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(Sustainable Management of Renewable Resources in Tropics)
Bandar Lampung, November 23rd - 24th 2017

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CONTENTS

ATTACK INTENSITY AND ITS POPULATION OF MAJOR PESTS IN CASSAVA (*Manihot esculenta* Crantz) BY APPLICATION OF "ZINCMICRO" FERTILIZER

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ABSTRACT

The major pests that attack the cassava plant are mealybug and mite. Mealybug (*Phenacoccus*) can reduce production by 30-80%, while mite (*Tetranychus*) can reduce production by more than 50% in cassava plantation. This study aims to (1) investigate the intensity of mealybug infestation and mite on cassava with application of "Zincmicro" fertilizer; (2) investigate the population of mealybug and mite on cassava with application of "Zincmicro" fertilizer. This research was conducted in Sulusuban, Seputih Agung, Lampung Tengah, starting from august 2016 until march 2017. This research use direct observation method by scoring the level of pest attack on cassava plantation. The experiment showed that: 1) Application of 20 kg ha^{-1} "Zincmicro" was significantly lower than without application "Zincmicro". Increasing the dosage of "Zincmicro" until 40 kg ha^{-1} did not differ significantly; 2) Although there was no significant different between with and without application "Zincmicro", application "Zincmicro" tended to be lower in mite attack intensity than without application "Zincmicro"; 3) The population of mealybug was more abundant in the upper leaves; meanwhile, the mite population was more abundant in the lower leaves. Application of "Zincmicro" tended to deacrease the population of mealybug and mite compared to without application "Zincmicro".

Keywords: cassava, mealybug, mites, "zincmicro" fertilizer

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is a useful plant. Cassava crop is widely cultivated because it can adapt in areas where water is limited. Lampung is the largest cassava production center in Indonesia. Production of cassava in Lampung Province in 2015 was reportedly reached 7,387,084 tons (Badan Pusat Statistik, 2016). Currently cassava has been developed as an agro-industry commodity, such as tapioca flour products, fermentation industry, and various food industries. Increasing demand for cassava as raw material of industry, should be fulfilled by increasing production (Wardani, 2015).

Fertilization is used to supply nutrients lost due to harvesting. Fertilizer needs must be in accordance with the amount of nutrients lost during harvest. The nutrient needs equal to the amount of nutrients lost when harvested while farmers only fertilize macro nutrients while the micro nutrients are relatively never used. The fulfillment of nutrient needs can support the health of cassava plant so that it can produce optimal and resistant to pest and disease attack. Pest and disease can decrease prodution until crop failure. Mealybug is one of the major pests of cassava. In 2009 to 2010 Thailand experienced crop failure due to mealybug attack. In Lampung, attack of mealybug could potentially cause crop failure (Rojanaridpiched, 2017). This study aims to investigate the intensity and the population of mealybug and mite on cassava with application of "Zincmicro" fertilizer.

MATERIALS AND METHODS

The research was conducted in Sulusuban, Seputih Agung, Lampung Tengah. Observations on population of mite and mealybug were done at Plant Pest Laboratory, Faculty of Agriculture, University of Lampung. This research was conducted for 8 months starting from August 2016 until March 2017. The materials used were cassava (clone UJ-3), "Zincmicro" fertilizer with Zn, Mn, B, Cu, Co, Mo, macro nutrients in the form of urea , SP-36, KCl, herbicides, 1 kg-plastic bags, 70% alcohol, aquades, glycerine, elastic bands and labels. While the tool used is hoe, sprayer, brush, vial bottle, binocular stereo microscope, binocular compound microscope, camera, and stationery. This research used direct observation method that is by scoring the level of pest attack on cassava cultivation. Population observation and identification were performed in the laboratory. The experiment was conducted by giving “Zincmicro” fertilizer to 12 experimental units consisting of “Zincmicro” fertilizer 0 kg ha^{-1}, 20 kg ha^{-1} and 40 kg ha^{-1} with 4 replications. The experimental unit is a plot of 23 m x 30 m.

