GROWTH RESPONSE OF SWEET CORN PLANTS (*Zea mays saccarata L.*) TO THE TREATMENT OF DRY ORGANIC FERTILIZER FROM COW MANURE AND LIQUID ORGANIC FERTILIZER FROM COCONUT WATER

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ABSTRACT

Cultivating sweet corn plants using chemical fertilizers continuously can cause soil damage where the organic content in the soil decreases due to an imbalance of nutrients in the soil. The farming method that can be done to increase fertility and add nutrients to the soil in a way that is safe for the soil and the ecosystem and can increase sweet corn production is by planting it using organic fertilizers. The right way that can be done to increase the growth response of sweet corn plants is by applying dry organic fertilizer from cow manure and liquid organic fertilizer from coconut water. Therefore it need a study that can examine the growth response of sweet corn plants with the treatment of these two organic fertilizers. This research was conducted by using a factorial randomized block design consisting of 2 factors with 16 combinations and 32 treatment plots. The first factor was liquid organic fertilizer from coconut water (P) which consisted of 4 levels, namely: 1) P0: 0 ml/ plot, 2) P1: 200 ml/ plot, 3) P2: 400 ml/ plot and 4) P3: 600 ml/ plot plot. The second factor was dry organic fertilizer from cow manure (K) which consists of 4 levels, namely: 1) K0: 0 kg/ plot, 2) K1: 1 kg/ plot, 3) K2: 2 kg/ plot and 4) K3: 3 kg/ plots. The parameters that were tested in this study were plant height, the length of fruit cob, and the weight of fruit per sample. The results showed that the treatment of dry organic fertilizer from cow manure and liquid organic fertilizer from coconut water had a significant effect on the growth of sweet corn plants. the best response to growth of sweet corn plant in tested parameters like the height of plant, the length of fruit cob, and the weight of fruit per sample was found in the treatment of 600 ml/ plot (P3) liquid organic fertilizer from coconut water and 3 kg/ plot (K3) dry organic fertilizer from cow manure.

Keywords: Growth Response, Sweet Corn, Organic Fertilizer, Cow Manure, Coconut Water

INTRODUCTION

Corn is a plant that has a role as a contributor to the needs of food sources, animal feed and industry. Sweet corn variety is one of the corn commodities that is well known by the people of Indonesia. Sweet corn has a different nutritional value than regular corn. Sweet corn has a different nutritional value than regular corn. Sweet corn has a fairly high nutritional value such as carbohydrates 70.7%, water 13.5%, protein 10.0%, fat 0.4% and 0.4% other substances. Sweet corn kernels contain a lot of reducing sugars (glucose and fructose), sucrose, polysaccharides, and starch. The sugar content contained in sweet corn kernels is 5-6% and the starch content is 10-11%. Whereas in ordinary corn it is only 2-3%, which means that ordinary corn has a difference of less than half the sugar content which found in sweet corn (Agustiara *et al*, 2016).

One of the factors that causes a decrease in corn productivity is caused by external factors such as the use of seeds that are not well selected, inoptimal at land preparation, and inappropriate fertilization applications (Feidy and Rotinsulu, 2020). Farmers tend to use more chemical fertilizers because the use of chemical fertilizers is easier to apply and get faster results. In essence, excessive use of chemical fertilizers will have a negative impact on soil and ecosystems. In general, agricultural land will experience a decrease in soil fertility due to nutrient deficits and reduced levels of organic matter in the soil (Arman *et al*, 2020).

