted specimens, the body of the adult female is oval, about 2.50 mm long and 1.70 mm wide. Antennae with 8 segments each about 300 µm. Legs well developed, short and slender. Claw stout about 30 µm long, with a denticle. Circulus about 170 µm wide divided by intersegmental line with a wrinkled surface. Ostiole well developed represented by posterior and anterior pair, with inner edges of lips sclerotized, each lip with a few trilocular pores. Anal ring bearing 6 setae, each about 115 µm long. Anal lobe cerarii each containing 2 conical setae and a few

trilocular pores but apparently no auxiliary setae. Multilocular disc pores are numerous on the abdomen (Figure 3.a). Anal lobe bars present (Figure 3.b). Dorsal surface with short and almost stiff setae, whilst ventral surface with normal flagellate setae. Cerarii always conspicuous, each bearing 2 or 3 truncate-conical setae, each cerarian setae sometimes curve at the apex (Figure 3.c). Cerarii numbering 18 pairs, each situated on a weak sclerotized base, mostly each smaller in area than the anal ring. Trilocular pores abundant, present in a regular arrangement, less numerous than on dorsum. A single pore sometimes occurring near lateral margin of abdomen, and 1 or 2 also present on head and thorax. Oral collar tubular ducts present considerably on head, thorax and abdomen of 2 main sizes; large type and slender type (Figure 3.d). An illustration of an adult female *P. bendovi* from Indonesia can be seen in Figure 4.

Comments. The species was listed tentatively as *Crisicoccus ? dischidae* (Takahashi) by Varshney (1992) and as *Crisicoccus* sp. by Ganguli & Ghosh (1964). It is a bit difficult to identify *P. bendovi* due to some similarities with *P. nilgircus*. However, they differ in the distribution of the tubular ducts and the number of multilocular disc pores. In *P. nilgircus*, ventral oral collar tubular ducts are absent from the margin of the head and thorax, represented by single ducts only near abdominal margins. In *P. bendovi*, multilocular disc pores are numerous on the abdomen, and tubular ducts are abundant around the margin including on the thorax and head. The species possess dorsal setae often varying in thickness, and abundant oral collar tubular ducts around the ventral margins; the micro ducts, although minute, are noticeable even under normal magnification.

Williams (2004) reported that *P. bendovi* attacked *Arachis hypogaea* L. (Fabaceae) in Tripura and Orissa, India. However, in Indonesia, we did not find the species on *A. hypogaea*. The species lives abundantly on a semi-parasitic plant, *L. pentandrus* living on avocado, cacao,

citrus, and cucumber tree. The species infested on *L. pentandrus* up to 20-40% of incidence, but rarely invaded the host trees of the semi-parasitic plant.

There is no information on how *P. bendovi* arrived in Indonesia, but it is probably unintentionally introduced by international trade from India to Indonesia. This speculation is similar to some new record of mealybug's occurrence reported by Zarkani. et al. (2020; 2021). Furthermore, it might occur probably reversely considering that in the past, like India, Bengkulu was also British colony, and as such, transportation activities between both places might be high. In addition, the species was probably also introduced some years before its report since the abundance of *P. bendovi* in some plants in the different territories with various infestation outbreak levels has occurred.

Dikomentari [9]: Please explain what do you mean, from a total number of plants?

Dikomentari [AZ10]: We corrected the sentence: This species was commonly found on semi-parasitic plant, *L. pentandrus*, up to 20-40% of incidence, i.e the number of infested plants divided by the total number of plants in a certain sampling quadrant. However, this species was barely found to invade the host trees of *L. pentandrus*.

Dikomentari [11]: Its hard to say that it coevolved with this host. Besides it was found in other hosts as mentioned by the authors.

Dikomentari [AZ12]: We deleted this sentence.

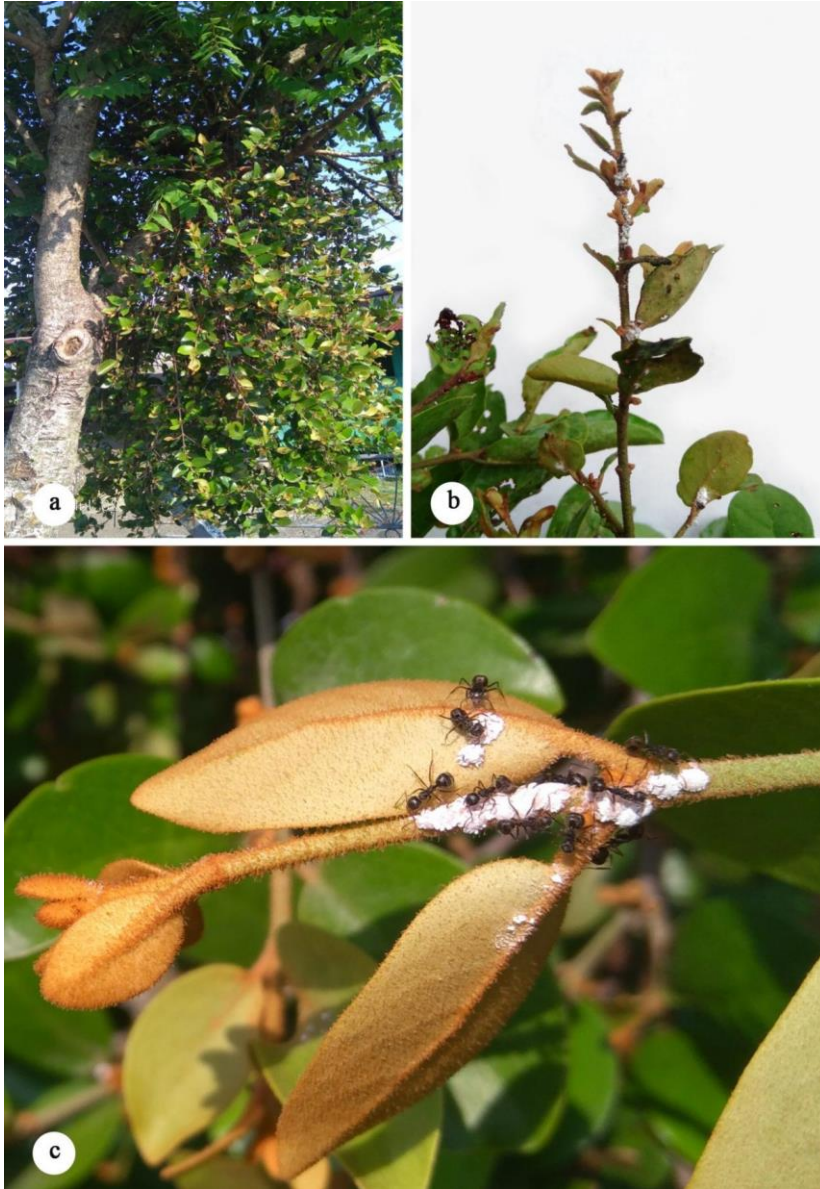


Figure 2. Nymphs and adults of *Planococcus bendovi* Williams attack a semi-parasitic plant, *Loranthus pentandrus* L. (Loranthaceae): a. Living tree of *L. pentandrus*; b. A colony of *P. bendovi* lives on *L. pentandrus*; c. Symbioses among ants and *P. bendovi*.

