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Effect of Biopesticide Gamak Leaf Extract on Jabon Caterpillar Pest Mortality (*Arthroschista hilaralis*) in White Jabon Plants *(Anthocephalus cadamba* Miq*)*

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Abstract

White Jabon (*Anthochepalus cadamba* Miq). is one of the tree species that has high prospects for industrial plantations and reforestation (greening) in Indonesia because it has very fast growth, very good adaptability. Disorders of plant disturbance organisms most commonly found in Jabon, Jabon caterpillar (*Arthroschista hilaralis*) become a major problem that can reduce the quality and quantity of wood. Pest control with chemicals does not provide maximum results so it is necessary to test with biopesticides. The study to examine the effect of gamal leaf extract as a natural insecticide was carried out using a completely randomized design with four treatments, namely the concentration of gamal leaf extract 0% (P0), 50% (P1), 75% (P2), 100% (P3). The results showed that gamal leaf extract as a vegetable insecticide had a positive effect on the mortality of A. *hilaralis* larvae in Jabon plants. The higher the concentration of gamal leaf extract, the higher the mortality rate in A. hilaralis larvae. This can be seen in the most effective concentration is the concentration of 100% with a mortality rate of 95%. The highest total mortality of A. *hilaralis* larvae occurred at a concentration of 100% ie 2.1 head / day. The higher the concentration of gamal leaf extract, the higher the speed of death of the larvae

Keywords: *Arthroschista hilaralis,* Gamal Leaf Extract, biopesticide , white Jabon

A. Introduction

The need for wood has become one of the important issues that has become a serious conversation in the past few years. Wood is needed for various industrial needs and building materials on the one hand, but on the other hand forest sustainability is no less important to reduce the impact of global warming as the times progress. Timber demand in Indonesia is estimated at 58 million m^3 and most still rely on logging from natural forests and not from cultivation or plantations (Warisno & Dahana, K., 2011).

Jabon putih (*Anthochepalus cadamba* Miq). is one of the tree species that has a high prospect for industrial plantations and reforestation (greening) in Indonesia, due to its very fast growth, its ability to adapt to various growing conditions, its relatively easy silvicultural treatment, and relatively free from pests and diseases serious. This type is also expected to become increasingly important for the timber industry in the future, especially when woodworking raw materials from natural forests are expected to decrease (Agri, F., 2011).

White Jabon (*Anthocephalus cadamba*) is a fast-growing industrial tree species from the Rubiaceae family and has many uses. Jabon has a shorter cycle, so it is profitable in terms of high production in a short time. Jabon is also classified as a light-demanding type and is fast growing at a young age. Jabon trees can grow to 45 m tall with 30 m branch-free height, and can reach a diameter of 160 cm. Jabon tree has a straight and cylindrical stem. Jabon planting is easy to do, easy to get seeds in large quantities and there are no obstacles in the procurement of seeds on a large scale (Martawijaya, A., Kertajusana, I., Mandang, Y.I, Prawira, S.A & Kadir, K., 1989). Other advantages of Jabon plants compared to other hard plants include fast growing with a growth of 10 cm / year stem diameter, harvesting of Jabon wood is relatively short 5-6 years (Halawane, J.E., Hanif N.H., & Khino, J., 2011).

However, in the maintenance of Jabon trees, especially white Jabon there are several obstacles such as the presence of pest attacks. Pest disorders (*Plant Pest Organisms*) can reduce the quality and quantity of wood in the Jabon forest stand. According to Salmawati 2018, one of the most common pests in the Jabon Putih plant is Jabon caterpillar (Arthroschista hilaralis). At present, in terms of pest control in cultivated plants, it still relies on chemicals as the main ingredient in controlling pests, but does not provide maximum results (Pribadi, A., 2010).

Biopesticides are a new breakthrough that can be used as an alternative to pest control that is safe, effective and easily obtained. Biopesticides are ingredients of pesticides whose basic ingredients are obtained from plants or plants. The advantages of plant-based insecticides, among others, are rapidly degraded so that they do not leave a residue for a long time, how they work quickly, the toxicity of mammals is low, and the toxicity to plants is also low (less phytotoxic) (Wyriadiputra, S., 2006).

One plant that can be used as a plant insecticide is gamal leaves (*Gliricidia sepium*), because the leaves and skin of the gamal stem have long been known as rodenticides in the American central and gamal extracts are also antifungal (Elevitch & Francis, 2006). The results of the Nismah study. E.L. Widiastuti and Sumiyani, E. (2009) showed that ethanol extract and fresh gamal leaf water can cause 100% death in demental booster pest (*Quadrastichus erythrinae*) after 72 hours of treatment on a laboratory scale. Gamal leaves contain many toxic compounds such as dikumarol, cyanide acid (HCN), flavonoids, tannins and nitrates (NO3). The results of the study by Nukmal, N., Utami, N., & Suprapto (2010) also prove that the polar (water and ethanol) extract of gamal leaves can cause 100% death in the dementia booster pest (*Quadrastichus erythrinae*) after 72 hours of treatment on a laboratory scale. Gamal leaf extract from macerated results with the lowest concentration of 2.19% can kill 50% of pepper-sucking pests (*Dasynus Piperis*) after the bioassay test treatment on a laboratory scale.

B. Methodology

This research used a completely randomized design (CRD) with four treatments and four replications, so that there were 16 treatment combinations. Each treatment was given 10 instar IV A. hilaralis larvae, so that the larvae used amounted to 160 tails. The four treatments tested are as follows:

P0 = Concentration of gamal leaf extract 0%
P1 = 50% gamal leaf extract concentration
P2 = Concentration of gamal leaf extract 75%
P3 = 100% gamal leaf extract concentration

1. Preparation and Maintenance of A. hilaralis

Test insects were obtained by collecting A. *hilaralis* larvae from the planted white Jabon which was attacked. The collected larvae are then put into a plastic jar that has been covered with organdy cloth. The larvae are nourished by being fed fresh white Jabon leaves and replaced every day. The life cycle of the larvae will become pupa, then become imago. The male and female moths are then transferred into a special maintenance jar of imago and fed with a 10% honey solution which is applied to cotton and hung in an imago cage.

After a few days, female moths lay their eggs on the jabon leaves that are on the maintenance jar. The eggs are then collected and then maintained until they enter the phase of the instar V larvae which will be used in the study.

2. Making Gamal Leaf Extract (Gliricida sepium)

Gamal leaves used in making this extract are selected from fresh leaves. Gamal leaves are cleaned and dried for 2-3 days, then blended until they form fine powder. The powder is then soaked in water for 24 hours. The solution is then filtered using gauze to get a stock solution. The stock solution was then diluted to obtain a pure gamal leaf extract concentration (100%). Gamal leaf extract is then diluted with water to obtain the desired concentration of 0%, 50%, 75% and 100%. Making the solution concentration of each treatment is using the formula:

$$V_1.C_1 = V_2.C_2$$

3. Application of Vegetable Insecticide Gamal Leaf Extract (Gliricidia sepium)

The tool used is a plastic container that has been given an organdy cloth cover. The containers were then filled with fresh white jabon leaves and each of them was given IV instar A. hilaralis larvae of 10 tails, so that the total larvae used in this study were 160 tails.

The application of biopesticides from gamal leaf extract was carried out in the afternoon by spraying white jabon leaves and A. hilaralis larvae using a hand sprayer with concentrations of each treatment 0%, 50%, 75% and 100%. After that, the plastic container was tightly closed and left for further observation of mortality of A. hilaralis larvae.

Data that has been collected is tabulated in table form, making it easier for the data analysis process. The data is then analyzed using Analysis of Variance or ANAVA and if there are significant differences, it will be further tested by Tukey's honestly significance difference (HSD).

C. Result and Discussion

1. Effect of Gamal Leaf Extract on Mortality of A. hilaralis Larvae

The results of observations on the administration of gamal leaf extract (*Gliricidia sepium*) on mortality of Jabon caterpillar (*Arthroschista hilaralis*) with different concentrations for 4 days showed different effects on each treatment. The highest mortality was found in the treatment of 100% extract concentration with an average mortality of 95%, and the lowest was at the smallest concentration ie control with an average mortality of 5% (Table 1, Figure 1).

Table 1. Average Mortality of Jabon Caterpillar (*Arthroschista hilaralis*) After Treatment of Vegetable Insecticide Gamal Leaf Extract

No.	Concentration Treatment (%)	Mortality Average (%)	Notation
1	0 %	5 %	a
2	50 %	45 %	b
3	75 %	72,5 %	c
4	100 %	95 %	d
	LSD 5 % = 12,38		

Description: Numbers followed by the same letters are not significantly different from the level of the LSD test 0.05

The average mortality of A. hilaralis larvae with the treatment of gamal leaf extract concentration showed a significant difference. The concentration of 0% is significantly different with concentrations of 50%, 75% and 100%. This shows that the higher concentration of gamal leaf extract will cause more flavonoid content, so the higher the killing power of A. hilaralis larvae, according to Mulyana (2002), the higher the concentration, the more active substances entering or being exposed to insects. Flavonoid compounds are one of the secondary metabolites in gamal leaves which are toxic. These compounds are known to act as insecticides and provide various effects on organisms.

