

Mealybugs (Hemiptera: Pseudococcidae) Associated with Dragon Fruit in Indonesia

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ABSTRACT

Mealybugs were recorded on dragon fruit, *Hylocereus undatus* (Family: Cactaceae) in Indonesia. The present of certain mealybug species on dragon fruit has become quarantine concern in country where the mealybugs species is absent. The objective of this study was to identify mealybugs species associated with dragon fruit and record the live specimen of adult females mealybug. Mealybugs were collected from 3 locations: Bogor (West Java), Banyuwangi (East Java), and Pontianak (West Kalimantan). Mealybugs found in the location were photographically documented and brought to the laboratory. Identification based on the prepared slide specimen was carried out in the Laboratory of Insect Biosystematics, Department of Plant Protection, Faculty of Agriculture, IPB University. There were 4 mealybugs species, *Ferrisia virgata*, *Planococcus minor*, *Phenacoccus solenopsis* and *Pseudococcus jackbeardsleyi* recorded on dragon fruit. Dragon fruit is recorded to be the new host of *Ph. solenopsis*. The morphological characteristics of fully developed mealy wax on live adult female were highlighted to align the characteristic diagnose of species identification based on slide mount specimen.

Keywords: adult female, fruits, *Hylocerus undulatus*, quarantine

1. INTRODUCTION

Mealybugs (Hemiptera: Pseudococcidae) are a small phloem-sucking insect and can cause considerable economic damage to fruit crops. Their name itself derives from a white, waxy secretion found on the bodies of adult females and nymphs of most species [1]. Due to the white wax covering its entire body and their similar morphology, they are very difficult to differentiate one and another. Most of them are an invasive pest of many economically important crop families grown in tropical and subtropical regions, such as Cucurbitaceae, Fabaceae, Solanaceae and Malvaceae [2]. There are 158 species of mealybugs with 35 of them are polyphagous that have been identified as pests worldwide [3]. They feed on almost all parts of plant, particularly on leaves, fruits and branches. The feeding activity may cause leaf yellowing, defoliation, reduced plant growth and in some cases death of plants [4].

Mealybug itself is first recorded over 40 years ago in Asia, including Indonesia [5]. Earliest work of mealybug collection in Indonesia was done by van der Goot in 1928, Betrem in 1937, and Wirdjati in 1949 [6]. The dispersion of this pest is helped by wind, bird, agricultural equipment and most crucial is through agricultural products. Recently, the

invasion of mealybug has accelerated quickly compared to that during the last century [7]. It is mainly due to mealybug can hide in the crevice of plant materials such as fruit, hence they are become easily transported via inter-regional and international agricultural trade. The same circumstance is also thought to be the main factor to cause mealybug invasion on dragon fruit in Indonesia.

Several species of mealybugs are also caused severe damages on yield and quality. The damages inflicted by these species are a result of their ability to transmit plant viruses and produce honeydew that promotes the development of sooty molds. Sooty molds are also often constantly lower the market value of commercial crop especially fruits, such as dragon fruit, mango, citrus, passion vine fruit and grape [8].

Dragon fruit is introduced to Indonesia in the 90s and widely cultivated by the local farmers in early 2000, especially in Pasuruan, Jember, Mojokerto, and Jombang. They become popular by their striking red color and distinctive flavours of fresh sweet and sour [9]. Currently, dragon fruit is one of the rising priorities of commercially cultivated fruits in Indonesia, with the central production is in East Java. In 2018, Indonesia have exported 76 tons of total dragon fruits to Malaysia, Japan, Singapore, Europe, and recently China [10]. The potential of expanding the

export of local dragon fruit is very likely. However, the presence of mealybug on the shipped dragon fruits is often become a major limiting factor on exporting those products as it may cause rejection in countries where the certain mealybug species is absent. For instance, the potential mealybugs associated with dragon fruit in Indonesia that become a quarantine concern to Australia are *Dysmicoccus neobrevipes* (grey pineapple mealybug), *Paracoccus marginatus* (papaya mealybug), *Planococcus lilacinus* (coffee mealybug), *Pl. minor* (pacific mealybug) and *Ps. jackbeardsleyi* (jack beardsley mealybug) [11].

