

New Report of Oriental Mealybug *Rhizoecus Amorphophalli* *Betrem* (Hemiptera: Pseudococcidae) in *Amorphophallus Muelleri* Tubers in Indonesia

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Abstract. Since 2020 porang (*Amorphophallus muelleri* Blume) has been declared as an important commercial crop grown in Indonesia. Recently, porang tubers a coated of a distinct white waxy substance was observed at seed storage. The symptoms pose a threat to tuber vigour quality due to the intensive infestation on stored tubers. This sap- sucking insect sucks the juice leading to desiccation and shrivelling of tubers. This study aims to identify the sap- sucking insect pest attacks the storage porang tubers. The studies carried out at ILETRI. Identification of the caused insect species was done by observing symptoms visually, morphological identification of adult females using Compound microscope Olympus Bx43 in 40 X magnification, and tuber germination and growth of 250 infested tubers in the field. Regarding to the specific symptoms whose soft body coated of a distinct white waxy substance and morphological measurement of the average length of the adult females ($862.62 \pm 46.3 \mu\text{m}$ with range between 764 - 904 μm), it's supposed caused by mealybug in *Rhizoecus amorphophalli* (Hemiptera:Pseudococcidae). Our founding revealed that *R. amorphophalli* is first discovered as causal agent of a mealybug pest of porang in Indonesia and turned out to be very detrimental because their infestation caused 90 percent of infested porang tubers unable to germinate and grow.

Keywords: Porang Pest, *Rhizoecus amorphophalli*, Mealybug Infestation, Tuber Vigour, Commercial Crop

1 Introduction

Porang (*Amorphophallus muelleri* Blume), a native aroid grows wild in Indonesian tropical forests, particularly in East Java and East Nusa Tenggara [1, 20]. Since 2019, porang have become prima donna crop in Indonesia. Currently, it has spread almost throughout Indonesia, both under industrial forest plants and in open areas [6]. This rapid increased is

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mainly caused by the high selling price of tubers, bulbils, and seed wide market, export commodities, easy to cultivate, organic plants, and more resistant to pests and diseases as well [6, 19].

Upon harvest, porang tubers are either marketed as dried corms and chips. The farmers are also store them as seed materials for next planting season. In its natural habitat, porang is exposed to minor pests and diseases, such as, *Cercopora* sp. and *Sclerotium rolfsii* that can slightly reduce quality of tubers [6, 8]. In August 2021, nearly all harvested porang tubers stored in the warehouse of ILETRI field station, Malang were heavily damaged by the insect showing symptoms in the form of white powder on the surface of the infested tubers. The symptoms were relatively similar to mealy bug infestation., i.e. they were white, produced cotton-like masses. Inside the white masses found a population of crawlers, males, females and eggs of attacking insect pest [7, 15, 17, 20, 21]. Mealybugs (Hemiptera: Pseudococcidae) declared as economically important insect pests worldwide [12, 20, 22]. These pests are polyphagous, may attack many crops that cause the host growth and the tuber storage problems [5, 8,14]. The information concerning mealybug in porang in Indonesia are scarce [22]. Correct identification of mealybug attacked the porang tubers is important. It will make controlling it easier and often more effective. A mistake in identification can lead to improper control tactics that cost time and money.

This study aims to identify the mealybug sap- sucking insect attacks the porang tubers and suggestion control strategies of this noxious pest may infect many crops that cause host growth problems.

2 Materials dan method

The studies were carried out at ILETRI-Malang in August 2021 - March 2022. A total of 300 infested porang tubers showed symptoms in the form of white powder on the surface of the infested tubers were used as material study. The examination included (1) Identification of insect species by observing the specific symptoms, (2) morphological identification of adult females, and (3) the impact infestation on porang tuber germination and growth.

2.1 Symptoms of mealybug infested porang tuber

A number of 300 sample of healthy and infested tubers were visually observed in December 2021 - January 2022. The first signs of mealybugs infestation, such as, white, cottony egg masses on plants, wax-covered plants, sticky honeydew, black sooty mold growing on top of honeydew or ants feeding on honeydew were observed in detail.

2.2 Morphological identification of mealybug infested porang tuber

The culture of *Rhizoecus* sp. was collected from the mealybug infested-tubers of porang at ILETRI Experimental Farm. Mealybugs from the infested tubers were soak in water or brushed onto the Petri dish (95 mm diam.) containing water using a hair brush. Adult female specimens were prepared for light microscopy using the modification slide-mounting method. Transfer gently the insect into water to rinse off the waxy substances. These specimens mounted directly without clearing in potassium hydroxide. They are mounted dorsal side up. Placed drop of thin water in the centre of a slide. Gently transferred specimens to slide, 3-4 specimens or more on a slide, mounted at least one ventral side up. Representatives of nymph, adult male and female stages included on each slide and finally place coverslip over. All measurement values were taken were given as a

range for each character using Compound microscope Olympus Bx43 in 40 X magnification. Key to *Rhizoecus* species based on length average and range adult females and identified using the following diagnostic keys [10].