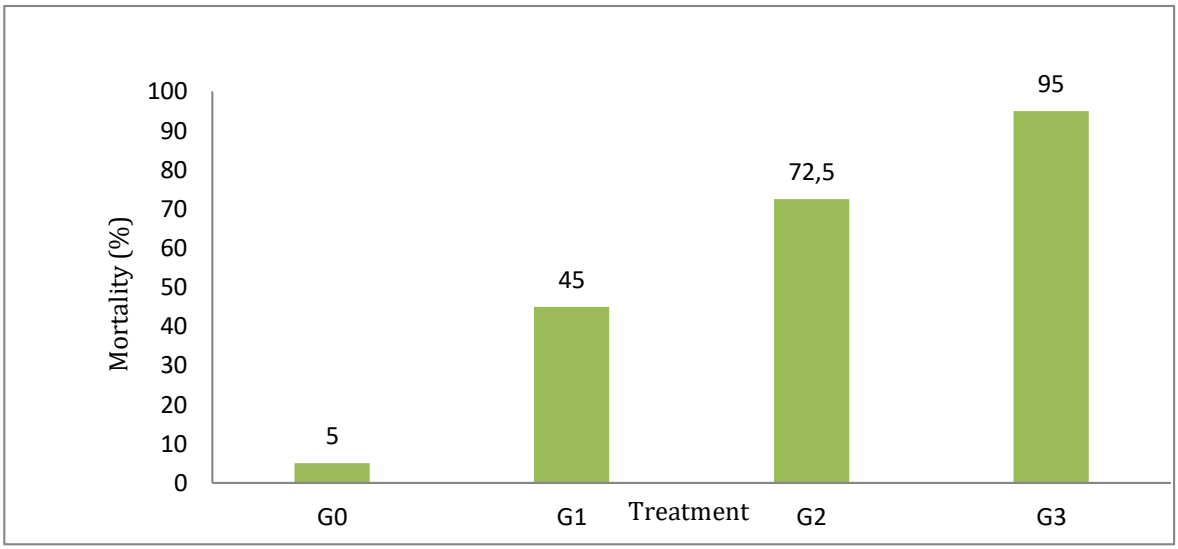

Figure 1. Average Mortality of Jabon (A. *hilaralis*) Caterpillar After Treatment of Vegetable Insecticide Gamal Leaf Extract.

Flavonoid compounds have a way of working that is by entering into the body of the caterpillar through the respiratory system which will then reduce nerve function and damage to the respiratory system and cause the caterpillar to be unable to breathe and eventually die. Flavonoids can also inhibit the ability to eat insects (antifeedant). When these compounds enter the insect's body, the digestive tract will be disrupted and inhibit the taste receptors in the insect's mouth area. This results in insects failing to get a sense stimulus so they are unable to recognize the food and eventually die of starvation.

Control treatment showed 5% hilaral mortality and 50% concentration of gamal leaf extract caused 45% mortality, 75% concentration caused 72.5% mortality and 100% concentration caused 95% mortality of hilaral A. This shows that the higher the concentration of gamal leaf extract, the higher the mortality of A. hilaralis.

A. *hilaralis* which died due to the treatment of biopesticides of gamal leaf extract has poisoned the stomach because it sucks up liquid that has been sprayed onto the leaves of Jabon as a test medium which is food from the caterpillar. This is in accordance with Sinaga, R (2009) which states that flavonoid compounds are stomach poisoning which works when the compound enters the insect's body and disrupts its digestive organs.

2. Speed Percentage of Death of A. hilaralis Larvae

The speed of death indicates the number of dead caterpillars in a certain time unit. Data collection is carried out 1 day after application up to 4 days. The highest mortality rate of A. hilaralis larvae was found in the treatment with 100% gamal leaf extract concentration of 2.1 head / day while the lowest was found in the control, 0.2 tail / day (Table 2, Figure 2).

Table 2. Average Speed of Death of *A. hilaralis* Larvae after Treatment of Gamal Leaf Extract

No	Concentration Treatment (%)	Speed of Death /day	Notation
1	0 %	0,2	a
2	50 %	1,35	b
3	75 %	2,075	c
4	100 %	2,1	c

Description: Numbers followed by the same letters are not significantly different from the level of the LSD test 0.05

The treatment of plant insecticidal concentrations of gamal leaf extract gave a significant effect on the speed of death of A. hilaralis caterpillar. The treatment with a concentration of 0% was significantly different with concentrations of 50%, 75%, and 100%. The 100% concentration treatment showed the highest mortality rate of 2.1 birds / day, but it was not significantly different from the concentration of 75% which showed a mortality rate of 2, 075 head / day. While at a concentration of 50% it only shows a death speed of 1.35 head / day. This shows that the higher the concentration of gamal leaf extract, the higher the speed of death of A. hilaralis as Prijono (2007) said that the more concentrated concentrations of biopesticides

given, the greater the effect on the speed of death of target organisms due to the accumulation of toxins caused by the insecticide. This is presumably because the higher the concentration, the higher the content of flavonoids that are toxic to insects.

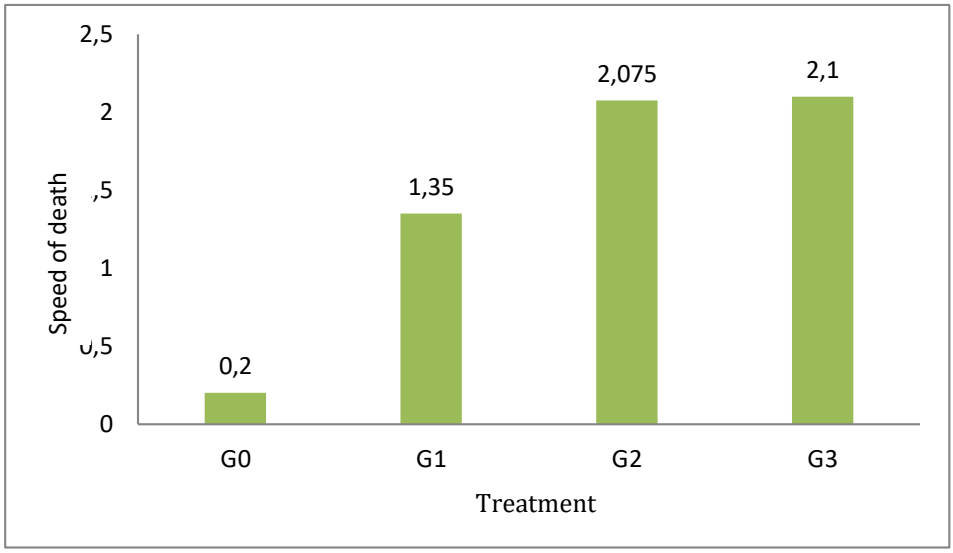

Figure 2. Average Speed of Death of A. hilaralis Larvae after Treatment of Gamal Leaf Extract.

The speed of death in the control, slower than all treatments, was 0.2 tail / day. This is due to the control treatment that there is no insecticide that can poison the insects, so that the mortality should not occur. However, in this study, the results of observations on the last day showed a mortality in the control even though only 2 larvae were caused by a failure to adapt to the local environment, not because of the active insecticide.

D. Conclusion

Gamal leaf extract as a plant insecticide has a positive effect on the mortality of *A. hilaralis* larvae in Jabon plants. The higher the concentration of gamal leaf extract, the higher the mortality rate in *A. hilaralis* larvae. This can be seen in the most effective concentration is the concentration of 100% with a mortality rate of 95%. The highest total mortality of *A. hilaralis* larvae occurred at a concentration of 100% ie 2.1 head / day. The higher the concentration of gamal leaf extract, the higher the speed of death of the larvae.

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The Effect of NPK-Zeo Fertilizer on Growth and Production of Cucumber (*Cucumis sativus* L.) in Iwoimopuro Village, Kolaka District

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Abstract

The Effect of NPK-Zeo Fertilizer on Growth and Production of Cucumber (Cucumis sativus L.) in Iwoimopuro Village, Kolaka District. This research aimed to determine the effect of liquid fertilizer NPK-ZEO growth and result of cucumbers. This research has taken place in the village Iwoimopuro, District Wolo, Kolaka District. This research is compiled using a Randomized Block Design (RBD). Obser rations were made on plant height, leaf number, age of the plant begins to flower, age of the plant begins to bear fruit, fruit number and fruit weight. The data were processed using the Finger Print Car List (Anova) followed by Least Significant Difference Test (LSD). The results showed that administration of NPK-ZEO significant effect on plant height, leaf number, age of the plant begins to flower, age of the plant begins to bear fruit, fruit number and fruit weight

Keywords: NPK-ZEO, (*Cucumis sativus* L.)

A. Introduction

Cucumber plants (*Cucumis sativus* L.) is one of the most consumed fruit vegetables in Indonesia, the freshness of cucumbers makes these vegetables have a lot of marinade. This is comparable to the market demand that is always high in vegetables, therefore many people are starting to be interested in cultivating these vegetables (Nawangsih, 2001).

NPK fertilizer is a type of compound fertilizer which contains three main nutrients at once. This fertilizer is a macro element that is absolutely needed by plants. As the name implies, these elements consist of elements N (nitrogen), P (phosphorus) and K (potassium). The NPK element is the main macro nutrient that is important to help plants carry out a series of plant processes (Rosmarkam & Yuwono, 2002).

Based on the Agricultural, Fisheries and Forestry Counseling Center in Wolo District (2010), land in Iwoimopuro Village, Wolo District is flat land and classified into alluvial and humus soils. Alluvial soils are also called sedimentary soils. River mud that settles in the lowlands will form sedimentary soils. Generally, this soil has a good fertility rate, so it can be used for farming. Whereas humus soil is soil formed from decay of plants. This soil type is dark and loose in nature so it is very suitable for agriculture (Munir, 1999).

The NPK element is very necessary for cucumber plants both to support growth and yield. NPK fertilizer is a compound fertilizer that has been mixed in such a way by the factory that it can be directly used. NPK is three nutrients that absolutely must exist and are needed in large quantities, so that the fertilizer produced has been prioritized containing nitrogen, phosphorus and potassium (N, P, K) (Lingga & Marsono, 2007).

NPK-ZEO compound liquid fertilizer is a compound liquid fertilizer that is enhanced by its elements which are easily absorbed by all parts of the plant from leaves, stems, fruits, to the roots and are very safe for soil structure. Based on the analysis of the Jogjakarta Institute of Agricultural Technology, NPK-ZEO compound liquid fertilizer contained elements of pH H2O 4.05%, N 5.2%, P2O5 2.37%, K2O 14.02%, Zn 1.21%, Boron 1.16%, Cu 0.52%, Mn 1.09%, Mo 0.16%, Co 0.15%, As 0.62%, Cd 0.01%, Pb 1.12%, and Hg 6.56%.