Optimal soil conditions for plant growth require soil organic matter in the top soil layer of at least 2%. To achieve these soil conditions, it is necessary to add organic matter in the form of agricultural waste and livestock waste at a minimum of 8-9 tons/ha every year (Maruapey, 2015). the best way that can be done to assist in improving soil quality and simultaneously increasing crop production is to use organic fertilizers either in solid or liquid form. Liquid organic fertilizer is a solution of the results of decomposition or the process of decomposing the remains of plant waste or industrial waste. Organic matter will be fermented and converted into simpler compounds such as sugar, glycerol, fatty acids and amino acids so that it will continue with aerobic and anaerobic processes (Purba *et al*, 2021). The advantage of liquid organic fertilizer is that the nutrients contained in it are more easily absorbed by plants (Mahdiannoor *et al*, 2016). Solid organic fertilizers derived from manure are the most suitable and natural soil amendments compared to synthetic soil amendments. In general, manure contains low macro-nutrients Nitrogen, Phosphorus and Potassium, but contains micro-nutrients in sufficient quantities for plant growth (Akerina *et al*, 2021).Organic matter derived from livestock manure contains C/N between 10/1-15/1. The application of livestock manure can improve the physical, chemical and biological properties of the soil, as well as being a source of nutrients for a long time so that plants can grow well. The main content of livestock manure is carbon in the form of organic compounds which can be used by microorganisms as an energy source, then the material is converted into compounds such as compost which has more stable properties (Akerina *et al*, 2021).

Based on the explanation of the background of this research, we conducted a study entitled "Growth Response of Sweet Corn Plants (*Zea mays saccarata* L.) to the Treatment of Dry Organic Fertilizer from Cow Manure and Liquid Organic Fertilizer from Coconut Water".

METHODS

Research Material

This research used several materials, including: 1) corn seeds of the sweet corn variety (*Zea mays saccarata* L.), 2) dry organic fertilizer from cow manure, and 3) liquid organic fertilizer from coconut water.

This study also used several tools, including: 1) a set of agricultural cultivation tools such as hoes, machetes, watering tools, and sprayers, 2) observation tools such as cameras, 3) measuring devices such as tape measure, and 3) a set of writing tools such as pens, markers, paper, books, and additional tools that support this research.

Research Design

This research was an experimental study using a factorial randomized block design consisting of 2 treatment factors and 2 blocks to obtain 32 research plots. The treatment in this study are dry organic fertilizer from cow manure and liquid organic fertilizer from coconut water. The parameters that were tested in this study were the height of plant, the length of fruit cob, and the weight of fruit per sample. The two types of factors made in this research as follows:

The first factor is the application of liquid organic fertilizer from coconut water with the symbol (P) which consists of 4 levels, including:

1. P0 = 0 ml/ plot
2. P1 = 200 ml/ plot
3. P2 = 400 ml/ plot
4. P3 = 600 ml/ plot

The second factor is the application of dry organic fertilizer from cow manure with the symbol (K) which consists of 4 levels, including:

1. K0 = 0 kg/ plot
2. K1 = 1 kg/ plot
3. K2 = 2 kg/ plot
4. K3 = 3 kg/ plot

The results of the study were analyzed by ANOVA analysis and continued with the DUNCAN mean difference test (DMRT).

Research Procedure

This research was conducted within 5 months, starting from the preparation stage to the stage of analyzing the results. The stages carried out in this study were divided into 3 groups of stages. The first stage is called the research material preparation stage, the second stage is called the cultivation and treatment aplication stage, the third stage is called the analysis stage.

The procedure for implementing the stages carried out in this study in detail are:

1. Research material preparation stage, including:
   a. Making the dry organic fertilizer from cow manure
   b. Producting the liquid organic fertilizer from coconut water
   c. Preparation the cultivation land
   d. Making the plots on cultivation land
2. Cultivation and treatment aplication stage, including:
   a. Seeding the experimental plants on the tray.
   b. Applicating the dry organic fertilizer from cow manure to the plots of cultivation land
   c. Planting the experimental plants on cultivation land
   d. Applicating the liquid organic fertilizer from coconut water to the plants on the plots of cultivation land
   e. Plant care which includes: watering, spraying, and weeding
   f. Harvesting the products of the experimental plant
3. Analysis stage, including:
   a. Calculating the average value of research parameters on research results
   b. Analyzing the parameters of the research results with statistical analysis

RESULTS AND DISCUSSION

The Height Of Plant

The height of plant was measured for each sample sweet corn plant using a tape measure. Measurements of the height of plant did from the base of the stem to the tip of the highest leaf. Plant height measurements were carried out when the plants were 3 weeks, 5 weeks and 7 weeks after plant.

