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# THE EFFECT OF APPLYING LIQUID ORGANIC FERTILIZER FROM FISH WASTE AND GOAT DUNG ON THE GROWTH AND PRODUCTION OF SWEET CORN (Zea Mays Saccaharata L)

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**Abstract**

This study aims to determine the effect of liquid organic fertilizer (POC) from fish waste and goat manure on the growth and production of sweet corn (Zea mays saccharata L.). The study was conducted using a Factorial Randomized Block Design (RAK) with two factors, namely the dose of fish waste POC (0, 100, 200, and 300 ml/plot) and the dose of goat manure fertilizer (0, 1280, 2560, and 3840 g/plot). The parameters observed included plant height, number of leaves, and cob weight per plot. The results showed that the application of fish waste POC and goat manure fertilizer had a very significant effect on the growth and production of sweet corn. The highest dose of fish waste POC (300 ml/plot) and goat manure (3840 g/plot) gave the best results with a plant height reaching 93.47 cm, the number of leaves 16.17 strands, and cob weight per plot of 3561.67 grams. However, the interaction between the two types of fertilizer did not show a significant effect. In conclusion, the use of liquid organic fertilizer from fish waste and goat manure separately can significantly increase the growth and yield of sweet corn.

**Keywords:***liquid organic fertilizer, fish waste, goat manure, and sweet corn*

## Introduction

Sweet corn (Zea mays saccharata L.) is a popular food crop in Indonesia. Market demand for sweet corn tends to increase over time, particularly with the presence of supermarkets and growing public awareness of healthy eating. This has encouraged many farmers to cultivate sweet corn as a highly economically valuable agricultural enterprise (Seprita and Surtinah, 2012). To achieve optimal plant growth and yield, fertilization is a crucial aspect of cultivation. Fertilization increases and improves soil fertility and provides essential plant nutrients. Fertilization can be done using both inorganic and organic fertilizers. However, the use of organic fertilizers is increasingly recommended due to their environmental friendliness, sustainable soil productivity, and improved soil structure and nutrient uptake by plants (Marvelia et al., 2006).

Sweet corn has a sweet taste and soft texture, making it highly sought after by the public. Furthermore, sweet corn also boasts a high nutritional value. Every 100 grams of sweet corn contains approximately 96 calories, 3.5 grams of protein, 1 gram of fat, 22.8 grams of carbohydrates, and various essential vitamins and minerals such as potassium, phosphorus, iron, vitamins A, B, and C (Iskandar, 2006). This high nutritional content also makes sweet corn a highly marketable food commodity.One form of organic fertilizer that is increasingly being used is liquid organic fertilizer (POC). Liquid organic fertilizer is more easily absorbed by plants. The process of producing POC is generally carried out through anaerobic fermentation, a process in the absence of oxygen, involving microorganisms to accelerate the decomposition of organic matter. The speed and quality of the fermentation results depend heavily on the type of microbes used and environmental conditions, such as temperature and pH, during the process.

One potential raw material for organic fertilizer (POC) is fish waste, such as heads, guts, fins, and scales, which are often discarded in fish farms or traditional markets. This waste still contains important nutrients such as nitrogen (N), phosphorus (P), and potassium (K), which are the main elements in organic fertilizer (Sastro, 2011; Hapsari & Welasi, 2013). With proper processing, fish waste can be used as a base material for an effective and environmentally friendly liquid fertilizer.Furthermore, goat manure is an organic material rich in nutrients. Unfortunately, its utilization in the field is still less than optimal. People generally use goat manure directly without prior composting, even though its dense and hard structure makes it difficult to decompose in the soil. Nutrient content in goat manure includes 1.26% nitrogen, 16.36 mg/kg phosphorus, and 2.29 mg/kg potassium. Furthermore, goat manure has a C/N ratio of around 20–25, indicating its potential as a good base material for organic fertilizer (Yolanda et al., 2020). To make liquid organic fertilizer from goat manure, weigh 5 kg of goat manure and add 10 liters of water, 10 cc of EM4, and 250 grams of granulated sugar dissolved in 1 liter of water. The mixture is then stirred until evenly distributed, the pH and initial temperature are measured, and then fermented in a closed container for 14 days. After fermentation, the solution is filtered to separate the dregs and produce a liquid fertilizer that is ready for use.Based on this background, this study aims to evaluate the effect of using liquid organic fertilizer from fish waste and goat manure on the growth and production of sweet corn plants.

