NEW INDONESIAN COUNTRY RECORDS AND SPECIES INFORMATION FOR MEALYBUGS (HEMIPTERA PSEUDOCOCCIDAE) IN WIRJATI’S HISTORIC COLLECTION (1)

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Between 1955 and 1960, a collection of slide-mounted mealybugs (Hemiptera: Coccomorpha: Pseudococcidae) was prepared by Mrs Wirjati, using samples collected between 1916 and 1960 from a variety of hosts in Indonesia. The collection is a record of which species were established in the country in 1960. The slides, deposited at the Indonesian Ministry of Agriculture in Java, are the earliest material in the national mealybug collection. There are 181 temporary slide mounts of unstained, waxy mealybugs mounted in agar or gum chloral media that have dried out to varying degrees. Specimens were retrieved from 50 representative slides and re-mounted as stained, archival mounts in Canada balsam. The method used to retrieve the specimens from the old mounts is described. The re-mounted specimens were re-identified using up-to-date, published identification keys, resulting in new identities for most of the specimens. Fifteen species belonging to 12 genera were identified, however specimens from four of the slides could not be identified beyond genus level. The Wirjati slides of Antoinia thaiensis Takahashi, Hordeolicoccus nephelii (Takahashi) and Paraputo corbetti (Takahashi) are new country records. The differences between the fauna in Wirjati’s collection and that found in Indonesia today are discussed.

KEY WORDS: national collection, historic fauna, Wirjati, slide curation, re-mounting.

INTRODUCTION

The Indonesian national collection of mealybugs, made by Mrs Wirjati between 1950 and 1960, has been stored at the Indonesian Centre for Agricultural Biotechnology and Genetics Resources Research and Development (ICABGRRD), Indonesian Agency for Agricultural Research and Development, Ministry of Agriculture (Jalan Tentara Pelajar No. 3 Cimanggu, Bogor, West Java), since the 1950s. It consists of 181 slide mounts stored in three wooden boxes. The significance of Wirjati’s collection is that it records which species were established in Indonesia between 1916 and 1960, providing baseline information that makes it possible to recognize which of the mealybug species are likely to have become established in Indonesia since 1960.

In the Wirjati collection, the slide labels were written in pencil or ink and were attached using water-soluble glue. Often the data noted on labels is incomplete. The condition of the original slide mounts is very poor, with dirt and mould on the exterior surfaces, the mountant turned brown or crystallized, and sometimes with large air gaps beneath the coverslips (Fig. I). In a few cases the specimens had been stained pink to purple using an unknown stain (Fig. II), but most of the specimens are unstained. In a single slide mount there are sometimes as many as seven specimens, not always of the same species. It was possible to deduce that Wirjati’s slides were made with water-soluble mountants because the edges of each coverslip had been sealed with oil-based paint to minimise evaporation of water from the mounts.

In each of the original mounts, evaporation of water through the imperfect seal has reduced the volume of the mountant so that the coverslip has been pulled down onto the specimens, crushing them. The two surfaces have become pressed together, making it extremely difficult to distinguish dorsal structures from those on the venter. The same phenomenon was noted in old slide mounts in the aphid collection at The Natural History Museum, London, UK (BROWN, 1997).

In some of the Wirjati mounts, the mountant (possibly an agar solution) was still liquid. In others, the mountant (possibly a gum chloral mixture related to Hoyer’s Medium or Berlese Fluid) had dried out completely, leaving either paths of a clear, hard, glassy substance and large air spaces under the coverslip, or crystals attached to the insect cuticle (especially the body setae), or both. The variety of ways in which the mountants had behaved suggested that several different recipes had been used. In all cases, the insect

1 Original scientific contribution presented and discussed at XIV International Symposium on Scale Insect Studies, Catania-Italy, 13-16 June 2016.
cuticles are still visible and the antennal segments can be counted at low power. However, it is difficult or impossible to see the setae either in the cerarii or on the body, and smaller structures like trilocular pores are not visible. Often the cuticles are badly crumpled and many of the cerarian setae have been lost. In a few of the mounts some of the more distinctive species can be recognized (for example, a few specimens of *Antonina* sp., *Exallomochlus hispidus* (Morrison), *Dysmicoccus lepelleyi* (Betrem) and *Hordeolicoccus nephelii* (Takahashi)), but in most of the original mounts the insects are not identifiable.