The analysis of variance based on the observation results of the height of plant parameters on the treatment of liquid organic fertilizer from coconut water and dry organic fertilizer from cow manure did not give an effect on the height of plant at 3 weeks after planting but give an effect at 5 weeks and 7 weeks after planting.

The average height of sweet corn plant at 3 weeks, 5 weeks, and 7 weeks after planting which has been tested by analysis of Duncan's distance test can be seen in Table 1. Table 1 shows that the treatment of liquid organic fertilizer from coconut water had a significant effect on the height of sweet corn plants at 7 week after planting. The highest sweet corn plant was found in the P3 treatment, which was 204.75 cm. These results had no

significantly different effect on treatment P2, which was 199.63 cm, but had a significantly different effect on treatment P1, which was 197.25 cm and treatment P0, which was 194.75 cm.

Table 1. The average height of sweet corn plant (cm) to treatment application of liquid organic fertilizer from coconut water (P) and dry organic fertilizer from cow manure (K) at 3, 5 and 7 weeks after planting (WAP)

Treatment Application	The average height of sweet corn plant (cm)					
	3 WAP		5 WAP		7 WAP	
Treatment "P"						
P0 = 0 ml/ plot	59,56	aA	121,81	bB	194,75	bA
P1 = 200 ml/ plot	61,09	aA	122,47	bB	197,25	bA
P2 = 400 ml/ plot	62,56	aA	126,75	abAB	199,63	abA
P3 = 600 ml/ plot	63,38	aA	134,34	aA	204,75	aA
Treatment "K"						
K0 = 0 kg/ plot	58,91	aA	121,22	bB	193,50	cB
K1 = 1 kg/ plot	60,63	aA	121,94	bB	196,38	bcAB
K2 = 2 kg/ plot	61,91	aA	127,28	abAB	201,34	abA
K3 = 3 kg/ plot	65,16	aA	134,94	aA	205,16	aA
Note : Numbers in the same column followed by the same letter are significantly different at the 5% level (lowercase letters) and very significantly different at the 1% level (uppercase letters).						

Table 1 also shows that the treatment of dry organic fertilizer from cow manure had a significant effect on the height of sweet corn plants at 7 week after planting. The highest sweet corn plant was found in the K3 treatment, which was 205.16 cm. This result had no significantly different effect on treatment K2, which was 201.34 cm, but had a significantly different effect on treatment K1, which was 196.38 cm and treatment P0, which was 193.50 cm.

Based on the results of the research that has been statistically analyzed, it can be explained that the application of liquid organic fertilizer from coconut water and dry organic fertilizer from cow manure have a significant effect on the height of sweet corn plant. Liquid organic fertilizer from coconut water has a significant effect on the height of sweet corn plant in the P3 treatment application, which was 600 ml/ plot. This is evidenced by the growth in the height of sweet corn plant which reached an average value of 204.75 cm. Dry organic fertilizer from cow manure has a significant effect on the height of sweet corn plant in the K3 treatment application, which was 3 kg/ plot. This is evidenced by the growth in the height of sweet corn plant which reached an average value of 205.16 cm. And between the treatment of liquid organic fertilizer from coconut water and the treatment of dry organic fertilizer from cow manure, it is clear that dry organic fertilizer from cow manure is better for the height of plants parameter response.

Coconut water which contains lots of minerals such as auxin and cytokinins is thought to be the cause of the increase in the height of sweet corn plants. Roza and Fifendidy (2019) stated that coconut water contains many nutrients that are useful for the growth of plant, including potassium as much as 7%, apart from that coconut water also contains the minerals sodium (Na), calcium, magnesium, ferum, cuprum, phosphorus, sulfur, and also contains auxins and cytokinins. Dongoran (2020) stated that the auxin and cytokinin hormones are capable for helping the growth of plant, because the auxin and cytokinin

hormones support the devided of the cell which results in the growth of shoot so that plant stems increase in height more quickly.

Figure 1 explains that the higher concentration of liquid organic fertilizer from coconut water given to sweet corn plants, the effectiveness and growth response of sweet corn plants will increase. This is shown by a graph that forms a linear equation $\hat{Y}$ = 194.238 + 0.016 (P) with a coefficient of determination (r^2) of 0.980. Thus, if the dose of liquid organic fertilizer from coconut water is increased, the height parameter of the sweet corn plant will increase.

