SPECIES, HOST RANGE, AND IDENTIFICATION KEY OF WHITEFLIES OF BOGOR AND SURROUNDING AREA

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ABSTRACT

Species identification, host range, and identification key of whiteflies of Bogor and surrounding area. Whitefly (Hemiptera: Aleyrodidae) is a group of insects that are small, white, soft-bodied, and easily found on various agricultural crops. Whitefly is a phytophagous insect; some species are important pests in agricultural crops that can cause direct damage and can become vectors of viral diseases. The last few years the damage caused by whitefly in Indonesia has increased. Unfortunately, information about their species and host plants in Indonesia, including in Bogor, is still limited. Kalshoven, in his book entitled Pest of Crops in Indonesia, published in the 1980s reported that there were 9 species of whitefly in Indonesia. The information on the book should be reconfirmed. Therefore, this study was conducted to determine whitefly species and its host plants in Bogor and its surroundings. Whiteflies is identified based on the ‘puparium’ (the last instar of the nymph) collected from various agricultural plants, ornamental plants, weeds, and forest plants. A total of 5 species of whiteflies were collected from 74 species and 29 families of plants. The collected whiteflies consist of four species belong to Subfamily Aleurodicinae and 1 species of Subfamily Aleyrodinae. The most often found whitefly species were Aleurodicus dispersus, A. dugesi, and Bemisia tabaci. A dichotomous identification key of whiteflies was created based on morphological characteristic of 35 collected species. The number of whitefly species in Bogor and surrounding areas were far exceeded the number of species reported previously by Kalshoven from all regions in Indonesia.

Key words: Aleyrodinae, Aleyrodinae, plant pests, vector of plant viruses

ABSTRAK


Kata kunci: Aleurodicinae, Aleyrodinae, hama tanaman, vektor virus tumbuhan
INTRODUCTION

Whiteflies (Hemiptera: Aleyrodidae) is a group of small, white, and soft-bodied insects. This insect is called “kutukebul” in Bahasa Indonesia because when flying in groups it looks like smoke (“kebul” in Javanese means smoke). Whitefly is characterized by a white waxy layer that is released through special glands in the abdomen. Both nymphs and imago usually have a layer of wax with various shapes so that they can be used for identification because the appearance and pattern of wax layers differ among species (Botha et al., 2000).

Whitefly is an important group of pests for agricultural crops due to its direct and indirect damage. During feeding period whitefly sucks on plant fluids and injects toxins into plant tissues (Watson, 2007), causing wilting, stunting and even dead of its host plants (Botha et al., 2000). The nympha may also induce physiological disorder of the host plants, such as abnormal ripening time of tomato plants and development of silver leaves on Cucurbitaceae family (Hoddle, 2004). Indirect damage caused by whitefly is related to its role as vectors for some viruses and accumulation of honeydew causing the growth of sooty molds (Francis et al., 2016).

Recently, whitefly has become a major pest throughout the world. Although whitefly is considered a tropical insect, many species are found throughout the world, especially in subtropical climates. Bemisia tabaci (Genn.) and Trialeurodes vaporariorum (Westwood) have been reported as major pests both in greenhouses and in the field in warm temperate regions (Martin et al., 2000). Nasrudin & Stocks (2014) have also reported economic losses in Indonesia due to the attack of many species of whitefly.

Kalshoven (1981) reported the diversity of whitefly in his book entitled “The Pest of Crops in Indonesia”. According to him, there are at least nine species of whitefly in Indonesia. However, the number of whitefly species in Indonesia should be far exceeds this number. Based on internet searches and literature studies, we found at least 66 species of whiteflies reported from Indonesia by some authors and this number is believed to increase as research continues on the diversity of these insects. Therefore, it is important to conduct surveys and research in order to update the status of whitefly diversity and distribution in Indonesia. According to Hodges & Evans (2005), research on the diversity of whitefly is essential in order to identify exotic and invasive whitefly, and provide appropriate recommendations for whitefly control. Furthermore, information related to the host’s range is also needed as information to support the success of control measures.