B. Methodology

This research was compiled based on Randomized Block Design (RBD) with the use of liquid NPK compound fertilizer as the single factor to be studied. The use of NPK compound fertilizer will consist of 4 levels, namely: NPK0 (control or not given NPK), NPK1 (concentration of 20 cc / l water), NPK2 (concentration of 40 cc / l water) and NPK3 (concentration of 60 cc / l water). Each treatment was repeated 3 times so that there were 12 experimental units in total.

Implementation of Research

Planting Preparation

1. Hatchery

The seeds are sown on plastic containing soil. Each polybag is filled with cucumber seeds as deep as 0.5-1.0 cm. After planting, it is covered with soil.

2. Land Preparation

The experimental land is cleaned of weeds by eroding and hoeing the soil. After weeds are cleaned, hoeed the experiment area as deep as ± 20 cm. Then the soil is left for 1 week then the soil is smoothed and flattened.

3. Formation of beds

The formation of beds is adjusted to the height of water on the land. The maximum length of beds is 3 m, height of beds is 40-60 cm, width of beds is 250 cm, distance of beds is 25 cm, and distance between rows of beds is 50 cm.

4. Planting and Maintenance

Seeds that are 10-14 days old, fresh green leaves can be transferred to the planting area.

Maintenance

Embedding is carried out as soon as the plants show signs of stunted (dead) growth or loss of seedlings due to being eaten by pests by replacing them with embroidered plants, embedding is done 1 week after planting. Weeding is done manually or by using hoes in accordance with the conditions of weeds that grow. Giving water (irrigation) is carried out routinely twice a day (morning and evening), especially in the initial phase of growth and the weather conditions are dry. Installation is done as early as possible (± 5 days after planting) so as not to disturb or damage the roots of cucumber plants. Cucumber plants that are ± 21 days old usually grow thickly leafy, need to be trimmed several leaves to stimulate the formation of flowers and fruit while accelerating fertilization. Pest and disease control will be carried out physically mechanically (picking up pests and turning them off and uprooting the disease-affected plants), unless forced to use pesticides as intended for use.

NPK-ZEO compound liquid fertilizer is given to plants when the cucumber plants are 2 weeks after planting and carried out until the plants emit flowers. Spraying is done by spraying all parts of the cucumber plant in accordance with the recommended concentration.

Harvesting

Cucumber fruit can be harvested when the plants are 2-3 months after planting.

1. *Observation*

Some growth variables and results that will be observed in this study are:

a) Plant height (m), measured at flowering.
b) Number of leaves (strands) at the time of flowering.
c) Plant life begins to flower (HST).
d) Plant age begins to bear fruit (HST).
e) The average number of fruit / stem of cucumber (fruit).
f) Average fruit weight of cucumbers (kg).

In each of the above observations, three sample plants were randomly drawn in each population (plot) to be measured / calculated according to the purpose of observation, *then averaged.*

2. *Data Processing Techniques*

Data will be processed tabulation on each observation variable, according to the number of treatment combinations in the number of replications used. Tabulations include the results of observations on each variable, the list of variance (ANOVA) and the average value of treatment along with the LSD comparison value (NP).

Data from the observation of each observation variable were analyzed based on variance and F test. If F count> F table means that the treatment tried significantly ($\alpha = {}_{0.05}$) or very significant effect ($\alpha = 0.01$) so that it can followed by LSD test (${}_{0.05}$) to see the difference between each treatment level tested.

C. Result and Discussion

Observations on plant height were measured at flowering, number of leaves at flowering, age of plants began to flower, age of plants began to bear fruit, average number of fruit / stem of cucumber, and average fruit weight of cucumbers showed significant effects in various observations as follows :

1. Result

Plant Height Measured When Flowering

Table 1. The Smallest Significant Difference Test (LSD $_{0.05}$) The Average Height of the Cucumber Plant at Flowering (cm)

Treatment	Average Plant Height (cm)	comparative value of $SD_{0,05}$
NPKO	128,52[a]	5.42
NPK1	131,80[a]	
NPK2	139,14[b]	
NPK3	141,26[b]	

Description: The average number followed by the same letter, is not significantly different from the LSD Test $_{0.05}$

The LSD0.05 test results in table 1 show that the NPK3 treatment (60 cc / liter of water) provides the highest plant height (141.26 cm), and NPK3 treatment is not significantly different from the NPK2 treatment (40 cc / liter of water) will but it was significantly different from the treatment of NPK1 (20 cc / liter of water) and NPK0 (without treatment). In contrast, NPK0 treatment produced the lowest plant height (128.52 cm) and NPK0 treatment was not significantly different from NPK1 treatment, but it was significantly different from NPK2 and NPK3 treatments.

Number of Leaves When Flowering

Table 2. The Smallest Significant Difference Test (LSD $_{0.05}$) Average Number of Leaves of Cucumber Plants at Flowering (Strands)

Treatment	Average Number of Leaves (strands)	comparative value of $LSD_{0,05}$
NPKO	22,33[a]	2,30
NPK1	25,00[b]	
NPK2	24,67[b]	
NPK3	27,22[b]	

Description: The average number followed by the same letter, is not significantly different from the LSD Test $_{0.05}$

The $LSD_{0.05}$ test results in table 2 show that the NPK3 treatment (60 cc / liter of water) shows the highest number of leaves (27.22 strands), and NPK3 treatment was not significantly different from NPK2 treatment (40 cc / liter of water) and treatment NPK1 (20 cc / liter of water) but significantly different from NPK0 treatment (without treatment). In contrast, NPK0 treatment produced the least number of leaves (22.33 strands) and NPK0 treatment was significantly different from the treatment of NPK1, NPK2 and NPK3.

Plant age begins to flower

Table 3. The Smallest Significant Difference Test (LSD $_{0.05}$) Age Average Cucumber Plants Start Flowering

Treatment	Average Age of Plants Starts Flowering	comparative value of $LSD_{0,05}$
NPKO	29,33[a]	0,76
NPK1	28,22[b]	
NPK2	26,56[c]	
NPK3	25,78[d]	

Description: The average number followed by the same letter, is not significantly different from the LSD $_{0.05}$ test

The LSD $_{0.05}$ test results in table 3 show that the treatment of NPK3 (60 cc / liter of water) produces the fastest growing age of the plant (25.78 days), and the NPK3 treatment is significantly different from the NPK2 treatment (40 cc / liter of water) , treatment of NPK1 (20 cc / liter of water) and NPK0 treatment (without treatment). In contrast, the NPK0 treatment yielded the lowest age for plants to start flowering (29.33 HST) and NPK0 treatment was significantly different from the treatment of NPK1, NPK2 and NPK3.

Plant age begins to bear fruit

Table 4. The Smallest Significant Difference Test (LSD $_{0.05}$) Age Average of Cucumber Plants Start to Be Fruitful

Treatment	Average Age of Plants Starts Fruiting	comparative value of $LSD_{0,05}$
NPKO	44,22[a]	0,87
NPK1	42,89[b]	
NPK2	42,00[c]	
NPK3	40,67[d]	

Description: The average number followed by the same letter, is not significantly different from the LSD $_{0.05}$ test

The results of the LSD $_{0.05}$ test in table 4 show that the treatment of NPK3 (60 cc / liter of water) resulted in the fastest age of fruiting plants (40.67 days), and NPK3 treatment was significantly different from the NPK2 treatment (40 cc / liter of water), treatment of NPK1 (20 cc / liter of water) and NPK0 treatment (without treatment). In contrast, the NPK0 treatment resulted in the lowest plant age (44.22 HST) and NPK0 treatment significantly different from the NPK1, NPK2 and NPK3 treatments.

Average Fruit / Cucumber Stem

Table 5. The Smallest Significant Difference Test (LSD $_{0.05}$) Average Fruit Number / Cucumber Stem (fruit)

Treatment	Average Number of Fruits / Stems of Cucumber (fruit)	comparative value of $LSD_{0,05}$
NPKO	14,00[a]	3,14
NPK1	14,22[a]	
NPK2	16,56[b]	
NPK3	19,00[b]	

Description: The average number followed by the same letter, is not significantly different from the LSD $_{0.05}$ test

The LSD 0.05 test results in table 5, show that the treatment of NPK3 (60 cc / liter of water) gives the highest number of cucumber fruit / stem (19,00 pieces), and this treatment is not significantly different from NPK2 treatment (40 cc / liters of water), but significantly different from the treatment of NPK1 (20 cc / liter of water) and NPK0 (without treatment). On the contrary, NPK0 treatment produced the lowest number of fruits (14.00 pieces) and NPK0 treatment was not significantly different from NPK1 treatment, but it was significantly different from NPK2 and NPK3 treatments.

Average Fruit Weight of Cucumbers

The LSD $_{0.05}$ test results in table 6, showed that the treatment of NPK3 (60 cc / liter of water) gave the heaviest average fruit weight of cucumbers (0.773 kg) and NPK3 treatment was significantly different from the NPK2 treatment (40 cc / liter of water),

treatment NPK1 (20 cc / liter of water) and NPK0 (without treatment). Conversely, NPK0 treatment produced the lowest fruit weight (0.610 kg), and NPK0 treatment was not significantly different from NPK1 treatment, but it was significantly different from NPK2, and NPK3 treatment.

Table 6. The Smallest Significant Difference Test (LSD0.05) Average Fruit Weight of the Cucumber

Treatment	Average Cucumber Fruit Weight	comparative value of $LSD_{0,05}$
NPKO	0,610[a]	0,07
NPK1	0,618[a]	
NPK2	0,676[b]	
NPK3	0,773[c]	

Description: The average number followed by the same letter, is not significantly different from the LSD Test 0.05

2. Discussion

The N element contained in NPK-ZEO compound liquid fertilizer is thought to be able to increase vegetative growth of plants such as root systems, stems, leaves, especially chlorophyll components in leaves. This is in accordance with the opinion of Buckman and Brady (1999), which states that elements in plants can increase vegetative parts, give green color to leaves, increase the percentage of protein content in fruit formation, and function as a regulator in the use of phosphorus, potassium and elements other elements.

