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Utilization of Liquid Organic Fertilizer of Pineapple Waste to Improving Growth of Sweet Corn Plant in Red Yellow Podsolic Soil

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ABSTRACT
This study aims to determine the effect of pineapple waste liquid organic fertilizer on the growth and yield of sweet corn in Red Yellow Podsolic soil and to obtain a dose of pineapple waste liquid organic fertilizer that can produce the highest growth and yield of sweet corn in Red Yellow Podsolic soil. This study used a completely randomized design (CRD), with 5 treatments repeated 5 times and 3 plant samples. The treatment given was in the form of a dose of liquid organic fertilizer with a dose of: P0 = 0 ml/l water, P1 = 25 ml/l water, P2 = 50 ml/l water, P3 = 75 ml/l water, P4 = 100 ml/l water. The parameters observed in this study were plant height, leaf area, root volume, soil pH, C-Organic content, N, C/N ratio and soil bulk weight. The data obtained were analyzed by fingerprint analysis of variance at the 5% level and then further tested with 5% HSD. Based on the results of the study, the dosage level of liquid organic fertilizer of pineapple waste had a significant effect on the variables of root volume and soil pH. However, it had no significant effect on the variables of plant height, leaf area, organic %C content, %N soil content, C/N ratio, and bulk density of Ultisol soil. The treatment level of liquid organic fertilizer from pineapple plant waste 50 ml/l gave the best results on the variable soil pH, and the dose of liquid organic fertilizer of pineapple plant waste 75 ml/l was the treatment that gave the best results on the variable root volume.

INTRODUCTION

Corn is the most important food crop commodity in Indonesia after rice. Apart from being a food ingredient, corn has many benefits, including as a raw material for the food industry, animal feed, chemical industry, and pharmaceutical industry. In terms of demand for corn for the food, feed and other industrial needs in Indonesia, it is projected that it will continue to increase in line with the increasing population. The amount of corn consumption per capita of the Indonesian population in the period 2014 to 2017 tends to increase, an average of 1.65% per year (Kementan, 2018). However, until now corn production has not been able to meet the needs of the community so the fulfilment of

production still requires additional imports. In 2018 imports of corn in Indonesia reached 72,710 tons. This indicates that national corn production has not been able to meet market demand.

One of the corn products that have good prospects for development is sweet corn. Especially in West Kalimantan, sweet corn production is low. The low corn production is due to the low harvested area. For this reason, it is necessary to increase maize production through extensification and intensification. Extensification is carried out by expanding the planting area or using land that has not been cultivated intensively, such as marginal land, one of which is Red Yellow Podsolic soil. Intensification is emphasized on the use of appropriate technology packages such as the use of high-yielding varieties, inorganic fertilizers, organic fertilizers, and others.

Red Yellow Podsolic soil is one type of soil in West Kalimantan that has potential for maize cultivation. Red Yellow Podsolic is one type of soil in the Ultisol group. The Red Yellow Podsolic soil type is widespread in West Kalimantan, covering an area of around 9.2 million hectares or 64.83% of the total area of West Kalimantan's 14.7 million hectares (BPS, 2017). Red Yellow Podsolic soil is classified as marginal land but has the potential to be developed in the agricultural sector. The nature of this soil has a very low organic matter content, acid soil reaction, low base saturation, high Al content, and low productivity. In addition, it has macro-nutrients such as phosphorus and potassium which are often deficient, thereby inhibiting plant growth (Hardjowigeno, 2003). These characteristics are obstacles in its use as agricultural land but can be overcome by fertilization technology, liming, and organic matter management.

The application of organic matter into the soil can be done by utilizing organic waste originating from agricultural activities which are processed into organic fertilizer, one of which is liquid organic fertilizer. Liquid organic fertilizer is very useful for increasing agricultural production both in quality and quantity, reducing environmental pollution, and sustainably improving land quality. In addition, liquid organic fertilizer contains complete macro and micronutrients. Even though the nutrients are in small amounts, all of their macro and micronutrient needs can be met (Parnata, 2004).

One of the agricultural wastes that can be used as raw material for organic fertilizer is pineapple peel. The largest pineapple producer in West Kalimantan comes from Kubu Raya Regency. Pineapple production in Kab. Kubu Raya in 2016 amounted to 13,298 tons of the total production of pineapple in West Kalimantan which totalled 34,951 tons (BPS, 2017). Until now, waste in the form of pineapple peel has not been utilized. An alternative that can be done in the utilization of the waste is that it can be used as a basic material for making liquid organic fertilizer. Pineapple skin contains 81.72% water; 20.87% crude fibre; 17.53% carbohydrates; 4.41% protein, and 13.65% reducing sugar (Wijana et al., 1991). Given the high content of carbohydrates, sugars and protein, pineapple peel can be used as raw material for making liquid organic fertilizer.