The following is a graph of the relationship between the treatment of giving liquid organic fertilizer from coconut water to the height of sweet corn plants at the age of 7 weeks after planting which is shown in Figure 1.

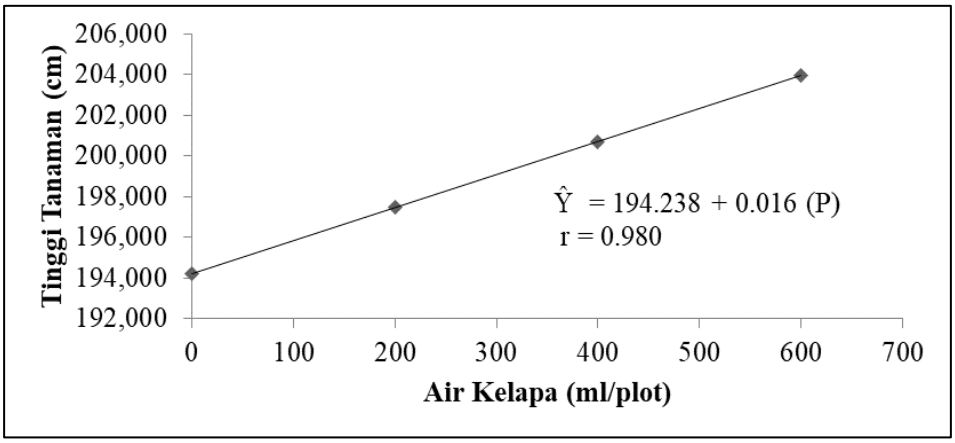

Figure 1. The relationship between the treatment of giving liquid organic fertilizer from coconut water to the height of sweet corn plants at 7 weeks after planting

While figure 2 explains that the higher concentration of dry organic fertilizer from cow manure given to sweet corn plants, the effectiveness and growth response of sweet corn plants will increase. This is shown by a graph that forms a linear equation $\hat{Y}$ = 193.103 + 3.994 (K) with a coefficient of determination (r^2) of 0.995. Thus, if the dose of dry organic fertilizer from cow manure is increased, the height parameter of the sweet corn plant will increase.

The following is a graph of the relationship between the treatment of giving dry organic fertilizer from cow manure to the height of sweet corn plants at the age of 7 weeks after planting which is shown in Figure 2.

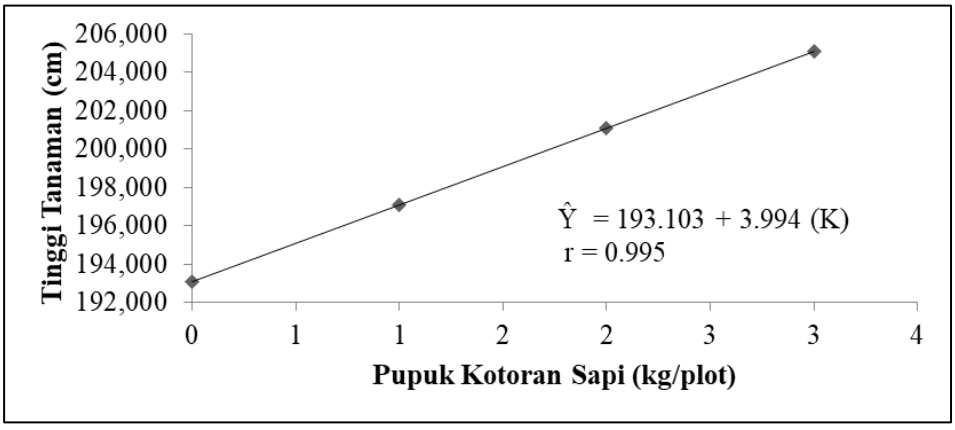

Figure 2. The relationship between the treatment of giving dry organic fertilizer from cow manure to the height of sweet corn plants at 7 weeks after planting

The Length of Fruit Cob

Measurement the length of friut cob was carried out after the harvest stage. The corn cobs that have been cleaned then measured using a tape measure from the base of the cob to the tip of the corn cob.