Rhizoecus sp. infested-porang tubers were sown at ILETTRI experimental field in February 2022. Before planting the infested tubers were washed, scrubbed with a brush, then dried in the sun for drying. Total area is 0.0625 ha, plant spacing 50 x 80 cm. Total 250 sample tubers were observed their growth and development. Observation focused on percentage of germination and plant growth. Observation carried out at one and two months after seedling and leaf fully opened

3 Results and discussion

3.1 The symptoms of mealybug infested porang tuber

Refer to Figure 1, a series of specific symptoms noticed on infested porang tubers. Initial symptoms are marked by the presence of cottony white spots-covered the outer surface of the tubers. The spot then extends to cover almost the entire tuber surface which depend on the growth and population of the mealybug. As a result of the liquid sucked by the mealybug, the tubers were become shrunk, wrinkled, and crushed. The infested tubers were also slowly blackened and dried. Symptoms of severe damage if the infested tubers were also infected with fungi and bacteria, that finally resulting porang tubers covered with sooty mold and emit a brownish liquid. These symptoms were easily distinguished from those caused by other storage pests. Inside the cottony white masses will be found a population of all stages of mealybug. This damaged will reduce the value of market acceptability, including as material planting, as well



Fig. 1. Caption of the Figure 1. Below the figure.

Based on a series of characteristic symptoms that appeared during observations, they are similar to those caused by mealybug infestation from the *Rhizoecus* genera

(Hemiptera:Pseudococcidae), particularly the presence of the cottony white substance on surface of porang tuber and insect bodies [13, 14, 15, 28]. *Rhizoecus* genera is important economically as an agent of post-harvest storage. *Rhizoecus* species have been known infested elephant foot yam (*Amorphophallus paeoniifolius*) is *R. amorphophalli* Betrem [20, 21]. Hardiyanti *et al* [6] reported *R. amorphophalli* attack the porang tuber in India. They suck cell sap from the elephant foot yam tubers, and the severely infested deformed tubers find no place in market, nor are accepted for cooking [9, 17, 20].

3.2 Morphological measurement of *Rhizoecus* sp. infested porang tubers

Under the compound microscope (40 x magnification) adult female body was creamy, elongate, oval, whitish, wingless, immobile and lightly covered with white mealy substance [Figure 2]. These results aligned with those reported by Sreerag *et al* [20]. Table 1 revealed that the average length of the 10 adult female specimens was $862.62 \pm 46.3 \mu\text{m}$ with range between 764 - 904 μm . These average lengths were in the average range with those reported by Sreerag *et al* [21], where the average length of female was $867.19 \pm 53.67 \mu\text{m}$ (range: 792.11 – 939.54 μm). Average of 10 male specimens was $336.75 \pm 13.50 \mu\text{m}$ (range: 36.03-353.30 μm). The average length measured was categorized medium sized compared to many other mealybugs. In addition, stadia larval length increased with the growth of larval stages 1 - 3. Length of larvae instar 3 larvae was $398.8 \pm 40.2 \mu\text{m}$ (range: 380-454 μm), instar 2 was $264.4 \pm 18.4 \mu\text{m}$ (132-312 μm) and instar 1 was $192.5 \pm 14.2 \mu\text{m}$ (178-198 μm), respectively. Based on the average adult female lengths and images, they are similar and relatively close to *Rhizoecus amorphophalli* which originally described from Malang - Indonesia on *Amorphophallus variabilis* at 1940 [4]. Following its life cycle, all porang tubers began to germinate, so re-culturing was not successful to obtain new insect specimens for further observation. Further identification is required to ensure the correctness to the species level.