Based on its nutritional content, pineapple peel can be used as an ingredient for making organic fertilizers. Based on the results of research by Salim (2008), organic fertilizer from pineapple peel contains nutrients 0.70% N, 19.98% C, 0.08% S, 0.03% Na, with a pH of 7.9. Tasari's research (2017) on maize cultivation by utilizing pineapple peel as a liquid organic fertilizer gave the best results at a concentration of 32 cc/litre of water for the growth and production of maize. The application of liquid organic fertilizer must pay attention to the concentration or dose applied to plants. Thus, it is necessary to research the use of liquid organic fertilizer derived from the organic waste of pineapple peel which is applied to Ultisol soil. The aims of this study were: (1) to determine the effect of liquid organic fertilizer from pineapple waste on the growth and yield of sweet corn in Red Yellow Podsolic soil, (2) to obtain a dose of liquid organic fertilizer from pineapple waste that could produce the highest growth and yield of sweet corn in Red Yellow Podsolic soil. This research is expected to be able to support the learning process about the concept of organic farming, especially about the use of agricultural waste that is processed into liquid organic fertilizer in the hope of increasing the growth and yield of sweet corn plants.

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METHOD

The research was conducted at the Faculty of Agriculture, Panca Bhakti University, Jl. Komyos Sudarso Pontianak will be held November 2020-January 2021. The materials used were pineapple peel waste, EM4, clean water, granulated sugar, sweet corn seeds of Bonanza F1 variety. The tools used were knife, blender, scale, measuring cup 150 ml, label paper, plastic drum as a container in the process of making organic liquid fertilizer, soil shovel, and sieve.

This study used a Completely Randomized Design (CRD) with 5 treatments. Each treatment consisted of 5 replications and each treatment unit consisted of 3 plants, so a total of 75 plants. The treatment given was in the form of a dose of liquid organic fertilizer given to each polybag that had been prepared. The doses of liquid organic fertilizer used were P0 = 0 ml/l water, P1 = 25 ml/l water, P2 = 50 ml/l water, P3 = 75 ml/l water, P4 = 100 ml/l water.

Research Implementation

1. Manufacture of liquid organic fertilizer with pineapple skin as raw material

Put 24 kg of pineapple peel waste that had been mashed into a plastic drum. Then mix 7.2 kg of granulated sugar, add 3,600 ml of EM4, and 24 litres of water into a plastic drum, then stir well so that it was well mixed, then tightly covered with plastic and allowed to stand for 4 weeks until the ingredients were well fermented. After 4 weeks the solution was marked by the presence of drops of water closed in the fermentation container, the solution smelled, and there was a layer of white fungus on the surface of the solution and on the walls of the container, the liquid organic fertilizer was filtered clean and stored in a closed bottle.

2. Preparation of planting media

The soil taken as a planting medium was red yellow Podsolik soil. Red Yellow Podsolic soil was sifted and weighed 8 kg. Then the soil was put into a polybag. Lime was given 2 weeks before planting. Then the soil was treated with liquid fertilizer by pouring 100 ml of water dissolved in liquid organic fertilizer according to the treatment dose. The soil was incubated for 2 weeks. Soil samples were taken before and after the research for chemical and physical analysis of Ultisol soil.

3. Planting

Planting was done by making a hole as deep as 3 cm. Each polybag was filled with two corn seeds of Bonanza F1 variety. After two weeks, one of the best plants was selected.

4. Maintenance

Watering was carried out every morning using Gembor, from the nursery to the end of the study. When it rains watering was not done. The treatment was given once every 1 (one) week until the age of 35 DAP by pouring liquid organic fertilizer into polybags with a dose according to the treatment of 100 ml. Weeding weeds that grow in polybags was done by pulling them out. Hoarding was done simultaneously with weeding.

5. Research Observations

The variables observed in this study were plant height, leaf area, maximum vegetative root volume, soil pH (before planting and at the end of the study), organic C content, soil N, C/N ratio, and soil bulk weight.

6. Statistical Analysis

The data obtained were analyzed by fingerprint analysis of variance at the 5% level and to determine the difference in the average value between treatments, the Honest Significant Difference (HSD) test was carried out at the 5% significance level ($\alpha = 0.05$).