In order to re-identify the mealybugs to modern standards, the specimens needed to be removed from the old temporary mounts, stained and then re-mounted as permanent mounts in Canada balsam. This improved the quality of the preparations to a level where they could be accurately identified to species level and used as a permanent reference resource by entomologists.

The aim of this study was to re-mount a representative part of Wirjati’s collection of mealybugs and re-identify the specimens, to record the species of mealybug present in Indonesia in the past. The resultant species records are compared with recent records from Indonesia.

MATERIALS AND METHODS

EXTRACTION OF SPECIMENS FROM OLD TEMPORARY SLIDE MOUNTS

Fifty old, temporary slide mounts from the Wirjati collection were selected for re-mounting. They were selected to represent samples from a variety of host-plants. The process of re-mounting is difficult and time-consuming, and only worth doing if the specimens are in good condition. Each slide was processed to extract the specimens as follows:

1. The slide was photographed in order to preserve the data in case the writing washed off during the re-mounting process, and to record the number of specimens in the mount.
2. To access the mountant, the paint seal was scratched and broken off the edge of the coverslip very carefully with a small, stiff spatula using horizontal movements, until all the coverslip edges had been exposed.
3. The tip of a mounted needle was used to scrape the last traces of the sealant from the coverslip edges, to completely expose the mountant in the crack. This ensured that the coverslip could lift off freely.
4. Under a stereomicroscope, a fine paintbrush was used to rinse the crack around the edge of the coverslip with 95% isopropanol, to remove any traces of paint or grease. Contact with the labels was avoided in case the alcohol smudged or dissolved anything written in ink.
5. The slide was placed in a petri dish, covered with cold water, and the dish was covered and labeled with the date. The dish was placed on a cold, thermostatically controlled hotplate at room temperature and heated to 60°C.
6. After a short time the water-soluble glue dissolved and the labels floated off the slide. The glue was gently

Fig. I – A Wirjati slide with air beneath the coverslip.

Fig. II – A Wirjati slide containing seven specimens stained pink to purple.
rinsed off their backs before they were removed from
the dish and placed face down on the glass lid to dry.
7. Heating continued and the slide was checked under the
stereomicroscope periodically to monitor progress of
dissolution of the mountant. In very thin mounts, this
process was very slow, so a bulb pipette was used to
gently flush water beneath the coverslip to remove the
mountant faster. Only when the coverslip moved when
shaking the dish slightly was the slide ready for the next
step.
8. Under the stereomicroscope, a mounted needle was
used to gently push the coverslip sideways. If it resisted
movement at all, the heating and soaking process was
resumed. Another attempt would be made after some
time; once the coverslip floated off the specimens easily,
their positions were noted.
9. If the specimens were still stuck on the slide, they were
soaked until they floated off into the water. If they were
attached to the coverslip, it was turned over so that the
specimens were on the upper surface, and soaking
continued until they floated off. A very gentle nudge
with a spatula or paintbrush to encourage them to move
did not hurt them, but no attempt was made to force
them off the glass using instruments as this would have
damaged them.
10. Once the specimens were floating free in the water (or
on the surface), a spatula was used to lift and transfer
them into clean water in a cavity block, where they were
covered and soaked until all traces of mountant inside
them had disappeared. At this stage they were ready to
be processed into a new slide mount.

PREPARATION OF RETRIEVED SPECIMENS INTO
PERMANENT SLIDE MOUNTS

The slide preparation method given by Sirese et al.
(2013) was used to re-mount the specimens. The process
involved maceration (if necessary), staining, dehydration,
de-waxing, clearing and mounting.

