



THE INFLUENCE OF LIQUID ORGANIC FERTILIZER COCONUT WATER AND CHICKEN MANURE ON COCOA (*Theobroma cacao* L.) PLANT GROWTH

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ARTICLE INFO	ABSTRACT
Date received : 19 Oct 2022 Revision date : 15 Nov 2022 Date received : 21 Nov 2022	<p><i>Research on the effect of giving Liquid Organic Fertilizer (LOF) coconut water and chicken manure on the growth of cocoa (<i>Theobroma cacao</i> L.) was carried out from February to July 2022. This study was conducted to determine the effect of giving chicken manure fertilizer and giving coconut water LOF to the growth of cocoa plants and their interactions. This study used a Split Plot Design consisting of 2 treatment factors with 6 combinations and 4 replications so that 24 plots were obtained with a total of 120 research plants. The main plot (main plot) is the provision of chicken manure with the symbol "A" consisting of A0 = No Treatment (Control) and A1 = 200 grams/polybag. The sub plot (child plot) is the provision of coconut water LOF which is given the symbol "K" consisting of K0 = No treatment (control), K1 = 100 ml/polybag and K2 = 200 ml/polybag. Parameters observed were plant height (cm), number of leaves (strands), leaf width (cm), leaf length (cm), dry weight (grams) and also base weight (grams). The results showed the effect of chicken manure on the growth of cocoa plants on plant height (cm), number of leaves, leaf width (cm), leaf length (cm), plant dry weight (grams), and plant wet weight in all parameters observed. showed no significant effect where the best treatment was obtained at A1 (200 grams/polybag). LOF administration of coconut water on the growth of cocoa plants on plant height (cm), number of leaves, leaf width (cm), leaf length (cm), plant dry weight (grams), and plant wet weight in all parameters observed showed no significant effect. There was no interaction between chicken manure fertilizer and coconut water LOF on the observed parameters.</i></p>
Keywords: Chicken Manure Fertilizer, Coconut Water LOF, Cocoa Seed Growth	

INTRODUCTION

Cocoa (*Theobroma cacao* L.) is one of the plantation commodities that is suitable for community plantations, because this plant can bloom and bear fruit all year round, so it becomes a source of income every six months of harvest (Usrin et. al., 2019). Cocoa (*Theobroma cacao* L.) is one of the leading commodities nationwide after oil palm and rubber crops. Cocoa is one of Indonesia's leading export commodities that has contributed foreign exchange to the country of US \$ 1.6 billion at the end of 2020. As the market demand for cocoa continues to increase, it is necessary to make efforts to increase national productivity and production in order to increase national cocoa exports (Central Statistics Agency, 2021).

A good cocoa breeding technique is one of the important aspects in cocoa cultivation, with the aim of being able to produce good and quality ready-to-plant seeds that can later produce optimally (Saragih, 2020). The thing that needs to be considered in breeding is the fertilization process. Organic fertilization has important functions for the soil, namely to loosen the top soil, increase the population of soil bodies, increase the absorption and shelf life of water which will overall increase soil fertility. One of the organic fertilizers is



chicken manure fertilizer. Chicken manure in general has advantages in the speed of nutrient absorption, nutrient composition such as N, P, K and Ca compared to cow and goat manure (Hasibuan, 2014).

Chicken manure has a relatively higher P element content than other manure. The content of this nutrient depends on the food given. In addition, in the chicken manure mixed the remnants of chicken food and husks used as a chicken coop base In some studies chicken manure manure gives better results in the first planting because chicken manure manure is easily decomposed and has sufficient nutrient content when compared to other manure (Manuel and Sandryan, 2017).

In addition to chicken manure fertilizer, another combination that can be used to promote the growth of cocoa plants is liquid organic fertilizer from coconut coconut water. The results showed that coconut water is rich in potassium, minerals including Calcium (Ca), Sodium (Na), Magnesium (Mg), Ferum (Fe), Cuprum (Cu), and Sulfur (S), sugar and protein. Besides being rich in minerals, coconut water also has 2 natural hormones, namely auxin and cytokinin which act as supporters of cell division (Purba et al., 2014).