The P element found in NPK-ZEO compound liquid fertilizer is thought to be able to increase the process of protein formation, fruit size and weight, and play a role in the process of photosynthesis and also as an energy source. Ispandi (2005), that element P is an element as a form of ATP which is an energy source for all metabolic processes in cells including the formation and process of transportation that takes place in plant tissues further Gardner, F., Pearce, R.B. & Mitchell, R.L. (2000), explain that crop yields are determined by the processes that control production include supply of nutrients, minerals and photosynthesis. Increased metabolic activity means that it can increase the process of forming proteins that are formed, then transferred to seeds as food reserves, so that the greater the food reserves formed in the fruit, the greater the number and size of fruit produced by plants.

The K element found in NPK-ZEO compound liquid fertilizer is thought to be able to improve metabolic functions, root systems, protein formation, activate enzymes, facilitate absorption of essential nutrients, and increase resistance to disease attack and stimulate the filling of seeds. Hardjowigeno (2002), asserts that the K element in plants functions to activate enzymes, improve the development of root systems, enhance resistance to pest and affect the absorption of other essential elements.

D. Conclusion

Based on the results of the study, it can be concluded as follows:

1. The administration of NPK-ZEO with concentration (60 cc / liter of water) NPK3 gives the best results on each observation variable, namely plant height, leaf number, flowering age, fruiting age, number of fruit / stem and fruit weight.
2. NPK0 treatment (without treatment) gives the lowest results on each observation variable

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Growth of Pepper Cuttings (*Piper ningrum* l.) at various type of Plant growth regulator

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Abstract

Pepper is an important crop in Indonesia because it is one of the country's foreign exchange sources because it is one of the export commodities. The availability of good plant materials will support increased production. Provision of growth regulators in vegetative propagation is very influential on the propagation of pepper plants. The purpose of this study was to determine the most effective combination of growth regulators for pepper cutting. This study was conducted using a randomized block design consisting of eight treatments namely Control (P1), metallic 2 mL L-1 water (P2), mastafol 2 mL (p3), Atonik 2 mL (P4), metallic 1 mL + Mastafol 1 mL (P5), metallic 1 mL + atonic 1 mL (P6), mastafol 1 mL + atonic 1 mL (P7), metallic 0.66 mL + Mastafol 0.66 mL + Atonic 0.66 mL (P8). Setek is grown on soil media: fuel husk: manure (2: 1: 1). The results showed that the best Plant growth regulator combination treatment for the growth of pepper cuttings was P7 (mastafol 1 mL L-1 water + atonic 1 mL L-1 water), which can be seen in the parameters of the number of roots, root length, root volume and number of shoots. The treatment of Plant growth regulator given did not significantly affect the character of leaf growth.

Keywords: atonic, pepper, mastophole, metallic, cuttings, Plant growth regulator

A. Introduction

Pepper is an important crop in Indonesia because it is a source of foreign exchange. Pepper is an export commodity that ranks sixth after rubber, oil palm, coffee, cocoa and coconut. However, pepper productivity in Indonesia is still low because the total exports are only 53,291 tons compared to Vietnam with a total export of 56,506 tons. Pepper plants are now widely cultivated in Indonesia (Aceh, Bangka, Lampung and West Kalimantan). This pepper plant produces two types of pepper namely white pepper and black pepper, the difference between white pepper and many black pepper lies in the method of post-harvest handling only. White pepper is obtained from pepper fruit whose skin is removed, while black pepper is obtained from pepper fruit whose skin is not removed (Setyono, R.T, 2004).

Pepper plants are developed both generatively and vegetatively. Generative breeding using seeds takes a long time so it is rarely done. Conversely vegetative propagation using cuttings is more done because the time needed is shorter with material that is easily obtained. The problem faced in developing pepper is that productivity is still low. One of the ways to increase pepper production is to procure seedlings by means of vegetative propagation or cuttings whose activities include selecting branch cuttings, cutting branch cuttings, giving treatment, preparing cuttings media, planting cuttings and using appropriate planting media and supported by the use of Plant Growth Regulator (atonic , metallic, and mastafol). Nurseries are needed as a way to provide large amounts of plant material. As it is known that pepper plants can be planted directly vegetatively with the condition that the planting material is in the form of stems with a size of 7-9. This requirement is an obstacle in increasing crop production because plant material is limited, it is different if plants are propagated vegetatively with seedlings in the form of stems with only 2-3 segments. This becomes an opportunity for the availability of plant materials appropriately so as to support increased production (Setyono, R.T., 2004).

Plant Growth Regulator is a means of supporting agriculture which has begun to be known for its use. Plant Growth Regulator has several objectives, which are stimulating the growth of roots, stems, leaves, flowers and fruit, increasing production, preventing flower loss and preventing stalk decay and improving plant health (Setyati, S., 2009).

Atonik serves to increase the production and quality of agricultural crops. The effect on plant growth and development is to accelerate protoplasmic flow, root growth, stimulate flowering and prevent the fall of flowers and fruit (Lestari, L., 2011).

Metallic is useful to prevent a decrease in crop production due to lack of micro elements. The metallic function is to nourish plants that have complete nutrient elements (Agustina, 2013). Mastafol can stimulate plant metabolism, increase and accelerate root development, and activate microorganisms in the soil. These factors can improve the retrieval of minerals in the soil, so that plants grow rapidly (Harjadi, S.S., 2009). Plant Growth Regulator can stimulate root growth. Research results from Ardaka, I.M., Tirta, I.G., & Darma, D.P. (2011), showed that the treatment of atonic Plant Growth Regulator, IAA, rootone f, had a significant effect on the growth of pepper cuttings. Based on the description above, this study was conducted to determine the effect of atonic, metallic, and mastafol administration on the growth of pepper cuttings.

B. Methodology

This research was carried out using Randomized Block Design (RBD). This study consisted of 8 treatments 3 replications and each replication had 4 units so that overall it consisted of 96 units. The concentration of Plant Growth Regulator used refers to the results of Rineksane's research, I.A. (2005) with the best concentration of Plant Growth Regulator (atonic) is 2 mL L-2.

The treatment in this study consisted of:

P1: Control (without plant growth regulator),
P2: Metallic 2 mL L-1 water,
P3: Mastafol 2 mL L-1 water,
P4: Atonik 2 mL L-1 water,
P5: Metallic 1mL L-1 water + Mastafol 1 mL L-1 water,
P6: Metallic 1 mL L-1 water + Atonik 1 mL L-1 water,
P7: Mastafol 1mL L-1 water + Atonik 1mL L-1 water,
P8: Metallic 0.66 mL L-1 water + Mastafol 0.66 mL L-1 water + Atonik 0.66 mL L-1 water.

The land used is cleaned of weeds or plant debris, and prepares locations for research by measuring the land area as needed for three replications so that it can accommodate 96

polybags. Prepare a medium for growing soil mixed with fuel husk and manure with a ratio of 2: 1: 1. The media is mixed until smooth and filled in polybags 14 x 20 cm in size. Polybags are arranged and marked in each treatment.

The cuttings used are taken from plants that are healthy and grow well, have sticky roots in the book, dark green leaves and are more than 10 months old but are not in a flowering or fruiting condition. Taking stem cuttings is taken from the primary stem or climbing tendrils (Orthotrop branches) instead of fruit branches. Cutting material is taken from pepper plants in the afternoon and is done by cutting cuttings using a sharp cutter to prevent damage. The segment taken is the segment to 4-9 from the tip of the climbing tendrils. Climbing tendrils that have been taken are cut into 3 cuttings because the cuttings to be made into seedlings are cut into 3 sections. Dissolve the growth regulator in the water according to the treatment. Stir the mixture first before splashing it into the polybag which has been filled with soil media and the rest is stored as a stock solution. After filling the planting media into polybags, cuttings of pepper plants are planted in polybags that have been filled with rice husks, manure and soil. Before planting for planting holes first by Portugal then cuttings of pepper plants are planted into polybags.

C. Result and Discussion

Vegetative propagation with cuttings, Plant Growth Regulator is intended to stimulate and stimulate the formation of roots in cuttings, so that the roots will be better and more numerous. One of the Plant Growth Regulators that can stimulate root growth is through administration of auxin. Among the various types of auxin, atonic Plant Growth Regulator is one type of auxin that is widely circulating in the market so that it is better known by the public. Atonic Plant Growth Regulator generally functions to encourage, inhibit or regulate physiological processes in plants (Kusumo, S., 2004). The use of appropriate Plant Growth Regulator will have a good effect on plant growth, but if too much will actually harm the plant because it will poison the plant. Conversely, if in small amounts it will have less influence on the growth of these plants (Ardana, R.C., 2009).

The results showed that the treatment of various growth regulating substances affected the character of the number of roots, root length, root volume, number of shoots and length of shoots and did not differ in the character of the number of leaves. The average increase in number of roots and the best root length was shown by P7 (mastafol + atonic), which were 29.00 (Table 1) and 3.98, respectively (Table 2).

Table 1. Average number of pepper plant roots in various types of Plant Growth Regulator

Plant Growth Regulator types	Average	Duncan
P1 (control)	7.00 ^{d}	5.72
P2 (metalik)	10.33 ^{cd}	6.00
P3 (mastafol)	13.58 ^{bc}	6.17
P4 (atonik)	18.08 ^{b}	6.28
P5 (metalik+mastafol)	16.83 ^{b}	6.36
P6 (metalik+atonik)	8.75 ^{cd}	6.39
P7 (mastafol+atonik)	29.00 ^{a}	
P8 (metalik+mastafol+atonik)	9.75^{cd}	

The numbers in the same column, followed by the same letters (a, b, c, d) are not significantly different from α 5% Duncan test.