**Research methods**

This research was conductedat the Experimental Land of the Faculty of Agriculture, Al Washliyah University, Jl. Sisingamangaraja No.10, Harjosari I, Medan Amplas District, Medan City, North Sumatra Province with an altitude of ±25 meters above sea level, with flat topography.This research started in November and was completed. The tools and materials used in this research are: hoes, rakes, measuring tools, plots, scales, handsprayer, knives, meters, barrels/buckets, stationery, documentation tools, Bonanza sweet corn seeds, liquid organic fertilizer from fish waste, goat manure, water, Inceptisol soil and other tools and materials that support the implementation of the research. This study used a Factorial Randomized Block Design (RAK) with two factors, namely: Factor of providing liquid organic fertilizer from fish waste (L): L0 = Control (Without Liquid Organic Fertilizer from Fish Waste), L1 = 100 ml/l/Plot, L2 = 200 ml/l/Plot, L3 = 300 ml/l/Plot and factor of providing goat manure fertilizer (K): K0 = Control (Without Organic Fertilizer from Goat Pen), K1 = 5 tons / ha equivalent to 1280 gr/plot, $K_2$= 10 tons / ha equivalent to 2560 gr/plot, K3 = 15 tons / ha equivalent to 3840 gr/plot.

The research implementation, namely the manufacture of liquid organic fertilizer from fish waste, was carried out before planting using materials such as fish innards, melted brown sugar, EM 4 or biofertilizer, goat urine, buckets, plastic, and rope to cover the bucket. The manufacturing process begins by preparing 3 kg of fish innards, then adding 1 liter of water, the fish is cut into small pieces and crushed until smooth like porridge. The fish porridge is put into a bucket, then added 2 liters of melted brown sugar, 30 cc of EM 4 per liter of water (about 5 bottle caps), and goat urine. All ingredients are stirred until evenly distributed, then the container is tightly closed using plastic that is tied so that the fermentation process runs well. Fermentation is carried out for 1-2 months or longer for better results. Fish POC that has been fermented properly does not emit a foul odor, but the fermentation process should be carried out far from residential areas because of the pungent odor.

Land processing begins by clearing grass and weeds using manual tools such as tripes and hoes. Next, the soil is loosened by hoeing to level and break up the soil to form a planting plot that is ready for use. Corn seeds were planted using the Bonanza variety. Two sweet corn seeds were planted in each planting hole, 2-3 cm deep, at a spacing of 25 x 25 cm. Planting two seeds per hole ensures that if one seed fails to germinate, the other can still thrive. Goat manure fertilizer was applied one week before planting by mixing it into the soil before forming the plots. The fertilizer dosages used varied: a control without fertilizer (K0), 2,000 grams per plot (K1), 4,000 grams per plot (K2), and 6,000 grams per plot (K3), equivalent to a dose of 10 to 15 tons per hectare. Liquid organic fish waste fertilizer was also applied once during the study, one week before planting. Fertilizer was applied to the soil around the corn plots at varying doses: no fertilizer (L0), 100 ml per plot (L1), 200 ml per plot (L2), and 300 ml per plot (L3). Plant maintenance involves several essential activities. Watering is done once a day, in the morning or evening, using a watering can, adjusted to soil moisture conditions and avoided during rain. Weeding is done once a week or as needed to control weeds in the planting area. Dead or poorly growing plants are removed one week after planting, using backup plants of the same age. Pest and disease control is carried out manually and chemically, with chemical control only used if the infestation reaches an economic threshold. Sweet corn is harvested 65-75 days after planting, when the husks are tight, the cobs are brown and slightly dry, and the cobs feel firm and full. At this time, the corn is ready to be harvested (Lisdayani et al., 2021).

