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# The Field Observed Insects would Challenge The Expansion of Porang (*Amorphophallus Muellery* Blume) Cultivation in Indonesia

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**Abstract:** *Porang (Amorphophallus muelleri Blume) has becomed an important agribusiness crop in Indonesia in the past recent years. Porang in the form of chips and flour has been exported to some countries. The processed products of porang have been proven to be useful for mantaining human health and for alleviating some illness. Consequently, corm of porang has been marketted at higher price than other tubers. The government of Indonesia also promoted the expansion of porang cultivation. As a result, growing porang on open agricultural land is unavoidable. The crops, like rice and maize, which have been commonly cultivated on large and open areas in Indonesia, experienced a serious damaged and even a failure of harvest by insects and diseases. Similarly, porang plants would possibly be exposed to a serious infestation of insects and pests when cultivated on open and larger areas. On the basis of the present field observation, some insects, listed in the following sections, were found on porang. These insects could potentially challenge the cultivation of porang in Indonesia in the future.*

**Keywords:** *Porang (Amorphophallus muelleri Blume), farming, insects*

## 1. INTRODUCTION

Sweet potato and cassava are tuber crops and ones of the important food sources for the people of Indonesia (Zuraida and Supriati, 2001; Saleh and Widodo, 2007; Hardoko *et al*., 2010; Ginting *et al*., 2014). Unlike sweet potato and cassava, porang (*Amorphophallus muelleri* Blume) has been considered as under-utilized tuber crop in Indonesia. However, due to its value in maintaning human health and curing some human illness (Yoshida *et al*., 2006; Yeh *et al*., 2007; Carlos *et al*., 2008; Alonso-Sande *et al*., 2009; Jagatheesh *et al*., 2010; Soedarjo, 2015), porang plant is becoming one of the important commercial tuber crops. As observed in farmers field in 2019-2020, the price of porang fresh tuber was much higher compared to the price of sweet potanto and cassava fresh tubers. Consequently, more farmers would be growing porang and larger area of porang cultivation is unavoidable.

As a commercial crop, porang in the form of chips and flour has been exported to Japan, China, and Korea and Australia at the present (Abriyani, 2019; Ahmad, 2019; Gesha, 2019 and Handayani, 2019). In support to porang cultivation enlargement, the Indonesian Ministry of Agriculture has introduced a program to increase corm production of porang (Sugara, 2020). Porang plant has been

naturally cultivated in forest under some degree of shading by the trees. Porang plant was reported to grow normally on Alfisol soil whothout shading (Soedarjo *et al*., 2020). Therefore, the expansion of porang cultivation could be carried out on open-farming areas. Expectedly, a significant corm production woud be achieved to meet the export demand.

However, farming of porang on open areas would be challenged by pest and diseases infestation. Sweet potato, cassava and other crops cultivated in a larger area on open areas have been deleteriously damaged by pests and diseases damages. Growth, yield and economic reduction due to pests and diseases infestation have been well-documented (Saleh *et al*. 2015; Marwoto *et al*. 2017; Faizin *et al*. 2019). Thus, taking porang to open-farming areas could similarly undergo damages and economic loss due to pests and diseases infestation. On the basis of field observation results, this manuscript reported the first information about the presence of some insects and the resulted damages on porang plants grown in the glasshouse and on farmers field.

## 2. METHODOLOGY

The present observation monitored the presence of insects on porang (*Amorphophallus muelleri* Blume) at farmers field, Probolinggo-East Java, and on porang plants at the Campus of Indonesian Legumes and Tuber crops Research Institute (ILeTRI), Malang-East Java. The field visit and field observation were undertaken during the porang growing season, from December 2019 to April 2020. The damage symptoms due to the respected insects was photographed as a proof of the insect infestation. Whenever possible, the yield reduction of porang due to the damage by certain insect was recorded quantitatively. The insects observed on porang plants were consulted to the entomologist in ILeTRI to identify the names of the insects. The names of insects found on porang plants were reported as listed in the following sections.