METHOD

Materials and tools

The materials used in this study were cocoa seeds, polybeg size 25 x 30, chicken manure fertilizer, coconut water LOF, EM4, brown sugar and shade. The tools used in this study were hoes, meters, drills, cameras, analytical scales, ordinary scales, ovens, sprayers, and stationery.

Research Methodology

This study used SPLIT PLOT Design with 2 treatment factors with 6 combinations. Main Plot is the application of chicken manure fertilizer which is given with the symbol "A" consisting of 2 levels, namely; A0 = No Treatment (Control); A1 = 200 grams/polybag. Sub Plot (child plot) is the giving of a coconut water LOF which is given with the symbol "K" consisting of 3 levels, namely: K0 = No treatment (control); K1 = 100 ml/polybag; K2 = 200 ml/polybag. Coconut water LOF is given after the cocoa plant has entered the week 3 Weeks after planting, by spraying it on the leaves of the cocoa plant.

Observation parameters

Measurement of parameters is carried out when the plants are 6.10 and 14 Weeks. Measurements are carried out using a ruler and wood. How to measure it by making a standard wood count coupled with the highest leaf length. Standard wood has a length of 6 cm. 3 cm below ground level and 3 cm above ground level. The parameters observed are plant height, number of leaves, leaf width, length of dry weight leaves and also wet weight

RESULTS AND DISCUSSION

Plant Height (cm)

Data on measuring the average height of cocoa plants due to the application of chicken manure and coconut water LOF at the age of 6 to 14 Weeks after the plant is shown in appendix 4,5,6,7,8 and 9

The results of the study after being analyzed at the age of 6 to 14 Weeks after planting, there was an unreal influence in the interaction between giving chicken manure and coconut water LOF, but it had no real effect on giving chicken manure and coconut water LOF. Duncan Distance Test results can be seen in Table 1.

Table 1. Average Plant Height (cm) Due to Chicken Manure and Coconut Water LOF At The Age of 6 To 14 Weeks After Planting.

Treatment	Plant Height		
	6 Weeks	10 Weeks	14 Weeks
A = Chicken Droppings			
A0 = Control	17.33 aA	19.50 aA	21.65 aA
A1=200g/polybag	18.20 aA	20.61 aA	23.20 aA
K = Coconut Water LOF			
K0 = Control	17.62 aA	19.23 aA	22.03 aA
K1 = 100 ml/polybag	17.75 aA	20.40 aA	22.44 aA
K2 = 200 ml/polybag	17.90 aA	20.51 aA	22.80 aA

Description: The numbers in the same column followed by the same letter show unreal differences at the 5% level (lowercase) and very noticeably different at the 1% level (uppercase letters).



Table 1 shows that the application of chicken manure to different plant heights is not real at the age of 6 to 14 Weeks after planting, where the plant height at A1 (200g) is 23.20 cm and at A0 (control) it is 21.65 cm.

Table 1 also shows that the administration of coconut water LOF to different plant heights is not real at the age of 6 to 14 Weeks after planting, where the plant height at K2 (200 ml / polybag) is 22.80 cm, K1 (100 ML / polybag) is 22.44 cm and K0 (control) is 22.03 cm.

Number of leaves

Data on the measurement of the average number of leaves of cocoa plants due to the application of chicken manure and LOF of coconut water at the age of 6 to 14 Weeks after the plant is shown in appendix 10,11,12,13,14 and 15

The average yield of the number of leaves at the age of 6 to 14 Weeks after planting due to the application of chicken manure and coconut water LOF, after being tested for the average difference using the Duncan Test can be seen in Table 2.

Table 2. Average number of leaves due to feeding chicken manure and coconut water LOF at the age of 6 to 14 Weeks after planting.

Treatment	Number of leaves		
	6 Weeks	10 Weeks	14 Weeks
A = Chicken Droppings			
A0 = Control	7.72 aA	11.02 aA	14.33 aA
A1 = 200 g/polybag	8.02 aA	11.30 aA	14.63 aA
K = Coconut Water			
K0 = Control	7.62 aA	11.00 aA	14.20 aA
K1 = 100 ml/polybag	8.00 aA	11.12 aA	14.60 aA
K2 = 200 ml/polybag	8.04 aA	11.40 aA	14.70 aA

Description: Numbers in the same column followed by letters that the same shows unreal differences at the 5% level (lowercase) and very noticeable differences at the 1% level (uppercase letters).