Observed parameters Plant height measurements were conducted every 2 weeks from 2 to 6 weeks old using a meter, from the base of the stem or a 5 cm standard stake to the highest point by straightening the leaves upwards. The number of leaves was counted manually every 2 weeks from 2 weeks old until the generative phase when flowers appeared, by counting fully opened leaves. The weight of the cob per plot was weighed once after harvest using a digital scale, after the corn was separated from its packaging.

## Results and Discussion

### Plant Height (cm)

Based on the results obtained, the average plant height data showed that the effect of providing liquid organic fertilizer (POC) from fish waste had a very significant effect and the effect of providing organic fertilizer from campsite manure had a very significant effect, while the interaction effect of providing liquid organic fertilizer (POC) from fish waste and goat manure had no significant effect on the growth and production of sweet corn plants.

Table 1. Data on the effect of providing liquid organic fertilizer (POC) from fish waste and goat manure on plant height (cm) 6 weeks after planting.

| Treatment L | Treatment K | | | | Average |
|---|---|---|---|---|---|
| | K0 | K1 | K2 | K3 | |
| **L0** | 82.83 | 83.33 | 84.08 | 85.17 | 83.85 d |
| **L1** | 86.08 | 87.25 | 87.92 | 88.67 | 87.48 c |
| **L2** | 89.25 | 89.33 | 89.67 | 89.92 | 89.54 b |
| **L3** | 90.50 | 90.92 | 92.50 | 93.47 | 91.85 a |
| **Average** | 87.17 c | 87.71cb | 88.54 ba | 89.31 a | |

Information : Numbers followed by different letters in the same treatment group are significantly different at the 5% level based on the DMRT test.

Based on table 1 above, it can be seen that the effect of fish waste POC has a very significant effect on the average height of corn plants. The highest average in plant height was in treatment L3 (300 ml/plot) which was 91.85 which was significantly different from treatment L2 (200 ml/plot) which was 89.54 which was significantly different from treatment L1 (100 ml/plot) which was 87.48 which was significantly different from treatment L0 (without fish waste POC) which was 83.85 which was the lowest average data on plant height.

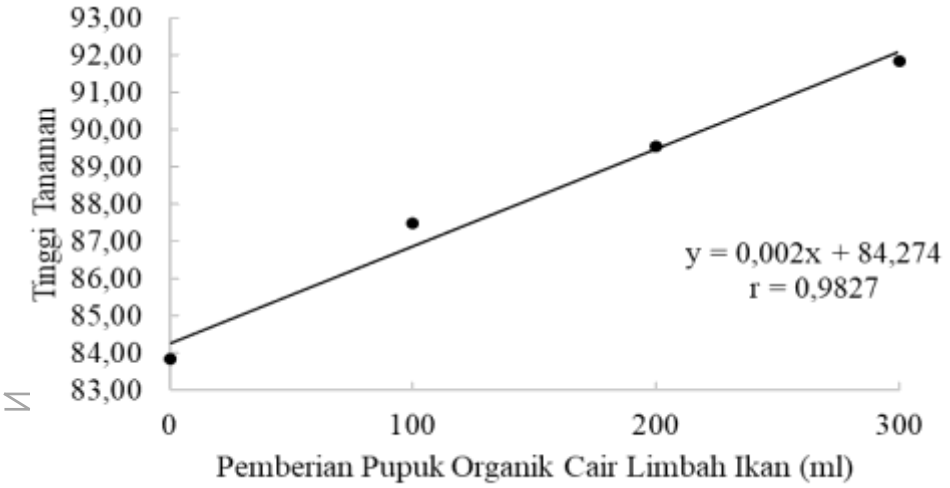


Figure 1. Data graph showing the effect of providing liquid organic fertilizer (POC) from fish waste on plant height at 6 weeks after planting.