## 3. RESULTS AND DISCUSSION

### 3.1. Warehouse moth (*Ephestia cautella*)

*Ephestia cautella* is a tropical warehouse moth and is allso called as an almond moth or cocoa moth. The larvae, puppae and imago of the moth are presented in figures 1B, 1C and 1D, respectively. The larvae of this warehouse insect was reported to cause an economic loss to the various stored products, such as dates, cacao, shallots (Aldawood 2013; Hasyim *et al*., 2014; Oyewo and Amo, 2018). The mean percentage of damage to cocoa beans by *E. Cautella* were 10.31 and 29.05 in the first and fourth months, respectively (Oyewo and Amo, 2018). Thus, the seeds stored longer would result in worse damages.

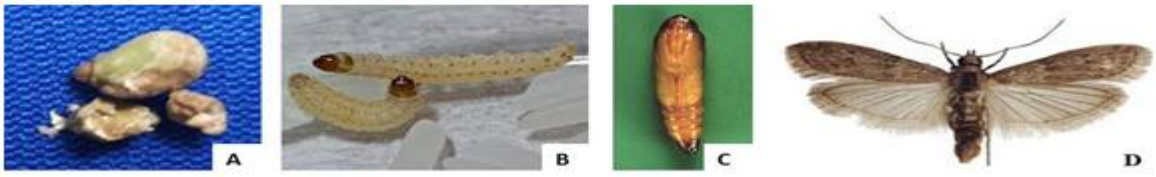


**Figure1.** *A. The damages of porang seeds by Ephestia cautella (present observation), B. Larvae of warehouse moth, C. Puppae of warehouse moth and D. Imago of warehouse moth.*

*B, C and D: (http://www.russellipm-storedproductsinsects.com/portfolio/anthrenus-verbasci-varied-carpet-beetle-2/- (accessed in 7 Nopember 2019:).*

The present observation showed that the insect also attacked the seed of porang (*Amorphophallus muelleri* Blume) stored uncealed at room temperature. The larvae of moth damaged the seeds of porang by feeding. As a result, porang seeds were seriously damaged and the apperance of damaged porang seed was presented on figure 1A. Initially, the moth attacked soybean seed stored side by side to the seed of porang. After a serious damage of soybean seeds, the larvae of moth also damaged the seed of porang. The result of this observation suggests that the moth *Ephestia cautella* preferred seeds of soybean to the seeds of porang. The present observation revealed the first information that the warehouse moth *Ephestia cautella* also attacked the stored seed of porang.

### 3.2. Mealybug

Mealybugs are insects that live on a wide range of host plants and are considered to be highly polyphagus (Addis et al., 2008; Mani et al., 2012; Sirisena et al. 2013). Mealybugs damage the host plants by inserting their hair-like mouthparts into plant tissue to suck up the sap of plant cell. An infestation of this insect was reported to deleteriously affect the growth and yield of host plants, e.g., enset plant (Addis et al., 2008). Warm dry weather, prolonged drought with scanty rain fall and less number of rainy days favour the faster multiplication of mealybugs (Ayyasamy and Regupahy, 2010). As a tropical country, Indonesia should be a favourable place for the mealybugs to properously grow. Thus, porang plants which is native to Indonesia could be a host to mealybugs.

Our observation revealed that porang plants planted on farmers' field and in the glasshouse were not infested by mealybugs. However, bulbils of porang stored at room temperature were infested by mealybugs. Bulbils infested by mealybugs were indicated by white color coverage on the surface of bulbils (Fig. 2 left). Whilst, clean surface of bulbil was shown by the uninfested one (Fig. 2 right). The diameter of bulbils on figure 2 (left and right) was measured to be approximately 3.0 cm. The weight of bulbils on figure 2 left and 2 right were 9.71 and 9.83 g. Thus, an infestation by mealybug caused a slight decrease of bulbil weight. Mealybugs live by sucking up the sap of the cell (Addis et al., 2008). The sap-sucking up of bulbil by malybugs could be the mechanism for a slight reduction of bulbil weight.