There have been no comprehensive reports regarding mealybug species associated with dragon fruits in Indonesia. Meanwhile, a quick and accurate identification of mealybugs in the field are crucial in order to arrange a suitable management measures, especially for a commercial crop. The commonly used method for distinguishing mealybug species is based on morphological characteristic observation using slide mount specimen under microscope, while observation using live specimen is rarely been done. This research aimed to identify mealybug species associated with dragon fruit in Indonesia, as well as to provide the photographic documentations of live specimen of female adult.

1.1. Materials and Methods

1.1.1 Field survey and mealybugs collection

The survey was conducted from August 2018 until February 2019 in 3 dragon fruit plantations in Indonesia: Banyuwangi (East Java), Pontianak (West Kalimantan) and Bogor (West Java). Each location was visited twice and each coordinate of those sites was recorded. The live mealybug that still have had undamaged wax was also recorded photographically. Mealybugs were collected from the infested dragon fruit plantation then put into a labelled Eppendorf tube containing 70% of ethanol. They were brought to the Laboratory of Plant Protection IPB University for preservation and further identification.

1.1.2 Slide mount preparation and species identification

The slide-preparation method used was following the procedures by Sirisena [12]. The preparation involved maceration using 10% potassium hydroxide (KOH), acidification using acidified 80% alcohol, staining using Acid Fuchsin and differentiation using 80% and 95% Isopropanol, de-waxing using histoclear phenol, clearing (Clove oil), and mounting on Canada balsam.

After the preparation was completed, specimen then proceeded to identify morphologically based on several identification keys: Abbas [13], Williams [5, 14, 15], and Cox [16].

1.2 Our Contribution

This paper serves the new record species of mealybug on dragon fruit in Indonesia and provide the live specimen characteristics of each mealybug species found. The characteristic of female adult wax can be used as the species identification references, while the photograph of the live mealybug can be used to primary recognizing the species name. This paper also can be used for quarantine inspection of export purposes related to mealybugs on dragon fruits.

1.3 Paper Structure

The rest of the paper is constructed as follows: section 2 serves species name of mealybug and the character description of each collected live female adult mealybug species, and photographic documentation are also presented; section 3 concludes the result of this paper.

2. RESULTS AND DISCUSSION

Mealybug infestation associated with dragon fruits was occurred in 4 locations from the total three surveyed provinces in Indonesia (Table 1) and shown in Figure 1.

Table 1 The occurrence locations of mealybug sampling sites in Indonesia

Province	Date	Location	Coordinate
East Java	July 10, 2019	Jambewangi Village, Sempu Sub-district, Banyuwangi District	8°17'3.41"S 114°7'50.12"E
West Kalimantan	August 6, 2019	Rasau Jaya Umum Village, Rasau Jaya Sub-district, Kubu Raya District	0°12'32.1"S 109°19'47.7"E
	August 7, 2019	Sungai Nyirih Village, Jawai Sub-district, Sambas District	1°20'05.7"N 109°04'15.2"E
West Java	September 4, 2019	Loji Sub-district, West Bogor District	6°35'20.10"S 106°46'2.70"E



Figure 1 Dragon fruit plantations: (a) East Java, (b) West Kalimantan, (c) West Java

There were 4 species of mealybugs found associated with dragon fruit in Indonesia, they were *Ferrisia virgata*, *Planococcus minor*, *Ph. solenopsis*, and *Ps. jackbeardsleyi* (Table 2). Among them, *Pl. minor* and *Ps. jackbeardsleyi* are listed as the potential pests of quarantine concern to Australia and they are also identified to be associated with Vietnamese dragon fruit [17]. *Ferrisia virgata* on dragon fruit only ever recorded once in Yogyakarta in 2012 [18] and has never been recorded until now, meanwhile *Ph. solenopsis* found in this research were the first record of the pest to be found on dragon fruits. Based on database on Scalenet, the only mealybug species ever recorded on dragon fruits are *Pl. minor*, *Ph. madeirensis*, and *Ps. jackbeardsleyi*, while those two species are absent [19]. All 4 species of mealybug found are considered as quarantine pests to several targeted export countries, although *F. virgata* is often excluded from the list as they are a cosmopolite pest while the other 3 are often intercepted in quarantine to several countries.