69 m

120 m

P1U1	P2U1	P3U1
P1U2	P2U2	P3U2
P1U3	P2U3	P3U3
P1U4	P2U4	P3U4

Figure 1. Experimental Layout

Information :
P1 = Treatment 1 (“Zincmicro” fertilizer 0 kg ha^{-1})
P2 = Treatment 2 (“Zincmicro” fertilizer 20 kg ha^{-1})
P3 = Treatment 3 (“Zincmicro” fertilizer 40 kg ha^{-1})
U1 = Repeat 1
U2 = Repeat 2
U3 = Repeat 3
U4 = Repeat 4

Cassava variety grown was UJ-3 clones. The soil was done by plowing twice with the time interval between the first plow and the second was 14 days. Cassava was planted with a spacing of 80 cm x 60 cm and length of cuttings of 25 cm. Fertilization was applied on 4 Week After Planting (WAP) with macro fertilizer in the form of urea 100 kg ha^{-1}, SP-36 100 kg ha^{-1}, and KCl 100 kg ha^{-1}, and “Zincmicro” fertilizer 0 kg ha^{-1}, 20 kg ha^{-1}, and 40 kg ha^{-1}. The second fertilization was conducted on 12 WAP with macro fertilizer in the form of urea 100 kg ha^{-1}, and KCl 100 kg ha^{-1}. Fertilization was done by means in addition to plants with a depth of 10 cm. Herbicide spraying was performed with systemic herbicides at 12 WAP and 24 WAP. Harvesting was done at 28 WAP. Observations were made when cassava aged 18 WAP to 26 WAP. The observation time interval was 14 days. Sampling was done by determining 10 rows of plants as subsample according to the diagonal direction on each plot. Each subsample consists of 10 samples. Determination of subsample was done randomly systematically. The first row determination was done randomly, the next row would be adjusted to the spacing and area of the experimental plot.

Observation of mite and mealybug population was conducted on one sample plant selected from subsampel line, after which the top, middle, and bottom leaves were taken with each 3 leaves. Three top, middle, and lower cassava leaves were put into plastic bags and tied with rubber bands and labeled. Leaf samples were taken to the laboratory and counted the number of individual mites and mealybug using a setereo microscope at magnification 2.5 times - 4 times.

Observation of the intensity of the attack was done visually based on the symptoms of mite and mealybug attack. Observation of the intensity of mite and mealybug attack was performed on each sample that was in the subsample. On observation of the intensity of plant damage caused by the mites was given a score of 0-5 as in Table 1. While in mealybug was scored 0-2 as in Table 2. The damage intensity was calculated by using the formula:

$$I = \Sigma ni \times vi/(N \times V) \times 100\%$$

I = Intensity of attack
ni =Number of leaves in each score category
vi = Score category (0 to 5)
N = Number of leaves in one plant
V = Value of the highest score (in this case 5)

Table 1. Scoring intensity of crop damage due to mite attack based on Indiati (2012).

Score	The magnitude of damage (%)	Information
0	0	Healthy leaves (no spotting)
1	$0 < x \leq 10$	There are early yellowish spots (about 10%) on some lower leaves and or middle leaves.
2	$10 < x \leq 20$	Yellowish spots rather (11-20%) in the lower and middle leaves.
3	$20 < x \leq 50$	Clear damage, many yellow spots (21-50%), few areas that do not experience necrotic (<20%), especially the lower and middle leaves rather shrink, a number of leaves turn yellow and fall off.
4	$50 < x \leq 75$	Severe damage (51-75%) in the lower and middle leaves, population of mites abundant and found white threads like cobwebs.
5	$x > 75$	Total leaf loss, shoots of smaller plants, more white threads, and death of plants.

RESULTS AND DISCUSSION

Intensity of Mealybug Attack (*Phenacoccus*). The intensity of severe mealybug attack is seen in cassava plants that were dwarfed and the leaves were curly and there was a collection of mealybugs that cover the lower surface of leaves and stems in the upper leaves of the cassava plant. The highest intensity of mealybug attack was found in plots without application of "Zincmicro" fertilizer. The intensity of attack on the plot with the application of "Zincmicro" fertilizer 20 kg ha^{-1} and 40 kg ha^{-1} was lower than the intensity of the attack on the plot without "Zincmicro" fertilizer. The intensity of the attack on plots given "Zincmicro" fertilizer 20 kg ha^{-1} and 40 kg ha^{-1} was not different (Figure 2).