Matafol contains enough food reserves in the form of carbohydrates and nitrogen so that it can increase the amount of root growth, then the given plant growth regulator can stimulate the emergence of roots, so that root growth is getting better. The type of plant growth regulator containing auxin like atonic has a large influence on the growth of root cuttings of pepper plants and gives the best influence on root growth compared to without the use of plant growth regulator. According to rineksane (2005) plant growth regulator acts to promote root growth, because plant growth regulator is a hormone that plays a role in stimulating root growth. The results of the study by ardaka et al. (2011) showed that the treatment of plant growth regulator types (atonic, mastafol, iaa and rootone f) significantly affected the number of roots and root length of pepper plants.

Tabel 2. The average length of the root of the pepper plant for various types of Plant Growth Regulator

Plant Growth Regulator types	Average	Duncan
P1 (control)	2.23 d	0.54
P2 (metalik)	2.51 cd	0.57
P3 (mastafol)	3.68 a	0.58
P4 (atonik)	2.30 d	0.60
P5 (metalik+mastafol)	2.71 bcd	0.60
P6 (metalik+atonik)	2.99 bc	0.61
P7 (mastafol+atonik)	3.98 a	
P8 (metalik+mastafol+atonik)	3.13b	

The numbers in the same column, followed by the same letters (a, b, c, d) are not significantly different from α 5% Duncan test.

The best volume average was treatment P7 (mastafol + atonic) and the lowest was treatment P1 (control) (Table 3). Mastafol Plant Growth Regulator can improve mineral extraction in the soil so that plants grow rapidly and atonics can also accelerate root growth when pressing so as to accelerate root growth. According to Heddy, S., Nugroho, W.H., & Kurniati, M., (2006) Plant Growth Regulator plays a role to encourage root growth.

Table 3. Average volume of roots of pepper plants in various types of Plant Growth Regulator

Plant Growth Regulator types	Average	Duncan
P1 (control)	0,69 c	0.54
P2 (metalik)	0.83 c	0.56
P3 (mastafol)	1.20 ac	0.58
P4 (atonik)	1.47 ab	0.59
P5 (metalik+mastafol)	0.92 c	0.60
P6 (metalik+atonik)	0.83 c	0.60
P7 (mastafol+atonik)	1.57 a	
P8 (metalik+mastafol+atonik)	0.98 ac	

The numbers in the same column, followed by the same letters (a, b, c, d) are not significantly different from α 5% Duncan test.

Table 4. Average number of shoots of pepper plants in various types of Plant Growth Regulator

Plant Growth Regulator types	Average	Duncan
P1 (control)	1.08 c	0.36
P2 (metalik)	1.50 ab	0.38
P3 (mastafol)	1.42 abc	0.39
P4 (atonik)	1.67 a	0.39
P5 (metalik+mastafol)	1.50 ab	0.40
P6 (metalik+atonik)	1.25 bc	0.40
P7 (mastafol+atonik)	1.75 a	
P8 (metalik+mastafol+atonik)	1.50 ab	

The numbers in the same column, followed by the same letters (a, b, c, d) are not significantly different from α 5% Duncan test.

The average number of shoots was highest in treatment p7 (mastafol + atonic) with an average value of 1.75 fruits and the lowest number of shoots indicated by p1 (control) with an average of 1.08 fruits (table 4). The average length of shoots for the longest shoots is indicated by metallic + atonic p6) with an average value of 9.44 cm (table 5). The hormones contained in atonic plant growth regulators are able to meet the needs of pepper cuttings and are also able to support physiological processes in the plant's body for the growth of pepper shoots. Mastafol can form a thin membrane on the surface of the leaf so that it can prevent excessive evaporation (ardaka et.al., 2011). Plant growth regulator application has a significant effect on increasing shoot length, number of shoots and number of leaves, the three observational parameters above are closely related and have the same origin.

Table 5. Average length of shoots of pepper plants in various types of Plant Growth Regulator

Plant Growth Regulator types	Average	Duncan
P1 (control)	5.96 c	2.68
P2 (metalik)	8.12 abc	2.81
P3 (mastafol)	7.58 abc	2.89
P4 (atonik)	10.30 a	2.94
P5 (metalik+mastafol)	6.65 bc	2.98
P6 (metalik+atonik)	9.44 ab	2.99
P7 (mastafol+atonik)	7.28 bc	
P8 (metalik+mastafol+atonik)	6.68 bc	

The numbers in the same column, followed by the same letters (a, b, c, d) are not significantly different from α 5% Duncan test.

The results of observations of the number of leaves showed that the treatment of plant growth regulator type had no significant effect (p< 0.05). The average number of leaves that tends to be higher is a combination of treatments with atonic additions. Leaf growth will be more maximal if the planting media is available with sufficient plant growth regulator and nutrients. Salisbury, f.b. & ross, c.w. (2005) stated that the effect of absorption of auxin was not only seen from the concentration of auxin but from the sensitivity of the receiving tissue (plant protein). Ardana, r.c. (2009), also stated that the use of plant growth regulator would have a good effect on growth if with proper use.

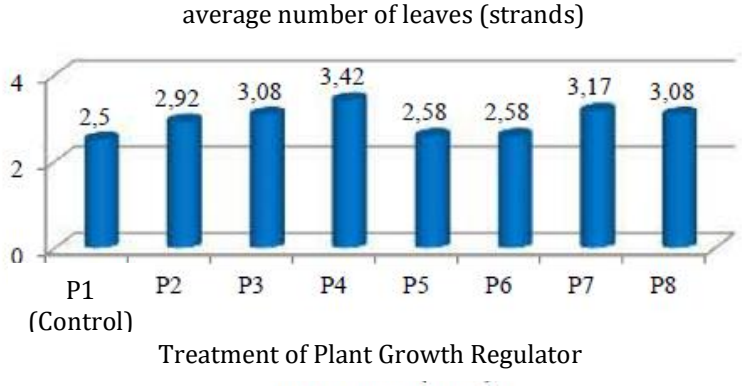

Figure 1. Average number of leaves of pepper plants on various types of Plant Growth Regulator

D. Conclusion

Based on the results of the study it can be concluded that the best Plant Growth Regulator combination treatment for the growth of pepper cuttings is P7 (mastafol 1 ml L-1 water + atonic 1 ml L-1 water), which can be seen in the parameters of root number, root length, root volume and number bud The treatment of Plant Growth Regulator given did not significantly affect the character of leaf growth.

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Effect of Procal Lime on the Growth and Results of Cucumber (*Cucumis sativus* L.)

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Abstract

The results showed that giving doses of procal lime 4,6875 Kg/swath (Ca3) shows the length of the longest plants i.e. 94,83 cm, the number of leaves by administering a dose of lime procal 4,6875 Kg/swath (Ca3) show the number of leaves that most namely 26,78 strands, the age of the plants start flowering by administering a doses of procal lime 4,6875 Kg/swath (Ca3) speed up the start of flowering plants age i.e. 26,78 (days after planting), the age of the plants begin to bear fruit by administering doses procal lime 4,6875 Kg/swath (Ca3) accelerating the age of the plants start fruiting i.e. 29,33 (days after planting), the amount of fruit plants by administering a doses of procal lime 4,6875 Kg/swath (Ca3) show the number of the most plant fruits namely 12,44 and the weight of the fruit plants by administering a doses of procal lime 4,6875 Kg/swath (Ca3) show the weight of the heaviest fruit i.e. 0,55 Kg

Keywords: fertilizer, lime procal, growth and yield of cucumber

A. Introduction

Cucumber (*Cucumis sativus* L.) is a plant of the tribe of pumpkin-labuan or Cucurbitaceae whose growth grows, the stems are round green and branched, the leaves are broad and hairy resembling pumpkin leaves. Cucumber is a type of vegetable plant that produces edible fruit. Benefits of Cucumber have diuretic properties, cooling effects, and cleansers that are beneficial to the skin. High water content; vitamins A, B, and C and minerals with values / 100 gr of cucumber (Sutarya, R., Grubben, G. & Sutarno Hadi, 1995).

Calcification is an act of giving lime ingredients to the soil layer to increase the pH of the soil to be neutral or near neutral so that the availability of macro and micro nutrients can be guaranteed. In addition, calcification in acid soils can reduce the micro-nutrient solubility of Al^{3+} and Mn^{2+} which generally poison aquaculture plants, spurring microbial activity in soil composers and improving physical soil sifaf (texture and structure) to be more stable. Calcification must at least pay attention to two things, namely the time of liming and the method of calcification. Calcification should be done at the beginning of the rainy season, ie 2-3 weeks before planting the seeds. With the right timing, lime can blend with the soil so that it effectively increases the pH of the soil (Sarpian, 2003).

Kelurahan 19 November is one of the centers for the development of vegetables and fruits in Wundulako District, Kolaka Regency. Biophysical conditions of land are generally dry land and paddy fields, the land is bumpy and flat which is classified into the type of soil Organosol. With air temperatures ranging from 25 ^{0}C to 30 ^{0}C. The average rainfall of 12,985 mm / year is divided into two seasons, namely the rainy season and the dry / dry season. In terms of altitude, Kelurahan 19 November is located at an altitude of 0-25 m above sea level, so it is categorized as a lowland which is generally suitable for cucumber cultivation.

Lime is a white and fine object made of sedimentary rock, forming rocks consisting of calcium minerals. Usually relatively limestone is formed in the deep sea with rock conditions containing calcium plates (coccoliths) formed by coccolithophores microorganisms. Lime (liming) is one of the actions to improve the soil so that the soil pH increases. Soils that are too acidic (low pH) cannot provide some important mineral nutrients for plants, such as phosphorus and calcium, and conversely increase the solubility of some minerals that can be toxic to plants such as Al and Mn. It is expected that calcification will increase pH to neutral, where at a neutral pH there are many nutrients that can be available to plants (Kuswandi, 2005).