The information of whitefly species diversity and its distribution in Bogor, West Java is limited. This research was initiated to study the taxonomy and distribution of whitefly in Bogor and its surrounding area.

MATERIALS AND METHODS

Research Site. Sampling and collection of samples was carried out through randomly collected whiteflies in various agricultural crops, weeds, and forest trees in Bogor, Cianjur, Sukabumi, and Garut from 2008 to 2017. The latitude and altitude of the field was recorded using a GPS (Global Positioning System). ‘Puparia’ of whiteflies were collected from the field and placed on tubes containing 70% of EtOH and brought to the laboratory for further samples preparation.

Whiteflies samples were subjected to slide mounting using protocol described by Martin (1987). First of all, the puparia were put into test tubes containing 80% KOH, and heated for 10 min. The puparia were then taken out using a brush and placed into new test tubes containing 10% KOH and reheated until the puparia became transparent. Furthermore, the puparia were transferred into the cyracle dish and the body content was removed by pressing it slowly; then it was washed twice with aquadest. Next step was placing the puparia into 50% EtOH for 10 min, then soaked it in a mixture of fuchsin acid and glacial acetic acid with a ratio of 1 : 1 for 20 to 30 min. The puparia was then destained by soaking in 80% EtOH until the appropriate color was obtained. The puparia were put into carbol xylene for 1 min, absolute EtOH (100%) for 5-10 min, and clove oil for 10 min. The puparia was then placed and arranged at center of the object glass, and Canadian balsam media was dropped over the samples before placing the cover glass. The slide-mounted specimens was dried in the drying element for 3 to 4 weeks. Special treatment was given for dark pigmented puparia before staining stage. After soaking in 95% EtOH for 10 min, the puparia was stabbed at the middle of the body, then soaked in 10% KOH solution for 1 to 2 days.

In some cases, pupal exuvia was collected from the field. Preparation of pupal exuvia specimens was similar from those of puparia specimens, except in the initial stages of slide mounting. The the pupal exuvia was soaked in 95% EtOH for 10 min, then in glacial acetic acid for 10 min. After washing the pupal exuvia with aquadest, it was soaked in carbol xylene for 1 min, then washed again with aquadest. The next stage was
the same as the method of making slide-mounted from puparia.

**Morphological-based identification and development of identification keys.** Observation of morphological characters was carried out using a Dyno-Eye digital microscope connected to a PC pugging in a compound microscope Olympus SZ-ST. Identification of the whiteflies using some references and identification keys, including Hodges & Evans (2005), Dooley (2006), Martin (1985), Martin (1987), Martin (1988), Martin et al., (2000), and Watson (2007). Photographed of whitefly specimen was taken using 12.1 Megapixel digital camera in order to captured detail morphological characters of whitefly for the purpose of developing taxonomic description.

Dichotomous identification key was developed based on morphological characters. It was first started with observation and recording of morphological characters, followed by making matrix of the morphological character and finally key development using Lucid Phoenix software (LucidCentral.org). The identification key was then tested using sample specimens.

**RESULT AND DISCUSSION**

Whiteflies were found in several areas in Bogor including Dramaga District, Cileungsi, Jasinga, West Bogor, Ciampea, Cigudeg, Central Bogor, and Cisarua. Environmental conditions seems to be suitable for the development of whitefly and the diversity of host plants in Bogor is quite high. Perrin et al., (2018) indicated that host plants and temperatures play an important role in biology of whitefly. Furthermore, climate change and rising temperature can induce the development of whitefly population (Marwoto & Inayati 2011).

The diversity of whitefly in Bogor area is quite high. A total of 35 species of whitefly were found from 74 species belong to 30 family of plants. The whiteflies species found in Bogor and its surrounding areas belong to two Subfamilies, i.e. Aleurodicinae and Aleurodinae. Based on general morphological characters, the two subfamilies can be distinguished by the presence or absence of compound pores. Whitefly from the Subfamily Aleurodicinae has compound pore on the abdomen (Figure 1) while the Subfamily Aleurodinae has no pore (Figure 2). Four species of Aleurodicinae and 31 species of Aleurodinae was found in various hosts, including agricultural crops, ornamental plants, weeds, and forest trees.