The intensity of attack on plant age of 18 WAP to 26 WAP did not appear to be different. In plots without application of "Zincmicro" fertilizer (P1), the intensity of the mealybug attack was 68.5% to 77.6%. In plots with application of "Zincmicro" fertilizer 20 kg ha^{-1} (P2), the intensity of mealybug attack was 31.9% to 43.1%. In plots with application of "Zincmicro" fertilizer 40 kg ha^{-1} (P3), the intensity of mealybug attack was 26.9% to 38.9%. The addition of "Zincmicro" fertilizer can affect the intensity of the attack of mealybug so that it is suspected to affect the cassava plant resistance.

Table 2. Scoring intensity of crop damage caused by pest infestation of mealybug

Score	Information	Picture
0	Healthy plants, There are no symptoms of white flea pest attack on the upper leaves.	
1	Symptoms of mild attacks. There are some parts of the leaves on the plant slightly curling.	
2	Symptoms of severe attacks. At the top of the plant to be dwarfed or "bunchy top", the upper leaves will curl and stem distortion	

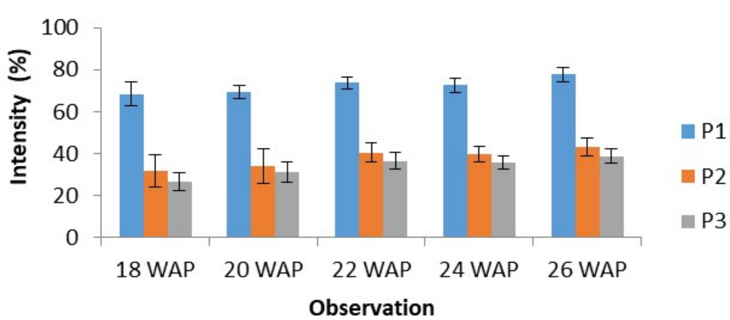

Figure 2. Bar chart of the intensity of a mealybug attack

According to Catalayud *et al*. (1994) in Wardani (2015), cassava resistance is caused by differences in content of secondary compounds in cassava plants. Cyanide acid compounds are secondary compounds contained in cassava plant floem. Floem is a tissue where mealybug sucks fluid to be consumed as a nutrient. The higher of cyanide acid content in cassava, the more susceptible the variety is to the attack of mealybug (Wardani, 2015).

Population of Mealybug (*Phenacoccus*) in Lower Leaf Zone. Populations of mealybug are mostly found in the upper leaf zone. However, in severe attacks, mealybug populations could be found in the lower leaf zone. The mealybug population in the plots with aplication of “Zincmicro” 20 kg ha^{-1} and 40 kg ha^{-1} was lower than the mealybug population in plots without “Zincmicro” fertilizer. The mealybug population in plots with application of “Zincmicro” without “Zincmicro” fertilizers did not differ (Figure 3).

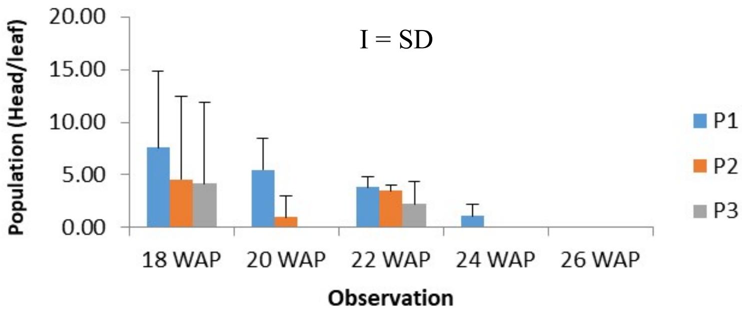

Figure 3. Diagram of the mealybug population stem in the lower leaf zone

The mealybug population at plant age of 18 WAP to 26 WAP did not appear to be differ. In plots without the application of “Zincmicro” fertilizer (P1), the population of mealybug 0 to 8 head per-leaf bottom. In the plot with application of “Zincmicro” fertilizer 20 kg ha^{-1} (P2), the population mealybug 0 to 5 head per leaf bottom. In the plot with the application of “Zincmicro” fertilizer 40 kg ha^{-1} (P3), the population mealybug 0 to 4 head per leaf bottom. Rainfall is a determinant factor in the dynamics of the mealybug population. Rain can cause mealybug to drift mechanically. Changes in mealybug population can also occur due to stress on plants caused by drought or lack of water. Drought will increase secondary compounds in cassava plants. This compound serves as phagostimulan for mealybug, so it can increase the population in plants (Nurhayati, 2012).

