THE EFFECT OF THE COMBINATION OF PALM OIL WASTE FACTORY (LPKS) AND CATTLE WASTE (LTS) IN SOLID-LIQUID AND LIQUID-SOLID OF SWEET CORN PLANTS (*Zea mays* Saccharata L)

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The research was carried out in Sei Mecirim Village, Sunggal Subdistrict, Deli Serdang, with an altitude of ± 400 meters above sea level. The research was conducted from February to March 2017. The research was entitled "Combination Effects of Palm Oil Waste Factory (LPKS) and Cattle Waste (LTS) in Solid-Liquid and Liquid-Solid of Sweet Corn Plants (Zea mays saccharata. Strut)". This research used Factorial Randomized Group Design (RBD) with Factor I was LPKS Combination: LTS symbol (P) consisted of P1: Solid-Liquid and P2: Liquid-Solid. Factor II was Percentage of LPKS combination: LTS symbol (C) consisted of C1: (100%: 0%), C2 (70%: 30%), C3 (50%: 50%), C4 (30%: 70%), C5 (0%: 100%), with 10 combination treatments and 3 replications. The results of the research carried out with the difference in substitution of Solid LPKS with Liquid LPS compared to Liquid LPKS with Solid LTS had a significant effect on the growth and production of sweet corn. To get the best growth and production was to use a combination of 70% LPKS with 30% LPTS (S3).

Keywords: Sweet corn, combination, LPKS, LTS, Solid, Liquid

INTRODUCTION

BACKGROUND

The origin of corn plants originated from America known thousands of years ago. Subsequently, it expanded to Mexico, Central America, and South America as well as to Spain, Portugal, France, Italy, and northern Africa. And finally, it developed in Indonesia in several regions (for example in Madura and Nusa Tenggara) so that in several regions, corn was a staple food (Amelinda, 2009).

Sweet corn has long been known to be brought by Indians and Americans. This was proven in 1779. In their journey through the river, they found sweet corn fields. In 1832, sweet corn was widely planted in America. In Indonesia, sweet corn was initially known in cans from imported products. Furthermore, it developed until being sold in supermarkets where sweet corn plants are endeavoured extensively due to the increasing of capacity and users (Writer Team, 1996).

The sugar level of sweet corn is relatively high and can be used as food ingredients, as an additive for medicines, and important ingredients for animal feed ingredients (Harizammry, 2007).

Corn production in Indonesia is still relatively low and one of the factors is the soil fertility factor where currently there is a lack of nutrients which is available. Decreased elements in the soil are caused by continuous usage of inorganic fertilizers and inappropriate usage of inorganic

pesticides. Efforts to repair the land is through fertilization, especially using fertilizers from organic matter. Giving organic fertilizer is one of the benefits that functions as an addition to soil nutrient materials as well as improving the physical, chemical and biological properties of the soil (Suntoro, 2003).

Organic fertilizers originating from cattle waste (solid such as feces and liquid such as urine) are often found wasted and their usages are still lacking by farmers. Therefore, it is necessary to inform the farmers about the usage of organic fertilizers such as cattle waste. Organic material originating from animal waste is often found is mature cow waste. The usage of immature cow waste can cause plants to die (Setiawan, 2008).

The supply of cow waste is obtained from farmers, especially its development from cow cattle farms in the North Sumatra Province for the past 5 (five) years, there has been a rapid population increased with an average annual population increased is 10.37%. The population of cow cattle in 2011 was 541,698 (Livestock Statistics, 2012). The feces production of a mature cow is 4,000 kg and the urine is 1000 litre/year so it is very potential to be used as the base for making organic fertilizers.

Organic fertilizers that have not been widely used and available are waste originating from palm oil factory. The waste from the palm oil factory is the solid and liquid waste that is obtained from the factory at hazardous waste disposal and is harmless after passing the latest process. Palm oil factory (LPKS) still contains a lot of nutrients needed by plants and increases nutrient availability in the soil.