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RESULTS AND DISCUSSION

Table 1
Recapitulation of Average Observation Results of Effect of Liquid Organic Fertilizer of Pineapple Waste on All Observation Variables

Treatment	Observation Variable							
	Plant Height (cm)	Leaf Area (cm2)	Root Volume (cm3)	Soil pH	C-Organic (%)	N-Ground (%)	C/N Ratio (%)	Filling Weight (gr/cm3)
P0	74.71	191.4	27 a	5.67 b	0.71	0.1	8.65	1.21
P1	81.37	235.46	28 ab	6.09 c	0.59	0.11	6.89	1.33
P2	69.49	265.54	40 bc	5.21 a	0.64	0.11	6.79	1.17
P3	66.77	185.95	24 a	5.32 b	0.65	0.11	7.03	1.11
P4	66,80	168.52	14 a	5.32 b	0.68	0.14	5.26	1.38
Influence	ns	ns	*	*	ns	ns	ns	ns

*Note: * = Significantly influential, ns = not significant.*
Values in the same column followed by the same letters indicate that the treatment is not significantly different at the 5% BNJ test level.

The results showed that the dose of pineapple waste liquid organic fertilizer treatment on all observation variables showed that the pineapple waste liquid organic fertilizer dose had a significant effect on root volume and soil pH variables. Meanwhile, the variables of plant height, leaf area, C-organic content, N content, C/N ratio, and soil mass had no significant effect on the treatment given.

In general, sweet corn plants experience obstacles in their growth. This can be seen from the average height of sweet corn plants which are generally low. Liquid organic fertilizer treatment of pineapple waste did not increase plant height. This is because the nutrient content in liquid organic fertilizer has not been able to meet the nutrient needs of sweet corn during its growth.

Nutrients N, P, K are macronutrients that are needed by plants, especially in the vegetative phase. According to Hidayati (2009), N, P, K are needed for plant growth, especially in stimulating the formation of plant height and enlargement of stem diameter. Nitrogen is a component associated with high photosynthetic activity, strong vegetative growth and dark green colour on the leaves (Ademiluyi & Fabiyi, 2015). This is supported by Damanik et al. (2011) who stated that nitrogen is very important for the formation of protein, leaves and various other organic compounds. According to Lakitan (2008), phosphorus plays a role in photosynthesis, respiration and plant metabolism to encourage the rate of plant growth, and potassium acts as an activator of various enzymes that are important in photosynthesis and respiration reactions. The application of fertilizer must be in the right dose to meet the nutrient needs of the plant to grow and develop properly.

Corn plant height had no significant effect on the liquid organic fertilizer dose of pineapple waste, also due to the slow nature of organic fertilizer available to plants and low nutrient content. This is following Damanik et al. (2011) which stated that the weaknesses of organic fertilizers are as follows: (1) low nutrient content; (2) relatively difficult to obtain in large quantities; (3) slowly available to plants; and (4) transportation and application is expensive because it is needed in large quantities.

In addition to plant height, determining the growth of a plant can be seen from the leaf area which is also a component of growth. This leaf area parameter can give an idea about the process and rate of photosynthesis in a plant. In this study, the liquid organic fertilizer dose of pineapple waste had no significant effect on the leaf area of sweet corn plants. This is due to the low nutrient content so it is not able to meet plant nutrients. Irsyad and Kastono (2019) stated that one of the most important factors in plant vegetative growth is the presence of nitrogen (N). The element N is needed by plants, one of which is as a constituent of chlorophyll. Nutrients that are fulfilled cause plant growth to be

maximized so that the photosynthesis process takes place well and optimizes the formation of chlorophyll (Siregar, 2017). The more the amount of chlorophyll, the photosynthesis will run smoothly in the presence of sufficient sunlight intensity. However, if N is not sufficient, it will indirectly reduce the leaf area of the plant.

In soils with N content below 0.4%, fertilizers containing N are given to support plant growth. In this study, the soil N content at the end of the study was low in each treatment successively, namely P0 = 0.10%, P1 = 0.11%, P2 = 0.11%, P3 = 0.11%, and P4 = 0.14 %. In addition, the total N content in the liquid organic fertilizer of pineapple waste was very low at 0.06%. Irsyad and Kastono (2019) suggested that organic fertilizers should be combined with inorganic fertilizers. Often, the macronutrient content in organic fertilizers is too low so that it is not able to meet plant nutrients.