Population of Mealybug (*Phenacoccus*) in Middle Leaves Zone. The mealybug population was found in the central leaf zone more than the mealybug population in the lower leaf zone. This showed that the mealybug population strikes at the top of the leaf towards the lower leaf. The population in the plots with application of “Zincmicro” fertilizer 20 kg ha^{-1} and 40 kg ha^{-1} was lower than the mealybug population in plots without “Zincmicro” fertilizer. The mealybug population in plots with application of “Zincmicro” fertilizer without “Zincmicro” fertilizers did not differ (Figure 4). The mealybug population at plant age of 18 WAP to 26 WAP did not appear to be differ. In plots without application of “Zincmicro” fertilizer (P1), the population mealybug 1 to 12 head of per-leaf. In plots with application of “Zincmicro” fertilizer 20 kg ha^{-1} (P2), the population mealybug 0 to 4 head per-leaf. In plots with application of “Zincmicro” fertilizer 40 kg ha^{-1} (P3), the population mealybug 0 to 9 head per-leaf.

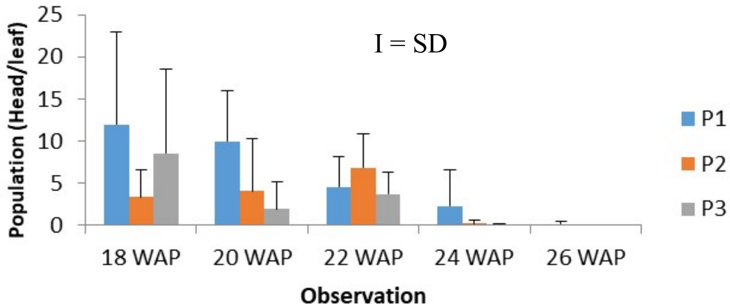

Figure 4. Diagram of the mealybug population stem in the central leaf zone

Population of Mealybug (*Phenacoccus*) in Upper Leaves Zone. When compared with the population in the middle and lower leaf zones, mealybug populations were found in the upper leaf zone. The population in the plots with application of “Zincmicro” fertilizer 20 kg ha^{-1} and 40 kg ha^{-1} was lower than the mealybug population in plots without “Zincmicro” fertilizer. The mealybug population in plots with application of “Zincmicro” fertilizer without “Zincmicro” fertilizers did not differ (Figure 5). The mealybug population at plant age of 18 WAP to 26 WAP did not appear to be differ. In plots without the application of “Zincmicro” fertilizer (P1), the population mealybug 1 to 20 heads per leaf top. In a plot with a “Zincmicro” fertilizer application of 20 kg ha^{-1} (P2), the mealybug population was 4 to 12 heads per leaf. In the plot with the application of “Zincmicro” fertilizer 40 kg ha^{-1} (P3), the population mealybug 1 to 10 heads per leaf top.

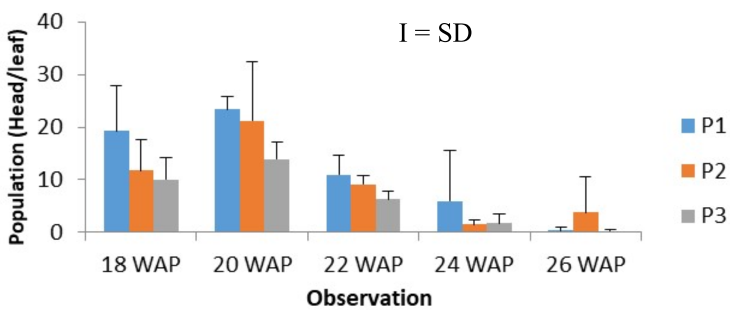

Figure 5. Diagram of the mealybug population stem in the upper leaf zone

Intensity of Mite Attack (*Tetranychus*). The intensity of severe mite attack was seen in the leaves of the yellow crop plants and red rust around the leaf bone. In severe attacks could cause the leaves to fall. High intensity of mite attack was found in plots without application of “Zincmicro” fertilizer. The intensity of attack on the plot with application of “Zincmicro” fertilizer of 20 kg ha^{-1} and 40 kg ha^{-1} was lower than the intensity of attack on the plot without “Zincmicro” fertilizer. The intensity of attack on plots with “Zincmicro” fertilizer and without “Zincmicro” fertilizer did not differ (Figure 6).