**Figure2.** *Mealybug-infected bulbil (left)nd healthy bulbil (right)*

### 3.3. Hornworm (*Agrius convolvuli*)

Hornworm (*Agrius convolvuli*) is considered to be polyphagous insect, because it could feed on most leaves of the various plants (Kaya et al., 2016; Halder et al. 2018). As observed on sweet potato, the larvae of *Agrius convolvuli* seriously damaged the leaves and caused in significant reduction in tuber yield (Figs. 3 A, B, C and D) (Halder et al., 2018).

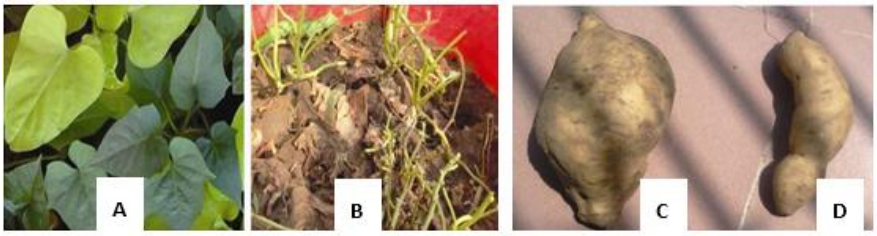


**Figure3.** *Performance of healthy sweet potato (A), growth of infested sweet potato by larvae of Agrius convolvuli (B), tuber of non-infested (C) and tuber of infested sweet potato by larvae of Agrius convolvuli (D).*

The larvae of *Agrius convolvuli* also damaged tuberous porang plant by feeding the leaves (Figure 4A and 4 B). All parts of the leaves, including the midrib of the leaves, were also eaten (Fig 4 B). However, the larvae of *Agrius convolvuli* did not fed on the leaves of the climbing ornamental plant which has similar form of leaf with taro plant (Fig. 4 C). Thus, the leaves of this ornamnetal plant were not preferred. The present observation revealed the first report regarding the preference of the larvae of *Agrius convolvuli* feeding on porang leaves. Referring to the damage of sweet potanto (Halder *et al*., 2018), the larvae of *Agrius convolvuli* could be a potential insect that could significantly reduce growth and corm yield of porang.


**Figure4.** *Larvae of Agrius convolvuli found on porang leaves (A), the larvae feeding on leaves of porang plant (B) and and the appearance of larvae of Agrius convolvuli fed by the leaf of ornamental crop (C)*

### 3.4. Armyworm (*Spodoptera litura*)

Armyworm, *Spodoptera litura*, is a polyphagous insect and could damage variety of crops, fruits and vegetables (Tengkano and Suharsono. 2005; Oliveira *et al*., 2014; Rebek and Hillock 2015; Igyuve *et al*., 2018; Lolodatu *et al*., 2019). The appearance of larvae, imago of armyworm and porang leaf damaged by the armyworm were depicted on figure 5 A (https://nufarm.com/id/gabah-2/ulat-grayak/), figure 5B (https://www.google.com/search? source=univ&tbm=isch&q=image+ulat+ grayak&client =firefox-b-d&sa=X&ved=2ahUKEwi5yK3V0NdqAhX-ILcAHVG2DI8Q7Al6BAgKECY&biw=126 6&bih=674#imgrc=7t1Ls-NfWHk fSM) and 5 C (present observation) respectively. The larvae of armyworm preferably damages leaves of plant by feeding. Recently, it was reported that armyworm badly attacked thousands of hectars of agricultural crops in Nusa Tenggara Timur, Indonesia and resulted in significant economic loss (Rosary, 2020). The present observation also revealed that porang leaf was prefered for feeding by armyworm and was badly damaged. Therefore, the porang leaves were also deleteriously damaged (Fig. 5 C). Thus, the present observation revealed the first information about the feeding preference of armyworm on porang leaves.