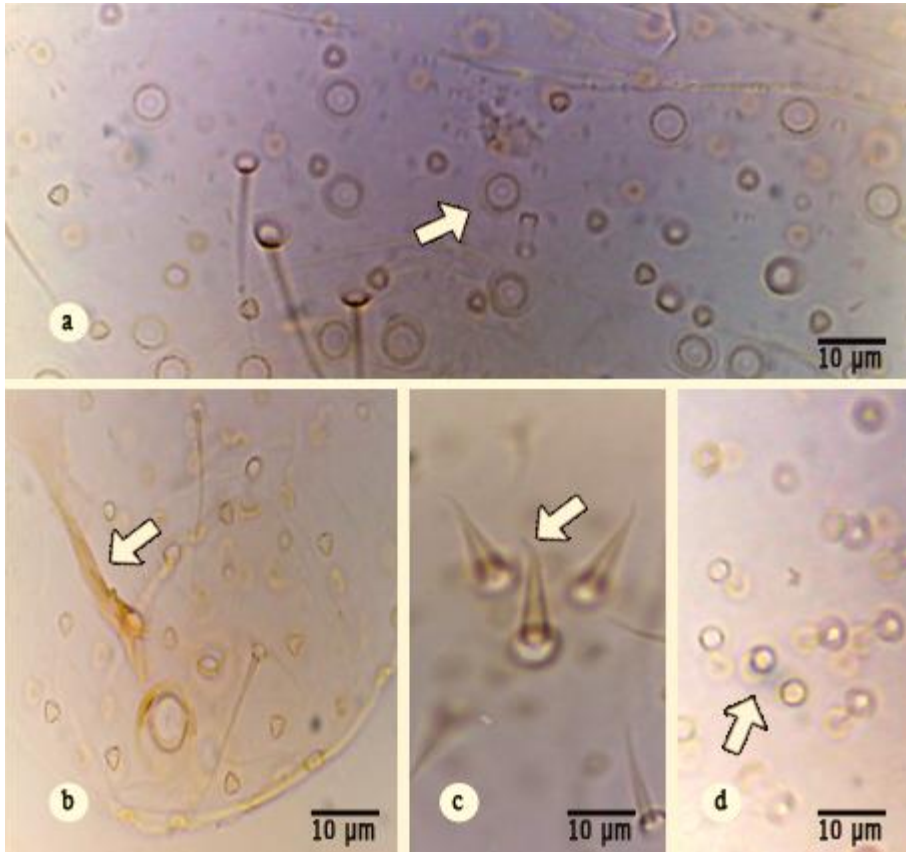


Figure 3. Morphological characters of *Planococcus bendovi* Williams: a. Numerous multilocular pores on ventral of the abdomen; b. Anal lobe bars; c. Truncate-conical setae, sometimes curve at the apex; d. Oral collar tubular ducts present considerably on head, thorax and abdomen.

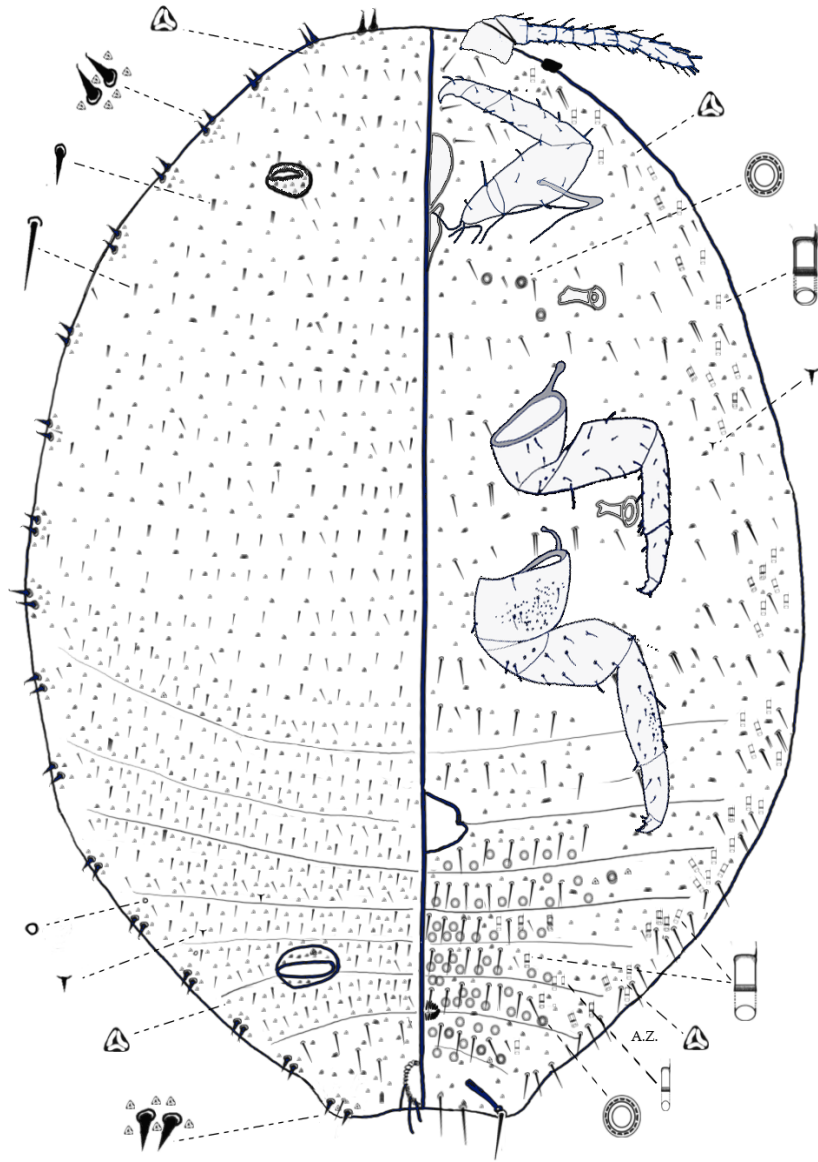


Figure 4. A female of *Planococcus bendovi* Williams. Specimen from Indonesia.

CONCLUSION

A mealybug species, *P. bendovi* has been reported for the first time from Indonesia and as well as from Southeast Asia. It was found on a semi-parasitic plant, *L. pentandrus* that lives on avocado, cacao, and cucumber tree. This is a new host of *P. bendovi*.