1. **Subfamily Aleurodicinae**

Subfamily Aleurodicinae is one of the three subfamilies of whitefly that have been known so far. The distinctive characteristics of this subfamily are the existence of four compound pores which is a special structure on the whitefly that can release wax (the pore has a variety of shapes) and the tongue-shaped lingula (Figure 1). Watson (2007) described the whiteflies belonging to the Aleurodicinae subfamily as follows: there are wax-producing pores in the subdorsum, 1 pairs at the head (cephalic) and 4 to 6 pairs at the abdomen, large-sized lingula, shape like a tongue, elongated to downward adjacent to the triangular orifice. At the lingula there are 4 hairs that are clearly visible, sometimes with 2 pairs of reduced hair. In nature, the puparia were often covered with waxy threads. Four species was successfully identified from Bogor and its surrounding area, i.e. *Aleurodicus dispersus, A. dugesii, A. destructor*, and *Paraleurodus minei*. *A. dispersus and A. dugesii* are known to have broader host range compared to the other 2 species (Table 1).

The first species, *A. dispersus* is a common species of whitefly, especially in cassava plants. Both nymph and adult can be found at the same time below the leaf surface. According to some literature, this species has many hosts range (polyphag). Gniffke (2011) states that besides in cassava plants *A. dispersus* can be found in papaya, chili, banana, hibiscus, and waringin plants in West Java. Furthermore, Nasrudin & Stocks (2014) reported the potency of *A. dispersus* in Indonesia to cause serious economic losses in chili plants. The distinctive characteristics of *A. dispersus* is the circular pattern of eggs on the leaf, so that this species is called “a spiraling whitefly”. Immature stadia (first four-instar nympha) of *A. dispersus* have an oval shaped and the body is covered by wax (Figure 6), while adult have transparent wings.

The second species, *A. dugesii* was found in Indonesia just recently (Hidayat & Watson 2008). The immature is covered with long wax. Schoeller et al. (2018) explained that the wax secreted by the nymph is a defense mechanism from parasites. Like *A. dispersus*, nymph and adult of these whitefly can be found below the surface of the leaf. *A. dugesii* is known as “giant whitefly” because of its large body length. Other characteristic of *A. dugesii* is the white wax that is secreted extends downward, and the adult has a gray pattern on the front wing and is very inactive (Muniappan et al. 2009).

*A. dugesii* is known as a polyphagous whitefly with a very broad host range including ornamental plants such as hibiscus, lotus, begonias, orchids; fruit crops
<table>
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<th>No.</th>
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<th>Host range</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td><em>Aleurodicus destructor</em></td>
<td>Bogor</td>
<td>Areaceae: coconut (<em>Cocos nucifera</em>)</td>
</tr>
</tbody>
</table>
such as avocados, oranges, bananas, guava, soursop; vegetables crops from the families Solanaceae, Brassicaceae, Cucurbitaceae; and also various types of weeds (Setiawati et al. 2016). During our survey in Bogor, A. dugesi was found in Lamiaceae, Apocynaceae, Annonaceae, Asteraceae, Areceae, Begoniaceae, Myrtaceae, Apocynaceae, Moraceae, Solanaceae, Caricaceae, Euphorbiaceae, Fabaceae, Lauraceae, Malvaceae, Musaceae, Rutaceae, Cannaceae, and Cucurbitaceae (Table 1).

The third species, A. destructor has a unique morphological characters i.e. white thick-wax at median dorsal and a thinner wax at margin of its body that looks like a lump. A. destructor is known as "coconut whitefly", because it commonly attacks coconut plants. The fourth, P. minei was discovered very recently in Indonesia (Nurulalia et al. 2012). P. minei has yellow to transparent pupa and 6 pairs of compound pores with 2 pairs sizes reduced at the anterior part (Fig 5).

2. Subfamily Aleyrodinae

There were 31 species of Aleyrodinae were identified in Bogor and its surrounding areas (Table 2). Some species of Aleyrodinae has a distinctive shaped of puparium. Aleuroclava aucubae has pear shaped (Figure 23); the pupa of Genera Aleurocanthus has a lot of spines such as in Aleurocanthus citri perpus (Fig 11); puparium of Minutaleurodes minuta has a flower-like shaped (Fig 31).