Table 2 shows that the application of chicken manure to different leaves is not real at the age of 6 to 14 Weeks after planting, where the number of leaves on A1 (200 g) is 14.63 and in A0 (control) it is 14.33.

Table 2 also shows that the administration of coconut water LOF to different leaves is not real at the age of 6 to 14 Weeks after planting, where the number of leaves in K2 (200 ml / polybag) is 14.60, K1 (100 ML / polybag) is 14.70 and K0 (control) is 14.20.

Leaf Width (cm)

Data on the measurement of the average leaf width of cocoa plants due to the application of chicken manure and coconut water LOF at the age of 6 to 14 Weeks after the plant are shown in appendix 16,17,18,19,20 and 21.

The interaction between the treatment of giving chicken manure and coconut water LOF did not show any unnoticeable different effects at the age of 6 to 14 Weeks after planting. The average yield of leaf width at the age of 6 to 14 Weeks after planting, after being tested for average differences using the Duncan Distance Test can be seen in Table 3.

Table 3. Average leaf width due to feeding chicken manure and coconut water LOF at the age of 6 to 14 Weeks after planting

Treatment	Leaf width		
	6 Weeks	10 Weeks	14 Weeks
A = Chicken Droppings			
A0 = Control	5.70 aA	6.84 aA	7.50 aA
A1 = 200 g/polybag	6.30 aA	6.90 aA	7.53 aA
K = Coconut Water			
K0 = Control	5.92 aA	6.70 aA	7.50 aA
K1 = 100 ml/polybag	6.00 aA	6.75 aA	7.52 aA
K2 = 200 ml/polybag	6.05 aA	7.11 aA	7.53 aA



Description: The numbers in the same column followed by the same letter show unreal differences at the 5% level (lowercase) and very noticeably different at the 1% level (uppercase letters).

Table 3 shows that the application of chicken manure to different leaf widths is not noticeable at the age of 6 to 14 Weeks after planting, where the number of leaves on A1 (200 g) is 7.53 cm and in A0 (control) it is 7.50 cm.

Table 3 also shows that the administration of coconut water to the number of different leaves is not real at the age of 6 to 14 Weeks after planting, where the number of leaves in K2 (200 ml / polybag) is 7.53 cm, K1 (100 ml / polybag) is 7.52 cm and K0 (control) is 7.50 cm.

Leaf Length (cm)

Data on measuring the average length of cocoa plant leaves due to the application of chicken manure and coconut water LOF at the age of 6 to 14 Weeks after the plant is shown in appendix 22,23,24,25,26 and 27.

Administration and Interaction in both treatments of chicken manure and coconut water LOF are not noticeable at the age of 6 to 14 Weeks after planting, the interaction between the treatment of giving chicken manure and LOF coconut water, after planting.

The average yield of leaf length at the age of 6 to 14 Weeks after planting due to the application of chicken manure and coconut water LOF, after being tested for average differences using the Duncan Distance Test can be seen in Table 4.

Table 4. Average leaf length due to feeding chicken manure and coconut water LOF at the age of 6 to 14 Weeks after planting

Treatment	Leaf Length		
	6 Weeks	10 Weeks	14 Weeks
A = Chicken Droppings			
A0 = Control	13.80 aA	15.90 Aa	16.80 aA
A1 = 200 g/polybag	14.60 aA	16.00 aA	16.90 aA
K = Coconut Water			
K0 = Control	14.01 aA	15.60 aA	16.30 aA
K1 = 100 ml/polybag	14.10 aA	16.04 aA	17.00 aA
K2 = 200 ml/polybag	14.41 aA	16.20 aA	17.20 aA

Description: The numbers in the same column followed by the same letter show unreal differences at the 5% level (lowercase) and very noticeably different at the 1% level (uppercase letters)

Table 4 shows that the application of chicken manure to different leaf lengths is not noticeable at the age of 6 to 14 Weeks after planting, where the number of leaves on A1 (200 g) is 16.90 cm and in A0 (control) it is 16.80 cm.