ACKNOWLEDGEMENTS

This project was made possible by small grant of the Faculty of Agriculture, University of Bengkulu. Cooperative Agreement No. 12/5/2021.

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SHORT COMMUNICATION

A FIRST RECORD OF MEALYBUG, *Planococcus bendovi* WILLIAMS (HEMIPTERA: COCCOMORPHA: PSEUDOCOCCIDAE) IN SOUTHEAST ASIA

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ABSTRACT

Planococcus bendovi Williams (Hemiptera: Coccoomorpha: Pseudococcidae) is a mealybug species that holotype and paratypes specimens were only recorded from India as a single slide. A series of surveys have been set up in Bengkulu province, Indonesia in 2021 and recorded the occurrence of *P. bendovi* in the country. The species was found on the leaves, trunks, and branches of a semi-parasitic plant, *Loranthus pentandrus* L. (Loranthaceae). This is the first report of *P. bendovi* in Indonesia as well as Southeast Asia regions.

Keywords: Biodiversity, host plant, insect pest, mealybug, taxonomy

ABSTRAK

Planococcus bendovi Williams (Hemiptera: Coccoomorpha: Pseudococcidae) merupakan spesies koya yang spesimen holotip dan paratip hanya direkodkan berasal dari India sebagai slaid tunggal. Beberapa siri tinjauan telah dibuat di wilayah Bengkulu, Indonesia pada 2021 dan merekodkan kehadiran *P. bendovi*. Spesies koya ini ditemui menyerang daun, batang dan dahan tumbuhan separa parasit, *Loranthus pentandrus* L. (Loranthaceae). Ini merupakan laporan pertama *P. bendovi* dari Indonesia serta dibeberapa kawasan di Asia Tenggara.

Kata kunci: Kepelbagaian biologi, tumbuhan perumah, serangga perosak, koya, taksonomi

INTRODUCTION

Mealybugs (Hemiptera: Coccothraupidae: Pseudococcidae) of the genus *Planococcus* Ferris was revised by Cox (1989) and now comprises about 49 extant species worldwide (Garcia-Morales et al. 2016). It is an important genus in which morphologically the adult female body is conspicuous by the anal lobe bars and 18 pair's cerarii (Danzig & Gavrilov 2010). *Planococcus* are considered difficult to identify, it has 8-segmented antennae, well-developed legs with translucent pores on coxae, tibiae and sometimes on femora, circulus present or absent, spiracles are well developed, multilocular disc pores rarely present on dorsum but numerous on ventral parts of abdominal segments, oral collar tubular ducts situated on the venter and present on both body sides, and discoidal pore present larger than trilobular pores (Williams 2004).

Some species of *Planococcus*, such as *P. citri* (Risso), *P. minor* (Maskell), *P. ficus* (Signoret) and *P. lilacinus* (Cockerell) are well-known as important insect pests of agricultural and horticultural crops worldwide. Mealybugs are sap-sucking insects that attack all parts of herbaceous plants and causing chlorosis, growth stagnation, drying of pods, twigs and branches, and even of entire plants under heavy infestation. Additionally, mealybugs mostly produce numerous quantities of honeydew, a good substrate for development of sooty mold, affecting photosynthesis, and causing faster plant deterioration. It is also potent to transmit some plant viruses (Daane et al. 2012; Franco et al. 2009). Many *Planococcus* species are polyphagous and may feed on over a hundred different host plants (Garcia-Morales et al. 2016), but some of them are oligophagous (Francardi & Covassi 1992) and even monophagous (Ben-Dov 1994).

In Indonesia, six *Planococcus* species were recorded namely *P. angkorensis* (Takahashi), *P. citri* (Risso), *P. dischidia* (Takahashi), *P. lilacinus* (Cockerell), *P. minor* (Maskell), and *P. sulawesi* Cox (Garcia-Morales et al. 2016). From these, *P. dischidia* and *P. sulawesi* are native species of Indonesia in which holotype species were collected from Kalimantan and Sulawesi island, respectively (Garcia-Morales et al. 2016; Williams 2004). The remaining species are cosmopolitans and polyphagous that spread over the world.

In this work, *Planococcus bendovi* Williams is recorded from Indonesia. In previous studies holotype and paratypes of this species was recorded from India as a single slide and deposited at Natural History Museum, United Kingdom, London (BMNH) (Williams 2004). Herein we report *P. bendovi* Williams as a new record for the fauna of Indonesia as well as the first record of southeast Asia.

MATERIALS AND METHODS

A series of surveys were carried on in Bengkulu province in 2021. Specimens were collected on a semi-parasitic plant, *Loranthus pentandrus* L. (Loranthaceae) living on avocado (*Persea americana* Mill), cacao (*Theobroma cacao* L.), and cucumber tree (*Averrhoa bilimbi* L.) growth spreading in Bengkulu city and Seluma district, a part of southern Sumatra (Figure 1).