Adult (imago) of Aleyrodinae was very difficult to find, generally only premature (pupa or puparium) are found below the leaf surface. In this subfamily, it is common to find mixed populations, i.e. more than one species on the leaves of the host plant. For example, a mixed population of Aleuroclava psidii, Diauleurodes kirkaldyi, Asialyrodes sp., Diauleurocura decempuncta can be found in rambutan leaves. Mixed populations were also found in citrus plants, namely Aleurocanthus citri perpus with Paraleurodes minei or Paraleurodes minei with Aleurocanthus dispersus.

One species of Aleyrodinae that is commonly found and known as a pest is Bemisia tabaci. B. tabaci is a very important pest because it also becomes a vector of viral diseases. According to Hashim et al. (2016) B. tabaci is commonly found in eggplant plants showing yellow symptoms in several areas in West Java (Bogor and Bandungan, Central Java Klaten and Blora), and the Special Region of Yogyakarta (Bantul). Furthermore, B. tabaci was reported to cause a decrease in the quality and production of tomato plants and at the same transmitted Tomato yellow leaf curl virus (TYLCV) (Fang et al. 2015). In Bogor, B. tabaci was found on Cucurbitaceae, Euphorbiaceae, Fabaceae, Solanaceae, Malvaceae, Moraceae, dan Araceae (Table 2). Morphology characteristics of B. tabaci include triangular vasiform orifice of the puparium and the presence of setae cauda at posterior (Figure 37).

Tabel 2. Whitefly species of the Subfamily Aleyrodinae and its host range found in Bogor and its surrounding area