First, if the specimens contained body contents they were
macerated by gently heating in 10% KOH. Any embryos or
eggs still inside the body could sometimes be gently
extracted through an existing hole in the cuticle, or a small
hole could be made in the cuticle if necessary to remove
them; however if these fragments resisted removal then they
were left to avoid causing serious damage to the insect
cuticle. If the body had been folded or crumpled, sometimes
it could be gently re-shaped while in KOH; however this
can only be done with specimens retrieved from aqueous
mountants. Specimens retrieved from Canada balsam
mounts are far too stiff, brittle and fragile to attempt
dissection or re-shaping.

After maceration, the specimens were soaked in water to
rinse out the KOH. If the body was mis-shapen, sometimes
it could be gently re-shaped while in water. Subsequently
any remaining KOH in the specimens was neutralised in
acidified 80% isopropanol before the cuticle was stained
with acid fuchsin. The specimens were then briefly rinsed in
acidified 80% isopropanol and then dehydrated in 95%
isopropanol, before being cleared in clove oil and then
mounted in Canada balsam. The slides were placed in a
thermostatically controlled oven at 40 °C to dry.

After three months, the slides were ready for labels to be
attached using non-water-soluble glue. If only one new slide
had been made, the original labels were attached to the new
mount. However, if more than one slide was made, then the
original labels were attached to the best slide mount and the
other slides were labeled with replica labels printed from
the photograph of the original slide. The re-mounted
specimens were identified using keys in Williams (2004)
and Cox (1989).

Re-mounting and re-identification were carried out at the
Plant Pest Diagnostic Center, California Department of
Food and Agriculture, Sacramento, California, USA (PDDC)
and the Department of Plant Protection, Faculty of
Agriculture, Bogor Agricultural University, Bogor,
Indonesia.

RESULTS AND DISCUSSION

Fifty original slides were re-mounted and re-identified. Some
stiffened specimens resisted being re-shaped; this
made the recognition of morphological characters and
identification to species level more difficult.

Of seven slides that were undetermined by Wirjati, six
were identified to species and the remaining one was
identified as Monophlebidae sp. One sample, identified
by Wirjati as “Diaspididae”, contained Odonaspis serrata
Ben-Dov (Diaspididae) and the mealybug Chaetococcus
bambusae (Maskell). Of four slides determined by Wirjati
only to family level, all were re-identified to species
level and one could only be re-identified to genus
Pseudococcus. Of 23 slides determined by Wirjati to genus
level, i.e. Antonina, Dysmicoccus, Nipaecoccus and
Pseudococcus, four were re-identified to genus level and
the remaining 19 to species level. Of 15 samples determined
by Wirjati to species level, the identity of four were
confirmed in the re-mounted material and the remaining
15 slides proved to belong to different genera and/or species
than the original determination. The original determinations
of the 50 Wirjati slides and their re-identifications are given in
Table 1. Below, each of the mealybug species is discussed,
and the species represented in the Wirjati collection are
compared to the mealybug species present in Indonesia
today.

Antonina thalensis Takahashi
This is the first record of A. thalensis from Indonesia,
collected on bamboo in Java, Bogor, 17.xii.1957 by
Soehardjan. Williams (2004) did not include Indonesia in
the distribution of this species.

Chaetococcus bambusae (Maskell)
Chaetococcus bambusae was found among specimens of
Odonaspis serrata Ben-Dov (Diaspididae) on one Wirjati
slide, which she had determined as Diaspididae. This
mealybug had been recorded from Indonesia previously;
the earliest record was from Java, collected by E. Jacobson
on bamboo in 1907 (Williams, 2004).

Dysmicoccus brevipes (Cockerell)
The earliest record of this species of Indonesia was a
plant quarantine interception at Washington DC, USA, from
Java, Bogor, in 1917. The 1960 sample in Wirjati’s
collection is additional evidence of its occurrence in
Indonesia (West Java, Subang, Pusakanegara).