The availability of nutrients in organic fertilizers can be more quickly decomposed and increases nutrient availability by fermentation with the addition of bio-activators. Various types of bio-activators have been available to help the fermentation process to change from not available to be available. This is because bio-activators contain lignolytic, hemicellulolytic, proteolytic and non-symbiotic nitrogen fixation bacteria to accelerate the decomposition of organic waste into organic fertilizers (Indriani, 2012).

RESEARCH METHOD

In this study, it was carried out using Factorial Randomized Block Design (RBD) with 10 substitution treatments and 3 replications. Factor I is a combination (P) consisting of P1 = Solid LPKS with Liquid LTS and P2 = Liquid LPKS with solid LTS. Factor II is the percentage of mixed combinations.

Substitution treatments for organic fertilizer used such as:

Combination of LP-PKS dan LPTS	LPKS (%)	LTS (%)
C1	100	0
C2	70	30
C3	50	50
C4	30	70
C5	0	100

RESEARCH IMPLEMENTATION

The materials which were used were Palm Oil Factory Waste (solid and liquid LPKS), Cattle Waste (solid and liquid LTS) and fermented using EM4 bio-activator. Making organic fertilizers with substitution fermentation (mixture) according to the treatment added with EM4 bio-activator at a dose of 0.25% and was stirred until homogeneous. Then, put it into the drum until full, close it tightly in an anaerobic state and tightly closed for 3 weeks. Fermented results were ready to be applied to corn plants in the field.

The research land was cleaned up from weeds and other plant remnants. Then, the soil was processed with hoes as deep as 10 cm. Next, the soil was scratched so that the surface became flat and was followed by making plots.

Fertilization was carried out at the time of planting using fermented fertilizers according to the treatment. Fertilization was carried out by way of planting in the planting hole which would be planted with 3 cm deep corn seeds with a spacing of 50 cm x 25 cm. Sweet corn seeds were planted with Tugal method by planting 3 seeds in each planting holes. Planting was carried out a week after planting so that the growth of plants was not hampered and continued simultaneously. The plants that were replaced were dead plants and abnormal growth plants.

Weeding sweet corn plants were carried out based on the condition of weeds around the planting and the soaring was done at the age of 3 weeks after planting. This aimed to close the open roots and make the growth of plants erect or sturdy by raising / hoarding soil on plant grass.

Harvesting sweet corn was done during the mature phase of milk and flour or about 14-21 days after the hair part of the female flower on the corn appeared. The hair had a brownish and yellowish brown colour, the seeds had fully developed to the tip of the cob and had the maximum size and condition of soft seeds filled with liquid like milk.

The parameters observed were plant height (cm), stem diameter (cm), production per sample (gr) and per-Ha production (tons).

RESEARCH RESULTS

The results calculation of the average effect of combination organic fertilizers derived from palm oil factory (LPKS) and cattle waste (LTS) which were carried out in the field towards the growth until it harvested and the observation results of each parameter were statistically analysed and when obtaining a Variety Investigation List significantly different, then it was proceeded to the test of the average Duncan Multiple Rang Test (BMRT).

The differences in the observation results and statistical analysis of each parameter that was tested could be seen as followed:

Plant Height (cm)

The growth parameters of corn plant height were carried out 3 times (2, 4 and 6 mst). The analysis results of the measurement data that were obtained from the effect of the combination form (P) and the combination of waste mixtures (LPKS and LTS) could be seen in Table 1.

Table 1. The average height of corn plants (cm) from the effect of the combination of LPKS mixtures with LTS at 2, 4 and 6 weeks after planting.