The analysis of variance based on the observation results show that the treatment of liquid organic fertilizer from coconut water and dry organic fertilizer from cow manure give an effect to the length of fruit cob parameters.

The average length of fruit cob in sweet corn plant after harvesting has been calculated and tested by analysis of Duncan's distance test can be seen in Table 2. Table 2 shows that the treatment of liquid organic fertilizer from coconut water had a significant effect on the length of fruit cob in sweet corn plants after harvesting. The longest average corn cob in sweet corn plant was found in the P3 treatment, which was 18.88 cm. These results had significantly different effect on treatment P2, which was 18.38 cm, treatment P1, which was 18.31 cm and treatment P0, which was 18.23 cm.

Table 2. The average length of fruit cob in sweet corn plant (cm) to treatment application of liquid organic fertilizer from coconut water (P) and dry organic fertilizer from cow manure

Treatment application	The average length of fruit cob	Notation
Air Kelapa (P)		
P0 = 0 ml/ plot	18,23	bB
P1 = 200 ml/ plot	18,31	bB
P2 = 400 ml/ plot	18,38	bAB
P3 = 600 ml/ plot	18,88	aA
Kotoran Sapi (K)		
K0 = 0 kg/ plot	17,86	bB
K1 = 1 kg/ plot	18,51	aA
K2 = 2 kg/ plot	18,67	aA
K3 = 3 kg/ plot	18,76	aA
Note : Numbers in the same column followed by the same letter are significantly different at the 5% level (lowercase letters) and very significantly different at the 1% level (uppercase letters).		

Table 2 also shows that the treatment of dry organic fertilizer from cow manure had a significant effect on the length of fruit cob in sweet corn plants after harvesting. The longest average corn cob in sweet corn plant was found in the K3 treatment, which was 18.76 cm. This result had a significantly different effect on the sweet corn cobs that were not treated like K0, which was 17,86 cm

Based on the results of the research that has been statistically analyzed, it can be explained that the application of liquid organic fertilizer from coconut water and dry organic fertilizer from cow manure have a significant effect on the length of fruit cob in sweet corn plants after harvesting. Liquid organic fertilizer from coconut water has a significant effect on the sweet corn cobs in the P3 treatment application, which was 600 ml/ plot. This is evidenced by the growth in the sweet corn cobs which reached an average value of 18.88 cm. Dry organic fertilizer from cow manure has a significant effect on the length of sweet corn plant in the K3 treatment application, which was 3 kg/ plot. This is evidenced by the growth in the

length of sweet corn plant which reached an average value of 18.76 cm. And between the treatment of liquid organic fertilizer from coconut water and the treatment of dry organic fertilizer from cow manure, it is clear that liquid organic fertilizer from coconut water is better for the length of fruit cob parameter response.

Dry organic fertilizer from cow manure is known to have phosphorus nutrients which can optimize growth and also sweet corn production. Maruapey (2015) explained that the nutrient phosphorus has a role in the formation of flowers, influencing the formation and size of corn cobs. Corn cobs are the development of female flowers, if female flowers can be formed perfectly then the formation of fruit cobs will also be perfectly formed.

Figure 3 explains that the higher concentration of liquid organic fertilizer from coconut water given to sweet corn plants, the effectiveness and growth response of sweet corn plants will increase. This is shown by a graph that forms a linear equation $\hat{Y}$ = 18.149 + 0.001 (P) with a coefficient of determination (r^2) of 0.886. Thus, if the dose of liquid organic fertilizer from coconut water is increased, the length of sweet corn cob parameter will increase.

The following is a graph of the relationship between the treatment of giving liquid organic fertilizer from coconut water to the length of sweet corn cob after harvesting which is shown in Figure 3.