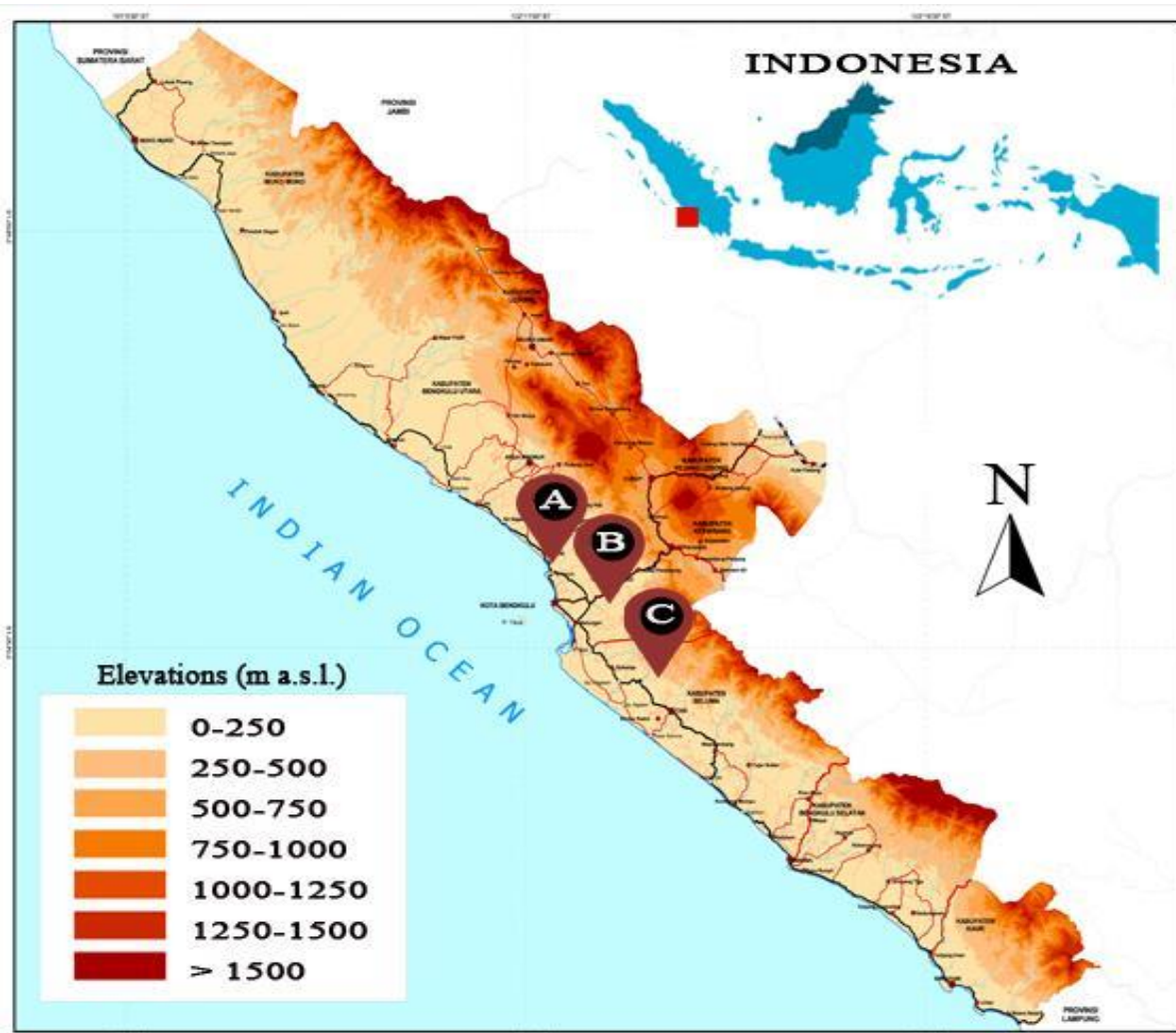


Figure 1. Sampling locations of *Planococcus bendovi* Williams: A, Muara Bangkahulu, Bengkulu city (03°45'36.1"S 102°16'00.5"E, 30 m a.s.l.); B, Slebar, Bengkulu city (03°49'25.3"S 102°19'08.3"E, 20 m a.s.l.); C, Air Periukan, Seluma reGENCY (04°00'46.2"S 102°25'44.3"E, 40 m a.s.l.)

Mealybug specimens were examined based on morphological characters. The specimens were preserved in 70% ethanol and slide-mounted as described by Kosztarab and Kozár (1988) with a few modifications. Furthermore, they were heated at 100°C - 50°C in 10% KOH and changed regularly for each 30 min in 2-3 hours, then washed in 70% ethanol for 30 min. The specimens were stained with a staining solution (15 ml Essig's Aphid Solution with a 2% aqueous solution of 20 drops acid fuchsin, 20 drops lignin pink and 20 drops of erythrosine). Specimens were then transferred to pure ethanol for a half hour and immersed in clove oil for an additional two hours. Finally, the specimens were mounted on a slide in Canada balsam and covered with a coverslip. Slides were then heated at 30°C for 48h. Mealybugs were identified using the keys of Hodgson (1994) and Williams (2004). The slide-mounted specimens of *P. bendovi* females are available from the mini scale insects museum at the Department of Plant Protection, Agricultural Faculty, University of Bengkulu with number series of AZ400-404.

RESULTS AND DISCUSSIONS

Planococcus bendovi Williams, 2004

Materials examined

Bengkulu province: 3 ♀♀, Muara Bangkahulu, Bengkulu city, *L. pentandrus* living on cucumber tree, 30 m a.s.l., 03°45'36.1"S 102°16'00.5"E, 10.iv.2020, Coll. A. Zarkani, (AZ400); 6 ♀♀, Slebar, Bengkulu city, *L. pentandrus* living on avocado tree, 20 m a.s.l., 03°49'25.3"S 102°19'08.3"E, 10.ii.2020, Coll. A. Zarkani (AZ401-402); 6 ♀♀, Air Periukan, Seluma district, *L. pentandrus* living on cacao tree, 40 m a.s.l., 04°00'46.2"S 102°25'44.3"E, 12.vi.2020, Coll. A. Zarkani (AZ403-404).

Diagnosis

In live specimens (after Williams 2004), body of adult female is veiled with white wax secretion. The species of *P. bendovi* live on the leaf, flower, and fruit of the host plants and it commonly live in symbioses with ants (Figure 2 a-c). On microscope slide specimen, body of female is broadly oval to rotund, about 2.50 mm long and 1.70 mm wide. Antennae each about 300 µm long, with 8 segments. Legs well developed, short for size of body and slender. Claw with a denticle, stout about 30 µm long. Circulus about 170 µm wide divided by intersegmental line with a wrinkled surface. Ostiole well developed represented by posterior and anterior pair, with inner edges of lips sclerotized, each lip with a few trilocular pores. Anal ring bearing 6 setae, each about 115 µm long. Anal lobe cerarii each containing 2 conical setae and a few trilocular pores but apparently no auxiliary setae. Multilocular disc pores are numerous on the abdomen (Figure 3a). Anal lobe bars present (Figure 3b). Dorsal surface with short and almost stiff setae, whilst ventral surface with normal flagellate setae. Cerarii always conspicuous, each bearing 2 or 3 conical setae, each cerarian setae sometimes curve shape at the tip (Figure 3c). Cerarii numbering 18 pairs, each situated on a weak sclerotized base, mostly each smaller in area than the anal ring. Trilocular pores abundant, present in a regular arrangement, less numerous than on dorsum. A single pore sometimes occurring near lateral margin of abdomen, and 1 or 2 also present on head and thorax. Oral collar tubular ducts present considerably on head, thorax and abdomen of 2 main sizes; large type and slender type (Figure 3d). An illustration of an adult female *P. bendovi* from Indonesia can be seen in Figure 4.

Comments

The species was listed tentatively as *Crisicoccus ? dischidae* (Takahashi) by Varshney (1992) and as *Crisicoccus* sp. by Ganguli & Ghosh (1964). It is a bit difficult to identify *P. bendovi* due to some similarities with *P. nilgiricus*. However, they differ in the distribution of the tubular ducts and the number of multilocular disc pores. In *P. nilgiricus*, ventral oral collar tubular ducts are absent from the margin of the head and thorax, represented by single ducts only near abdominal margins. In *P. bendovi*, multilocular disc pores are numerous on the abdomen, and tubular ducts are abundant around the margin including on the thorax and head. The species possess dorsal setae often varying in thickness, and abundant oral collar tubular ducts around the ventral margins; the micro ducts, although minute, are noticeable even under normal magnification.