<table>
<thead>
<tr>
<th>No.</th>
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<th>Location</th>
<th>Host range</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Aleuroclava psidii</td>
<td>Bogor</td>
<td>Myrtaceae: guava (P. guajava), water apple (S. samarangense), Sapindaceae: rambutan (Nephelium lappaceum).</td>
</tr>
<tr>
<td>2</td>
<td>Aleuroclava jasmini</td>
<td>Bogor</td>
<td>Myrtaceae: bay-leaf (Syzygium polyanthum), Oleaceae: jasmine (Jasminum sambac), Sapindaceae: rambutan (Nephelium lappaceum)</td>
</tr>
<tr>
<td>3</td>
<td>Aleuroclava canangae</td>
<td>Bogor</td>
<td>Areceae: salak (Salacca zalacca), Myrtaceae: guava (P. guajava)</td>
</tr>
<tr>
<td>4</td>
<td>Aleuroclava aucubae</td>
<td>Bogor, Sukabumi</td>
<td>Myrtaceae: Rose apple (Syzygium malaccense)</td>
</tr>
<tr>
<td>5</td>
<td>Aleurocanthus woglumi</td>
<td>Bogor</td>
<td>Areceae: coconut (C. nucifera), palm oil (E. guineensis), palem putri (V. marilii), areca nut (Areca catechu), palem phoenix (P. roebelenii), Rutaceae: orange (Citrus sinensis)</td>
</tr>
<tr>
<td>6</td>
<td>Aleurocanthus spiniferus</td>
<td>Bogor, Cianjur</td>
<td>Areceae: coconut (C. nucifera), palm oil (E. guineensis), areca nut (A. catechu), Moraceae: jackfruit (Artocarpus heterophyllus), banyan tree (F. benjaminia), Myrtaceae: guava (P. guajava), Rutaceae: orange (Citrus sinensis)</td>
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</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td><em>Aleurocanthus cocos</em></td>
<td>Bogor</td>
<td>Arecaceae: coconut (<em>C. nucifera</em>), palem putri (<em>V. marillii</em>)</td>
</tr>
<tr>
<td>8</td>
<td><em>Aleurocanthus citriperdus</em></td>
<td>Bogor, Cianjur</td>
<td>Rutaceae: Lime (<em>Citrus aurantifolia</em>), pamelo (<em>Citrus maxima</em>)</td>
</tr>
<tr>
<td>9</td>
<td><em>Aleurotrachelus atratus</em></td>
<td>Bogor</td>
<td>Arecaceae: palm oil (<em>E. guineensis</em>), palem putri (<em>V. marillii</em>), yellow palm (<em>D. lutescens</em>), palem manila (<em>Adonidia merrillii</em>), squirrel palm (<em>Wodyetia bifurcata</em>), japanese palm (<em>Ptychosperma macasturii</em>)</td>
</tr>
<tr>
<td>10</td>
<td><em>Aleurotrachelus annonae</em></td>
<td>Bogor</td>
<td>Arecaceae: Areca nut (<em>A. catechu</em>), coconut (<em>C. nucifera</em>), yellow palm (<em>D. lutescens</em>)</td>
</tr>
<tr>
<td>11</td>
<td><em>Aleurotrachelus caeruleascens</em></td>
<td>Bogor</td>
<td>Aracaceae: Coconut (<em>C. nucifera</em>)</td>
</tr>
<tr>
<td>12</td>
<td><em>Aleurotrachelus tracheifer</em></td>
<td>Bogor</td>
<td>Fabaceae: winged bean (<em>Psophocarpus tetragonolobus</em>)</td>
</tr>
<tr>
<td>13</td>
<td><em>Cockeriella psidii</em></td>
<td>Bogor, Sukabumi</td>
<td>Myrtaceae: Guava (<em>P. guajava</em>), bay-leaf (<em>S. polyanthum</em>)</td>
</tr>
<tr>
<td>14</td>
<td><em>Cockeriella quaintacei</em></td>
<td>Bogor</td>
<td>Arecaceae: Red palm (<em>Cyrtostachys renda</em>)</td>
</tr>
<tr>
<td>15</td>
<td><em>Cockeriella meghaleynensis</em></td>
<td>Bogor</td>
<td>Arecaceae: Coconut (<em>C. nucifera</em>), palm oil (<em>E. guineensis</em>), yellow palm (<em>D. lutescens</em>)</td>
</tr>
<tr>
<td>16</td>
<td><em>Diauleurolobus</em> sp.</td>
<td>Bogor</td>
<td>Malvaceae: Hibiscus (<em>Hibiscus rosa-sinensis</em>), Fabaceae: dada bong (<em>Erythrina microcarpa</em>)</td>
</tr>
<tr>
<td>17</td>
<td><em>Diauleurodes kirkaldyi</em></td>
<td>Bogor</td>
<td>Oleaceae: Jasmine (<em>Jasminum sambac</em>), Rubiaceae: morinda fruit (<em>Morinda citrifolia</em>), Convolvulaceae: Ipomoea triloba</td>
</tr>
<tr>
<td>19</td>
<td><em>Asialeyrodes</em> sp.</td>
<td>Bogor</td>
<td>Magnoliaceae: Green cempaka (<em>Michelia clippamaca</em>), Myrtaceae: water apple (<em>S. samarangense</em>)</td>
</tr>
<tr>
<td>21</td>
<td><em>Aleurotuberculatus neolitseae</em></td>
<td>Bogor</td>
<td>Myristicaceae: Nutmeg (<em>Myristica fragrans</em>), Moraceae: jackfruit (<em>Artocarpus heterophyllus</em>)</td>
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<tr>
<td>22</td>
<td>Aleuropterus perseae</td>
<td>Bogor</td>
<td>Bignoniaceae: Kecutan (<em>Spathodea campanulata</em>)</td>
</tr>
<tr>
<td>24</td>
<td>Lipalereyodes sp.</td>
<td>Bogor</td>
<td>Euphorbiaceae: Meniran (<em>Phyllanthus niruri</em>), katuk (<em>Sauropus androgynus</em>)</td>
</tr>
<tr>
<td>25</td>
<td>Minutalerodess minuta</td>
<td>Bogor</td>
<td>Myrtaceae: Rose apple (<em>S. philippensis</em>), Rubiaceae: asoka flower (<em>Ixora coccinea</em>), Verbenaceae: hardwood tree (<em>Tectona grandis</em>)</td>
</tr>
<tr>
<td>26</td>
<td>Orchemoplates mammeeferus</td>
<td>Bogor</td>
<td>Euphorbiaceae: Croton (<em>Codiaeum variegatum</em>)</td>
</tr>
<tr>
<td>27</td>
<td>Parabemisia sp.</td>
<td>Bogor</td>
<td>Moraceae: Jujube (<em>Artocarpus heterophyllus</em>)</td>
</tr>
<tr>
<td>28</td>
<td>Setaleuroidea sp.</td>
<td>Bogor</td>
<td>Rubiaceae: morinda fruit (<em>M. citrifolia</em>)</td>
</tr>
<tr>
<td>29</td>
<td>Trialeurodes vaporiorum</td>
<td>Bogor, Cianjur, Garut</td>
<td>Fabaceae: Long beans (<em>Vigna unguiculata sesquipedali</em>), Solanaceae: eggplant (<em>Solanum melongena</em>), tomato (<em>Lycopersicon esculentum</em>), Musaceae: banana (<em>Musa paradisiaca</em>)</td>
</tr>
<tr>
<td>30</td>
<td>Aleurolobus marlatti</td>
<td>Bogor</td>
<td>Arecaeeae: palem phoenix (<em>P. robelenii</em>), palm oil (<em>E. guineensis</em>), yellow palm (<em>D. lutescens</em>), Musaceae: Banana (<em>Musa paradisiaca</em>)</td>
</tr>
</tbody>
</table>