Based on Figure 1 above, it shows that the effect of fish waste POC administration has a positive effect on corn plant height. The higher the fish waste POC administration, the higher the corn plant height obtained. Based on the linear results obtained with the equation y: 0.002 x + 84.274 with a correlation coefficient of 98.27%. Corn plant growth is influenced by several general factors, namely internal and external factors (Mayly et al., 2022). Internal factors include the plant's genes, based on the variety/type of corn planted, while external factors include factors surrounding the corn plant itself. One factor that influences plant height is environmental conditions. A favorable environment can accelerate corn plant growth. Ecosystem components consist of abiotic and biotic components that influence plant growth and development (Mayly et al., 2022).

The addition of fish waste organic fertilizer (POC) can increase the nutrients in corn plants due to its content. Furthermore, liquid organic fertilizer is easily absorbed by plants because it is a liquid, allowing the nutrients to be directly absorbed and utilized by the plants. According to Desnataliansyah (2023), liquid organic fertilizer (POC) is an organic fertilizer available in liquid form, containing nutrients in a solution, making it easily absorbed by plants.

Meanwhile, the effect of goat manure fertilizer has a very significant effect on the average height of corn plants. The highest average in plant height in the K3 treatment (3840 g/plot) is 89.31 which is not significantly different in the K2 treatment (2560 g/plot) which is 88.54 which is not significantly different in the K1 treatment (1280 g/plot) which is 87.71 which is not significantly different in the K0 treatment (without organic goat manure fertilizer) which is 87.17 which is the lowest average data on plant height.

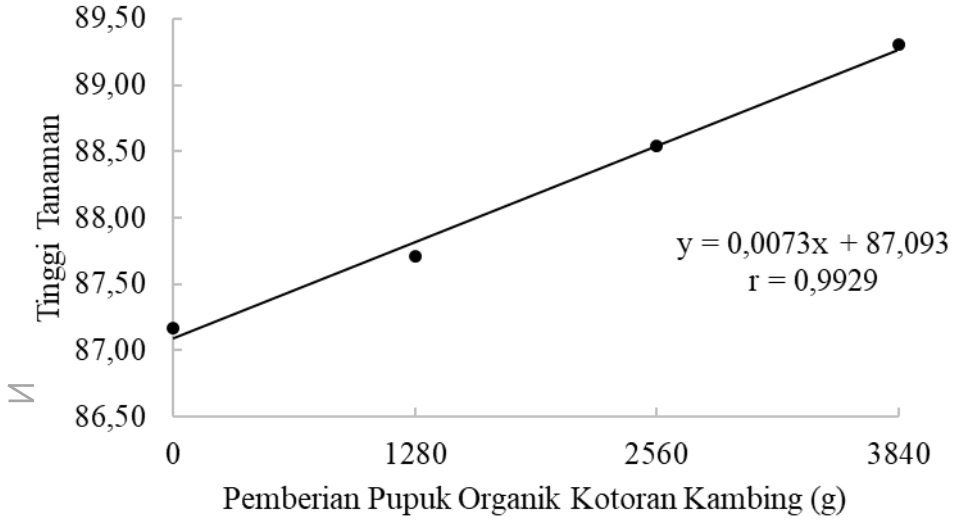


Figure 2. Data graph showing the effect of providing organic goat manure fertilizer on plant height 6 weeks after planting.