Treatment	2 mst	4 mst	6 mst
Mixture of LPKS : LTS (P)			
P1 (Solid:Liquid)	30.88a	77.17a	186.79a
P2 (Liquid:Solid)	30.61a	75.59a	176.37a
Combination percentage (C)			
C1 (100:0)	30.83a	82.33a	186.66a
C2 (70:30)	29.33a	80.80a	183.49a
C3 (50:50)	30.81a	73.29a	183.51a
C4 (30:70)	31.63a	74.94a	182.02a
C5 (0:100)	31.10a	70.56a	172.21a

Note: The letters in the same column are not significantly different at 5%

Plant height during each growth (Table 1) with the effect of the combination form (P) shows no significant difference ($p > 0.05$) for each measurement (2, 4 and 6 mst). Although the difference was not real, the mixture of solid LPKS with liquid LTS (P1) averaged 186.79 cm at 6 mst, higher than the Solid-Liquid (P2) on average 136.37 cm. Likewise, the effect had no significant effect ($p > 0.05$) on each measurement (2, 4 and 6 mst). The highest planting height was obtained at the usage of 100% LPKS (C1) with the usage of 100% LTS (C5) with the lowest plant height.

Production

Sweet corn production included weight/sample (g/ear), production (ton/ha), and ear diameter (cm). The observation results and the measurement that the effect of the combination of LP-KS: LC-TS

(P1) and LCP-KS: LP-TS (P2) showed a significant difference ($p < 0.05$) on production (ton/ha), whereas the difference was not significant for production (g/sample) and ear diameter (cm). The average production and ear diameter could be seen in Table 2.

Table 2. Average production (g/sample and ton/ha) and ear diameter (cm) of sweet corn of the effect of the combination of LPKS and LTS at harvest time.

Treatment	Production (g/sample)	Production (ton/ha)	Ear Diameter (cm)
Combination form (P)			
P1 (Solid:Liquid)	125.90a	8.93a	4.57a
P2 (Liquid:Solid)	124.06a	7.65b	4.56a
LPKS : LTS (C)			
C1 (100:0)	136.57a	9.18a	4.87a
C2 (70:30)	135.97a	9.23a	4.52a
C3 (50:50)	123.11ab	8.15ab	4.47a
C4 (30:70)	121.84ab	7.46b	4.48a
C5 (0:100)	107.40b	7.43b	4.48a

Note: The letters in the same column are not significantly different at 5%

Table 2. shows that production (g/sample) is not significantly different, but the mixed form of LPPKS + LCTS (P1) averages 125.90 g/sample, higher than the mixture of LCPKS + LPTS (P2) on average 124.06 g/sample. The analysis showed that the highest production of sweet corn was produced by a mixture of 70% LPKS with 30% LTS (C2) with an average of 9.23 tons/ha with no significant difference to C1, C3 and C4, but significantly different from C5 (the lowest production average of 7.43 tons/ha). The percentage effect (C) on production (ton/ha) gave a significant difference with the highest production of 9.23 tons/ha, but it significantly did not differ from C1 and C3 and significantly differed from C4 and C5. From the results, the lowest percentage of mixture production was produced with 100% LTS (C5) with an average of 107.40 g/sample or 7.43 tons/ha.

The diameter of sweet corn ears (Table 2) with the statistical analysis results shows no significant difference ($p > 0.05$) both the usage of a mixture of solid-liquid and liquid-solid (P) with a diameter of P1 and P2 approaching the same while the combination percentage (C), ear diameter with the usage of 100% LPKS (C1) on average 4.87 cm was the highest while the lowest was produced using 100% LTS (C5) and 70% LPKS with 30% LTS (C4) averaging 4.48 cm.

Analysis of Organic Fertilizer Nutrients

The results of sample analysis for each combination treatment of organic fertilizer which gave a percentage of nutrients were varied (Table 3).

The most nutrient obtained in the combination of LPKS with LTS in Solid-liquid (P1) compared to the Organic C nutrients, P2O5 and K2O compared to the Liquid-Solid (P2) combination while the total of N-nutrients was produced on P2.

Table 3. Average nutrients of organic fertilizers combined with LPKS and LTS (%).