Identification key of collected whiteflies in Bogor and its surrounding area

1a Puparium with 4 to 6 pairs abdominal compound pores in subdorsal, large-sized lingula shaped like tongue and 1-2 pairs of setae at the tip (Figure 1), nymph and pupa secreted white wax that covered the surface of body ................................................................. *Subfamili Aleurodicinae* (2)
1b Puparium without abdominal compound pores in subdorsal and 5 pairs pores simple (if any) (Figure 2), various shape and size of lingula, color of pupa has variation, nymph and pupa does not secreted or slightly wax on the surface of body. ................................................... Subfamili Aleyrodinae (5)

Figure 2

2a With 6 pairs abdominal compound pores that size are same and big, one setae at lingula (Figure 3), commonly found on coconut trees ......................... Aleurocarthus destructor

Figure 3
2b With 4 to 6 pairs abdominal compound pores that have same size. Two pairs setae at the tip of lingula (Figure 4) .................................................................................................................. 3

![Figure 4](image)

**Figure 4**

3a 6 pairs abdominal compound pores present with splines shaped on the median area, 2 pairs abdominal compound pores at anterior that the size reduced, discal pore among abdominal compound pores segment VIII and vasiform orifice (Figure 5), female adult secreted wax like a nest shaped ........................................... *Paraleyrodes minei*

![Figure 5](image)

**Figure 5**

3b 4-6 pairs abdominal compound pores, lots of small pores in subdorsal, very wide host range (polyphagous) .......................................................................................................................... 4

4a 4 pairs abdominal compound pores at segment III-VI that have same size (Figure 6), pattern of wax like a tail at posterior......................... *Aleurodicus dispersus*

![Figure 6](image)

**Figure 6**
4b  With 6 pairs abdominal compound pores on segment III-VIII, abdominal compound pores segment III-VI have same size, while segment VII and VIII reduced (Figure 7), many of wax and elongated like a beard .................................................................................. *Aleurodicus dugesii*

![Figure 7](image)

5a  Spines with acute pointed at subdorsal, pupal usually dark (Figure 8) or pale until slightly blackness..............................................................................................................6

![Figure 8](image)

5b  Spines at subdorsal absent, pupal color pale or dark..............................................................................................................9

6a  11 pairs spines at subdorsal...............................................................................................................................7

6b  More than 11 pairs of spines at subdorsal.......................................................................................................................8

7a  11 pairs acute spines at subdorsal that have same size (Figure 9), found on citrus leaves, guava, and jack fruit.........................................................................................................................*Aleurocanthus spiniferus*