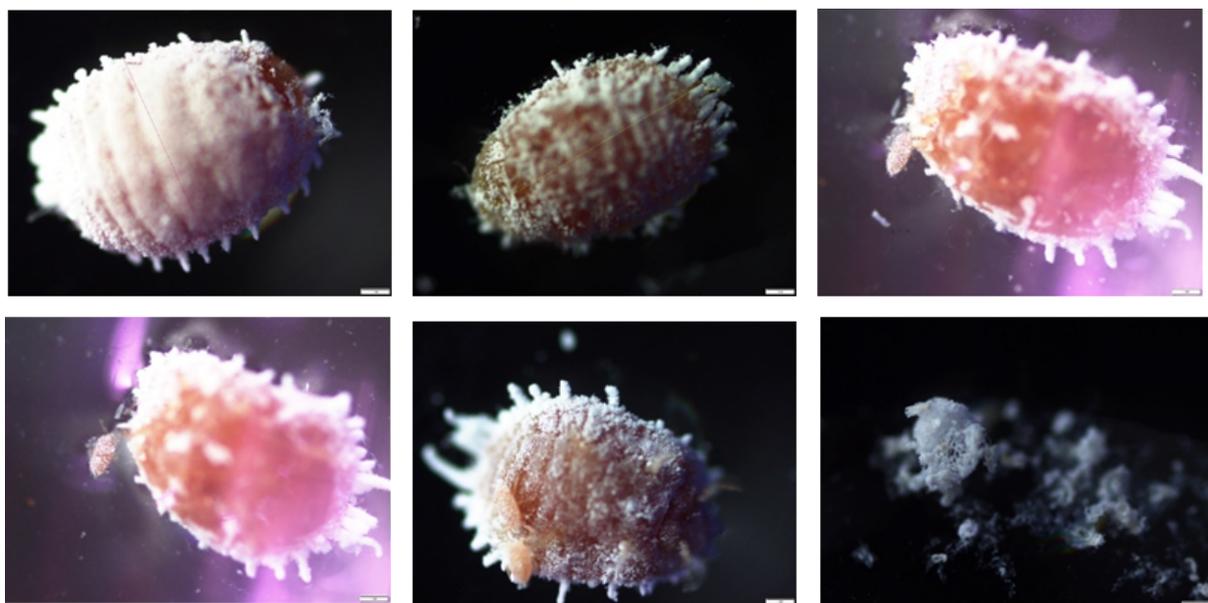


Fig. 2. The adults female were oval and semi-translucent. Images were taken using Compound microscope Olympus Bx43 in 40 X magnification.

Table 1. The length measurements of *Rhizoecus* sp. stages infested porang tubers at ILETRI

Parameters	Larval/Nymph (μm)			Adult (μm)	
	1	2	3	Male	Female

Means±SD	192.5±14.2	264.4±18.4	398.8±40.2	345.75±12.48	862.62±46.37
Range	178-198	132-312	380-454	320-410	764-904
N	10	10	10	10	10

SD= Standart deviation; N = Numbers of observation. Measurements were taken using Compound microscope Olympus Bx43 in 40 X magnification

3.3 The effects of mealybug infested-tuber on germination and growth

Results of field observations proved that only 20 porang tubers which were infested with mealybugs germinated. The remaining 180 tubers failed to germinate. Therefore, almost 90 percent of porang tubers infested with mealybugs failed to germinate. Then of the 10 percent of tubers that were able to germinate in the field, some experienced delayed in germination, growth disturbance and died (Figure 3).



Fig. 3. Poor germination and growth of infested-porang tubers in field. Before planting the infested tubers were washed, scrubbed with a brush, then dried in the sun for drying.

Our finding supposed that *R. amorphophalli* is first discovered as causal agent of a mealybug pest of *A. muelleri* in Indonesia, base on the characteristic specific symptoms, image and length of the adult females. Previously, this species has been reported from *Amorphophallus variabilis*, *A. paeoniifolius* and *Amorphophallus* sp. In Indonesia [4]. Currently, three new species of Rhizoecus (*R. americanus*, *R. omphalius* and *R. pignerator*) identified from Sumatera rainforest [2] and stated 370 species of scale insects were recorded in Indonesia so far. *R. amorphophalli* distributed in 12 countries, mostly in South and Southeast Asia, Micronesia and the Hawaiian Islands. Impacts of climate change, patterns and inputs of agricultural cultivation, *R. amorphophalli* will be the main obstacle to the development of porang in Indonesia through trade and exchange of infested tuber, bulbil and seed planting materials. This pest has a wide range of host plants, including 6 families and 9 genera, namely Dioscoreaceae, Zingiberaceae, Asteraceae, and Araceae (*Colocassia* and *Amorphophallus*) [8, 12]. In a pest integrated management program, these host plants need to be adequately controlled to avoid the re-infestation of commercial porang. Due to *R. amorphophalli* seriously damaged the highest economic value of porang yields (tuber, bulbil, and seed) both in field and storage, if not controlled properly it will be very detrimental to farmers because the tuber will reject by the commercial market and increase production costs due to a shortage of seeds and pesticide inputs as well. Existence of *R. amorphophalli* have never been reported by farmers whose grown porang under teak and

mahogany industrial forests. However, with increasing the expansion to food crop areas and new openings areas with intensive cultivation, this insect pest needs to be watched out for and prepared for an environmentally friendly management strategy. Without any control measures, mealybug population increases by 4-5 times during the storage period [15]. A combination of selected cultural practices, botanic chemical treatment, soak tubers in salt solution for cleaning tuber seed material may be more effective [17, 18]. The selected control method was suggested as a means to get rid of mealybug and dissolve the insect's wax which cover insect body, for instances; salt solution (1000 ppm) [15, 17].

4 Conclusions

According to the specific symptom characteristics, image and measurement of adult female body supposed the mealybug infested porang tuber close or similar to *Rhizoecus amorphophalli* and reported here for the first investigation attacked porang tuber in Indonesia. This pest turned out to be very detrimental because their infestation caused 90 percent of infested porang tubers unable to germinate and grow. Techniques for the production of clean planting materials in nurseries and a regulation of the distribution and exchange of planting materials should be devised. Knowledge about the biology and distribution of this mealybug has paramount importance in devising proper management strategies.

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