**Figure5.** *A. Larvae of spodoptera litura (A), imago of spodoptera litura (B) and and damage of porang leaves by spodoptera litura (C).*

### 3.5. Whitefly (*Bemisia tabaci* Genn)

Whitefly, *Bemisia tabaci* Genn, is commonly observed to infest legumes, such as soybean, mungbean, peanut and was reported to adversely affect the growth and grain yield (Gulluoglu *et al*., 2010; Marwoto and Inayati. 2011; Mir Kabir *et al*. 2014; Kasno *et al*., 2015; Murgianto and Hidayat, 2017; Nurrohman *et al*. 2019). Beside legumes, this insect also adversely infest other agricultural crops, such as chili pepper, cassava, sweet potato , tomato, eggplant and cucumber (Narendra *et al*. 2017; Purnama *et al*. 2017; Lu *et al*. 2019**;** Mohammadali *et al*., 2019; Misaka *et al*., 2020**).** The adverse effect of whitefly infestation was due to its role in transmitting viral disease from infected plant to the infested plant (Narendra *et al*. 2017).

In the present observation, porang plants were laid out side by side to the soybean plants in the glasshouse of ILeTRI. Initially, soybean plants were seriously infested with whiteflies and the soybean leaves showed curly and dwarf. At this present observation, porang plants were not yet infested with whiteflies. The whiteflies infested porang plants after the harvest of all soybean plants. Porang plants were eventually infested with high population whiteflies. At the beginning, when population of whiteflies was low, the leaves of porang did appear curly (Fig. 6A). After sometimes, when more number of whiteflies accumulated on the below side of the leaves, the leaves of porang turned to curly (Fig 6B). Whilst, the unifested porang plants showed normal growth (Fig. 6C). The result of the present observation revealed the first information that porang plant could be infested severely by whiteflies. After harvest, the corm produced by the whiteflies infested porang was much lower (24 g of corm/plant) than the healthy porang plants (190 g of corm/plant. Corm yield was reduced by 87% due to whiteflies infestation (Fig. 6D).

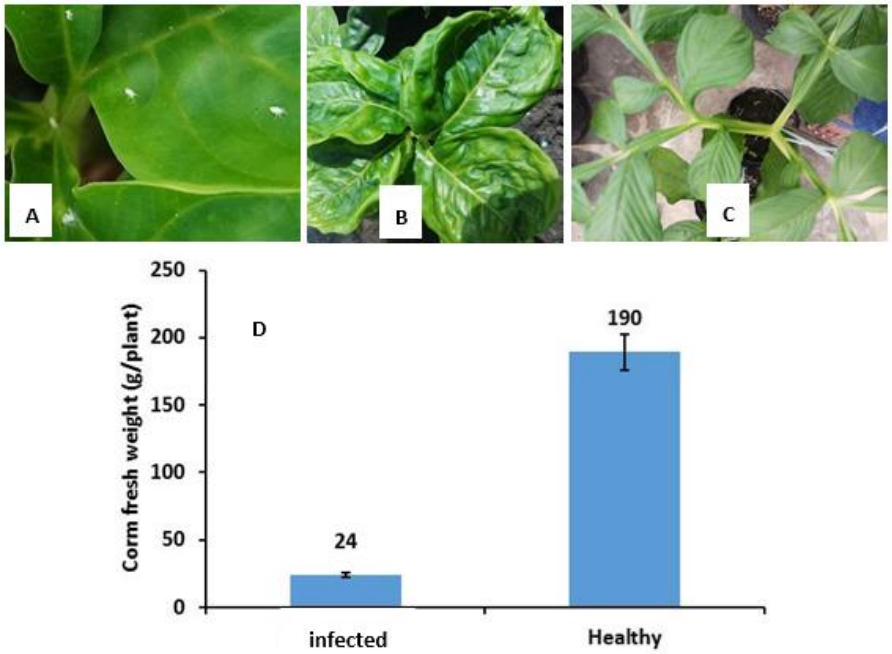


**Figure6.** *Whiteflies on leaf of porang (A), Curly leaves of porang due to whiteflies (B), healthy porang leaves (C) and corm fresh weight of Bemisia infected and healthy porang plants (D).*

