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Population and attack intensity of Leaf Sucking pests during plantation initiation of three white potato (*Solanum tuberosum* L.) varieties in medium latitude, East Lombok

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Abstract. Potato (*Solanum tuberosum* L.) is increasingly important crop in Indonesia. Current potato plantation in Indonesia is mainly undertaken in high land areas. However, limited availability of suitable areas limits the production, and therefore extension of production to a lower latitude is needed. Successful plantation in medium latitude may include selection of suitable variety and management of major potato pests. The aim of this investigation was to find out the species of Leaves Sucking pest of three white potatoes (*Solanum tuberosum* L.) and its population and attack intensity in medium latitude., East Lombok. The method used in this research is descriptive method with survey technique and data collection in the field. The results showed that five species of leaf sucking pests obtained during the plantation, i.e. Bemisia tabaci, Aphid spp., Thrips palmy, Planococcus sp., and Tetranychus spp. Bemisia tabaci, Aphid spp., Thrips palmy, and Planococcus sp were observed in all varieties while Tetranychus spp was obtained in Granola variety only. In addition, the highest population and attack intensity of sucking pest was found in McRusset variety at age 9 weeks after planting (wap), followed by Bliss and Granola variety. In all potato varieties, the dominance of leaf-sucking pests was Aphids spp. with abundance equal to 77.36%, 78.70%, and 83.81% for Blis, McRusset and Granola varieties, respectively.

1 Introduction

Potato (*Solanum tuberosum* L.) is increasingly important commodity in Indonesia. The popularity of potato as staple food increases following changes of consumption habits and lifestyle in younger generation. Consequently, potato consumption in Indonesia has increased from 1,476 kg per capita per annum in 2014 to 2,282 kg per capita per annum in 2018 [1]. The rate of increase in potato consumption was 13,9% or 9 folds higher than rate of increase in Indonesia population of 1.52 % per annum [1]. On the other hand, the annual potato production in Indonesia for the last 5 years was not increase, that were between 1.1 to 1.2 billion ton, and thus there is a need to increase potato production in Indonesia, including the potato variety used by the industry [2].

Potato is sub-tropical plant and in Indonesia is cultivated in high-mountainous land area, the area with suitable climate for optimal potato production [3]. At the meantime, the major centers for potato production in Indonesia are West Java, Central Java, East Java, South Sulawesi, North Sumatra, South



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Sumatra and West Nusa Tenggara [2]. However, the availability of suitable, high-land areas in Indonesia is limited, and therefore extension of potato plantation to lower latitudes is needed in attempts to increase potato production in Indonesia. Several researches has shown that potato plantation in lower latitudes is possible [4,5], although the yield is lower than in highlands [5]. Therefore, development of suitable production technology for potato plantation in lower latitudes is required.

Growth and yield of plant are influenced by the plant genotype, environment and their interaction [6,7], and thus selection of suitable variety of white potato is crucial for successful introduction of potato plant to lower latitudes. There are two main potato varieties cultivated in Indonesia at the meantime: Granola and Atlantic varieties. The Granola variety is a major cultivated potato variety in Indonesia (91.4% total area of potato farmer). This variety is used as cooking potato as it has fairly firm cooking type, higher resistant to late blight and drought [8]. The Atlantic variety is considered as industrial potato, used mainly for production of potato chips as it has good crisp characteristics with white tuber. However, the Atlantic variety more susceptible to late blight [8]. Therefore, development of potato cultivation in lower latitudes may involve introduction of cooked and industrial potato varieties, including the variety for french-fries and potato chips such as Blis and McRusset varieties.

An important factor which may prevent development of potato plantation in lower latitudes is the condition of higher temperature than the highland, which can inhibit the formation of potato tubers and provide favorable condition for faster growth and breeding of pest and disease, thus may cause crop loss. Thus evaluation of the growth and yield of several potato varieties as well as pest and disease infestation among the varieties are important in order to establish suitable condition for initiation of potato plantation in the new areas.