Lime Procal is a type of lime that can increase plant growth, increase leaf green (chlorophyll), and increase plant resistance from pests and diseases. Giving Nitrogen (N) to plants will encourage the growth of organs related to photosynthesis, namely leaves. Plants that have enough N supply will form wider strands with higher chlorophyll content, so that the plant is able to produce enough carbohydrates / assimilates to support vegetative growth. So that it can certainly affect the quality of the plants and the yield of cucumbers. Procal lime composition containing CaO + MgO> 53%, $CaCO_3$ + $MgCO_3$> 96%, Nitrogen ± 2%, K2O <1%, Micro Nutrient (Si, B, S), Organic Material (Humic Acid), Max. Moisture 3 %, Active Calcium (Ca) ± 16%, and Mesh Fineness 400> 50%.

B. Methodology

The research was designed using a Randomized Block Design (RBD) with a single factor, namely lime treatment. This lime treatment consists of 4 levels, namely:

- Ca0 (without lime) = control.
- Ca1 (2.5 tons / ha) or converted to 1.5625 kg / plot
- Ca2 (5 tons / ha) or converted to 3.125 kg / plot
- Ca3 (7.5 tons / ha) or converted to 4.6875 kg / plot

Each treatment was repeated 3 times so that there were 12 experimental units. Each experimental unit, measuring 2.5 m x 2.5 m, the distance between plots in 1 group = 25 cm

and the distance between groups is 0.5 m. The total area of the experimental unit = 10.75 mx 8.5 m = 91.375 m2. Each experimental unit, both in groups and between groups, has a drainage channel 20 cm deep and 25 cm wide.

Implementation Method

1. Soil Processing

The soil is treated with a hoe as deep as a layer (25-30 cm) then smoothed to obtain a softer soil structure. After that, beds of size 2.5 m x 2.5 m are made with a height of 25-30 cm beds. When making beds, the surface of beds is flattened and cleaned from all tree roots, remnants of wood dikes and other dirt so that the land is ready for planting.

2. Seed Nursery

The cucumber seeds to be planted, soaked in ± 300 C warm water for 9 hours so that the seed skin becomes soft to prevent pathogens that might be carried by the seeds.

3. Planting

Planting is done directly after soaking cucumber seeds in warm water for 9 hours. Planting is done in the afternoon to avoid excessive transpiration in cucumber seeds. The desired spacing is 70 cm x 50 cm. Each planting hole is planted with 1 cucumber seedling.

4. Plant preservation

Preservation of cucumber plants includes planting, installation of stakes, giving water, weeding (sanitation), fertilizing, pruning, and controlling pests / diseases.

Embedding is done to replace plants that die, do not grow or are damaged by pests / diseases. Embedding is carried out about 4 weeks after planting the seeds by using reserve seeds that have been prepared in advance.

Mounting is done when the plant reaches ± 40 cm in height for the propagation site. Height of ± 1.5 m to rise and creep above the para-transverse along the beds.

Giving water needs to be done regularly to maintain soil moisture to remain high. Plants need a lot of water until the fruit is ripe, but should not be excessive because it will cause the roots to be prone to fusarium wilt. Watering needs to be done if there is no rainfall.

Weeding (sanitation) needs to be carried out periodically according to the conditions of growing weeds, using tools physically (manually). Weeding is avoided by spraying weeds by using herbicides (poisons) because they will endanger the ecology of the plantations and the environment.

Basic fertilization was carried out using 10 tons / ha of cow manure or converted to 6.25 kg / plot, which was carried out in conjunction with the provision of Cretaceous Procal, which was at 2 weeks before planting seeds. Manure and lime (according to the dosage) are mixed and stirred - stir in the top layer as deep as 20-25 cm evenly. When finished in lime, beds need to be watered so that the lime dissolves in the soil grains.

Crop trimming is done by removing buds - lateral buds or side buds that grow on the first leaf armpit until the eight armpit leaves. The shoots that grow from the ninth leaf armpit and so on are left (maintained) for the ovary. After the main stem grows 20 segments, the main stem shoots must be pruned frequently after reaching that height.

Disease control is done in an integrated manner (IPM) by combining healthy cultivation methods, physical and mechanical means if there is an attack of pests / diseases. How to avoid chemical pesticides wherever possible, except for other methods as above, unable to prevent pests / diseases. For example, if there are symptoms of wilt, it is controlled by the Benlate Fungicide.

5. Harvesting

Cucumber fruit can be harvested at the age of 49-64 days after the seeds are planted, depending on the variety (type) and local climate. Signs of cucumber fruit ready to harvest are: (1) fruit becomes hard, (2) dark green fruit skin color, (3) elongated fruit stalks and dividing lines connecting cucumber stalks and fruit are obvious, (4) fruit tip begins to color white and flower crown slowly disappear.

Observation variable
The variables observed in the study were:
1. Plant length (cm) at age 14; 21; 28; 35; 42 (days after planting).
2. Number of leaves (strands) at age 14; 21; 28; 35; 42 (days after planting).
3. Plant life begins to flower (days after planting).
4. Plant age begins to bear fruit (days after planting).
5. The average number of fruit plants.
6. Average fruit yield (Kg).

Data Processing Techniques

Data is processed by tabulation on each observation variable, according to the number of treatments in the number of replications used. Tabulations include the results of observations on each variable, the list of variance (ANOVA) and the average value of treatment along with the LSD (NP) comparison value.

Data analysis technique

Data from the observations of each observation variable were analyzed based on variance and F test. If F count> F tabe means the treatment tried significantly (ɔ- = 0.05) or very significant effect (nyata = 0.01) so that it can followed by LSD test to see the difference between each treatment level tested.

C. Result and Discussion

Result

1. Plant Length

Table 1. The Smallest Significant Difference Test (LSD 0.05) The Average Length of Cucumber Plants on the First Second Week Measurement / 14 HST (cm)

Treatment	Average Plant Length (cm)	comparative value of $LSD_{0,05}$
Ca0	17,77	2,90
Ca1	19,56	
Ca2	21,67	
Ca3	23,71	

Description: The average number followed by letters that are not the same, is significantly different from the 95% confidence level.

Table 1 shows, treatment Ca3 gives the longest average yield of cucumber plants, although not significantly different from Ca2 treatment but significantly different from Ca1 and very significantly different from Ca0.

Table 2. The Smallest Significant Difference Test (LSD 0,05) The Average Length of Cucumber Plants on the Second Measurement of the Third Week / 21 days after planting (cm)

Treatment	Average Plant Length (cm)	comparative value of $LSD_{0,05}$
Ca0	23,69	4,03
Ca1	26,39	
Ca2	28,86	
Ca3	31,72	

Description: The average number followed by letters that are not the same, is significantly different from the 95% confidence level.

Table 2 shows, the treatment of Ca3 gives the longest average yield of cucumber plants, although not significantly different from Ca2 treatment but significantly different from Ca1 and very significantly different from Ca0.

Table 3. The Smallest Significant Difference Test (LSD 0.05) The Average Length of Cucumber Plants on the Third Measurement of Fourth Week / 28 days after planting (cm)

Treatment	Average Plant Length (cm)	comparative value of $LSD_{0,05}$
Ca0	35,54	5,58
Ca1	39,13	
Ca2	42,22	
Ca3	48,41	

Description: The average number followed by letters that are not the same, is significantly different from the 95% confidence level.

Table 3 shows, the treatment of Ca3 gave the longest average yield of cucumber plants, but it was significantly different from the Ca2 treatment and was very significantly different from the treatment of Ca1 and Ca0.

Table 4. The Smallest Significant Difference Test (LSD 0.05) The Length of the Cucumber Plant on the Fifth Four-Week Measurement / 35 days after planting (cm)

Treatment	Average Plant Length (cm)	comparative value of $LSD_{0,05}$
Ca0	55,54	7,53
Ca1	59,13	
Ca2	62,22	
Ca3	70,93	

Description: The average number followed by letters that are not the same, is significantly different from the 95% confidence level.

Table 4 shows, the treatment of Ca3 gave the longest average yield of cucumber plants, but was significantly different in the treatment of Ca2 and Ca1, and was significantly different from the treatment of Ca0.

Table 5. The Smallest Significant Difference Test (LSD 0.05) The Average Length of Cucumber Plants at the Sixth Week Sixth Measurement / 42 days after planting (cm)

Treatment	Average Plant Length (cm)	comparative value of $LSD_{0,05}$
Ca0	71,08	11,58
Ca1	78,26	
Ca2	86,70	
Ca3	94,83	

Description: The average number followed by letters that are not the same, is significantly different from the 95% confidence level.

Table 5 shows, the treatment of Ca3 gives the longest average yield of the length of cucumber plants, although not significantly different from the treatment of Ca2 but significantly different from Ca1 and very significantly different from Ca0.

2. Number of Leaves

Table 6 shows, the treatment of Ca3 gave the most results on the average number of leaves of cucumber plants, but it was significantly different from the treatment of Ca2 and Ca1, and was significantly different from Ca0.

Table 6. The Smallest Significant Difference Test (LSD 0.05) Average Number of Cucumber Plant Leaves in the Second Week First Calculation / 14 days after planting (strands)

Treatment	Average Number of Leaves (strands)	comparative value of $LSD_{0,05}$
Ca0	6,44	3,15
Ca1	8,11	
Ca2	7,67	
Ca3	12,33	

Description: The average number followed by letters that are not the same, is significantly different from the 95% confidence level.

Table 7. The Smallest Significant Difference Test (LSD 0.05) Average Number of Cucumber Plant Leaves in the Third Week Second Calculation / 21 days after planting (strands)

Treatment	Average Number of Leaves (strands)	comparative value of $LSD_{0,05}$
Ca0	8,22	3,64
Ca1	11,22	
Ca2	11,44	
Ca3	17,33	

Description: The average number followed by letters that are not the same, is significantly different from the 95% confidence level.

Table 7 shows, the treatment of Ca3 gives the most results on the average number of leaves of cucumber plants, and is very significantly different from the treatment of Ca2, Ca1, and Ca0.

Table 8. The Smallest Significant Difference Test (LSD 0.05) The Average Number of Cucumber Plant Leaves in the Fourth / 28 days after planting (strands)

Treatment	Average Number of Leaves (strands)	comparative value of $LSD_{0,05}$
Ca0	10,00	3,76
Ca1	13,22	
Ca2	13,44	
Ca3	19,33	

Description: The average number followed by letters that are not the same, is significantly different from the 95% confidence level.