### 3.6. Grass hopper

The attack of grass hopper on leaves of porang was observed on porang grown in the glasshouse. The grass hopper was small, aprroximately 1 cm of length (head to ovipositor) (Figure 7A). The grass hopper fed on leaves and left holes after feeding (Fig. 7B). By observing the degree of leaf damages, this grasshopper does not seem to be a serious threat to growth and corm yield of porang. However, if the grass hoppers present at huge number, the damage would be possibly deleterious. The presence of certain number of grasshoppers in one plant significantly reduced the growth of wheat and canola and also teak (Begna and Fielding. 2003; Pratiwi *et al*., 2012). Growth reduction due to grasshoppers infestation was also reported on maize (Leatemia and Rumthe. 2011). Referring to the reports of plant damages by the previous investigators (Begna and Fielding. 2003; Leatemia and Rumthe. 2011), grasshoppers could also possibly imposed the growth damages and an economic loss to porang plant. The occurance of grasshopper on porang was the first observation reported by this present observation.


**Figure7.** *A. Grass hopper was feeding on leaf of porang, B) the feeding left holes on leaf of porang.*

### 3.7. White Grubs

White grubs, also known as root grubs, are soil-inhabiting polyphagous insects. In soils, the larvae of white grubs utilize organic matter as well as the roots of many economic crops as their food, such as sugarcane, cassava, sweet potato, grasses and maize in all over the world (Hann *et al*., 2008; Mane and Mohite, 2014; Setiawati et al., 2014; Teshita and Gashaw, 2014; Adrian *et al*. 2019). White grubs can be devastating agricultural pests by feeding on crop roots and often resulted in plant death. This insect was reported to deleteriously attack maize in Tuban and caused around Rp 3 million loss in one hectar (Pioneer, 2018). A devastating effect of white grubs on rice plantation and sugarcane plantation was also observed and reported by Adrian et al. (2019) and Asmara (2019) in Indonesia.

The present observation revealed the ocurance of white grubs in soil planted with porang (*Amorphophallus muelleri* Blume) within the stand of trees in Probolinggo regency, East Java. At time of observation, the damages on porang plant was not discovered even though the white grubs were found (Figs. 8A and B). Porang was a new plant in this tree area, it was the second year of growing season. Unnoticed damages on porang plants might be due to small population of white grubs. Previously, the white grubs were not observed within the roots of the trees. Thus, the introduction of porang as new plant might induce the occurance of white grubs. Therefore, the population of white grubs would be magnifying along with the longer growing season of porang plants. As reported by previous invetigators on other crops (Hann *et al*., 2008; Mane and Mohite, 2014; Setiawati *et al*., 2014; Teshita and Gashaw, 2014; Adrian *et al*. 2019), the white gurbs would also impose a devastating effect on porang in the future.