Perlakuan	C-Organik	N-Total	P2O5	K2O
Bentuk Campuran LPKS + LTS (P)				
P1 (Padat:Cair)	27.51	0.31	0.24	0.43
P2 (Cair:Padat)	24.19	0.38	0.14	0.36
Persentase campuran (C) LPKS : LTS				
C1 (100:00)	31.68	0.41	0.25	0.17
C2 (70:30)	34.18	0.41	0.19	0.34
C3 (50:50)	18.83	0.24	0.14	0.25
C4 (30:70)	19.93	0.24	0.09	0.44
C5 (0:100)	15.23	0.12	0.22	0.66

Note: Analysis results of the Proximate Laboratory of North Sumatra BPTP 2018

From table 3, it can be seen that the usage of the mixtures of LPKS with LTS in solid-liquid (P1) compared to liquid-solid (P2) gives nutrients with P1> P2, except for N-Total nutrients while P2O5, K2O, and Organic C were P1> P2. The different percentage combination influenced nutrients. It could be seen that the mixture of 70% LPKS with 30% LTS (C2) gave the highest nutrient in C-Organic and P2O5 on average 34.11% and 0.25%, respectively when the total of N-nutrients in C1 and C2 were on average 0.41%. K2O was obtained at 100% LTS (C5). The decreasing percentage of LTS affected the C-organic nutrient, N-total, P2O5 decreased, except the increasing of K2O nutrients.

Correlation

Many nutrients affected the production per unit area, the nutrient content in organic fertilizers (the mixture percentage of LPKS and LTS fertilizers) from the analysis results obtained that C-Organic nutrients affected most of the production. Besides, K2O took a role in its influence on sweet corn production (Table 4) with r = 0.92 for C-organic and r = 0.85 for P2O5. From Table 4, it can also be seen that P2O5 and N-Total had less role in productivity which was seen with r = 0.56 and r = 0.76 (Table 4).

Table 4. Average of Nutrient Correlation of combined organic fertilizers towards Production (ton/ha)

Ŷ	a	B	r
C-Organic	5.54	0.11	0.92
N-Total	5.91	5.48	0.76
P2O5	8.06	0.054	0.56
K2O	10.26	-4.435	0.85

Note: The results of analysis regression between nutrient of organic fertilizer (%) with production (tons/ha)

DISCUSSION

From the data observations and statistical analysis, it was found that the effect of the combination treatment of forming organic fertilizer from a mixture of Solid Palm Oil Waste (LP-PKS) with Liquid Cattle Waste (LC-TS) as (P1) and LC-PKS with LP-TS (P2) gave no significant effect ($p > 0.05$) on the growth of plant height (cm), production (kg/sample and ton/ha) and ear diameter (cm).

The effect of organic fertilizer mixing on different parameters was not evident and it was assumed that the higher percentage of nutrient from the two mixed forms of LPPKS + LCTS (P1) and LCPKS + LPTS (P2), then it closed so that nutrient elements found in the soil can be used by corn plants. Availability of nutrients in the soil through proper fertilization during the growth and development of the plant resulted in the activation of plant roots and the addition of nutrients so that nutrients could be absorbed from the roots of the plant from the soil.

The effect percentage of the mixture of the organic ingredients (C) gave a significantly different effect ($p < 0.05$) on corn production. The percentage transformation of the mixture would affect changes in the nutrient of fertilizers which contributed to growth and production. The total N-nutrient was obtained from the mixture percentage was each treatment (C) which was quite high and reached 0.41%. This is better than the analysis results in the soil without fertilization by Yu, et al. (2011) who stated that generally, the nutrient of nitrogen in wet soil was 0.15% and in dry land was 0.12%.