Dysmicoccus lepelleyi (Betrem)
Betrem described D. lepelleyi from a specimen sent to
him by R.H. Le Pelley in 1937, collected on Annona
muricata (Annonaceae) from Java, Bogor. The earliest
Indonesian collection was made by van der Goot in 1928,
also from Java, Bogor, on Mangifera indica (Anacardiaceae)
(Williams, 2004). Wirjati’s 1949 sample from
**Table 1 – List of original determinations and re-identifications of specimens remounted from Wirjati’s slides.**

<table>
<thead>
<tr>
<th>No.</th>
<th>Slide code</th>
<th>Original determination</th>
<th>Collection data</th>
<th>Present identification</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CC162</td>
<td>Undetermined</td>
<td>Bogor, 18.vii.1957, leg. Wirjati, on <em>Scombortia</em> sp.</td>
<td><em>Planococcus minor</em> (Maskell)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>CC209</td>
<td>Undetermined</td>
<td>Sindangsari, 21.xi.1957, leg. Hamann, on <em>Manihot</em> sp.</td>
<td><em>Planococcus lilacinus</em> (Cockerell)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>CC235</td>
<td>Undetermined</td>
<td>Bogor, xii.1957, leg. Tjoa Tjien Mo, on <em>Dendrobium</em> sp. roots</td>
<td><em>Pseudococcus cryptus</em> Hempel</td>
<td>Earliest record</td>
</tr>
<tr>
<td>4</td>
<td>CC280</td>
<td>Undetermined</td>
<td>Pusakanegara, 14.iii.1960, leg. Dandi, on <em>Glycine max</em></td>
<td><em>Dysmicoccus brevipes</em> (Cockerell)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>CC293</td>
<td>Undetermined</td>
<td>Lembang, Kalimantan, 8.ix.1960, leg. Hamann, on <em>Capsicum</em> sp.</td>
<td><em>Planococcus minor</em> (Maskell)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>CC295</td>
<td>Undetermined</td>
<td>Bogor, 15 km near Pontianak, 3.v.1960, leg. Hamann, on <em>Mangifera indica</em></td>
<td>Monophlebidae</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>CC296</td>
<td>Undetermined</td>
<td>Singkawang, 13.v.1960, leg. Hamann, on <em>Anona muricata</em></td>
<td><em>Planococcus minor</em> (Maskell)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>CC74</td>
<td>Diaspididae and 'spec 2'</td>
<td>−, 24.v.1955, leg. Hamann, on bamboo</td>
<td>Chaetococcus vombaseae (Maskell), <em>Odonaspis serrata</em> Ben-Dov</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>CC224</td>
<td>Pseudococcidae</td>
<td>Bogor, 17.xii, 1957, leg. Wirjati, on <em>Crotonaria</em> sp.</td>
<td><em>Planococcus minor</em> (Maskell)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>CC248</td>
<td>Pseudococcidae</td>
<td>Sukabumi, 25.viii,1958, leg. Wirjati, on <em>Mangifera indica</em></td>
<td><em>Exallomochlus hispidus</em> (Morrison)</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>CC265</td>
<td>Pseudococcidae</td>
<td>Bogor, 26,i.1959, leg. Wirjati, on <em>Solanum santwongsei</em></td>
<td><em>Planococcus minor</em> (Maskell)</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>CC270</td>
<td><em>Pseudococcus</em> sp.</td>
<td>Bogor, 13.x,1959, leg. Oey Hong Peng, on <em>Theobroma cacao</em> stem</td>
<td><em>Exallomochlus hispidus</em> (Morrison)</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>CC270</td>
<td><em>Pseudococcus</em> sp.</td>
<td>Bogor, 13.x,1959, leg. Oey Hong Peng, on <em>Theobroma cacao</em> stem</td>
<td><em>Exallomochlus hispidus</em> (Morrison)</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>CC270</td>
<td><em>Pseudococcus</em> sp.</td>
<td>Bogor, 13.x,1959, leg. Oey Hong Peng, on <em>Theobroma cacao</em> stem</td>
<td><em>Exallomochlus hispidus</em> (Morrison) adult and immature</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>CC287</td>
<td>Pseudococcidae</td>
<td>Bogor, 5(iv,1960, −, on orchids</td>
<td><em>Pseudococcus</em> sp.</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>CC225</td>
<td><em>Antonina</em> sp.</td>
<td>Bogor, 17.xii,1957, on <em>Bambusa</em> sp.</td>
<td><em>Antonina thaiensis</em> Takahashi New country record</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>CC11</td>
<td><em>Dysmicoccus</em> sp.</td>
<td>Bandung, 6.x,1955, leg Hamann, on <em>Anona squamosa</em></td>
<td><em>Saisetia coffeae</em> (Walker)</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>CC11</td>
<td><em>Dysmicoccus</em> sp.</td>
<td>Bandung, 6.x,1955, leg Hamann, on <em>Anona squamosa</em></td>
<td><em>Dysmicoccus lepelleyi</em> (Betrem)</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>179</td>
<td><em>Nipaecoccus</em> ?</td>
<td>Bogor, 20.vii,1957, leg Wirjati, on <em>Polyrachis</em> sp. nest on palm</td>
<td><em>Dysmicoccus lepelleyi</em> (Betrem)</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>179</td>
<td><em>Nipaecoccus</em> ?</td>
<td>Bogor, 20.vii,1957, leg Wirjati, on <em>Polyrachis</em> sp. nest on palm</td>
<td><em>Pseudococcus</em> sp.</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>CC152</td>
<td><em>Planococcus</em> sp.</td>
<td>Bogor, −, −, on <em>Elettaria cardamomum</em></td>
<td><em>Planococcus</em> sp.</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>17</td>
<td><em>Pseudococcus</em> sp.</td>
<td>No data</td>
<td><em>Dysmicoccus lepelleyi</em> (Betrem)</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>CC10</td>
<td><em>Pseudococcus</em> sp.</td>
<td>Bandung, 6.X,1956, leg Hamann, on <em>Psidium guajava</em></td>
<td><em>Exallomochlus hispidus</em> (Morrison) adult and immature</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>CC86</td>
<td><em>Pseudococcus</em> sp.</td>
<td>Wanatijpta, 4.II,1956, leg. Kosim, on <em>Acalypha indica</em></td>
<td><em>Planococcus minor</em> (Maskell)</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>CC91</td>
<td><em>Pseudococcus</em> sp.</td>
<td>Perigi, 23.XII,1955, leg. Kosim, on <em>Pterocarpus indicus</em></td>
<td>Monophlebidae</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>CC213b</td>
<td><em>Pseudococcus</em> sp.</td>
<td>Sindangsari, 21.XI,1957, leg. Hamann, on <em>Coffea</em> sp.</td>
<td><em>Planococcus lilacinus</em> (Cockerell)</td>
<td></td>
</tr>
</tbody>
</table>