In table 4. also showed that the administration of coconut water LOF to different leaf lengths was not real at the age of 6 to 14 Weeks after planting, where the number of leaves on K2 (200 ml / polybag) was 17.20 cm, K1 (100 ml / polybag) was 17.00 cm and K0 (control) was 16.30 cm.

Dry Weight (grams)

Data on the measurement of the average dry weight of cocoa plants due to the application of chicken manure and coconut water LOF at the age of 6 to 14 Weeks after the plant are shown in appendix 28 and 29 The results of the study after statistical analysis showed that the administration of chicken manure and coconut water LOF was not real at the age of 6 to 14 Weeks after planting, the interaction between the treatment of giving chicken manure and coconut water LOF also did not show any unreal different effects at the age of 6 to 14 Weeks after planting.

The average dry weight yield at the age of 6 to 14 Weeks after planting due to the application of chicken manure and coconut water LOF, after being tested for the average difference using the Duncan Distance Test can be seen in Table 5.



Table 5. Average dry weight due to feeding chicken manure and coconut water LOF at the age of 6 to 14 Weeks after planting

Treatment	Plant Dry Weight (grams)
A = Chicken Droppings	
A0 = Control	3.32 aA
A1 = 200 g/polybag	3.60 aA
K = Coconut Water	
K0 = Control	3.30 aA
K1 = 100 ml/polybag	3.43 aA
K2 = 200 ml/polybag	3.65 aA

Description: The numbers in the same column followed by the same letter show unreal differences at the 5% level (lowercase) and very noticeably different at the 1% level (uppercase letters)

Table 5 shows that the application of chicken manure to the dry weight of different plants is not real at the age of 6 to 14 Weeks after planting, where the number of leaves on A1 (200 g) is 3.60 grams and in A0 (control) it is 3.32 grams.

In table 5. also showed that the administration of coconut water LOF to the dry weight of different plants was not real at the age of 6 to 14 Weeks after planting, where the number of leaves on K2 (200 ml / polybag) was 3.65 grams, K1 (100 ml / polybag) was 3.43 grams and K0 (control) was 3.30 grams.

Wet Weight (grams)

Data on the measurement of the average wet weight of cocoa plants due to the application of chicken manure and coconut water LOF at the age of 6 to 14 Weeks after the plant are shown in appendix 30 and 31

The results of the statistical analysis showed that the interaction between the treatment of giving chicken manure and coconut water LOF showed an intangible difference at the age of 6 to 14 Weeks after planting as well as the results of the administration of the two treatments. The average results of wet weight, after being tested for the average difference using the Duncan Distance Test can be seen in Table 6.

Table 6. Average wet weight due to feeding chicken manure and coconut water LOF at the age of 6 to 14 Weeks after planting

Treatment	Plant Wet Weight (grams)
A = Chicken Droppings	
A0 = Control	9.30 aA
A1 = 200 g/polybag	11.80 aA
K = Coconut Water LOF	
K0 = Control	10.12 aA
K1 = 100 ml/polybag	10.70 aA
K2 = 200 ml/polybag	10.90 aA

Description: The numbers in the same column followed by the same letter show unreal differences at the 5% level (lowercase) and very noticeably different at the 1% level (uppercase letters).

In table 6. shows that the application of chicken manure to the dry weight of different plants is not real at the age of 6 to 14 Weeks after planting, where the number of leaves on A1 (200 g) is 11.80 grams and in A0 (control) it is 9.30 grams.

In table 6. also showed that the administration of coconut water LOF to the dry weight of different plants was not real at the age of 6 to 14 Weeks after planting, where the number of leaves on K2 (200 ml / polybag) was 10.90 grams, K1 (100 ml / polybag) was 10.70 grams and K0 (control) was '10.12 grams.