Based on Figure 2 above, it shows that the effect of organic goat manure fertilizer has a positive effect on corn plant height. The higher the organic goat manure fertilizer application, the higher the corn plant height obtained. Based on the linear results obtained with the equation y: 0.0073 x + 87.093 with a correlation coefficient of 99.29%. Meanwhile, the interaction effect of fish waste POC and goat manure did not significantly affect the average height of corn plants. The highest average plant height was in the L3K3 treatment (300 ml and 3840 g/plot) which was 93.47, while in the L0K0 treatment (without fish waste POC and goat manure) it was 82.83 which was the lowest average data on plant height.

**Number of leaves (blades)**

From the average number of leaves data, the effect of providing liquid organic fertilizer (POC) from fish waste had a very significant effect and the effect of providing organic fertilizer from campsite manure had a significant effect, while the interaction effect of providing liquid organic fertilizer (POC) from fish waste and goat manure had no significant effect on the growth and production of sweet corn plants.

Table 2. Data on the effect of providing liquid organic fertilizer (POC) from fish waste and goat manure on the number of leaves 6 weeks after planting

| Treatment L | Treatment K | | | | Average |
|---|---|---|---|---|---|
| | K0 | K1 | K2 | K3 | |
| **L0** | 15.00 | 15.00 | 15.08 | 15.25 | 15.08 c |
| **L1** | 15.25 | 15.25 | 15.25 | 15.25 | 15.25 bc |
| **L2** | 15.25 | 15.28 | 15.33 | 15.33 | 15.30 b |
| **L3** | 15.42 | 15.50 | 15.83 | 16,17 | 15.73 a |
| **Average** | 15.23b | 15.26 b | 15.38 ba | 15.50 a | |

Information : Numbers followed by different letters in the same treatment group are significantly different at the 5% level based on the DMRT test.

Based on table 2 above, it can be seen that the effect of fish waste POC has a very significant effect on the average number of corn leaves. The highest average number of leaves was in treatment L3 (300 ml/plot) which was 15.73 which was significantly different from treatment L2 (200 ml/plot) which was 15.30 which was not significantly different from treatment L1 (100 ml/plot) which was 15.25 which was not significantly different from treatment L0 (without fish waste POC) which was 15.08 which was the lowest average data on the number of leaves.

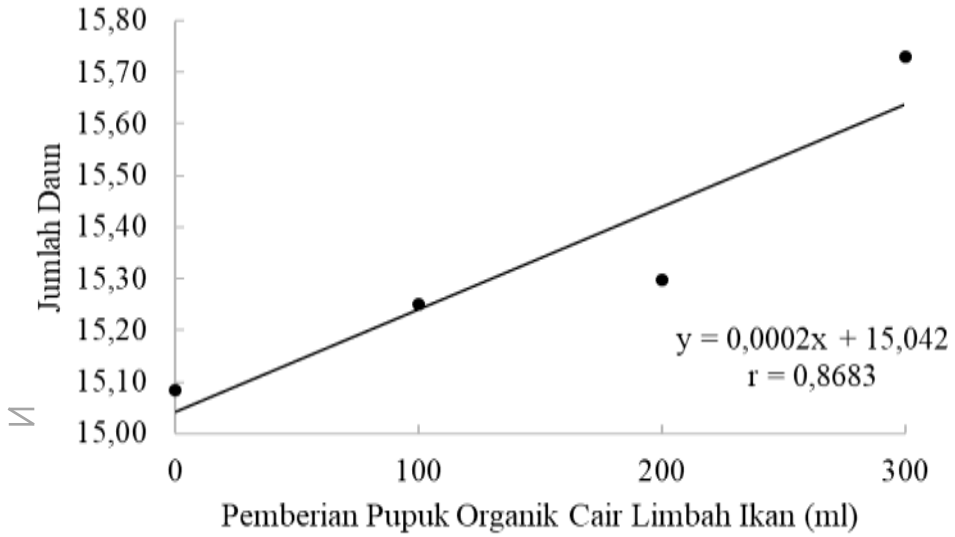


Figure 3. Graph of Average Number of Plant Leaves Data on the Effect of Liquid Organic Fertilizer (POC) from Fish Waste on the Growth and Production of Sweet Corn Plants at 6 WAP.