Williams (2004) reported that *P. bendovi* attacked *Arachis hypogaea* L. (Fabaceae) in Tripura and Orissa, India. However, in Indonesia, we did not find the species on *A. hypogaea*. The species lives abundantly on a semi-parasitic plant, *L. pentandrus* living on avocado, cacao, citrus, and cucumber tree. This species was commonly found on semi-parasitic plant, *L. pentandrus*, up to 20-40% of incidence, i.e the number of infested plants divided by the total

number of plants in a certain sampling quadrant. However, this species was barely found to invade the host trees of *L. pentandrus*.

There is no information on how *P. bendovi* arrived in Indonesia, but it is probably unintentionally carried by overseas trade from India to Indonesia. This speculation is similar to some new record of mealybug's occurrence reported by Zarkani et al. (2020; 2021?). Furthermore, it might occur probably reversely considering that in the past, like India, Bengkulu was also British colony, and as such, transportation activities between both places might be high. In addition, *P. bendovi* was probably also invaded some years before its report since the population of such species in some host plants in the different territories with various infestation outbreak levels has occurred.



Figure 2. Nymphs and adults of *Planococcus bendovi* Williams attack a semi-parasitic plant, *Loranthus pentandrus* L. (Loranthaceae): a. Living tree of *L. pentandrus*; b. A colony of *P. bendovi* lives on *L. pentandrus*; c. Symbioses among ants and *P. bendovi*

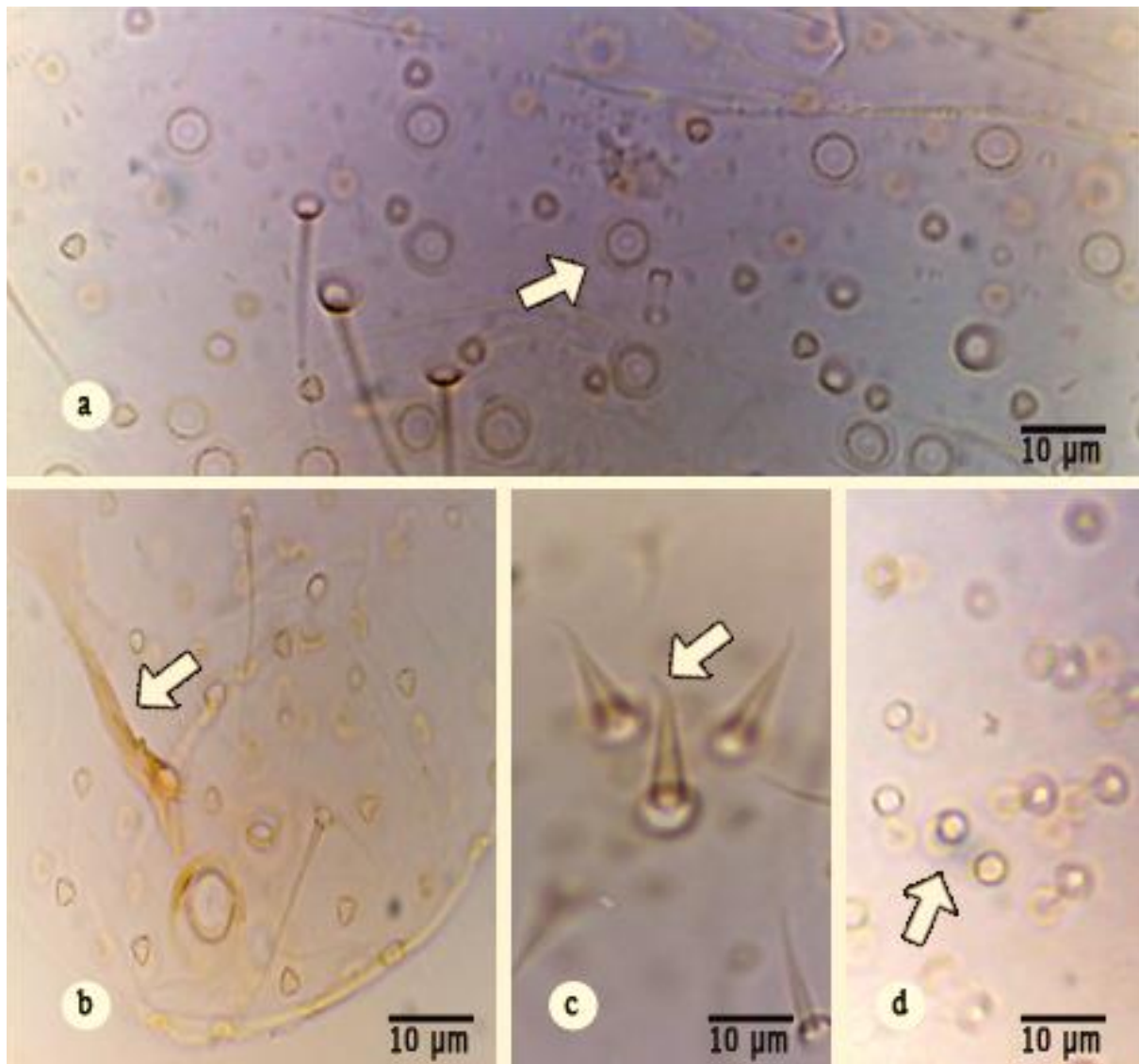


Figure 3. Morphological characters of *Planococcus bendovi* Williams: a. Numerous multilocular pores on ventral of the abdomen; b. Anal lobe bars; c. Conical setae, sometimes curve at the apex; d. Oral collar tubular ducts present considerably on head, thorax and abdomen