Leaf-sucking pests such as aphids (*Aphids* sp.), Triphs (*Triphs palmi*), Red mites (*Tetranychus* sp.) and whitefly (*Bemisia tabaci*) are major pests during potato plantation. The attack by leaf-sucking pests can cause damage to the plants [9]. In addition, the leaf-sucking pests can act as vectors for potato viruses diseases [10-12]. The attack by leaf-sucking pests and potato virus disease can significantly reduce potato yield. Many reports suggested that temperature and humidity affected the diversity, growth and population of pest species [13-15]. In Lombok Island, different dominant species of leaf sucking insects were observed in different latitudes. In Sembalun area of West Lombok, at latitudes of ca. 1200 m above sea level (asl), the dominant sucking pest in potato plantation of Granola variety was trips [12] while in the Santong area of North Lombok, at ca. 500 m asl, the dominant species of potato leaf sucking pest was *Myzus persicae* [16]. Therefore, the diversity and population of leaf-sucking pests, as well as its attack intensity may be influenced by potato varieties and latitudes of cultivation. This information is required in order to develop suitable cultivation technology, including pest management, for extension of potato plantation to lower land latitudes, especially in medium latitude areas.

2. Materials and method

The experiment was conducted in Timba Nuh Village, of Pringgasela District, East Lombok (latitude of ca. 750 m asl), from June to September 2016. The plantation was established from disease and virus-free nuclear G₀ tubers of white potatoes. The method used in this research is descriptive method with survey technique and data collection in the field

To collect and evaluate the population of leaf sucking insects, yellow sticky traps was placed at 2 wap, 5 traps in each plot. The traps were made from bottles of mineral water (capacity of 1.5 L). Each bottle was painted yellow and covered with transparent plastic bags coated with mouse glue, and equipped with a bamboo holder of 40 cm long. Evaluation of insect were done by observation of insect types and population in the traps weekly (from week 3 to week 10) and after that the plastic cover was replaced with the new cover.

Attack Intensity were calculated by using a formula as follows:

$$I = \frac{\sum(n.v)}{Z.V} \times 100 \% \quad (1)$$

Table 1. Scale of pest attack intensity value.

Scale		Value
0	If there is No leaf Attack	0 %
1	If there is Leaf attack	1% - 25%
2	If there is Leaf attack	26% - 50%
3	If there is Leaf attack	51% - 75%
4	If there is Leaf attack more than	75%

The growth of potato plants was examined every two weeks by measuring the number of leaves, the number of primary branches, and plant height. The plants were harvested at 90 days after planting, and then yield were examined (number of tuber, weight of tuber per plant, and yield per plot).

3. Results and discussion

There were 5 species of leaf sucking pests obtained during plantation initiation of three potato varieties (Bliss, McRusset and Granola L), identified as *Bemisia tabaci*; *Aphid* spp., *Thrips palmy*, *Planococcus* sp., and *Tetranychus* spp. *Bemisia tabaci* and *Aphids* spp. were obtained from early plantation. The population of *Bemisia tabaci* and *Aphids* spp increased during the plantation, with highest population of *Bemisia tabaci* was at 8 wap while population of *Aphids* spp continued to increase to 9 wap (Figure 1).