Those mealybug species were usually found on fruit surface near areole or in the crevice. They were also preferred to stay and feed on or beneath the scale and sometimes they could be found on the flower end pit (Figure 2).

Table 2 The distribution of mealybug species in sampling sites

Species/Location	East Java	West Kalimantan	West Java
<i>Ferrisia virgata</i>	+*	+	+
<i>Planococcus minor</i>	+		+
<i>Phenacoccus solenopsis</i>	+	+	
<i>Pseudococcus jackbeardsleyi</i>		+	+

*Note: + = present

2.1. *Ferrisia virgata*

The striped mealybug *F. virgata* is highly polyphagous pest of 77 plant families that can transmit cocoa and pepper viruses [20]. From the survey, *F. virgata* was found in all 3 sampling site, West Kalimantan, West Java and East Java. In Indonesia *F. virgata* is first introduced between 1910 – 1914 and first recorded by Keuchenius in 1915 [21]. This species also has been documented by Kalshoven in 1982. Sartiami stated that *F. virgata* is the mealybug species that is most recorded by Wirjati in 1955-1960 [6]. Geographically, the pest distribution has been recorded in



Figure 2 Mealybugs on dragon fruit: (a) mealybugs colony, (b) in the crevice, (c) on the scale

all continents. Currently, among the other mealybug species found in Indonesia, *F. virgata* has the broadest dispersion worldwide.

Diagnostic of live *Ferrisia virgata*: Adult female greenish-yellow in colour with a pair of dark dorsal longitudinal stripes. Body oval to elongate with adult female length approximately 4-5 mm. Antennae with eight segments, legs dark brown, two posterior waxy tails or tassels are half of the body in length, dorsum covered with long slender cottony-like wax filaments in all directions (Figure 3).



Figure 3 *Ferrisia virgata*: (a) a colony on the scale, (b) an adult female on the fruit's surface

2.2. *Planococcus minor*

Planococcus minor or commonly known as passion vine mealybug is extremely polyphagous and has been reported being host species of 65 plant families [22]. From the survey, *Pl. minor* was found in Bogor. From the Wirjati's collection of mealybugs between 1955-1960, the pest has been recorded in 1955 on *Dysoxylum macrocarpum* in Bogor [6]. In their global distribution, the pest has been recorded in 64 countries [19].

Diagnostic of live *Planococcus minor*: Female was pale yellow in color with oval shape and 2-4 mm long (Figure 4). Antenna with eight segments. Body is covered with a slightly dark thin mealy wax, while ovisac present

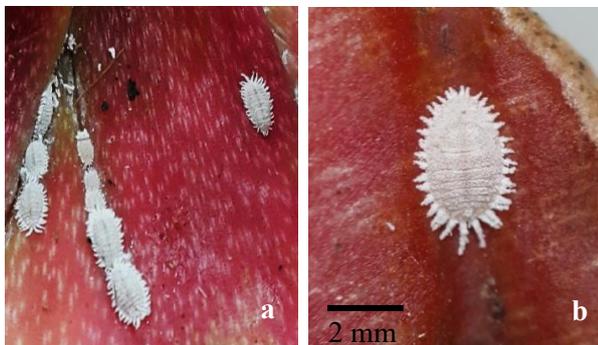


Figure 4 *Planococcus minor*: (a) a colony, (b) an adult female

beneath or beside the posterior end of adult female. There are 18 pairs of short lateral filaments with the two posterior end filaments longer than others. Sometimes the two posterior end filaments jutted out. A longitudinal median stripe present on the dorsum from the thorax and extended to half of the abdomen. In the field, *Pl. minor* often misidentified as *P. citri* given the identical wax-filament morphology.

