The attack intensity of *Paracoccus marginatus* Williams & Granara de Willink (*Hemiptera: Pseudococcidae*) on papaya

N Pramayudi¹*, D Bakti², M C Tobing², Husni¹

¹Program Study of Plant Protection, Faculty of Agriculture, Universitas Syiah Kuala, Darussalam, Banda Aceh 23111, Indonesia
²Program Study of Agrotechnology, Faculty of Agriculture, Universitas Sumatera Utara, Padang Bulan, Medan 20155, Indonesia

*Email: nur_pramayudi@unsyiah.ac.id*

**Abstract.** The mealybug, *Paracoccus marginatus* is one of the important insect pests in papaya (*Carica papaya* L.). The high potential for damage caused by this pest poses a threat to the production of papaya in Indonesia. The aim of this study was to evaluate the intensity of *P. marginatus* attack on papaya by observing variables such as plant varieties, planting seasons and cultivation methods. The area of observation plots was about 2,000 m². The cultivation technique applied was monoculture with a spacing of 2.5 m x 2.5 m. Thirty plots of plants were collected from each plot of plants using diagonal sampling technique. The total number of leaves and the number of leaves attacked were recorded. Damage intensity was determined based on the category: no attack (score 0), mild 1-25% (score 1), moderate 26-50% (score 2), severe 51-75% (score 3), and very severe 76-100% (score 4). The attack intensity was higher in the dry season than rainy season. The results show that attack was higher in the dry season than rainy season. The intensity of the attack was also higher in Thai varieties both in the rainy and dry seasons. More intensive pest control shall be applied in the dry season and in the introduced varieties.

1. **Introduction**

The mealybug, *Paracoccus marginatus* Williams & Granara de Willink (*Hemiptera: Pseudococcidae*), is one of the key insect pest species feeding on papaya (*Carica papaya* L.) [1,2]. The first case of *P. marginatus* attack on papaya plants in Indonesia was reported in mid-2018, precisely in Sukaraja District, Bogor Regency [3]. According to the Central Bureau of Statistics, papaya production in North Sumatra declined from 27,757 tons in 2013 to 26,238 tons in 2014 [4].

Papaya mealybug has the ideal ability to grow, survive and reproduce in a temperature ranging between 18°C - 30°C [5] hence Indonesia provides a suitable environment for this pest to live. This pest also has the longest life cycle and the highest periodicity in papaya plants compared to mulberry, jatropha, and potato [6]. *P. marginatus* also showed the highest net reproduction rate (Ro) in papaya plants compared to cotton, cassava, mulberry, brinjal, hibiscus, and potato [7].

The severe damage of this pest poses a serious threat to papaya fruit production in Indonesia. *P. marginatus* is a new pest on papaya plants in Indonesia, hence the knowledge about this pest is still
limited. Therefore, various studies need to be undertaken to deliver fundamental information about this pest. This study is aiming to evaluate the attack rate of *P. marginatus* on papaya plants through focusing on several variables namely papaya variety, growing season, and cultivation method.

2. Materials and methods

This research was conducted at a papaya plantation owned by farmers in Deli Tua and Patumbak sub-districts, Deli Serdang regency. Observations were performed in the rainy season (August 2017-January 2018) and in the dry season (February-July 2018). The records of *P. marginatus* mealybug attack intensity on papaya plants were carried out on two varieties, namely Calina and Thailand varieties between 2 and 26 months after sowing. The size of the plot was around 2,000 m². The plants were sown in monoculture cultivation with a spacing of 2.5 m x 2.5 m (320 stems). Fertilization was done by using manure and urea fertilizer. The sample crops received no pesticide treatment.

From each planting plot, 30 sample plants were gathered using a diagonal sampling technique. In each plant, the total number of leaves and the number of leaves attacked by mealybugs were counted and the proportion was calculated. The damage intensity was categorized by the following category: no attack (score 0), mild attack 1-25% (score 1), moderate attack 26-50% (score 2), severe attack 51-75% (score 3), very severe attack 76-100% (score 4).

The monitoring on the development of the mealybug *P. marginatus* on papaya plants were completed in the rainy and dry season. The early attack of mealybugs on plant height were documented based on 30 sample plants for each variety [8]. Afterwards, the follow up observations were organized every two weeks. The results of the observations were tabulated and compared to find the trends between the two varieties.