(continued)
Java, Bogor, is additional evidence; the species is probably endemic to Java.

**Dysmicoccus orchidum** Williams

*Exallomochlus hispidus* (Morrison)

This species is the commonest in the remounted slides from Wirjati’s collection; out of 50 re-mounted slides, 14 contained *E. hispidus*. In 1958, Wirjati described the species as new under the name *Pseudococcus dorsospinosus* (Wirjati, 1958); Williams (2004) placed this name as a junior synonym of *E. hispidus*. Based on the specimen data intersegmental line, and that the anal lobe cerarian sclerotization is paler near the bases of the conical cerarian setae.
in Wirjati (1958) and Williams (2004), the sample prepared by Wirjati, collected in July 1927 by Vos, is the earliest record of *E. hispidus* from Indonesia.

**Hordeolococcus nephelii** Takahashi

Wirjati’s slide is the first record of *H. nephelii* from Indonesia. She had labeled the slide as *Phenacoccus sp.*, collected by Hamann in Bogor, 5.iv.1958, on Nam-nam (*Cynometra cauliflora*, Fabaceae), a new host record for this species according to the host list in García Morales et al., 2016.

**Maconellicoccus hirsutus** (Green)

Wirjati’s slide of *M. hirsutus* was prepared from a sample from Rappard’s field work in East Java dated 1916, and was originally misidentified as *Planococcus citri* (Risso). The slide pre-dates the material listed in Betrem (1937), so it is the earliest record of *M. hirsutus* from Indonesia. The species is probably native to southern Asia (Williams, 2004).