![Figure 9](image)
7b  11 pairs acute spines at subdorsal, one pairs at posterior has longer size than others and like a tail (Figure 10), commonly found on citrus leaves. ................................................................. *Aleurocanthus woglumi*

8a  16 pairs acute spines at subdorsal that have same size (Figure 11), commonly found on citrus leaves. ................................................................. *Aleurocanthus citriperdus*

8b  30 to 36 pairs acute spines at subdorsal (Figure 12) ............................................. *Aleurocanthus cocois*
9a Rachis (indentation pattern) at subdorsal abdomen (Figure 13), pupa color pale or dark. .......................................................... 10

![Figure 13](image)

9b Rachis at dorsal abdomen absent. .......................................................... 14

10a Longitudinal stripe at subdorsal elongated from cephalothorax to anterior abdomen (figure 14) .......................................................... 11

![Figure 14](image)

10b Dark puparium, rachis pattern at abdomen, the eyespot like comma shaped with brighter color at anterior subdorsal present, margin dentate (like 3 teeth pattern) at posterior, triangular vasiform orifice (Figure 15) .......................................................... *Aleurolobus marlatti*

![Figure 15](image)
11a Process of thickening or pigmenting at subdorsal pupa present

11b Without thickening and pigmenting process at subdorsal pupa

12a Process of thickening or pigmenting at molting suture present (Figure 16) .......................................................... Aleurotrachelus caerulescens

Figure 16

12b Rhachis at subdorsal very thick (Figure 17) .......................................................... Aleurotrachelus tracheifer

Figure 17

13a 3 pairs spines at the margin of dorsal (Figure 18) .......................................................... Aleurotrachelus annonae

Figure 18
13b  Spines at the margin of dorsal absent, irregular margin.......................... *Aleurotrachelus atratus*

![Figure 19](image)

14a  5 pairs pores at subdorsal (Figure 20), 12 pairs sub marginal setae and one pairs lanceolate cephal thorax (if visible), pupa secreted shine blue wax ....................................................... *Dialeuropora decempuncta*

![Figure 20](image)

14b  Do not have the characteristics as mentioned above .................................................................15
15a  Dentate sub marginal row, some species with papillae at subdorsal (Figure 21) .................................. 16

Figure 21

15b  Do not have the characteristics as mentioned above ................................................................. 20

16a  One pairs of round shape tubercles at metathorax (Figure 22), pupa color pale ....................... 17

Figure 22

16b  Tubercle at mesothorax absent, pupa color dark or pale .......................................................... 18

17a  Papillae at subdorsal area absent, dentate sub margin (Figure 23) ........................................... Aleuroclava aucubae

Figure 23
17b Papillae at subdorsal area, the color of sub margin area more transparent that others part of pupa, dentate sub margin and margin of pupa.........................................................................................*Aleurotuberculatus neolitseae*

18a “T” shaped at cephalothorax, tubercles along median abdomen (Figure 24), yellow to transparent pupa with pigmentation at cephalothorax, median abdomen, and vagiform orifice .................. *Aleuroclava psidii*

![Figure 24](image1)

18b Without “T” shaped at cephalothorax, one pairs of setae at cephalothorax and 3rd legs (if any), papillae rows at subdorsal ........................................................................................................ 19

19a Setae at cephalothorax and 3rd legs usually consist of one segment (if any) (Figure 25), widen shaped at median (from mesothorax to abdomen segment 5), cephalothoracic fold not clear, usually found on jasmine.................................................... *Aleuroclava jasmini*

![Figure 25](image2)
19b Setae at cephalothorax and 3rd legs (if any) usually consist of two segment, body oval, cephalothoracic fold clear (Figure 26), usually found on guava..................................................*Aleuroclava canangae*

![Figure 26](image)

20a Oval to round shaped pupa, fold that separate sub margin area with dorsal disc present, longitudinal and transversal molting suture allied with cephalothoracic suture, concentric with margin and easy to molted when the adult emerged from pupa (Figure 27) .............................................................. *Cockerelliella* (21)

![Figure 27](image)

20b Fold that separate sub margin area with dorsal disc absent...............................................................23

21a Oval pupa, papillae at subdorsal, sub marginal suture clear...............................................................22