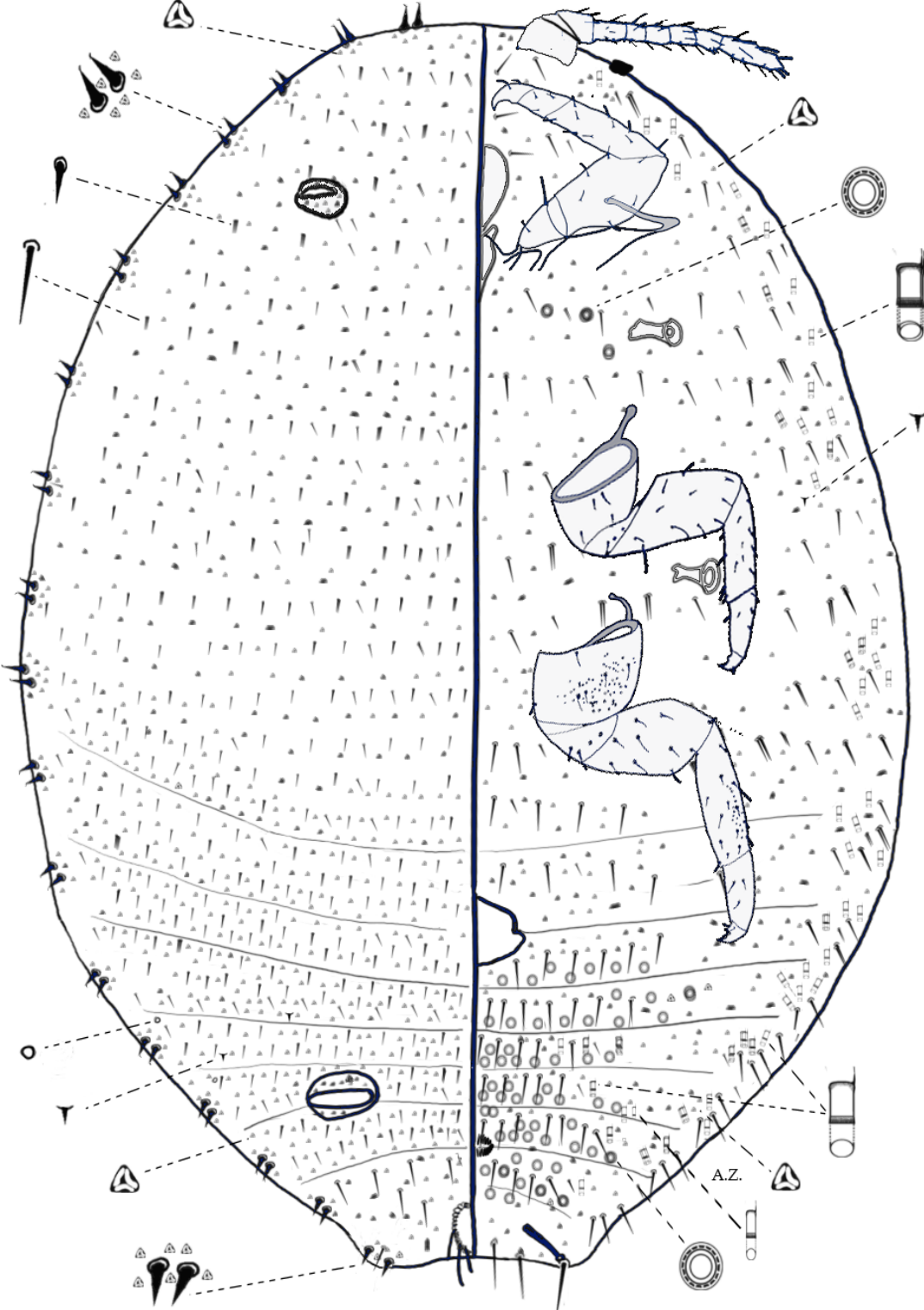


Figure 4. A female of *Planococcus bendovi* Williams. Specimen from Indonesia

CONCLUSION

A mealybug species, *P. bendovi* has been reported for the first time from Indonesia and as well as from Southeast Asia. It was found on a semi-parasitic plant, *L. pentandrus* that lives on avocado, cacao, and cucumber tree.

ACKNOWLEDGEMENTS

The authors express profound gratitude to the Faculty of Agriculture, University of Bengkulu for granting a grant No. 12/6/2021 to conduct the research.

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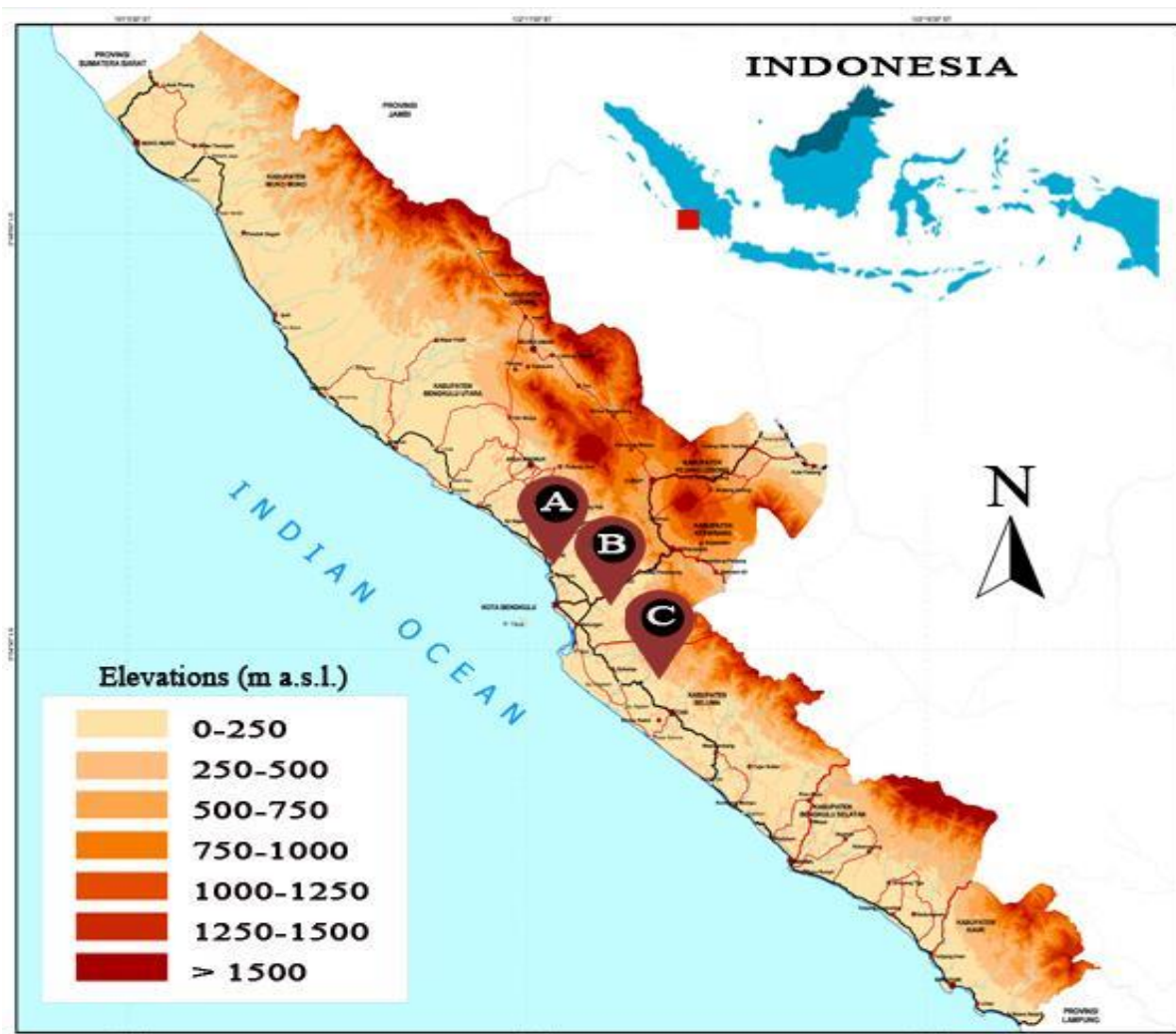