Based on Figure 3 above, it shows that the effect of providing fish waste POC has a positive effect on the number of corn plant leaves. The higher the fish waste POC application, the higher the number of corn plant leaves obtained. Based on the linear results obtained with the equation y: 0.0002 x + 15.042 with a correlation coefficient of 86.83%. Meanwhile, the effect of goat manure fertilizer significantly affected the average number of corn leaves. The highest average number of leaves was in the K3 treatment (3840 g/plot) which was 15.50 which was not significantly different from the K2 treatment (2560 g/plot) which was 15.38 which was not significantly different from the K1 treatment (1280 g/plot) which was 15.26 which was not significantly different from the K0 treatment (without organic goat manure fertilizer) which was 15.23 which was the lowest average data on the number of leaves.

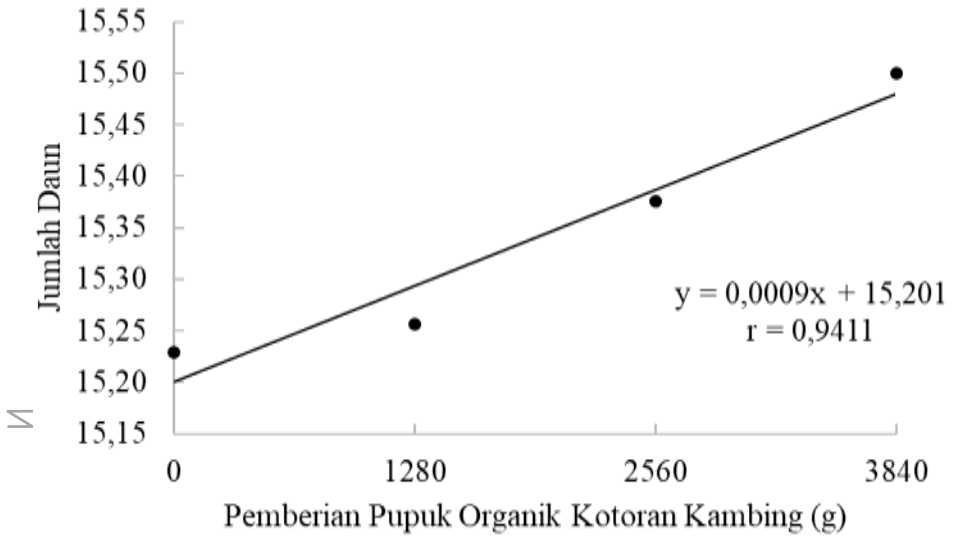


Figure 4. Data graph showing the effect of providing organic goat manure fertilizer on the number of plant leaves 6 weeks after planting.

Based on Figure 4 above, it shows that the effect of providing organic goat manure fertilizer has a positive effect on the number of corn plant leaves. The higher the application of organic goat manure fertilizer, the higher the number of corn plant leaves obtained. Based on the linear results obtained with the equation y: 0.00009 x + 15.201 with a correlation coefficient of 94.11%. Goat manure organic fertilizer is an organic fertilizer in solid form that is excellent for improving the physical and biological properties of the soil because it contains complete nutrients ranging from micro and macro as food for microorganisms so that the movement or activity of microorganisms makes the soil more fertile. According to Ida, 2013. Organic fertilizer can improve the physical properties of the soil such as soil permeability, soil porosity, soil structure, water retention capacity and soil cations (Samah, 2019). Meanwhile, the interaction effect of fish waste POC and goat manure did not significantly affect the average number of corn leaves. The highest average number of leaves was in the L3K3 treatment (300 ml and 3840 g/plot) which was 16.17 while in the L0K0 treatment (without fish waste POC and goat manure) it was 15.00 which was the lowest average data on the number of leaves.