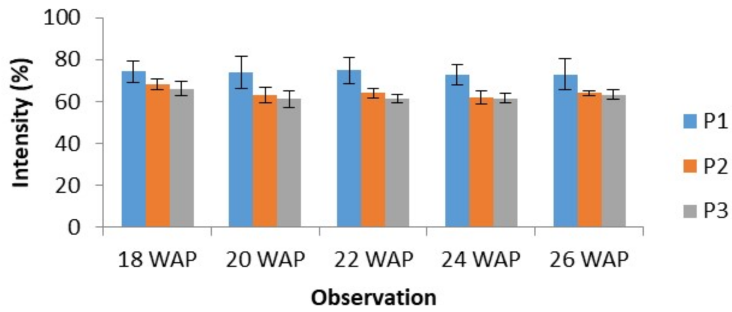

Figure 6. Bar chart of mite intensity intensity

The intensity of attack on plant age of 18 WAP to 26 WAP did not look differently. In plots without application of "Zincmicro" fertilizer (P1), the intensity of the mite attack was 72.87% to 74.25%. In plot with application of "Zincmicro" fertilizer 20 kg ha^{-1} (P2), the intensity of mite attack was 61,98% to 66,2%. In plots with application of "Zincmicro" fertilizer 40 kg ha^{-1} (P3), the intensity of mite attack was 61.16% to 66.2%. "Zincmicro" fertilizer did not affect the intensity of mite attack. Dry climate is a factor that supports the proliferation of mites. Mites can fall mechanically due to rain (Rismunandar, 1981).

Population of Mites (*Tetranychus*) in Lower Leaf Zone. Mites were found in the lower leaf zone. In severe attacks, mite populations can be found up to the upper leaf zone. The population of mites on plot with application of "Zincmicro" fertilizer 20 kg ha^{-1} and 40 kg ha^{-1} was lower than the mite population in the plot without "Zincmicro" fertilizer. The population of mites on plots with application of "Zincmicro" fertilizer without "Zincmicro" fertilizers did not differ (Figure 7). The population of mites at plant age of 18 WAP up to 26 WAP did not look differently. In plots without the application of "Zincmicro" fertilizer (P1), the population of mites 7 to 74 heads per leaf. In the plot with application of "Zincmicro" fertilizer 20 kg ha^{-1} (P2), population of mites was 7 to 64 heads per leaf bottom. In a plot with application of "Zincmicro" fertilizer 40 kg ha^{-1} (P3), the mite population was 10 to 61 heads per leaf. Weather can affect mite populations. Mites populations decline at the start of the wet season and remain at a low level in winter. Maximum and minimum temperatures have a positive correlation with mite attacks (Sadeghi et al., 2016).

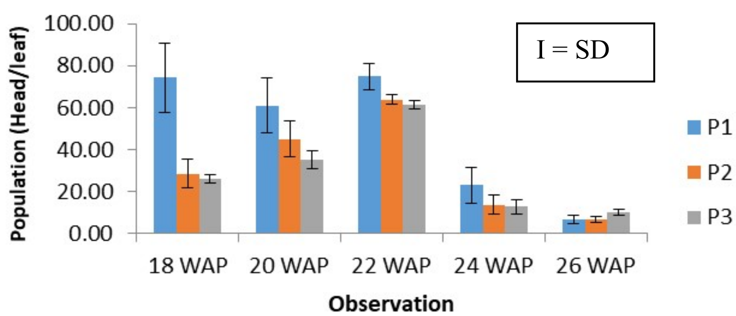

Figure 7. Diagram of the mites population stem in the lower leaf zone

Population of Mites (*Tetranychus*) in Middle Zone Leaves. The population of mites found in the middle leaf zone indicated that the mite populations were mostly found in the lower leaf zone, so the development of the mites populations spreaded to the upper leaf zone through the central leaf zone. The population of mites on plot with application of "Zincmicro" fertilizer 20 kg ha^{-1} and 40 kg ha^{-1} was lower than the mite population in the plot without "Zincmicro" fertilizer. The population of mites in plots given "Zincmicro" fertilizer without "Zincmicro" fertilizer did not differ (Figure 8). The population of mites at plant age of 18 WAP up to 26 WAP did not look different. In plots without application of "Zincmicro" fertilizer (P1), the population of mites was 11 to 36 heads per middle leaf. In a plot with application of "Zincmicro" fertilizer 20 kg ha^{-1} (P2), the population of mites 4 to 27 heads per-leaf the middle. In the plot with the application of "Zincmicro" fertilizer 40 kg ha^{-1} (P3), the population of mites 4 to 18 heads per-leaf the middle. Fertilization will affect the durability of the impulse.

