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Impact of Oil Palm Solid Waste and Cow Cattle Waste Fertilizers to Growth and Productions of Sweet Corn (*Zea mays saccharata* L)

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ABSTRACT

The research of using fertilizers of solid oil palm leftovers with cow cattle waste to growing and producing of sweet corn had completely done. The research was carried out in Sei Mencirim Village, Sunggal Sub-district, Deli Serdang, North Sumatra, April - September 2019. The purpose of the study was to see the impact of combination of solid oil palm waste (SOPW) with Solid Cow Cattle Waste (SCCW) to growth and productions of sweet corns. Randomized Factorial Group Design was used with 12 treatments and 3 replications, factor I: combinations of SOPW and SCCW, symbol "C" in three measures: C1 (100% SOPW), C2 (50% SOPW + 50% SCCW) and C3 (100% SCCW); Factor II: the doses of the fertilizers, symbol "D" in 4 stages: D0 (control), D1 (5 ton/ha), C2 (10 ton/ha), D3 (15 ton/ha). The data obtained were analyzed by Duncan's Multiple Range Test (DMRT), The size of each plot was 2 m x 1.5 m. Result of the study shown, there is a significant difference ($p < 0.05$) of plants height (cm), stems' diameter (mm), leafs' wide (cm2), cobs diameter (cm), production per sample (g) and total production (ton/ha) by the effects of using combination of solid oil palm waste (SOPW) with solid cow cattle waste (SCCW) to growth and productions of sweet corns.The combination of 50% SOPW and 50% SCCW (C2) was the best and the field trial had shown that the amount of 10 tons/ ha (D2) of the fertilizers produced 6.77 tons of sweet corn.

Keywords: Oil Palm Waste, Cow Cattle Waste, Productions, Sweet corn

INTRODUCTION

Corn (Zea mays L) is one of the essential plants in the world and it is just in the third position after rice and wheat. In Central and South America, it is used as the main carbohydrate resource, while in the United States of America it is used as alternative animal feeds. Similarly in other countries such as South Benin that oil palm is a commercial crop and is planted by many families and plays a role in social culture (Adegbola et al., 2009). Corn is used as a staple food in Indonesia, especially in the East, where the rainy season is shorter and hotter than in the West. For Example Madura and East Nusa Tenggara regions most corn local people's main food. However, those corn waste is just thrown away even though it is in a cattle farming center in Indonesia. Most of the corn production in East Java is used as raw material for poultry feed. The corn products and its waste can be used for animal feed (Ardiana, et al. 2015). It looks different when compared with the region of Gorontalo province, where most corn is processed to produce oil and flour for industrial raw materials (Amelinda, 2009). Even so, the significant oil production in Indonesia is from the oil palm.

The wide of oil palm plantation is continuingly rising in the country. Directorate General of Plantation, the Ministry of Agriculture (2015) noted that the wide of oil palm plantation is 33.500.691 ha with 11.300.370 ha of which had been produced. From that amount, Sumatera is 7.139.060 ha, Java is 33.578 ha, Kalimantan is 3.639.737 ha, Sulawesi is 370.675 ha, and Maluku and Papua is 117.320 ha

Within the Island of Sumatra, North Sumatra producing fresh fruit bunches approximately 6 million tons (BPS, 2014), resulting in a sizeable foreign exchange income. However, the oil palm factories also produce Chemical Oxygen Demand (BOD) and Biochemical Oxygen Demand (BOD) waste which is detrimental to the surrounding community. The waste of the industries is in solid and liquid form or Palm Oil Mill Effluent (POME). Generally, such waste is used as basic ingredients of organic fertilizer, because of its high organic things.

The solids oil palm waste (SOPW) had nutrients of N, P, K, Mg and Ca that useful for oil palm growth in the seedling. Panjaitan (2010) studied the seedlings of oil palm and found out that SOPW had a significant impact on the height, stem diameter, leaf amount, and wide of the leaves. Utomo and Widjaja (2004), stated that the SOPW had 81,65% of dry materials, 12,63% of crude protein; 9,98% of crude fiber; 7,12% of crude fat; 0,03% of calcium; 0,003% of phosphor; 5,25% of hemicellulose; 26,35% of cellulose and 3454 kilocalories/kg of energy. The SOPW had the least phosphors, therefore needed to add with external phosphors to meet the needs of plants. In the soil, the phosphor is not mobile nutrient, some bounds by soil particles, and in the small amount is available for the plants. Tambunan (2016) added, the length increment of the leaves shown the increase of the protoplasm as the effect of size and amount of cells. The availability of N, P and K can be increased amount of chlorophyll of the plant, and the activities of photosynthesis are also increased to produce more assimilate to support length growth of the plant’s leaves.