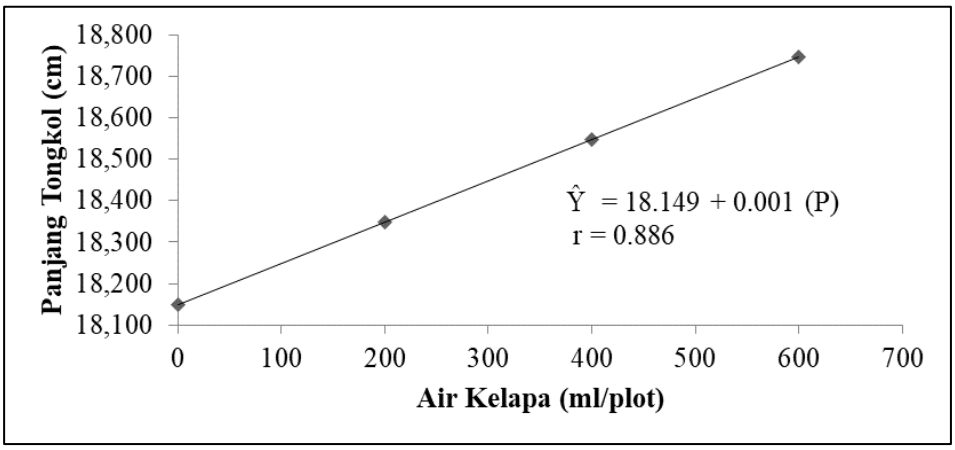

Figure 3. The relationship between the treatment of giving liquid organic fertilizer from coconut water to the length of sweet corn cob after harvesting

While figure 4 explains that the higher concentration of dry organic fertilizer from cow manure given to sweet corn plants, the effectiveness and growth response of sweet corn plants will increase. This is shown by a graph that forms a linear equation $\hat{Y}$ = 193.103 + 3.994 (K) with a coefficient of determination (r^2) of 0.995. Thus, if the dose of dry organic fertilizer from cow manure is increased, the length of sweet corn cob parameter will increase.

The following is a graph of the relationship between the treatment of giving dry organic fertilizer from cow manure to the length of sweet corn cob after harvesting which is shown in Figure 4.

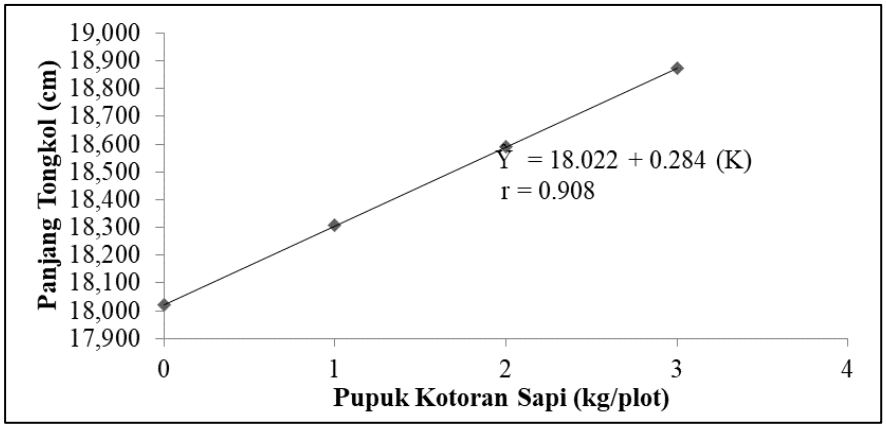

Figure 4. The relationship between the treatment of giving dry organic fertilizer from cow manure to the length of sweet corn cob after harvesting

The Weight of Fruit per Sample

The weight of the fruit per sample was weighed after harvesting. Weighing is done by means of scales. Weighing the weight of the fruit per sample is done by weighing the weight of each fruit for each sample.

The analysis of variance based on the observation results show that the treatment of liquid organic fertilizer from coconut water and dry organic fertilizer from cow manure give an effect to the weight of the fruit per sample parameters.

The average weight of the fruit per sample after harvesting has been calculated and tested by analysis of Duncan's distance test can be seen in Table 3. Table 3 shows that the treatment of liquid organic fertilizer from coconut water had a significant effect on the weight of the fruit per sample after harvesting. The heaviest average of the fruit per sample in sweet corn plant was found in the P3 treatment, which was 194.53 g. This results had significantly different effect on treatment P2, which was 182.34 g, treatment P1, which was 181.53 g and treatment P0, which was 180.09 g.