In table 8 shows, the treatment of Ca3 gives the most results on the average number of leaves of cucumber plants, and is very significantly different from the treatment of Ca2, Ca1, and Ca0.

Table 9 shows, the treatment of Ca3 gave the most results on the average number of leaves of cucumber plants, although it was significantly different in the treatment of Ca2, Ca1 and very significantly different from Ca0.

Table 10 shows, the treatment of Ca3 gives the most results on the average number of leaves of cucumber plants, and is very significantly different from the treatment of Ca2, Ca1 and Ca0.

Table 9. The Smallest Significant Difference Test (LSD 0.05) The Average Number of Leaves of Cucumber Plants in the Fifth Fourth Week Calculation / 35 days after planting (strands)

Treatment	Average Number of Leaves (strands)	comparative value of $LSD_{0,05}$
Ca0	13.11	4.45
Ca1	16.22	
Ca2	16.33	
Ca3	22.22	

Description: The average number followed by letters that are not the same, is significantly different from the 95% confidence level.

Table 10. The Smallest Significant Difference Test (LSD 0.05) Average Number of Leaves of Cucumber Plants in the Sixth Week / 42 days after planting (strands)

Treatment	Average Number of Leaves (strands)	comparative value of $LSD_{0,05}$
Ca0	17,00	3,44
Ca1	20,22	
Ca2	20,44	
Ca3	26,78	

Description: The average number followed by letters that are not the same, is significantly different from the 95% confidence level.

3. Age begins to flower

Table 11. The Smallest Significant Difference Test (LSD0.05) Age of the Cucumber Plant When Starting Flowering on the Fourth Week (days after planting)

Treatment	Average Age of Plants Starts Flowering	comparative value of $LSD_{0,05}$
Ca0	33,33	2,48
Ca1	31,00	
Ca2	29,78	
Ca3	26,78	

Description: The average number followed by letters that are not the same, is significantly different from the 95% confidence level.

Table 11 shows, the treatment of Ca3 gave the fastest average yield for the age of cucumber plants at flowering, although it was significantly different from the Ca2 treatment and was very significantly different from the treatment Ca1, Ca0.

4. Age starts to bear fruit

Table 12. The Smallest Significant Difference Test (LSD 0.05) The Age of the Cucumber Plant When Starting Fruiting on the Fifth Sunday (days after planting).

Treatment	Average Age of Plants Starts Fruiting	comparative value of $LSD_{0,05}$
Ca0	36,56	2,74
Ca1	34,00	
Ca2	32,67	
Ca3	29,33	

Description: The average number followed by letters that are not the same, is significantly different from the 95% confidence level.

Table 12 shows, the treatment of Ca3 gives the fastest average yield for the age of cucumber plants at the time of fruiting, although it is significantly different from the treatment of Ca2 and is very significantly different from the treatment of Ca1, Ca0.5.

5. Amount of Fruit Planting

Table 13. The Smallest Significant Difference Test (LSD 0.05) The Average Amount of Fruit Per-Plant Cucumber in the First to Third Harvest.

Treatment	Average Number of Fruits / Plants	comparative value of $LSD_{0,05}$
Ca0	11,11	0,70
Ca1	11,55	
Ca2	11,89	
Ca3	12,44	

Description: The average number followed by letters that are not the same, is significantly different from the 95% confidence level.

Table 13 shows, the treatment of Ca3 gives the most results on the average number of cucumber fruit plants, although not significantly different from the Ca2 treatment, significantly different from the treatment of Ca1 and very significantly different from Ca0.

6. Plant Fruit Weight

Table 14. Smallest Significant Difference Test (LSD 0.05) Average Fruit Weight of Cucumber Plants in First to Third Harvest (Kg)

Treatment	Average Fruit Weight (Kg)	comparative value of $LSD_{0,05}$
Ca0	0,26	0,09
Ca1	0,27	
Ca2	0,42	
Ca3	0,55	

Description: The average number followed by letters that are not the same, is significantly different from the 95% confidence level.

Table 14 shows, the treatment of Ca3 gives the heaviest results on the average weight of the fruit of the cucumber plant, although it was significantly different from the Ca2 treatment and was very significantly different in the treatment of Ca1, Ca0.

Discussion

In soil conditions that are too acidic or low in soil pH, agricultural lime containing nutrients (Calcium (CaO) and Magnesium (MgO) needs to be added to the soil, so that it becomes neutral and the pH of the soil is stable according to the needs of the plants to be planted. The pH level of the soil needed by plants varies, depending on the type of plants to be planted (Setiadi & Parimin, 2002).

Soil calcification aims to increase soil pH if the acidity of the soil is below neutral, and is also useful for improving soil structure, increasing soil microorganism activity so that it can improve the nitrification process and decomposition of soil organic matter (humus), eliminate toxic substances without removing substances other important substances, adding nutrients to Posphat (P), molybdenum (Mo), calcium (Ca), and Magnesium (Mg), increasing plant growth and plant productivity (Cahyono, 2003).

The results showed that the treatment of Ca3 (7.5 tons / ha dose) gave better results on the variables of growth and production observed compared to Ca0 (control), Ca2 (dose of

5 tons / ha), and Ca1 (dose 2.5 ton / ha). The average height generated in the treatment of Ca3 (4.6875 kg / plot) compared to Ca0 (Control) on the observation of yield components is due to the main function of Cretaceous Procal which is able to influence the increase in acidic soil pH, to pH which leads to neutral and ultimately reduce poisoning (Al, Fe, Mn) and nutrients that are needed by plants such as N (nitrogen), P (phosphorus), K (potassium), S (sulfur), Mg (magnesium), Mo (molybdenum) available to plants so that they absorb food well. Which can increase plant growth, increase the color of leaf green (chlorophyll), and increase the resistance of plants from pests and diseases. So that it can function double, besides increasing soil pH, it also fulfills plant nutrients which are easily absorbed by roots as plant food nutrients in its growth (Aliuddin A, A Ashandi, dan B Jaya. 1990).

D. Conclusion

The results of this study indicate that giving Lime Procal with a dose of 4.6875 Kg / plot (Ca3) still showing the best growth and fruit production of cucumber plants.

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Yield Potential Analysis of Cacao Clones in Various Location in East Kolaka Regency, Southeast Sulawesi

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Abstract

The Southeast Sulawesi government has designated Kolaka Timur as one of the cocoa production centers in Southeast Sulawesi. One of the successes of the superior seed assembly business depends on the availability of complete and accurate information about the potential of cocoa to be chosen as elders for subsequent development, so that yield analysis and early selection in the analysis of genetic diversity of smallholder cocoa have been developed in that location. This research was carried out using the Split-Plot Design (RPT). Sampling was carried out in 3 main locations (L) with an area of ± 2 ha, in each of the main locations divided into three plots (P) namely plots one Sulawesi 2 clones, plots two local clones and plots 3 MCC02 clones. A sampling of cacao leaves and fruit was taken as many as 30 samples with three replications per location. The results showed that cocoa which has the potential for good yields to be developed in the East Kolaka Regency based on the analysis of the component production of dry seed weight was the MCC02 cocoa clone with an average of 35.33 grams of fruit (L2P3) respectively. The different locations show different levels of Cacao yield and adaptation

Keywords: Cacao, Clones, yield potential, local genotype

A. Introduction

Indonesia is the world's third largest exporter of cocoa beans with 550,000 dry seed production (ICCO, 2011). Sulawesi is known as the center cocoa producing area in Indonesia with a land area of 538,760 ha or 68% of the national cocoa land area. Poli – Polia sub-district is the center of cocoa bean production in East Kolaka with an increase in the land area of 6.31% per year with an average planting area of 7,176 ha per year and become the largest area of cocoa plantations in Southeast Sulawesi. However, in 2012, there was a decline in production to 48,823 tons in 1 year (Dinas Perkebunan Kabupaten Kolaka, 2013). The productivity of cocoa land is still low, each around 753 kg/ha/ year (Dinas Pertanian, Kehutanan, dan Perkebunan Kabupaten Kolaka Timur, 2014). Cocoa productivity in East Kolaka decreased compared to previous years, the decrease in production was due to the age of cocoa plants ao 18 years, high intensity of pest attacks, not yet utilizing superior seeds (Dinas Perkebunan Kabupaten Kolaka, 2013)

Completion of the problem of decreasing cocoa production needs to be done in an integrated manner between various components of cultivation. Plant material is a component that underlies the success of the plant cultivation process, but until now the adoption of cocoa superior plant material is still relatively low. Cocoa plantations in Southeast Sulawesi are smallholder plantations that have evolved from generation to generation, so farmers in the field tend to use available plant material on land that is not identified by their breeders. The choice of plant material is an essential initial action in cocoa cultivation (Susilo, A.W., 2007). Recommended plant material must be of high yielding broodstock, high-quality seeds, and resistant to pests and diseases. One of the successes of the superior seed assembly business depends on the availability of complete and accurate information about the genetic diversity of cocoa that will be chosen as an elder (Rubiyo, 2009). Analysis of cocoa genetic diversity on smallholder plantations in East Kolaka still needs to be done, considering that the government of Southeast Sulawesi has designated Kolaka Timur as one of the cocoa production centers in Southeast Sulawesi. Superior plant material that has high yield and production is a criterion that demands cocoa cultivation activities, so in this study, an analysis of production and the initial selection was carried out in the analysis of the genetic diversity of smallholder cocoa plantations.

B. Methodology

The samples taken in this study were cocoa plants that had long been developed by the community in East Kolaka Regency. This research was carried out using the Split-Plot Design. Sampling was carried out in 3 main locations (L) with an area of ± 2 ha, in each of the main locations divided into three plots (P) namely plots one Sulawesi 2 clones, plots two local clones and plots 3 MCC02 clones. A sampling of cocoa leaves and fruit was taken as many as 30 samples with three replications per the main location so that the total sample observations amounted to 270 samples.