The integrations of oil palm and livestock particularly cows also found in North Sumatera. Setiawan (2016) pointed out that the development of beef cattle farms recently in North Sumatra is upsurge in average of 10,37%. The population of beef cattle in 2014 was 647 thousand (Setiawan, 2016). The cattle are not only source of meat for people but also produce liquid waste that is potentially used as organic fertilizers (Amelinda, 2009).

According to Rao (1991), soil could be enriched by application of higher amount of organic materials that tends to decompose large amounts of nitrogen into the soil before planting each fresh crop to boost yield. Also Maharani. (2017) share the same ideas and adviced the use of higher levels of organic manures. The use of compost with manure or not improves plant yield. This was explained by the richness of palm oil mill wastes in nitrogen and potassium. Despite its richness, it is important to add manure for its fast and best mineralization.

Each kind of waste has different nutrient content and advantages respectively. Both kinds of waste, therefore, need to combine with different percentages to obtain good organic fertilizers. In this study, we would produce organic fertilizers by the two kinds of waste that comprises of high nitrogen. Akil (2009) believed that nitrogen is the main element in organic fertilizers to increase corn productions (Suwardi & Efendi, 2009). The corn needed more nitrogen during their growing; therefore the amount of the element should be more available in the soil along the stage (Akil, 2009).

Previous research (Lubis, A.R., et al, 2018) has tested the use of solid’s oli palam waste (SOPW) is better tahan Solid’s Cow Cattle Wastes (SCCW), therefore we want to retest and in this test a combination of the two wastes is carried out (SOPW with SCCW) on growth and peroduction of sweet corn (Zea mays Saccharata) in the field.

METHODOLOGY

The research was carried out in Sei Mencirim Village, Pasar IV, Sunggal Subdistrict, Deli Serdang Regency, North Sumatra, April to September 2019. Randomized Factorial Group Design

(Hanafiah and Kemas, 2011) was used with 12 treatments and 3 replications, Factor I: factor I: combinations of SOPW and SCCW, symbol "C" in three measures: C1 (100% SOPW), C2 (50% SOPW + 50% SCCW) and C3 (100% SCCW), and Factor II: doses of the fertilizers, symbol "D" in 4 stages: D0 (control), D1 (5 tons/ha), C2 (10 tons/ha), D3 (15 tons/ha).

Each material was measured and weighted based on the amounts needed and placed on tarpaulin and add molasses of 0.5% and bio activator EM4 with a concentration of 0.25%. Those ingredients were mixed and entered into the drum and tightly closed (an-aerobe) for three weeks to be used fertilizers (Indriani and Hety, 2012). The fertilizer was then checked in the Laboratory of Agriculture assessment Institute of North Sumatra (Balai Pengkajian Pertanian Sumatra Utara) before they were applied to the land-based on the treatment by sown away. The corn was planted a week after the fertilizers has sowns. Several parameters observed are the high of the plants, stem diameters, leafs wide, cobs diametre, production per sample, and total production per hectare.

RESULTS

The Proximate Analyzes

Table 1. The average of nutrients of combinations of solid oil palm waste (SOPW) and Solid's Cow Cattle Wastes (SCCW) fertilizers

Combinations	C-Organic (%)	N-Total	P_2O_5	K_2O	pH
C1 (100% SOPW)	50.06	0.35	0.32	0.42	7.44
C2 (50% SOPW + 50% SCCW)	42.22	0.53	0.38	0.31	7.37
C3 (100 % SCCW)	55.01	0.39	0.24	0.50	7.77
STDEV	6.45	0.09	0.07		

Laboratory result analyses of BPTP Medan, North Sumatra

The laboratory result of the different organic fertilizers (based on each treatment), is shown in Table 1.