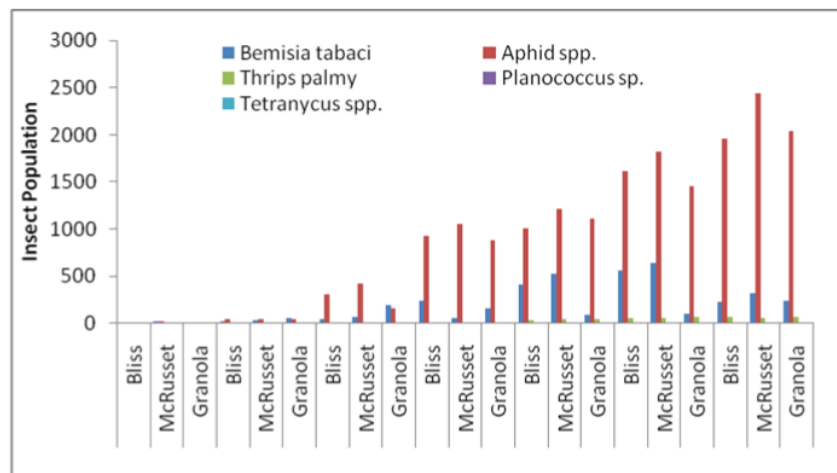
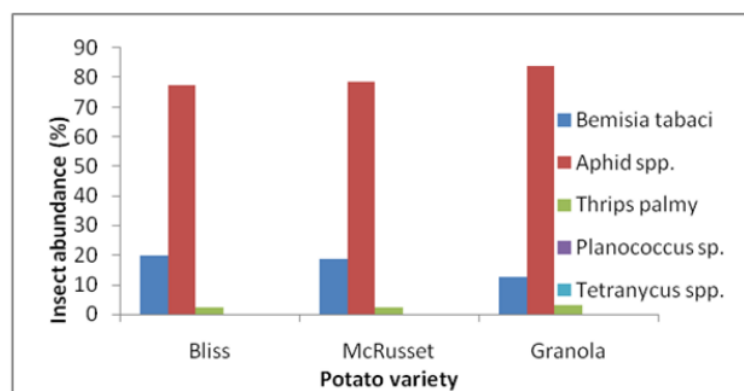


Figure 1. Population of five species of leaf sucking pests in three varieties of potato plants during plantation in Timba Nuh Village, East Lombok.

As can be seen from the figure 1 above, that *Aphid* spp. was the dominant species followed by *Bemisia tabaci*, *Thrips palmy*, *Planococcus* sp., and *Tetranychus* spp. Total population of *Aphid* spp. in the insect traps during the plantation was 18.491, with the abundance of 77.36%, 78.70%, and 83.81% for Bliss, McRusset and Granola varieties, respectively (Table 2 and Figure 2). The lowest population was *Tetranychus* spp. of 5 which only be found in Granola variety. This could because of the host range of *Aphis* spp is wider than other species of leaf sucking pests that lead to this species had higher survival level. On the other hand, the species of spider mite *Tetranychus* spp had the lowest population and attack intensity during observation due to the main hos to this species is not potato crop, and this pest more likely prefer to find other hosts including several weeds around the potato plantation area [10].

Table 2. Population of five species of leaf-sucking pests trapped in three potato varieties.

Species of leaf-sucking insect	Population of each species of leaf sucking pest in the traps during cultivation of three potato varieties			Total population
	Bliss	McRusset	Granola	
Bemisiatabaci	1509	1666	854	4029
Aphid spp.	5838	6974	5679	18491
Thripspalmy	186	197	217	600
Planococcus sp.	14	25	21	60
Tetranychusspp.	0	0	5	5

**Figure 2.** The abundance of each leaf-sucking pest's species in three potato varieties during plantation in lower latitude of Timba Nuh Village.

This is presumably because when the crop at age 6-8 week after planting, the availability of food for the pests in abundance so that will be followed by the increasing of pest populations. In addition, appropriate environmental conditions will affect the growth and development of the pests. Temperature is one important factor and influential for the life of insects that affect the activity and the development of insects [17]. The average temperature during the observation were between 20-29°C and the humidity ranges from 53-92%. The conditions of temperature and humidity during observation are suitable for the growth and development of the pests. The appropriate temperature range for the growth of pest populations is from 15 to 33°C [16]. The growth of insect pest populations will decrease in temperature of 14°C and 41°C.