Effect of Chicken Manure Application On Cocoa Plant Growth (*Theobroma cacao* L)

The results showed that after a statistical analysis showed that the effect of applying chicken manure fertilizer on cocoa plant growth on plant height (cm), number of leaves, leaf width (cm), leaf length (cm), plant dry weight (grams), and wet weight of plants in each observation of 6 Weeks to 14 Weeks all parameters observed showed an unreal effect, this is because the nitrogen nutrients contained in chicken manure fertilizer are insufficient to meet the nutrient needs of cocoa plants (*Theobroma cacao* L). Nitrogen in relatively large amounts at any stage of plant growth, especially at vegetative growth stages, such as bud



formation, or stem and leaf development. Entering the generative growth stage, the need for nitrogen begins to decrease. Without sufficient supply of nitrogen, good plant growth will not occur (Philip and Shivaraj, 2018)

According to Nandi et al (2015) chicken manure nutrients have a content of: water content of 57%, organic matter 29%, N 1.5%, P₂O₅ 1.3%, K₂O 0.8%, CaO 0.07%, according to Avane (2019) the nutrient content in chicken manure as much as 100 gr has a content of: N 1.70%, C / N 10.80%, P 2.12% and K 1.45%. So at a dose of 200 gr chicken manure has a nutrient content of N 2.40%, C / N 20.80%, P 4.24% and K 2.90%. While the nutrient needs of cocoa plants in nursery stages in the age range of 5 months require N 2.4 Kg, P 0.6 Kg, K 2.4 Kg, Ca 2.3 Kg, Mg 1.1 Kg, Mn 0.04 Kg, Zn 0.01 Kg (Indonesian cocoa research center, 2021). From the availability of chicken manure nutrients, it can be seen that there are very few and very insufficient nutrient intake needed for cocoa plants.

Effect of Coconut Water LOF Administration on Cocoa Plant Growth (*Theobroma cacao* L)

The results showed that after a statistical analysis showed that the effect of LOF administration of coconut water on cocoa plant growth on plant height (cm), number of leaves, leaf width (cm), leaf length (cm), plant dry weight (grams), and wet weight of plants in each observation of 6 Weeks to 14 Weeks all parameters observed showed an unreal effect, This is due to the small dose of coconut water given which causes the use of ineffective hormones that cause plant growth to be disturbed. According to Ashari et. al (2019) states that growth regulators can work effectively in providing good physiology, it must be given proper concentration.

In addition to containing various nutrients and having 2 growth regulators, namely auxin and cytokinin, according to Eynade and Akharume (2018), coconut water is an endosperm liquid that contains organic compounds. These organic compounds include auxin and cytokinin. Auxins function in inducing cell elongation, affecting apical dominance, inhibition of axillary and adventitious shoots and root initiation while cytokinins serve to stimulate cell division in tissues and stimulate bud growth (Salisbury and Ross, 1995).

Mayura (2014) reported that giving coconut water at a concentration of 500 ml had a significant effect on plant height, number of leaves, length and width of leaves and stem diameter in kayumanis, besides that wulandari et al (2013) reported that giving coconut water 60% can increase the number of leaves 4.5 strands of wet weight of canopy 2.37 grams and dry weight of canopy 0.90 grams.

Interaction between the application of chicken manure fertilizer and coconut water LOF to the growth of Cocoa plants (*Theobroma cacao* L)

From the results of the data after statistical analysis that it shows no interaction between the application of chicken manure fertilizer and coconut water LOF to the growth of cocoa plants, this is due to the lack of nutrient supply available between chicken manure fertilizer and coconut water LOF as well as the small amount of auxin and cytokinin hormones given, because the dose of coconut water LOF is too small and this causes plant growth to be less than optimal.

Bandana et al (2016) mineral nutrients are classified as essential nutrients that must at least meet 3 criteria, namely (1) without the presence of these nutrients, plants cannot complete their life cycle, (2) the function of these nutrients cannot be replaced by other nutrients, and (3) these nutrients are directly involved in plant metabolism, namely as a component needed in enzymatic reactions. According to Tobing et. al (2019) states that growth regulators can work effectively in providing good physiology, it must be given proper concentration.

CONCLUSIONS

The results of the study after statistical analysis showed that the application of chicken manure had an unreal different effect on plant height, number of leaves, leaf width, leaf length, dry weight of plants and wet weight of plants, where the best treatment was obtained at A1 (200 grams / polybag). Statistical analysis showed that the administration of coconut water LOF had an unreal different effect on plant height, number of leaves, leaf width, leaf length, dry weight of the plant and wet weight of the plant, where the best treatment was obtained at K2 (200 ml / polybag). There was no interaction between the application of coconut water LOF and chicken manure fertilizer to plant height, number of leaves, leaf width, leaf length, alkaline weight of the plant and dry weight of the plant

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