2.3. *Phenacoccus solenopsis*

The cotton mealybug *Ph. solenopsis* is originated from New Mexico, USA, discovered on several cotton growing areas and later become an invasive pest of cotton and infesting 55 plant families including ornamentals and vegetables [3]. The *Ph. solenopsis* was found in West Kalimantan and East Java. In Indonesia, *Ph. solenopsis* is first recorded on tomato in Bogor by Muniappan in 2009 [7]. In advance, this pest has been recorded in the neighborhood countries, such as Malaysia in 2006 [23], Vietnam in 2007 and late: Thailand in 2009 [24]. Currently, the distribution of this pest is widespread with agricultural trade as the main role promoting its spread.

Diagnostic of live *Phenacoccus solenopsis*: Adult female is oval in shape, 5 mm in length, and somewhat rounded in lateral view. Body is dark grey to almost black and covered with thin powdery wax. There are 18 lateral wax filaments with the posterior pairs are the longest. Antenna 8 to 9 segmented. There are series of dorsal transverse markings on the dorsum: 3 pairs on thorax and 3 pairs on the abdominal segments (Figure 5).

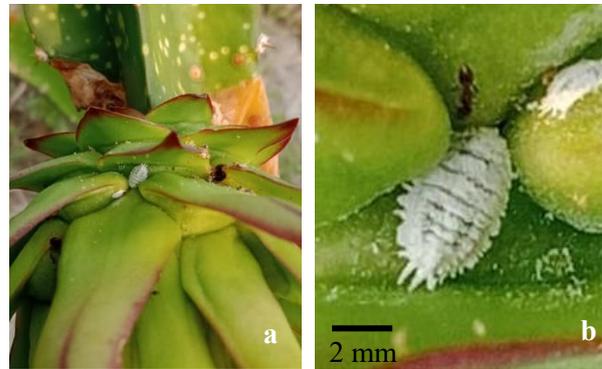


Figure 5 *Phenacoccus solenopsis*: (a) between the scales of young fruit, (b) an adult female

2.4. *Pseudococcus jackbeardsleyi*

The Jack Beardsley mealybug has invaded approximately 47 countries [25] and 22 plant species have been reported as hosts in Asian countries [5]. From the survey, *Ps. jackbeardsleyi* was found in East Java and West Java. In Indonesia, *Ps. jackbeardsleyi* is first recorded in 1988 by Williams in Jasinga, Banten on unknown hosts [25]. Unlike the others, this pest is still relatively new to

many countries and often found intercepted in country where the pest is absent.

Diagnostic of live *Pseudococcus jackbeardsleyi*: Body grayish in color with several parallel lines perfectly clear on the dorsum. Body flat oval to elongate with female adult length up to 3 mm. There are 17 pairs of thin waxy lateral filaments with a pair of posterior end filament length about one half of the body. Antenna 8-segmented, well developed legs with tibia longer than femur (Figure 6).

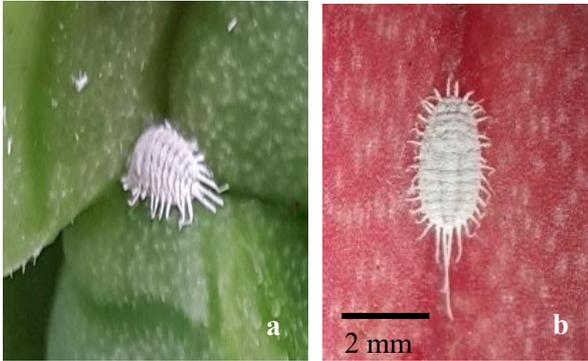


Figure 6 *Pseudococcus jackbeardsleyi*: (a) on young fruit, (b) on a ripe fruit

3. CONCLUSION

Mealybugs are recorded on dragon fruits in three provinces in Indonesia, West Kalimantan, East Java, and West Java. There are 4 mealybugs species found on the dragon fruits, they are *Ferrisia virgata*, *Planococcus minor*, *Phenacoccus solenopsis* and *Pseudococcus jackbeardsleyi*. Species *Ph. solenopsis* is first recorded on dragon fruit.

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