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RESULTS AND DISCUSSIONS

Planococcus bendovi Williams, 2004

Materials examined

Bengkulu province: 3 ♀♀, Muara Bangkahulu, Bengkulu city, *L. pentandrus* living on cucumber tree, 30 m a.s.l., 03°45'36.1"S 102°16'00.5"E, 10.iv.2020, Coll. A. Zarkani, (AZ400); 6 ♀♀, Slebar, Bengkulu city, *L. pentandrus* living on avocado tree, 20 m a.s.l., 03°49'25.3"S 102°19'08.3"E, 10.ii.2020, Coll. A. Zarkani (AZ401-402); 6 ♀♀, Air Periukan, Seluma district, *L. pentandrus* living on cacao tree, 40 m a.s.l, 04°00'46.2"S 102°25'44.3"E, 12.vi.2020, Coll. A. Zarkani (AZ403-404).

Diagnosis

In live specimens (after Williams 2004), body of adult female is veiled with white wax secretion. The species of *P. bendovi* live on the leaf, flower, and fruit of the host plants and it commonly live in symbioses with ants (Figure 2 a-c). On microscope slide specimen, body of female is broadly oval to rotund, about 2.50 mm long and 1.70 mm wide. Antennae each about 300 µm long, with 8 segments. Legs well developed, short for size of body and slender. Claw with a denticle, stout about 30 µm long. Circulus about 170 µm wide divided by intersegmental line with a wrinkled surface. Ostiole well developed represented by posterior and anterior pair, with inner edges of lips sclerotized, each lip with a few trilocular pores. Anal ring bearing 6 setae, each about 115 µm long. Anal lobe cerarii each containing 2 conical setae and a few trilocular pores but apparently no auxiliary setae. Multilocular disc pores are numerous on the abdomen (Figure 3a). Anal lobe bars present (Figure 3b). Dorsal surface with short and almost stiff setae, whilst ventral surface with normal flagellate setae. Cerarii always conspicuous, each bearing 2 or 3 conical setae, each cerarian setae sometimes curve shape at the tip (Figure 3c). Cerarii numbering 18 pairs, each situated on a weak sclerotized base, mostly each smaller in area than the anal ring. Trilocular pores abundant, present in a regular arrangement, less numerous than on dorsum. A single pore sometimes occurring near lateral margin of abdomen, and 1 or 2 also present on head and thorax. Oral collar tubular ducts present considerably on head, thorax and abdomen of 2 main sizes; large type and slender type (Figure 3d). An illustration of an adult female *P. bendovi* from Indonesia can be seen in Figure 4.

Comments

The species was listed tentatively as *Crisicoccus ? dischidae* (Takahashi) by Varshney (1992) and as *Crisicoccus* sp. by Ganguli & Ghosh (1964). It is a bit difficult to identify *P. bendovi* due to some similarities with *P. nilgiricus*. However, they differ in the distribution of the tubular ducts and the number of multilocular disc pores. In *P. nilgiricus*, ventral oral collar tubular ducts are absent from the margin of the head and thorax, represented by single ducts only near abdominal margins. In *P. bendovi*, multilocular disc pores are numerous on the abdomen, and tubular ducts are abundant around the margin including on the thorax and head. The species possess dorsal setae often varying in thickness, and abundant oral collar tubular ducts around the ventral margins; the micro ducts, although minute, are noticeable even under normal magnification.

Williams (2004) reported that *P. bendovi* attacked *Arachis hypogaea* L. (Fabaceae) in Tripura and Orissa, India. However, in Indonesia, we did not find the species on *A. hypogaea*. The species lives abundantly on a semi-parasitic plant, *L. pentandrus* living on avocado, cacao, citrus, and cucumber tree. This species was commonly found on semi-parasitic plant, *L. pentandrus*, up to 20-40% of incidence, i.e the number of infested plants divided by the

total number of plants in a certain sampling quadrant. However, this species was barely found to invade the host trees of *L. pentandrus*.

There is no information on how *P. bendovi* arrived in Indonesia, but it is probably unintentionally carried by overseas trade from India to Indonesia. This speculation is similar to some new record of mealybug's occurrence reported by Zarkani et al. (2020; 2021a & b). Furthermore, it might occur probably reversely considering that in the past, like India, Bengkulu was also British colony, and as such, transportation activities between both places might be high. In addition, *P. bendovi* was probably also invaded some years before its report since the population of such species in some host plants in the different territories with various infestation outbreak levels has occurred.



Figure 2. Nymphs and adults of *Planococcus bendovi* Williams attack a semi-parasitic plant, *Loranthus pentandrus* L. (Loranthaceae): a. Living tree of *L. pentandrus*; b. A colony of *P. bendovi* lives on *L. pentandrus*; c. Symbioses among ants and *P. bendovi*