Table 1 shown, the highest C-Organic was found in pure Solid Cow Cattle Waste fertilizers C (100 % SCCW) was 55.01%, while in C2 (50% SOPW + 50% SCCW) was only 42.22 %, and in the fertilizer of pure solid oil palm waste, C1 was 50.06 %. The nutrients of N-total was increase in C2 (50% SOPW + 50% SCCW) 0.55% and P2O5 is 0.38%. meanwhile, the value of K2O was decreasing to 0.31 % compares to C1 and C3. The nutrients were changing when the solid oil palm waste (SOPW) and Solid Cow Cattle Wastes (SCCW) were combined.

Moreover, organic manures application along with fertilizers also induced alterations in soil physico-chemical properties of soil. The addition of organic manures, regardless of its nature, abridged soil pH. Similar findings were also reported by Yaduvanshi (2003) that a reduction of soil pH occurred when green manure or farmyard manure was used in alkaline soils.

The Corn Growth

Table 2. The Effect of Organic Fertilizer Combination and Its amount to the Average of Plants Height (cm), Stem diameter (mm) and wide of the leaf (6 Weeks After Planting).

Treatments	Plants Height (cm)		Stem Diameter (cm)		Leaf's Wide (cm^2)	Expl
Combinations						
C1 (100 % SOPW)	164.08	ab	15.25	a	284.34	ab
C2 (50% SOPW +50% SCCW)	170.33	a	15.70	a	304.18	a
C3 (100 % SCCW)	157.63	b	13.50	a	240.12	b
Dosages (D)						
D0 (Control)	144.78	c	12.99	b	208.95	b
D1 (5 tons/ha)	162.93	b	15.03	ab	253.68	b
D2 (10 tons/ha)	171.34	ab	15.12	ab	313.05	a
D3 (15 tons/ha)	177.00	a	16.13	a	329.18	a

Explanation: the numbers in a column with an identical alphabet are no significant differences in the level of 5 %.

The height vegetative growing, stem diameter, and wide of corn leaves by trial of the combination fertilizers C2 (50% SOPW + 50% SCCW) showed significant statistical differences as seen in Table 2.

Table 2 revealed that the height of plants caused of the combination of organic fertilizers had a significant different whereas the highest was found in the combination of 50% of SOPW with 50% SCCW (C2) of 170.33 cm, but not significant compared to 100% of SOPW (C1) of 164.08 cm and 100% of SCCW (C3). The lowest plants were found in the treatment of 100% of SCCW (C3) was 157.63 cm. The difference in plant height from the effect of the combination of solid oil palm waste (SOPW) with solid cow cattle waste (SCCW) is shown in fig 1.

The trial result dosage of the fertilizers revealed that the highest plants found in D3 (15 tons/ha) was 177 cm had significant differences compared to D1 5 tons/ha) and D0 (control), but not significant to D2 (10 ton/ha) was 171.34 cm. In this research, the lowest plants control (D0) was 144.78 cm, significant different from D1, D2, and D3. Comparing of the three dosages of combination, the D1, D2 and D3 shown that the D1 (100% of SOPW) had a lowest plants height of 162.93 cm, which is significantly different with D3 (15 tons/ha) but not with D2 (10 ton/ha). In this context, the combination of fertilizers of 10 tons/ha (D2) was expected to be applied.

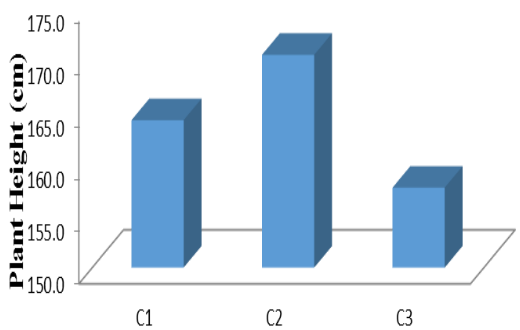

Fig 1. Graph of the Effect of Combination of Organic Fertilizers on Plant Height (cm)

Based on the results of the regression test on the use of a combination of organic fertilizers and their dosages found that plant's height accretion along with dosage increase of the fertilizers in positive correlation with the value of $\hat{Y} = 2.101\ D + 148.2$ and r = 0.96, as seen in fig 2. Table 2 revealed that plants using a combination of organic fertilizers had an impact on plant height. Plants that use a combination of 50% SOPW and 50% SCCW (C2) fertilizer has a height of 170.33 cm, while plants with 100% fertilizer. SOPW (C1) has a height of 164.08 cm, and plants with 100% fertilizer SCCW (C3) have a height of 157.63 cm.