21b Pupa covered with granules, sub marginal suture absent (Figure 28) ............................................. *Cockeriella quaintacei*

![Figure 28](image)
22a Papillae rows at subdorsal present, cephalothoracic suture with transversal moulting suture are separated (Figure 29) ................................................................. *Cockerelliella psidii*

![Figure 29](image)

22b Papillae arranged at abdomen, cephalothoracic suture with transversal moulting suture are separated (Figure 30) ................................................................. *Cockerelliella meghaleyensis*

![Figure 30](image)

23a Small-round shaped pupa .................................................................................................................. 24

23b Medium to large-oval shaped pupa ................................................................................................. 25

24a Widen area of pupa present (from metathoracic to abdomen segment 2) (Figure 31) ...................... ............................................................................. *Minutaleyrodes minuta*

![Figure 31](image)
24b Round-shaped pupa (relative), fold at the margin of pupa present (Figure 32) .......................................................................................................................... *Asialeyrodes* sp.

![Figure 32](image)

25a Dentate margin, 1 to 2 pairs setae at abdomen.................................................................................................................................26

25b Setae at abdomen absent .................................................................................................................................................................27

26a Dentate margin, 2 pairs setae at median anterior abdomen (Figure 33) .......................................................................................... *Asiothrixus antidesmae*

![Figure 33](image)

26b Trachea pores like comb-shaped, one row tooth-shaped of glands present, one pairs setae at abdomen segment 1 (Figure 34) .......................................................................................................................... *Orchamoplatus mammæferus*

![Figure 34](image)
27a  Granules at subdorsal disc present, reticulation at tracheal cleft and at caudal furrow area present, large-round-shaped pupa (Figure 35)................................. *Rusostigma* sp.

![Figure 35](image)

27b  Do not have the characteristics as mentioned above ......................................................... 28

28a  Papillae rows at sub marginal present (Figure 36), papillae that found on the leaf which have lot of cuticula bigger than papillae at sub margin, the short scale found at each base of mid and back legs................................................................. *Trialeurodes vaporariorum*

![Figure 36](image)

28b  Papillae rows at sub margin absent, do not have the characteristics as mentioned above ................................................................. 29

29a  Oval pupa, vasiform orifice longer than caudal furrow ....................................................... 30

29b  Do not have the characteristics as mentioned above .......................................................... 31
30b Without setae cauda and trachea pores, vasiform orifice like half-moon shaped, smooth margin (Figure 38)...............................................................................................................Parabemisia sp.

31a Brown to black of median line at puparium (from mouth until abdomen segment-1, setae abdomen segment 8 at the widest area of vasiform orifice) (Figure 39).............................................Dialeurodes kirkaldyi

31b Do not have the characteristics as mentioned above.................................................................32

32a Oval pupa, one pairs tubercles on median thoracic area..............................................................33

32b Tubercle at median abdomen area present, tubercles at thorax are not set (if any) .........................34
33a Tubercle very clear, sub marginal furrow present, slightly dentate margin (Figure 40) .................................................................................................................. *Dialeurolobus* sp.

33b Tubercle not clear, layer of wax at sub margin area present, dentate sub margin (Figure 41) .................................................................................................................. *Lipaleyrodes* sp.

34a Tubercle at abdomen segment 1 to 3 and fold of thorac to abdomen segment 8 at submedian present, without setae (Figure 42) .................................................................................................................. *Aleuroputeus perseae*
34b Tubercles on median area at all segment of thorax and abdomen present, setae only found at anterior and posterior of puparia (Figure 43) .................................................. Setaleyrodés sp.

CONCLUSION

Whitefly species found in Bogor region belongs to the subfamily Aleurodicinae (4 species) and subfamily Aleyrodinae (31 species). The most common species are Aleurodicus dispersus, A. dugesii and Bemisia tabaci. A dicotomous identification key of 35 whitefly species has been successfully constructed based on morphological characters. The number of whitefly species found in Bogor and surrounding areas outnumbered the species previously reported by Kalshoven in all regions of Indonesia. This fact may have implications on the greater threat of pests in cultivated plants.

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