**Weight of Cob Per Plot (g)**

The average cob weight data per plot showed a very significant effect of providing liquid organic fertilizer (POC) from fish waste and a significant effect of providing organic fertilizer from campsite manure, while the interaction effect of providing liquid organic fertilizer (POC) from fish waste and goat manure had no significant effect on the growth and production of sweet corn plants.

Table 3. Data on the effect of providing liquid organic fertilizer (POC) from fish waste and goat manure on the weight of cobs per plot at harvest time

| Treatment L | Treatment K | | | | Average |
|---|---|---|---|---|---|
| | K0 | K1 | K2 | K3 | |
| **L0** | 1626.67 | 1511.33 | 1625.00 | 1651.67 | 1603.67 c |
| **L1** | 1721.67 | 1825.00 | 1850.00 | 1983.33 | 1845.00 c |
| **L2** | 2153.33 | 2276.67 | 2405.00 | 2466.67 | 2325.42 b |
| **L3** | 2516.67 | 2758.33 | 2930.00 | 3561.67 | 2941.67 a |
| **Average** | 2004.58 b | 2092.83 b | 2202.50 ba | 2415.83 a | |

Information : Numbers followed by different letters in the same treatment group are significantly different at the 5% level based on the DMRT test.

Based on table 7 above, it can be seen that the effect of fish waste POC has a very significant effect on the average weight of tuna per plot. The highest average weight of tuna per plot is in treatment L3 (300 ml/plot), namely 2941.67, which is significantly different from treatment L2 (200 ml/plot), namely 2325.42, which is significantly different from treatment L1 (100 ml/plot), namely 1845.00, which is not significantly different from treatment L0 (without fish waste POC), namely 1603.67, which is the lowest average data on tuna weight per plot.

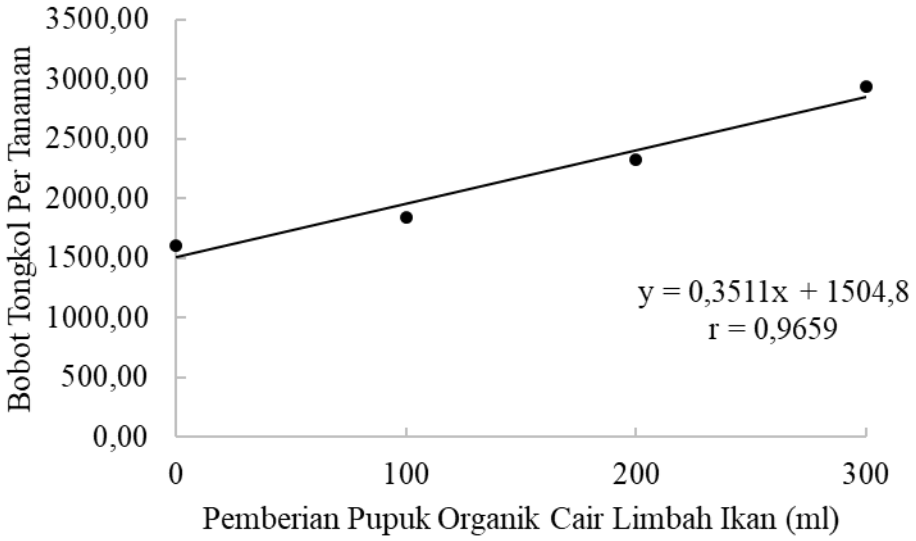


Figure 5. Data graph showing the effect of providing liquid organic fertilizer (POC) from fish waste on the weight of tuna per plot at harvest.

