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Host plant and intensity pest attack *Paracoccus marginatus* on papaya plant in North Minahasa Regency

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Abstract. The purpose of this study is to find out distribution and the host range of mealybug *Paracoccus marginatus* and their attack intensity in the field, especially in the centers of papaya cultivation in the North Minahasa region, North Sulawesi Province, Indonesia. The study uses a survey method conducted in four villages, namely: Matungkas, Laikit, Dimembe and Tetei. Sampling was done by purposive sampling. Sampling was carried out in three fields per village that had different cropping systems on the farms cultivated by farmers. Each location was sampled and observations were made on papaya plants to see whether papaya mealybug were attacked or not attacked. Samples of mealybug and host plants from the field were brought to the laboratory for identification. The results showed the attack intensity of mealybug ranged from 13.67% to 60%. Symptoms of mealybug attack on papaya plantations was varied from the symptoms of low intensity to high intensity. The results of this research found host plants of *P. marginatus* consisted of seven species of plants, besides papaya namely: *Annona muricana*, *Persea gratissima*, *Codiaeum spp.*, *Aglonema spp.*, *Anthurium spp.*, *Hibiscus spp.* and *Jatropha spp.*

1. Introduction

The pest insects are one of the constraints in the cultivation of papaya plants in North Sulawesi Province. Some insect pest species that attack papaya plantations are: fruit flies, armyworm, mites, aphids, shell lice, grasshoppers and mealybug. Papaya mealybug, *Paracoccus marginatus*, a serious invasive pest affecting horticultural crop especially on papaya plants [1][2]. In Indonesia this pest was first discovered in papaya plants in Bogor in May 2008 along with CRSP / Virginia Tech / Clemson University, USA IPM Team and later found it in papaya plants in the Capital City District, Manado City [3][4]. These pests then spread so quickly and reportedly attacked papaya and other plants in many places throughout Indonesia. This papaya mealybug pest has distribution throughout the city of Manado so that by the end of 2009 almost all papaya that had grown in the yard of the house were attacked by these pests and eventually died. These pests have been found in the city of Manado [4]. The results of Research 2011 found that mealybug *P. marginatus* are not only spread in the Manado area and its surroundings, but have spread to almost all regions in North Sulawesi including the Minahasa, North Minahasa, to South Minahasa and Southeast Minahasa regions [5].

Mealybug *P. marginatus* attacking papaya plants also attack cassava plants, distance and other plants that release sap [6]. This pest attack on papaya plants both young and fruitful, can kill the plant less than 3 months from the beginning of pest infestation on the plant. Furthermore, research found that these pests are very dangerous attacks, because it can reduce the results of mealybug sucking liquid plants from leaves to fruit. Pests can attack on various on part of papaya plant such as the stems, leaves, petioles, flowers and fruit [7]. The spread of this mealybug can be caused by wind, seeds,

people, or carried by other insects and birds. The presence of high and polyphagous mealybug has the potential to spread very quickly. Insecticides are used by farmers to kill these pests. In addition, the use of insecticides will leave toxic residues in the fruits and leaves of plants which are important food ingredients for humans as well as negative impacts on the natural enemy, environment such as pollution and pest resistance. Therefore, this pest control is the most appropriate, which is preferentially limiting the entry of these pests in crops by removing host plants that are around papaya plants. For this reason, a survey study was needed to know the species of host plants of mealybug *P. marginatus* and their level of attack in the field, especially in the centre of papaya cultivation in the North Minahasa region.

2. Methods

This study used a survey method and carried out in the center of papaya planting in North Minahasa North Sulawesi Indonesia. Sampling was done by purposive sampling. Sampling was conducted in four villages which were different from Matungkas, Laikit, Dimembe and Tetei on North Minahasa. Observations were made on the farms cultivated by farmers. Each location carried out three field and every location was taken 50 plant samples for observation. The observation was made on papaya plants to see whether papaya mealybug were infested or not infested. Observations were made in the papaya farmer by seeing whether there were symptoms of papaya mealybug infested, then calculating the attack intensity of mealybug. In papaya planting, observations plant host of mealybug were carried out around the plants, namely plants that were also attacked by mealybug. In addition to near papaya planting, observations were carried out on several plants that showed symptoms of mealybug attack in the North Minahasa region. Plants that are attacked are taken as a sample by cutting the affected part, then put it in a transparent plastic bag, then take it to the laboratory. Observations in the laboratory to identify the types of plants attacked by mealybug. Observation Parameters: 1) species of plants attacked by mealybug, 2) symptoms of mealybug attack and 3) intensity of mealybug attack. The data obtained were prepared, tabulated and analyzed by variance and continued with further tests using Duncan New Multiple Range Test (DNMRT) at the level of 5%.

3. Result and Discussion

The observation area, namely North Minahasa, is a central area of papaya cultivation. The intensity of mealybug attacks in this area is summarized in Table 1. The level of attack of mealybug pests is generally low to high level attack ranging from 13.67% to 60%. Differences in attack rates are found in each village. The highest level of pest attack is found in Matungkas village which can reach 80% followed by Laikit reached 40% and Dimembe 36.67%. The attack rate of papaya mealybug in Tetei village showed a significant difference with the level of attack of mealybug in the other three villages. The difference in the level of attack of mealybug in the papaya planting is influenced by cropping conditions, land sanitation and cropping, crop varieties, and climate. The presence of pest insects is influenced by differences in temperature, climate, geographical conditions and vegetation in the region [8]. Besides that, the determining factor is the low and high level of pest infestation in the field, namely the use of pesticides. Local farmers are very dependent on the use of pesticides. In the location of plants that have just been sprayed with insecticides especially on Tetei village, the intensity of mealybug infestation will be lower than in plants without spraying. An average yield loss of 91% on papaya crop was reported in the affected farms [9].