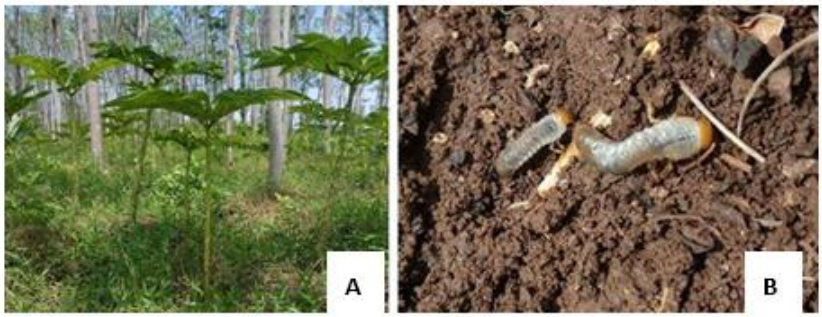


**Figure8.** *A. Porang plants within the stand of trees and B. White grub in the soil*

### 3.8. Teak insect

Porang plants was grown at farmers' field where teak tree was grown as border. Teak trees were sometime devastated by the attack of some insects. Rahmana (2016) reported a devastating infestation of larval teak insects in Pamekasan, East Java, Indonesia. The damaged-teak tree left leaves as shown in figure 9A. Similar symptom of leaf damage was also observed on leaves of teak tree in Probolinggo grown as border where porang plants were grown (Fig. 9B). Porang plants grown on farmers field in Probolinggo which was bordered with teak trees were also found to show similar damage symptom (Fig. 9C). At the time of field observation, the larvae or imago of insects infested teak tree and porang plants was not found. By comparing the damage symptom among the plants shown on Figures 9A, B and C, the type of insect was presumably the same. The insects of teak tree grown as the border would easily move to the porang plants in the field as the main crop.

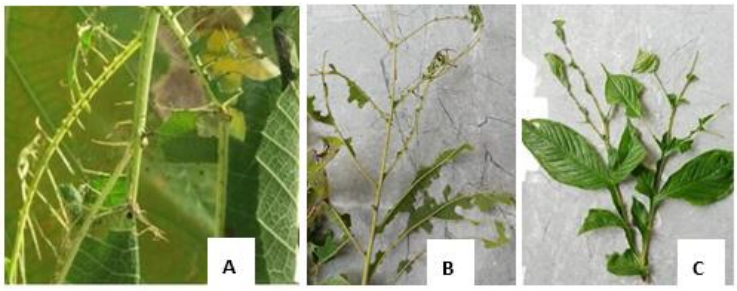


Figure 9. Symptom of damage on teak leaves due to the larvae of teak insect in Pamekasan [(A) Rahmana (2016)], symptom of damage on teak leaves in Probolinggo (B) and symptom of damage on porang leaves in Probolinggo.

### 3.9. Black cutworm *(Agrotis ipsilon)*

*Agrotis ipsilon,* black cutworm, (Lepidoptera: Noctuidae) is known to be polyphagous insect because the insect was found to attack estate plant like coffee (*Coffea arabica*) and cotton, vegetables and ornamental crop (Foster and Gaylor. 1987; Maghfiroh and Binawati 2012; Fernandes *et al*., 2013; Mamahit and Manueke. 2016; Armi *et al*. 2019). In Brazil, the black cutworm caused coffea plant dead of 13.9% (Fernandes *et al*., 2013) and serious damage of red onion, more than 50% of plant dead, was reported by Armi *et al*. (2019). Thus, black cutworm is considered to be one of the harmful insects.

The present work observed the occurance of black cutworm on farmers' field grown with porang. One of the porang plants grown in the glass house was found dead. When up-rooted, damaged corm of the dead porang plant was observed (Fig. 10). Near the corm was found the larvae of black cutworm. Thus, the corm could probably be fed by the black cutworm. However, the present observation did not notice the serious damage of porang plant due to black cutworm on farmers' field. Since the porang plant was newly introduced, it was the second year of porang growing season, the population of black cutworm would be too low to cause a damage to newly introduced porang plants. Referring to an adverse effect of black cutworm to plants that has been established for years, like red onion, the black cutworm could be a serious threat to porang plant in the near future.

**Figure 10.** *Damaged of corm of porang could be due to black cutworm*.

## 4. CONCLUSION

The present work observed some insects which could be a potential threat to an expansion of porang cultivation in Indonesia. The idenfied insects in the present work are warehouse moth (*Ephestia*

*cautella*), mealybugs, hornworm (*Agrius convolvuli*), armyworm (*Spodoptera litura*), whitefly (*Bemisia tabaci* Genn), grass hopper, white Grubs, teak insect, and black cutworm *(Agrotis ipsilon)*

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