Based on Figure 5 above, it shows that the effect of fish waste POC administration has a positive effect on the weight of corn cobs per plot. The higher the fish waste POC administration, the higher the weight of corn cobs per plot obtained. Based on the linear results obtained with the equation y: 03511 x + 1504.8 with a correlation coefficient of 96.59%. Meanwhile, the effect of goat manure fertilizer significantly affected the average weight of cobs per corn plot. The highest average cob weight per plot was in the K3 treatment (3840 g/plot) which was 2415.83 which was not significantly different from the K2 treatment (2560 g/plot) which was 2202.50 which was not significantly different from the K1 treatment (1280 g/plot) which was 2092.83 which was not significantly different from the K0 treatment (without goat manure organic fertilizer) which was 2004.58 which was the lowest average data on cob weight per plot. The use of organic fertilizer can increase corn plant production as in the research of Reyna, et al., 2020. The use of organic fertilizer can increase the growth and yield variables of corn plants.

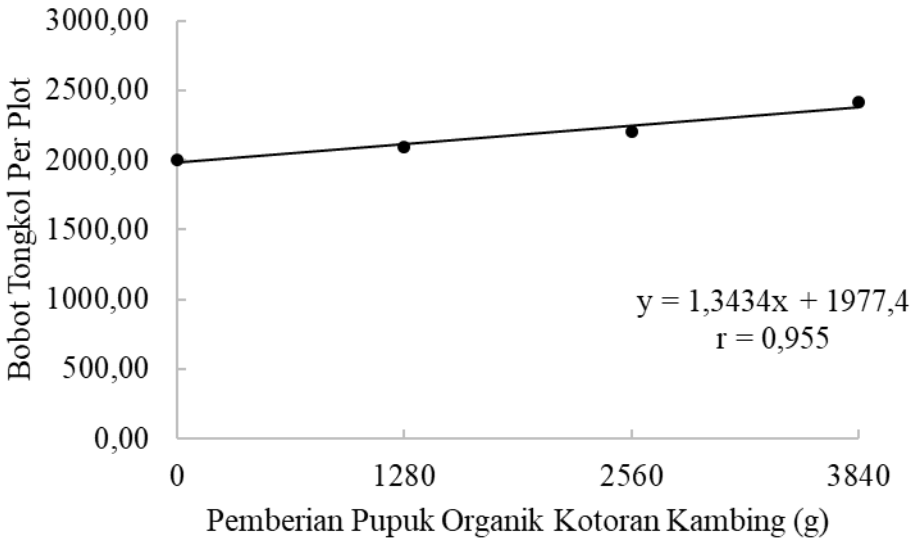


Figure 6. Data graph showing the effect of providing organic goat manure fertilizer on the weight of cobs per plot at harvest time.

Based on Figure 6 above, it shows that the effect of providing organic goat manure fertilizer has a positive effect on the weight of corn cobs per plot. The higher the application of organic goat manure fertilizer, the higher the weight of corn cobs per plot obtained. Based on the linear results obtained with the equation y: 1.3434x + 1977.4 with a correlation coefficient of 95.50%. Meanwhile, the interaction effect of fish waste POC and goat manure had no significant effect on the average weight of corn cobs per plot. The highest average weight of corn cobs per plot was in the L3K3 treatment (300 ml and 3840 g/plot) which was 3561.67, while in the L0K0 treatment (without fish waste POC and goat manure) it was 1626.67 which was the lowest average data on corn cob weight per plot.

The interaction effect of giving fish waste POC and goat manure did not have a significant impact. This happened possibly because both materials are organic materials with the same benefits, namely being able to improve the physical properties of the soil, contributing a small amount of nutrients in the soil in a complete form between micro and macro nutrients, and being able to improve soil biology because it is food for microorganisms in the soil. So the impact caused was not significant between the two organic materials, plus they were planted in inceptisol soil which is a soil that is classified as low soil fertility (Swanda, et., al, 2015).

## Conclusion

The application of liquid organic fertilizer (POC) made from fish waste significantly improved almost all growth and production parameters of sweet corn, while the organic fertilizer from goat manure also significantly improved several key parameters. However, the combination of the two fertilizers did not significantly affect sweet corn growth and production.

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