Opinion Lingga (2003) stated that the provision of more nutrient-containing fertilizers needed to be done based on the nutrient of the fertilizer, the concentration, and mixture of organic fertilizers. Organic fertilizers in a percentage mixture of waste into organic fertilizer can increase the activity of microorganisms in the soil and thereby helping to decompose organic materials and make them available to plants. As it is known that this organic fertilizer is rich in microorganisms in the soil. The same opinion was said by Hasibuan (2006) that the growth and life of microorganisms would be hampered and disturbed if there was a shortage of organic matter and other nutrients in the soil. Besides that, Hasibuan (2006) stated that organic fertilizers had an important role such as

increasing levels of topsoil in the soil and could prevent Al and Fe poisoning in acid-reacting soils. This can be maintained if the fertilizer is given continuously.

Apart from getting additional nutrients, compound fertilizers have other properties that are beneficial for plants. Decomposition of plant material, microorganisms, and soluble potassium re-enter into the soil (Maruapey, 2012).

Organic fertilizer from a combination of LPKS with LTS causes a difference in nutrient as well as the sweet corn production. This is due to the tested organic fertilizer was being able to add nutrients in the soil and is sufficient for the development of corn plants. One of the factors is more dominant than other factors so that other factors will be covered and not affect the plants(Suriatiyah, 2009).

Availability of nutrients in the soil during growth and production is not the same. Provision of fertilizers should be given to the amount needed by plants when plants need to produce better growth (Almodares et al, 2006).

Setiadi (2000) reported that one of the limiting factors in plant growth and development is the absorption of essential nutrients. The process of the plant growth in absorbing nutrients in the metabolic process such as cell growth that can be fulfilled, means that the availability of food for growth is increasing.

The main nutrient in influencing the production of corn in this study is the C-Organic element and the percentage of K2O. Both of these elements give a Correlation towards Production in table 4.

Soil organic plays an important role in increasing and maintaining chemical fertility, physics, physical chemistry, and soil biology which will determine the plant productivity and the sustainability of land usage for agriculture (Ding et al. 2002). The nutrient of soil organic is quite important for plants on acidic dry land.

The usage of fertilizers as an effort to increase the production of corn that has been cultivated by farmers has assumed that fertilizers and fertilization methods are one of the things that cannot be separated in their farming activities (Anonim, 2007).

Giving organic fertilizer has advantages compared to inorganic fertilizers because, in the organic fertilizers, there are hormones, N-fixing microbes, and P & K solvents which are very necessary for plants for the growth and production. (Lingga, P., and Marsono. 2004; Anonim, 2010).

The availability of nutrient in various mixture percentages into organic fertilizers provides the potassium elements which are needed by these plants. This is proven by the potassium correlation to production. This is in accordance with the opinion of Marsono (2001) who stated that potassium played a role in plant growth and development. Plants that have enough potassium will be able to grow well and cause better absorption of water and nutrients. Novizan (2002) stated that

elements of potassium were needed by plants in the synthesis of proteins, carbohydrates, and translocation of carbohydrates to be more smoothly.

Potassium plays an important role in plant growth, especially during the maturation of plants because it affects photosynthesis in the formation of chlorophyll, filling seeds and essential in carbohydrate formation (Suminarti, 2011). One of the potassium which is known well is KCl. KCl fertilizers which are known so far are mostly mining products (Marsono and Sigit, 2002). Potassium which is contained in plants in cation k + plays an important role in respiration and photosynthesis. Potassium can also increase the sugar level (Taiz and Zeiger, 2002). Potassium is very important for the growth and development of the corn. Approximately, 25% of potassium is found in corn kernels after harvesting and the rest of them are found in the stem and ear. This is in line with the results of research that young plants do not need too much potassium, but the needs will rise quickly, especially during the eve of panicle released (PS Writing Team, 2002).

CONCLUSION

- The usage of organic fertilizers from a mixture of LPKS with LTS (solid-liquid or liquid-solid) has the same effect on the growth and production of sweet corn plants.
- Percentage of mixture for C2 with LPKS and LTS was 70: 30 by producing the highest production.

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