Production analysis was carried out by observing production components which consisted of a number of fruits per plant, the weight of fruit (g), number of seedlings, the weight of fresh seeds (g) and weight of dry seeds (g). Observation of the weight of dry seeds is done by removing seeds from the fruit, then remove the fruit until clean. Cacao beans that have been cleaned, then dried are dried in the sun. Data were analyzed using F-test and continued with the LSD test..

C. Result and Discussion

High yielding superior crop material is a criterion that demands cocoa cultivation. Selection of superior cocoa plant material in this study was carried out by observing the components of production, namely the number of fruit, fruit weight, number of seeds, the weight of fresh seeds and weight of dry seeds in the three observation locations. Observation of production components shows results that vary in each location. The first location was superior to the number of seeds with an average number of seeds as much as 48.33 in the cocoa clone MCC02 (LIP3). The second location was superior to fruit weight, fresh seed weight, and dry seed weight respectively with an average of 503.08 grams (L2P2) on local clones, 140.29 grams (L2P2) on local clones and 35.33 grams (L2P3)) on MCC02 clones. The third location is superior to the number of crop fruits with an average of 39.30 (L3P1) in Sulawesi clones 2.

Observations on the character of the average number of fruits per plant, fruit weight, number of seeds of fresh and dry seed weight showed that there were significant effects due to differences in clones and cocoa planting locations. At location one (L1) the best clones for fruit number per plant were P2 (34.42 pieces), the best clones at location 2 (L2) were P3 (17.48 pieces) and the best clones at location three (L3) were P1 (39.30 pieces). The best locations for P1 clones are L3, P2 and P3 clones at location L1 (Table 1).

Table 1. Number of fruit crops

Location (L)	Clones (P)			LSD Test$_{0.05}$
	P1	P2	P3	
L1	$30,50^{b}_{y}$	$34,42^{a}_{x}$	$28,50^{a}_{y}$	4, 61
L2	$15,58^{c}_{x}$	$14,75^{c}_{x}$	$17,48^{c}_{x}$	
L3	$39,30^{a}_{x}$	$30,07^{b}_{y}$	$22,01^{b}_{z}$	
NP BNT$_{0.05}$	3,62			

Description: Numbers followed by the same letters on the line (x, y, z) and columns (a, b, c) means that they are not significantly different from the LSD test level $\alpha = 0.05$

Table 2 shows that at location one (L1), the best clone is P3 (418.26 g). The best clone at location 2 (L2) is P2 (503.08 g), and the best clone in location three (L3) is P1 (470.68 g). The best location for P1 clones is L3, P2 and P3 clones at L2 location.

Table 2. Fruit Weight (g)

Location (L)	Clones (P)			LSD Test$_{0.05}$
	P1	P2	P3	
L1	$339,27^{b}_{x}$	$333,17^{c}_{x}$	$418,26^{a}_{x}$	92,55
L2	$451,98^{a}_{x}$	$503,08^{a}_{x}$	$468,50^{a}_{x}$	
L3	$470,68^{a}_{x}$	$406,15^{b}_{x}$	$442,33^{a}_{x}$	
LSD Test$_{0.05}$	72,64			

Description: Numbers followed by the same letters on the line (x, y, z) and columns (a, b, c) means that they are not significantly different from the LSD test level $\alpha = 0.05$

The best locations for the average number of seeds were P1 clones (31.78), and P2 (39, 54) were location two (L2) and P3 clones (48.33) at location one location (L1) (Table 3). The yield potential of cocoa is determined by its genetic nature, while actual production in the field is determined by the environment in which it grows. Conditions that are appropriate for a particular type of plant will provide a healthy appearance, with good root development so that the plant will provide high production. To be able to grow and produce well, cocoa plants want suitable land, which has certain climatic conditions and soil conditions. The temperature conditions that are suitable for cocoa plants are the average temperature between 150C - 300C, with an optimum temperature of 25.50C. The ideal height for planting cocoa is not higher than 800 m above sea level. This condition is by the location of cocoa sampling. The location for sampling cocoa is located in the Poli-Polia District of the Eastern Kolaka Regency. East Kolaka Regency is geographically located in the western part of Southeast Sulawesi Province, extending from North to South between 2º00'-5º00 'South Latitude and stretching from West to East between 120º45'-124º06 'East Longitude. The mainland region of eastern Kolaka Regency has a height generally below 1,000 meters above sea level and is located around the equator, so this area has a tropical climate with a minimum air temperature of around 10 ° C and a maximum of 31 ° C or an average of 24 ° C - 28 ° C. Based on the above, cocoa is a suitable commodity developed in East Kolaka Regency.

Table 3. Number of seeds

Location (L)	Clone (P)		
	P1	P2	P3
L1	31,40[a]	27,39[b]	48,33[a]
L2	31,78[a]	39,54[a]	41,50[b]
L3	31,73[b]	31,67[b]	27,50[c]
LSD Test$_{0.05}$	5,28		

Description: Numbers followed by the same letters in the columns (a, b, c) means that they are not significantly different from the BNT test level $\alpha = 0.05$

The average seed weight at location one (L1) the best clone is P1 (103.97 g). The best clone at location 2 (L2) is P2 (140.29 g), and the best clone at location three (L3) is P1 (100.53 g). The best locations for P1, P2, and P3 clones at L2 locations (Table 4). The number of cocoa plants that become fruit until cooked and the number of seeds in the fruit and the weight of the seeds is the factors that determine production. Based on the results of the study, the MCC02 cocoa clones had the potential to be developed from other clones because they had the number of seeds (L1P3) and dry seed weight (L2P3) the highest average of the three observation locations. This is because cocoa beans are the most used part of the plant. Cocoa beans in dry form are part of traded cocoa fruit. Parts of cocoa fruit that can be utilized, such as fruit peels, pulp, and cocoa beans (Ernianti, Zakaria, F.R. & Prisoeryanto, P.B, 2012). For generative breeding needed seeds that have a yield of 20% of the yield power of the average plant population, produce seeds with a dry weight of more than 1 gr, the fat content of more than 50% and percentage of epidermis less than 12%, resistant or tolerant to disease pests. The MCC02 clone has the advantage of elongated elliptical seeds, flat surface, dry seed weight of 1.61 grams, 12.0% seed skin content and fat content of 49.2%, resulting in an average number of fruit trees of 86.26, the number of seeds is flat fruit average 39.9 fruit values on average 14.33 production averages 2.82 kg/tree (3.132 kg/ha/ year) (DITJENBUN, 2012).

Table 4. Fresh seed weight (g)

Location (L)	Clones (P)			LSD Test$_{0.05}$
	P1	P2	P3	
L1	$103,97^{a}_{x}$	$100,03^{b}_{x}$	$90,00^{b}_{x}$	20,84
L2	$116,00^{a}_{x}$	$140,29^{a}_{x}$	$121,58^{a}_{xy}$	
L3	$100,53^{a}_{x}$	$85,33^{b}_{y}$	$57,72^{c}_{y}$	
LSD Test$_{0.05}$	16,36			

Description: Numbers followed by the same letters on the line (x, y, z) and columns (a, b, c) means that they are not significantly different from the LSD test level α= 0,05

Table 5 shows that at location one (L1), the best clone for dry seed weight is P3 (23.36 g). The best clone at location 2 (L2) is P3 (35.33 g), and the best clone in location three (L3) is P2 (27.08 g) — the best location for P1, P2 and P3 clones at L2 location. Local cocoa clones are the highest cocoa clones which have the highest fruit weight and fresh seed weight (L2P2) from the three observation locations. The moisture content of seeds is a physical property that greatly influences yield, water content affects the durability of cocoa beans, especially during storage and transportation. Cocoa beans that have high water content are very susceptible to attack by fungi and insects, both of which are highly disliked by consumers because they tend to cause damage to basic tastes and aromas that cannot be repaired in the next process. The standard quality of cocoa beans for export quality is 6-7%. If it is higher than that value, cocoa beans are not safe for a long time.

Table 6. Dry seed weight (g)

Location (L)	Clones (P)			LSD Test$_{0.05}$
	P1	P2	P3	
L1	$21{,}80\,^{b}_{x}$	$19{,}00\,^{b}_{y}$	$23{,}36\,^{b}_{x}$	3,83
L2	$27{,}55\,^{a}_{y}$	$29{,}80\,^{a}_{y}$	$35{,}33\,^{a}_{x}$	
L3	$22{,}08\,^{b}_{y}$	$27{,}08\,^{a}_{x}$	$26{,}78\,^{b}_{x}$	
LSD Test$_{0.05}$	3,01			

Description: Numbers followed by the same letters on the line (x, y, z) and columns (a, b, c) means that they are not significantly different from the LSD test level α= 0,05

In the field, farmers generally prefer MCC02 clones and Sulawesi 2 clones from local clones. According to the Indonesian Coffee and Cocoa Research Center (DITJENBUN, 2014), the average production of MCC02 is 2.82 kg/tree or 3.1 tons/ha/ year. The potential for production of MCC02 clones is very large when compared to other clones such as Sulawesi 1 around 1.8-2.5 tons/ha/ year and Sulawesi 2 around 1.8-2.75 tons/ha/ year.

To obtain genetic material that can be used to improve cocoa plant material, collection and exploration of cocoa germplasm need to be done by collecting local clones, introductions, or new clones from individual tree selection. The East Kolaka Regency is one of the centers of cocoa production as an exploration target to improve the genetic diversity of cocoa. Cocoa planting centers for smallholder plantations are in four provinces in Sulawesi, namely South Sulawesi 280,957 ha, Southeast Sulawesi 257,277 ha, Central Sulawesi 229,320 ha, and West Sulawesi 195,845 ha (Direktorat Jenderal Perkebunan, 2011).

D. Conclusion

The results showed that cocoa which has the potential for good yields to be developed in the East Kolaka Regency based on the analysis of the component production of dry seed weight is the MCC02 cocoa clone with an average of 35.33 grams of fruit (L2P3) respectively. The different locations show different levels of cacao yield and adaptation.

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