Table 1. Intensity of attack by papaya mealybug *Paracoccus marginatus*^a.

Village/Field	Attack intensity (%)	Notation
Matungkas	60,00	a
Laikit	40,00	a
Dimembe	36,67	a
Tetei	13,67	b

^aThe numbers in the lane followed by unequal letters differ significantly according to the DNMRT test at the 5% level

The results showed that symptoms of a distant mealybug attack appear on the part of the plant that is attacked in white flour, and from near white flour symptoms it is seen as a mass of colonies of mealybug. Mealybug are covered in a layer of wax or white flour. The wax layer is a secretion from mealybug. Infestation of mealybug appears as cluster of cotton like mass on the above ground portion of plants with long waxy filaments[2]. The survey showed that mealybug *P. marginatus* attack papaya from leaves, petioles, stems, fruit stalks and fruit. Symptoms of mealybug attack on papaya in plantations varied from symptoms of low intensity, as in Figure 1a, that were seen only one group of mealybug pests in the fruit. However, there are also plants in the plantation that are categorized as moderate intensity by mealybug attack. Where the attack has distribution to the fruit is less than half the fruit. There are also some trees are categorized as high intensity, as in Figure 1b, that symptoms appear to be severe attacks shown from the attack of mealybug already present in the whole fruit, and the spread of attacks on plants from leaves and stems. The attack of papaya mealybug is typically seen as mealybug mass shaped like cotton on the top and bottom of plants[10]. Mealybugs cause deformity, wrinkling and rolling of the leaf edges and early leaf drop. Attack to unripe fruits causes sap running and blemishes, a source of fruit downgrading. Papaya fruit can be heavily infested with mealybugs, becoming white and essentially inedible. Under heavy infestations, the abaxial side of the lower leaves can be covered with insects that congregate near the main vein[11].

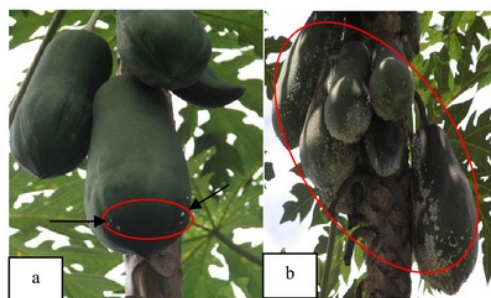


Figure 1. Symptoms of attacks by mealybug *P. marginatus* on papaya. a) low intensity b) high intensity

The results of this research found the host plants of mealybug *P. marginatus* consisted of eight species plant, namely besides papaya, Annona (*Annona muricata*), avocado (*Persea gratissima*), croton (*Codiaeum variegatum*), Aglonema (*Aglonema* spp.), Anthurium (*Anthurium* spp.) and Hibiscus (*Hibiscus rosa sinensis*) and Jatropha (*Jatropha* spp.) can be shown on Table 2. The research showed that the mealybug *P. marginatus* was polyphagous insect which have host plants of more than one plant species from several different plant families. The host plant species of mealybug *P. marginatus* pests are various species plants. These pests have more than 60 species of host plants[12]. Furthermore, papaya mealybug had host plants including: hibiscus, advocates, oranges, cotton, tomatoes, green beans, soybeans, taro, mangoes and cherries[13]. Host plants of mealybug pests found in West Java, including: peanuts, croton, taro, waluh, hibiscus, rosella and others[14]. In Kenya reported the papaya mealybug was found to infest papaya (*Carica papaya*), cassava (*Manihot esculenta*), chili pepper (*Capsicum annuum*), guava (*Psidium guajava*), mango (*Mangifera indica*), and eggplant (*Solanum melongena*)[9]. The presence of mealybug in various host plants, accelerates the movement and spread of mealybug to healthy papaya plants that surround it. The presence of host plants in the field allows pests to be able to withstand the conditions of the main host pl *Annona muricata* ants not available. This causes the development of these pests has always been a problem for papaya farmers.

Table 2. Host Plants of mealybug *P. marginatus* on North Minahasa regency.

Number	Host Plant of mealybug	
	Common name	Species
1.	Papaya	<i>Carica papaya</i>
2.	Sirsak/Annona	<i>Annona muricana</i>
3.	Advokad/Avocado	<i>Persea gratissima</i>
4.	Puring/Croton	<i>Codiaeum variegatum</i>
5.	Aglonema	<i>Aglonema</i> spp.
6.	Anthurium	<i>Anthurium</i> spp.
7.	Kembang sepatu/Hibiscus	<i>Hibiscus rosa sinensis</i>
8.	Jarak/Jatropha	<i>Jatropha</i> spp.

4. Conclusions

The attack intensity of mealybug *Paracoccus marginatus* in North Minahasa Regency generally ranges from 13.67% to 60%. The symptoms of mealybug attack on papaya plantations was various intensity from low intensity until high attack intensity. Mealybug *P. marginatus* is polyphagous pests which have seven host plants species besides papaya (*Carica papaya*), namely: Annona (*A. muricana*), avocado (*P. gratissima*), croton (*C. variegatum*), Aglonema (*Aglonema* spp.), Anthurium (*Anthurium* spp.), Hibiscus (*Hibiscus rosa sinensis*) and Jatropha (*Jatropha* spp.).

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