3. Results and discussion

The intensity of *P. marginatus* attack was different in each growing season and each plant variety. Overall, the intensity of the attack was higher in the dry season. The Thailand papaya suffered a worse attack intensity in both the rainy and dry seasons. Additionally, the severe to very severe attacks were only recorded on Thailand varieties in the dry season. In the dry season, the attack intensity occurred earlier in week 10 while for the rainy season the initial attack was found later in week 12 (figure 1).

Notes:

0 = no attack  
1 = mild attack (1-25%)  
2 = moderate attack (26-50%)  
3 = severe attack (51-75%)  
4 = very severe attack (76-100%)

Papaya, like other herbaceous, is a favourable plant for insects from the scale insects’ groups such as *P. marginatus*. The insects began to invade plants since as early as 10 weeks after sowing. Insects with piercing-sucking mouthparts prefer young herbaceous plants. At first, this pest invaded the leaf shoots then spreads throughout the other leaves until reaching the fruit. Severe and very severe intensity led to fruit defects with a deteriorating appearance and unpleasant taste for consumption. At very severe attack level, the pest can trigger plant death.
Figure 1. The Intensity of *Paracoccus marginatus* attack on papaya varieties Calina (Cal) and Thailand (Thai) in the rainy and dry seasons in the field.

The attack of mealybugs could be noticed with some initial symptoms that usually occurred for around 4-6 days. Firstly, the papaya plant shoots started to wrinkle. Afterwards, an increase in the aphid population made the symptoms quickly become a bunchy top in which the shoots were wrinkled and clumped together (figure 2). These symptoms lasted about 10-12 days. When the aphid reached a high population (approximately 200-1000 individuals per shoot), then the leaf senescence happened earlier. The shoots remained leafless until it rains. Re-sprouting of the plant shoots might be expected after precipitation, but the left stem marks would remain with short or wrinkled internodes due to aphid attack.

![Figure 2. The bunchy top symptom on papaya plant.](image)

The intensity of *P. marginatus* attack on the Thailand variety was higher than that of the Calina variety. The Calina variety grew taller than the Thailand variety while papaya plants largely grow taller in the rainy season than in the dry season. Before 14 weeks after sowing, the growth of the Thailand variety appeared to be more rapid, but afterwards the Calina variety grew faster and surpassed the Thailand variety (figure 3). Hence, the Calina variety produced more leaves than the Thailand variety. A higher number of leaves might soften the attack intensity if the number of leaves affected is the same in each variety.

Various factors are shaping the growth and development of an insect, both physical and chemical factors. Physical factors comprise the structure of the host plant, temperature, and humidity. Meanwhile, chemical factors involve nutrient content and secondary compounds present in plants [9]. Papaya plants are the main hosts for *P. marginatus*. Compared to eggplant and parthenium (a
shrub from the Asteraceae family), papaya provided the best quality of life for *P. marginatus* indicated with a higher fecundity than the other plants [10]. It is estimated that the nutritional content of papaya plants matched the nutritional needs of *P. marginatus*.

![Figure 3. Plant height (cm) of papaya varieties Calina (Cal) and Thailand (Thai) in the rainy and dry seasons in the field.](image)

The intensity of *P. marginatus* attack was significantly influenced by the season. The attacks increased rapidly from February, or after the plant is 3 weeks after sowing, and reached a rainfall peak in June. The relatively hot temperature and low rainfall during the dry period triggered the flea population to develop more rapidly, especially in Pseudococcidae [11,12]. On the other hand, high and intensive rainfall is one of the mechanical controls for *P. marginatus* in plants. Rainfall could wipe out attached eggs and small nymphs from their host plants so that only the stronger insects can survive [13].

Mechanical control such as rainfall can then be mimicked by watering with a spray hose or with a sprinkler hose during the dry season. The principle of this system is to put pressure on the water in the pipe and emit it into the air so that it resembles rain which then falls on the surface of the soil or plants. Besides being able to irrigate plants, watering can also mechanically slash the population of mealybugs. In general, irrigation is useful for assisting soil cultivation, regulating soil temperature and microclimate, washing the soil from soluble salts or high acids, cleaning dirt or garbage in waterways, and flooding the soil to eradicate pests and diseases [14].

**4. Conclusions**

*Paracoccus marginatus* attacked the introduced Thailand papaya varieties with higher amount of attack than that of Calina variety in the dry season. More intensive control should be carried out in the dry season on this introduced variety. Soil treatment can serve as a control technique for *P. marginatus*. It is necessary to develop a holistic pest control package integrating good agricultural practices, regulation, biological and chemical control approaches.

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