**Nipaecoccus nipae** (Maskell)

The Wirjati slide of *N. nipae*, dated 26.x.1957, is the earliest record of this species from Indonesia. It was also collected by G.W. Watson from a palm in West Java, near Bandung, on 17.iv.1997 and 25.iv.1997 (Williams, 2004).

**Paraputo corbetti** Takahashi

Wirjati identified her single specimen as *Formicoccus mangiferae* Betrem (now *Paraputo mangiferae* (Betrem)); no locality or date were given. When the slide was re-mounted, re-identification indicated that the specimen is *Pa. corbetti*. However, Williams (2004) concluded that *Pa. corbetti* is a variant of *Pa. mangiferae* Betrem, 1937. Further study of additional samples from East Java, especially from mango, would help clarify whether *Pa. corbetti* is a junior synonym of *Pa. mangiferae* or a distinct species.

**Planococcus lilacinus** (Cockerell)

*Planococcus lilacinus* is the third commonest species in the re-mounted Wirjati slides, represented in eight slides out of 50. The earliest collection of *Pl. lilacinus* from Indonesia was by Betrem (1937) on the roots of coffee in Java, when he described the species under the name *Pseudococcus deceptor*. The placement of *Ps. deceptor* as a junior synonym of *Pl. lilacinus* was made by Cox (1989).

**Planococcus minor** (Maskell)

*Planococcus minor* is the second commonest species in the remounted Wirjati slides, represented in ten slides out of 50. Wirjati slide-mounted an alcohol sample collected by Franssen from *Psidium guajava* (Myrtaceae) in Java, Bogor, in 1935, and P. van der Goot identified it as *Phenacoccus ornatus* Green (now *Rastrococcus ornatus* (Green)). Remounting of this slide revealed two species, *Pl. minor* and *Rastrococcus chinensis* Ferris, indicating that there was a mixed population on the host. This is the earliest record of *Pl. minor* from Indonesia.

One of Wirjati’s slides had been misidentified as *Planococcus keniae* Le Pelley, so re-identification of the sample as *Pl. minor* confirms that *Pl. keniae* is not present in Indonesia. *Planococcus keniae* is only found in the Afrotropical Region (CABI, 2016). The absence of *Pl. keniae* in Indonesia was supported by Cox (1989) and Williams (2004). Records of the occurrence of this species in Indonesia in Betrem (1937) and Kalshoven (1981) need to be corrected.

Another of Wirjati’s slides had been identified as *Pl. citri* (Risso) but re-mounting and re-identification revealed that it was *Pl. minor*. The presence of *Pl. citri* on *Coffeea* sp. (Rubiaceae) in East Java was recorded by Betrem (1932), but Williams (2004) remarked that this species’ population was less dominant than that of *Pl. minor*. According to Williams & Miller (2010), *Pl. citri* was listed from Krakatau Island on *Macaranga tanarius* (Euphorbiaceae) by Dammerman (1948). Bearing in mind the difficulty of separating *Pl. citri* from *Pl. minor* based on morphology, the accuracy of these early records of *Pl. citri* and the presence of this species in Indonesia are questionable.

**Pseudococcus cryptus** Hempel

One undetermined Wirjati slide contained a mealybug collected from Java, Bogor, on the root of *Dendrobium* sp. (Orchidaceae) in July 1957 by Tjoa Tjien Mo. The re-mounted specimen has been re-identified as *Ps. cryptus* and represents the earliest field-collected material of this species from Indonesia. Williams (2004) noted its occurrence in Indonesia from plant quarantine-intercepted material in USA but the date of that record was not given.

**Rastrococcus chinensis** Ferris

A Wirjati slide mount of a sample collected by Franssen from Java, Bogor, on *Psidium guajava* (Myrtaceae) on 27.v.1935 was identified by P. van der Goot as *Phenacoccus ornatus* Green (now *R. ornatus*). Nineteen years later, Ferris (1954) collected mealybugs from China in 24.xi.1954 on an unknown host and described the species as *Rastrococcus chinensis*. The re-mounted Wirjati slide was found to contain a mixture of *R. chinensis* and *Pl. minor*. The earliest Indonesian record of this species is from a collection by van der Goot at Java, Bogor, on *Eugenia sp.* (Myrtaceae) in 1928 (Williams, 1989).