Table 3. The average weight of the fruit per sample in sweet corn plant (cm) to treatment application of liquid organic fertilizer from coconut water (P) and dry organic fertilizer from cow manure

Treatment application	The average weight of the fruit per sample	Notation
Air Kelapa (P)		
P0 = 0 ml/plot	180,09	bB
P1 = 200 ml/plot	181,53	bAB
P2 = 400 ml/plot	182,34	bA
P3 = 600 ml/plot	194,53	aA
Kotoran Sapi (K)		
K0 = 0 kg/plot	175,06	cB
K1 = 1 kg/plot	184,00	bAB
K2 = 2 kg/plot	185,81	abA
K3 = 3 kg/plot	193,63	aA
Note : Numbers in the same column followed by the same letter are significantly different at the 5% level (lowercase letters) and very significantly different at the 1% level (uppercase letters).		

Table 3 also shows that the treatment of dry organic fertilizer from cow manure had a significant effect on the weight of the fruit per sample in sweet corn plants after harvesting. The heaviest average of the fruit per sample in sweet corn plant was found in the K3 treatment, which was 193.63 g. This result had significantly different effect on treatment K2, which was 185.81 g, treatment K1, which was 184.00 g and treatment K0, which was 175.06 g.

Based on the results of the research that has been statistically analyzed, it can be explained that the application of liquid organic fertilizer from coconut water and dry organic fertilizer from cow manure have a significant effect on the weight of the fruit per sample in sweet corn plants after harvesting. Liquid organic fertilizer from coconut water has a significant effect on the weight of the sweet corn per sample in the P3 treatment application, which was 600 ml/ plot. This is evidenced by the growth in the the weight of the fruit per sample which reached an average value of 194.53 g. Dry organic fertilizer from cow manure has a significant effect on the weight of the sweet corn per sample in the K3 treatment application, which was 3 kg/ plot. This is evidenced by the growth in the weight of the sweet corn per sample which reached an average value of 193.63 g. And between the treatment of liquid organic fertilizer from coconut water and the treatment of dry organic fertilizer from cow manure, it is clear that liquid organic fertilizer from coconut water is better for the weight of the sweet corn per sample parameter response.

Liquid organic fertilizer from coconut water contains nutrients that can meet the nutrients needed by sweet corn plants. Liquid organic fertilizer from coconut water contains various types of nutrients such as Potassium, Sodium, Phosphorus, Calcium, Manganese, Ferum, Cuprum and Sulfur. As explained by Tambunan (2018) that plants reach their growth rate when the nutrients needed by plants are sufficiently available and balanced in the soil. If the nutrients needed by plants are lacking or not available in the soil, it will affect plant growth and production. Dry organic fertilizer from cow manure is also able to make sweet corn plants grow well. dry organic fertilizer from cow manure contains various kinds of nutrients needed by sweet corn plants. So that it can help plant growth well in the vegetative and generative phases. This is in accordance with research by Riswanto (2017) which states that the application of dry organic fertilizer from cow manure can increase plant growth because dry organic fertilizer from cow manure is easily decomposed by bacteria and microorganisms found in the soil so that dry organic fertilizer from cow manure can converted into a source of nutrients that are useful for plant growth and development in both the vegetative and generative phases.

Figure 5 explains that the higher concentration of liquid organic fertilizer from coconut water given to sweet corn plants, the effectiveness and growth response of sweet corn plants will increase. This is shown by a graph that forms a linear equation $\hat{Y}$ = 178.006 + 0.022 (P) with a coefficient of determination (r^2) of 0.854. Thus, if the dose of liquid organic fertilizer from coconut water is increased, the weight of the sweet corn per sample parameter will increase.

The following is a graph of the relationship between the treatment of giving liquid organic fertilizer from coconut water to the weight of the sweet corn per sample after harvesting which is shown in Figure 5.