Liquid organic fertilizer of pineapple waste had a significant effect on the root volume. The growth of the root system was a response to differences in soil nutrient concentrations so that the root density was the highest. The dose of liquid organic fertilizer made the maximum root volume. This increase was influenced by an improvement in the structure of the physical properties of the soil due to the content of organic matter from the addition of organic fertilizer so that the O_2 diffusion process or aeration will occur more so that the physiological process of roots is better (Setyorini et al., 2006). In addition, it is suspected that the root volume was influenced by environmental factors, especially soil conditions that cause plant root growth to be good so that the penetration power of roots into the soil becomes large. One of the environmental factors that affect was the availability of water for plants that have been met so that it affects the increase in root volume. The application of organic fertilizer to the soil will produce a deep root system and a good root process (Saputra et al., 2017).

The provision of liquid organic fertilizer of pineapple plant waste had a significant effect on soil pH. Based on the results of the study, it was found that there was a decrease in soil pH due to the use of liquid organic fertilizer of pineapple plant waste containing organic matter. According to Mukhlis et al. (2011), the application of organic matter can increase the pH value of the soil because organic matter can chelate Al^{3+} metal, so there is no Al^{3+} hydrolysis reaction, wherefrom the Al^{3+} hydrolysis reaction 3 H^{+} ions are produced which can acidify the soil. According to Bunga and Lewar (2008) that organic fertilizer by sprinkling into the soil is the addition of plant nutrients into the soil so that the soil is richer in nutrients and fertile.

Liquid organic fertilizer administration of pineapple plant waste had no significant effect on the weight of organic C content, soil nitrogen, soil C/N ratio, and bulk density. The addition of organic matter was directly proportional to the increase in soil C-Organic. The increase in soil pH is closely related to the decomposition process of organic acids given through the liquid organic fertilizer of pineapple plant waste. However, in this study, the results obtained showed that the application of organic matter through the liquid organic fertilizer of pineapple plant waste was not able to increase the organic C content in the soil.

Soil nitrogen content at the end of the study was low and showed no significant effect on the treatment given. This is because, in addition to the low N content of the soil, the N content of the fertilizer is low. On the other hand, nitrogen is easily lost by evaporation and carried by water through percolation. According to Parnata (2004), with the provision of organic fertilizers, these nutrients will be bound by organic matter so that they can be available to plants.

The soil C/N ratio at the end of the study showed no significant effect on the liquid organic fertilizer dose of pineapple waste. The quality of organic fertilizers is largely determined by the magnitude of the ratio between the amount of carbon and nitrogen (C/N ratio). If the C/N ratio is high, it means that the ingredients for organic fertilizer have not been completely decomposed. Based on the results of this study, the application of liquid organic fertilizer incubated for 2 weeks had shown a low C/N ratio in each treatment given, namely P0 = 8.65%, P1 = 6.89%, P2 = 6.69%, P3 = 7.03% and P4 = 5.26%.

According to Novizan (2007), if the C/N ratio has reached 12-20, it means that the nutrients have been released through the mineralization process so that they can be used by plants. In addition, the determining factor for the value of the C/N ratio is the length of fermentation. In this study, the length of fermentation was carried out within 2 weeks. According to Setyorini et al. (2001), the higher the C/N ratio, the longer the organic matter reform process will take. The density of the soil is an important thing in analyzing the physical properties of the soil because it will affect the porosity of the soil, water movement, air circulation and the movement of plant roots (Puja, 2008).

Soil density at the end of the study showed no significant effect on the liquid organic fertilizer dose of pineapple waste. Based on the results of this study, the administration of liquid organic fertilizer of pineapple waste showed the weight of the soil for each treatment given, namely P0 = 1.21 g/cm^3, P1 = 1.33 g/cm^3, P2 = 1.17 g/cm^3, P3 = 1.11 g/cm^3, and P4 = 1.38 g/cm^3. This was due to differences in the organic matter content of each treatment. Hakim et. al. (1986) stated that soils with organic matter content had a lower density than soils with lower organic matter content. In addition, bulk density is also influenced by the content of organic matter and the level of soil density where the higher the organic matter, the lower the bulk density and this applies vice versa at level soil density, Dense soil will have a high density. This could be seen in the high density of soil in the liquid organic fertilizer treatment with the highest dose of P5 = 1.38 g/cm^3.

CONCLUSIONS

The dose treatment of pineapple waste liquid organic fertilizer could not increase plant height, leaf area, organic %C content, soil %N content, C/N ratio and bulk density of Ultisol soil. The dose treatment of pineapple plant waste liquid organic fertilizer 50 ml/l was the treatment that gave the best results on the soil pH parameter, and the 75ml/l dose of pineapple plant waste liquid organic fertilizer was the treatment that gave the best results on the root volume parameter.

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