This resistance characteristic rised and was driven by the existence of certain environmental conditions so that the plant was able to survive against pest attacks. Resistance of this impulse occured, among others, due to the fertilization and irrigation and other cultivation techniques. The life and development of insects was strongly influenced by the state of nutrition availability in plants, whereas the nutrient conditions of plants were affected by fertilization and irrigation. The availability and proportion of nutrients greatly affected pest life. For example Aphis louse is very sensitive to N content in plants and has a negative response to the content of K (Untung, 1993).

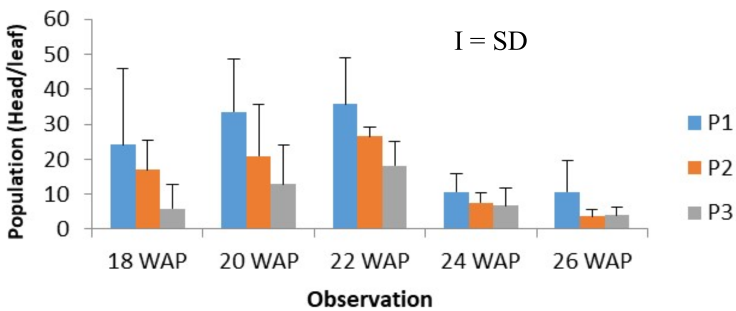

Figure 8. Diagram of the mites population stem in the central leaf zone

Population of Mites (*Tetranychus*) in Upper Leaf Zone. The population of mites found in the upper leaf zone indicates that the mite populations were mostly found in the lower leaf zone so that the mites extended their attacks towards the upper leaf zone. The population of mites in the upper leaf zone was less than the population of the lower leaf zone. This was because the mites first attacked the lower leaves. The population of mites on plot with application of "Zincmicro" fertilizer 20 kg ha^{-1} and 40 kg ha^{-1} was lower than the mite population in the plot without "Zincmicro" fertilizer. The population of mites in plots given "Zincmicro" fertilizer and without "Zincmicro" fertilizer did not differ (Figure 9).

The population of mites at plant age of 18 WAP up to 26 WAP did not look different. In plots without the application of "Zincmicro" fertilizer (P1), the population of mites 0 to 19 heads per-leaf top. In the plot with application of "Zincmicro" fertilizer 20 kg ha^{-1} (P2), population of mites 0 to 8 heads per leaf top. In plots with application of "Zincmicro" fertilizer 40 kg ha^{-1} (P3), the population of mites was 0 to 5 heads per leaf.

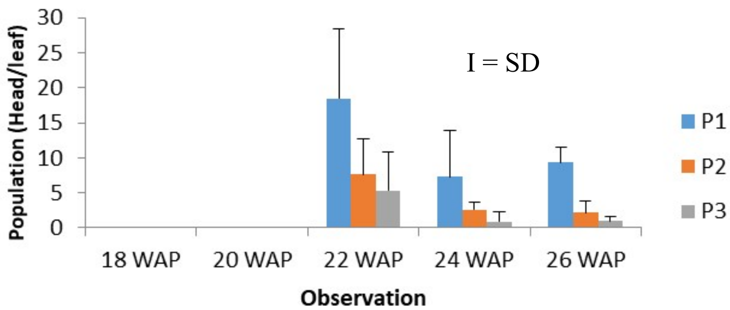

Figure 9. Diagram of the mite population stem in the upper leaf zone

CONCLUSION

Based on this research it can be concluded that application of 20 kg ha^{-1} "Zincmicro" was significantly lower than without application "Zincmicro". Increasing the dosage of "Zincmicro" until 40 kg ha^{-1} did not differ significantly; although there was no significant different between with and without application "Zincmicro", application of "Zincmicro" tended to reduce mite attack intensity than without application "Zincmicro"; and the population of mealybug was more abundant in the upper leaves; meanwhile, the mite population was more abundant in the lower leaves. Application of "Zincmicro" tended to decrease the population of mealybug and mite compared to without application of "Zincmicro".

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