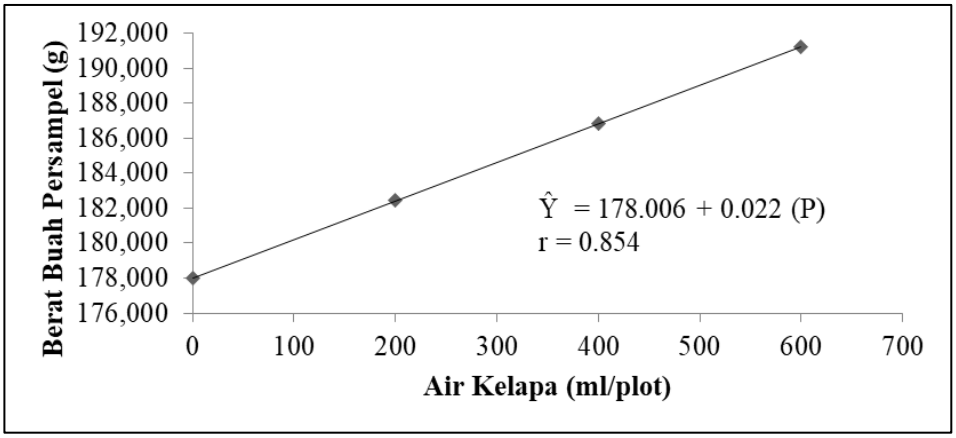

Figure 5. The relationship between the treatment of giving liquid organic fertilizer from coconut water to the weight of the sweet corn per sample after harvesting

While figure 6 explains that the higher concentration of dry organic fertilizer from cow manure given to sweet corn plants, the effectiveness and growth response of sweet corn plants will increase. This is shown by a graph that forms a linear equation $\hat{Y}$ = 176.000 + 5.750 (K) with a coefficient of determination (r^2) of 0.974. Thus, if the dose of dry organic fertilizer from cow manure is increased, the weight of the sweet corn per sample parameter will increase.

The following is a graph of the relationship between the treatment of giving dry organic fertilizer from cow manure to the weight of the sweet corn per sample after harvesting which is shown in Figure 6.

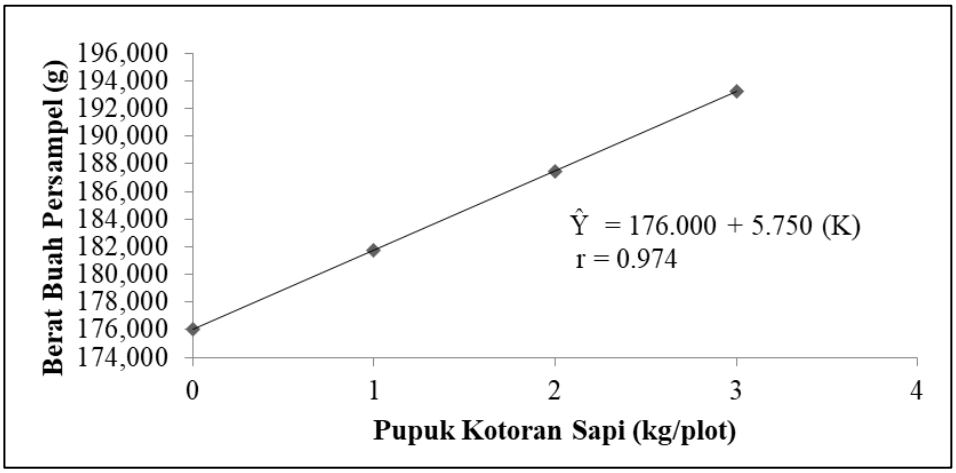

Figure 6. The relationship between the treatment of giving dry organic fertilizer from cow manure to the weight of the sweet corn per sample after harvesting

CONCLUSION

The conclusions that can be made in this study are:

1. The treatment of dry organic fertilizer from cow manure and liquid organic fertilizer from coconut water had a significant effect on the growth of sweet corn plants.
2. The best response to growth of sweet corn plant in tested parameters like the height of plant, the length of fruit cob, and the weight of fruit per sample was found in the treatment of 600 ml/ plot (P3) from liquid organic fertilizer from coconut water
3. The best response to growth of sweet corn plant in tested parameters like the height of plant, the length of fruit cob, and the weight of fruit per sample was found in the treatment of 3 kg/ plot (K3) from dry organic fertilizer from cow manure.

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