However, when the crops at age 9-10 weeks after planting, the insect populations tend not to be constant, due to the role of natural enemies of the pests. In addition to the high amount of food, insect populations are also controlled by several other components including abiotic and biotic factors. Biotic factors used in decreasing the population of insect is predators that can affect the growth and development of the insect [16] said, the number of pest populations are influenced by several factors such as biological factors that are biological agents and physical factor such as food, temperature and humidity. The availability of food in abundant circumstances will support the growth of insect populations. The decrease of insect population is also due to the catalytic and mortality [16]. During the observation there are 3 species of biological agents that are predators of the leaf-sucking insect such as *Coccinella transversalis* F., *Menochilussex maculates* and *Paederus fuscipes*.

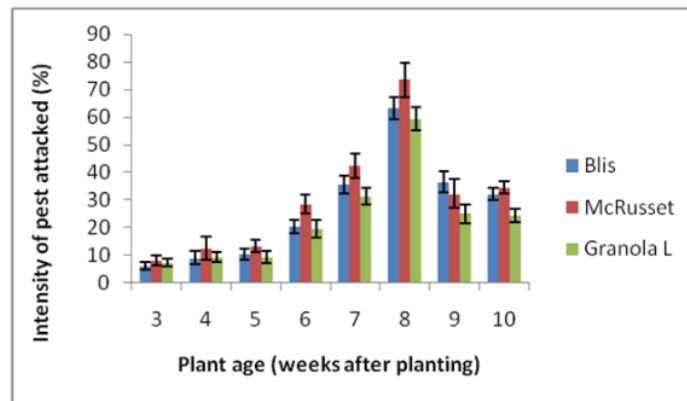


Figure 3. Intensity of attack by leaf-sucking pests during the plantation of three potato varieties in lower latitude of Timba Nuh Village, East Lombok.

As with the insect population, the intensity of attack by leaf-sucking pests in all potato varieties increased from the first observed attacked at the age of 3 wap to 8 wap, and decreased after that. From the early observation, the highest intensity of attack was observed in McRusset variety, followed by Bliss and Granola variety. The highest attack intensity in all variety was at 8 wap, that were 83.2 %, 73.4% and 59.4% for Bliss, McRusset and Granola varieties, respectively.

The infestation by leaf sucking insects influenced the yield of the three potato varieties, at which Bliss produced the highest yield of 1621.6 g/m² and McRusset had the lowest yield of 1051.9 g/m².

Table 3. The height and number of leaves of the three potato varieties in lower latitude of Timba Nuh Village, East Lombok.

Yield Component	Bliss	McRusset	Granola L
Number of tuber/plant	8.1± 2.23	5.3± 3.2	7.1± 2.2
Weigh of tuber per plant (g)	263.2 ± 29.7	194.6± 21.3	242.8± 23.9
Yield/m2 (g)	1621.6±152.4	1051.9±94.3	1304.5 ± 121.4

All of the data above suggested that leaf-sucking pests were observed in all of the three varieties cultivated, with highest population and attack intensity in McRusset variety and the lowest in Granola L variety. In this research. The dominant species of leaf-sucking insects in the three potato varieties was *Aphids* spp, followed by *Myzus persicae* and *Thrip palmy*. The results suggest that different dominant species of leaf-sucking pests observed in this research (at Timba Nuh Village of 750 m asl) than these in Sembalun area of West Lombok (at latitudes of ca. 1200 m asl) and in the Santong area of North Lombok (at ca. 500 m asl) which were *Trips* [12] and *Myzus persicae* [16], respectively.

4. Conclusion

It can be concluded that the highest population and attack intensity of sucking pest was found in McRusset variety at age 9 weeks after planting (wap), followed by Bliss and Granola variety. In all potato varieties, the dominance of leaf-sucking pests was *Aphids* spp. with abundance equal to 77.36%, 78.70%, and 83.81% for Bliss, McRusset and Granola varieties, respectively.

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