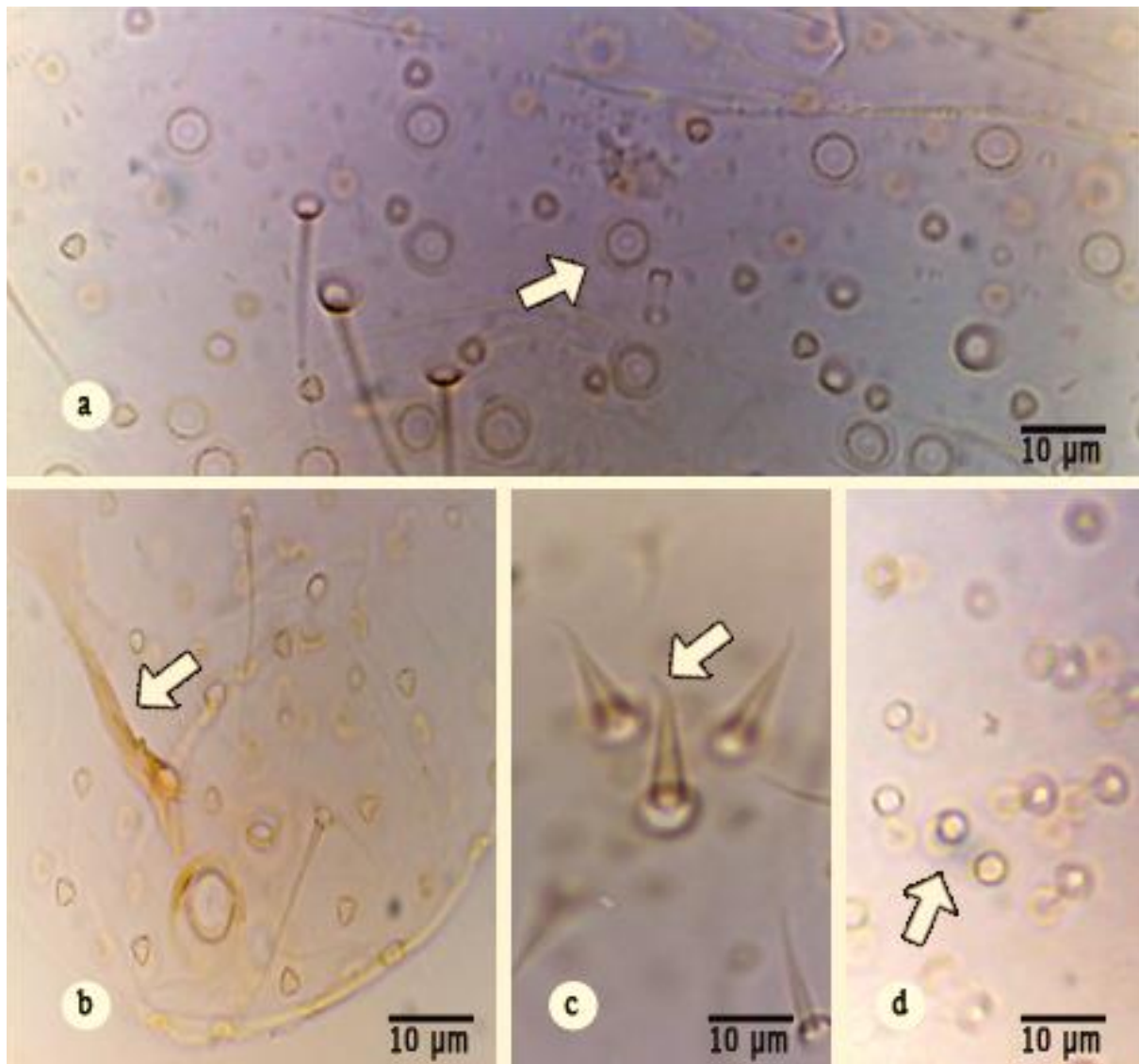


Figure 3. Morphological characters of *Planococcus bendovi* Williams: a. Numerous multilocular pores on ventral of the abdomen; b. Anal lobe bars; c. Conical setae, sometimes curve at the apex; d. Oral collar tubular ducts present considerably on head, thorax and abdomen

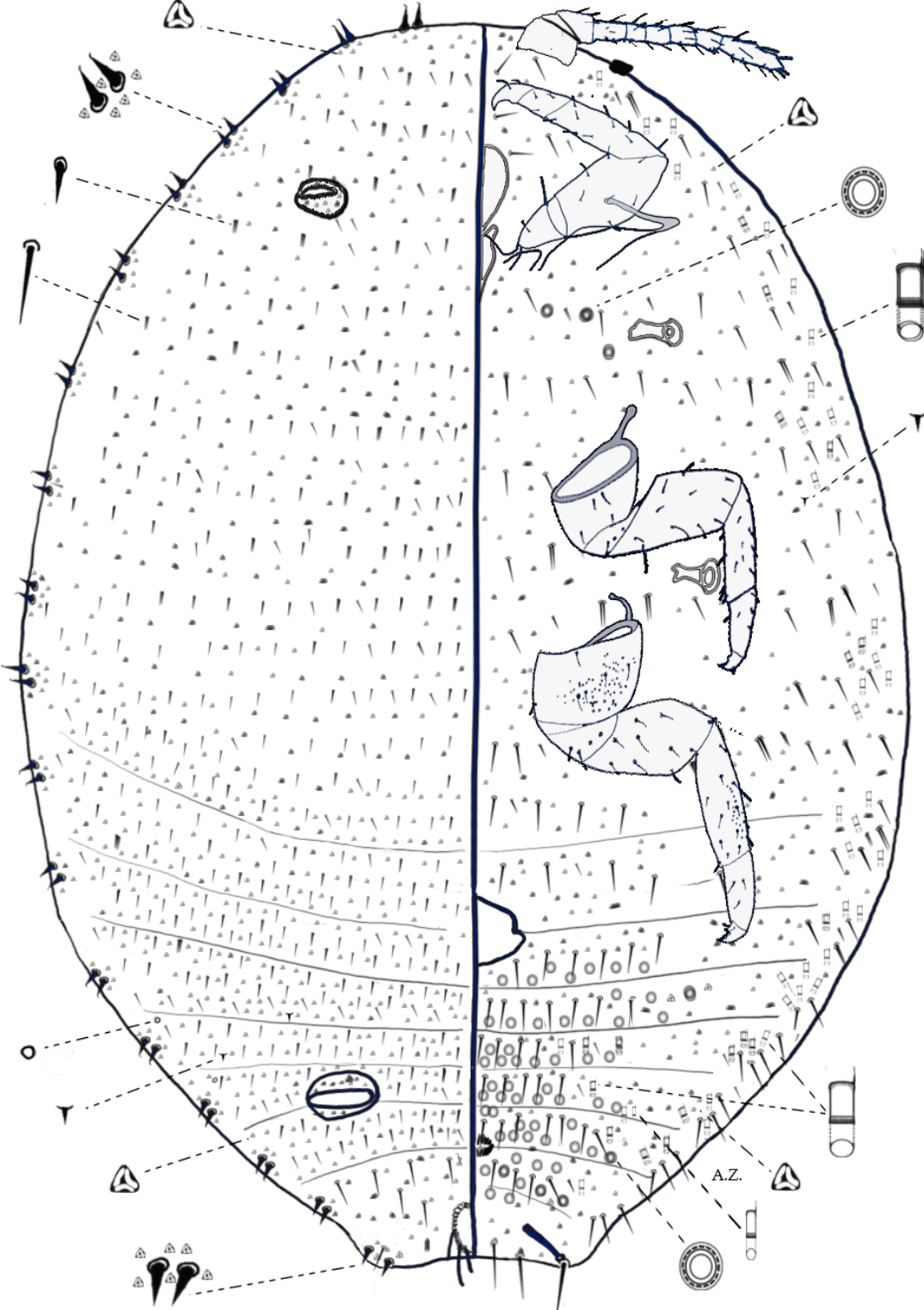


Figure 4. A female of *Planococcus bendovi* Williams. Specimen from Indonesia

CONCLUSION

A mealybug species, *P. bendovi* has been reported for the first time from Indonesia and as well as from Southeast Asia. It was found on a semi-parasitic plant, *L. pentandrus* that lives on avocado, cacao, and cucumber tree.

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