**Saccharicoccus sacchari** (Cockerell)

Wirjati collected this specimen on *Saccharum officinarum* (Poaceae) in Java, Bogor, on 26.iii.1960. According to the material listed by Williams (2004), this is the earliest record of *Saccharicoccus sacchari* from Indonesia. The distinctive hour-glass-shaped circulus in Wirjati’s specimen can be recognized easily.

### Invasive Mealybug Species in Indonesia

Human trade in fresh plant material between countries facilitates the movement of mealybugs from one country to another; passive movement of first-instar nymphs (crawlers) or ovisc material containing eggs can also occur on the clothing of tourists (Kairo et al., 2000). Mani & Shivaju (2016) noted the spread of the invasive mealybugs *Paracoccus marginatus* Williams & Granara de Willink and *Phenacoccus manihoti* Matile-Ferrero to other countries through the sale of planting material, plants and fresh fruits. At present, 98 species of mealybug have been recorded as present in Indonesia (García Morales et al., 2016). Some of these species are recognized as invasive in Indonesia, e.g. *Phenacoccus solani* Ferris and *Pseudococcus jackbeardslcyi* Gimpel & Miller (Williams, 2004). Moreover, in recent years, several other new introductions of invasive mealybugs to Indonesia have been published: *Pa. marginatus* (in Muninbanp et al., 2009), and *Ph. manihoti* on *Manihot esculenta* (Euphorbiaceae) and *Ph. solenopsis* (Tinsley) on *Solanum lycoperiscum* (Solanaceae) (in Muninbanp et al., 2011). Although Sartiami et al. (2010) published the discovery of *Ps. jackbeardslcyi* on *Piper nigrum* in Sukamulya, West Java, Indonesia, this species...
had been recorded previously from Indonesia by Williams (2004). None of these invasive species were found in Wirjati’s collection, indicating that, when Wirjati prepared the slides in 1955-1960, they had not yet reached Indonesia.

CONCLUSION

Fifteen species of mealybugs were re-identified from Wirjati’s collection, belonging to 12 genera: Antonina, Chaetococcus, Dysmicoccus, Exallomochlus, Hordeolicoccus, Maconellicoccus, Nipaeococcus, Paraputo, Planococcus, Pseudococcus, Rastrococcus and Saccharicoccus. Of the 50 slides re-mounted, four could only be identified to genus level. A few specimens of the families Monoplebidae, Coccidae and Diaspididae and a coccinellid larva were found among the mealybugs re-mounted from the collection. In the 50 Wirjati slides re-identified so far, were found the earliest field-collected Indonesian samples of six mealybug species: Exallomochlus hispidus, Maconellicoccus hirsutus, Nipaeococcus nipae, Planococcus minor, Pseudococcus cryptus and Saccharicoccus sacchari; also found were new country records of three species: Antonina thaiensis, Parapuccus corbettii and Hordeolicoccus nephelii. Based on the re-identified slides, none of the invasive species now found in Indonesia are represented in Wirjati’s collection.

ACKNOWLEDGEMENTS

The authors thank Dr. Karden Mulya, Director of ICABGRRD, Ministry of Agriculture, Indonesia, for permission to re-mount and re-identify Wirjati’s mealybug slides. We would also like to thank to Ms Susan McCarthy (Branch Chief, Plant Pest Diagnostic Center, California Department of Food & Agriculture, Sacramento, U.S.A. (PDDC)), and Dr. Asih A. Nawangsih (Head of Department of Plant Pest and Diseases, Faculty of Agriculture, Bogor Agricultural University), Indonesia for permission to carry out re-mounting and re-identification of mealybugs at those facilities. We are grateful to Dr. Sri Suharini Siwi (ICABGRRD), for taking care of Wirjati’s slide collection for many years, and to Dr. Soemartono Sosromarsono (Bogor Agricultural University, Indonesia) and Dr. Martin Hauser (PDDC), for translating Betrem’s papers.

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