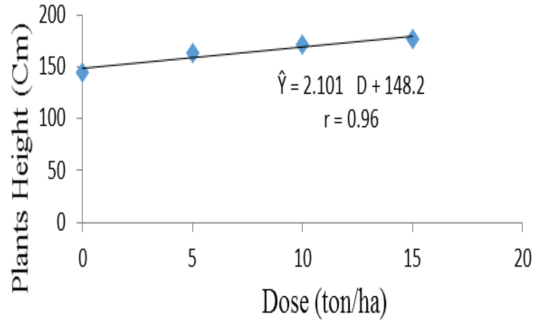

Fig 2. The Amount of Organic Fertilizers to Plants' Height

Table 2 also shows that all combination treatments of the fertilizers had not significant differents to the stem diameter of the plants with a range of 13.5 mm (C3) to 15,25 mm (C1). However, the influence of the quantity of the fertilizers had significant different where the D3 (15 tons/ha) had the biggest stem diameters of 16.13 mm, significant different with D0 (control) of 12.99 mm, but not significant with D1 (5 tons/ha) and D2 (10 tons/ha). The view from the effect of the dose of organic fertilizer on steam diameter. It is correlated with the linaer equation $\bar{Y} = 0.190\ D + 13.39$ and r = 0.93 as shown in Fig 3.

The result of measurement and statistical analysis show that the leaf area is also significantly different from the effect of the combination treatment (C). The combination of 50 % SOPW with 50 % SCCW (C2) averaged 304.18 cm2, giving the widest leaf area, but not significantly different from 100 % SOPW (C1) averaging 284.34 cm2 but significantly different from the use of 100 % SCCW (C3). The difference in the leaf area of corn plants from the effect of the organic fertilizer dose can be seen in Fig 4.

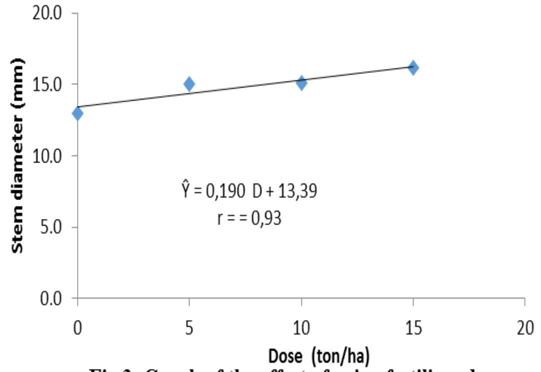

Fig 3: Graph of the effect of using fertilizer doses organic to the diameter of the corn stalk

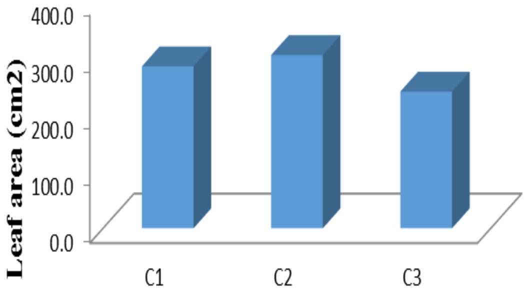

Fig 4. Graph of the Effect of Combination of Organic Fertilizers on Leaf area (cm2).

Moreover, Table 2 is also shown that the number of fertilizers had a significant impact on the leaf's wide. The amount of D3 (15 tons/ha) had the largest leaf wide of 329.18 cm^2, had non significant to D2 (10 tons/ha) of 315.05 cm2, but significant to D1 and D0. The lowest leaf wide was found in D0 (control) of 208.95 cm2, has significant differences with D2 and D3, but not to D1. Comparing D1, D2 and D3 shown that D1 (100 % SOPW) had the lowest wide leaf of 253.68 cm2, had significantly different from D2 as well as D3. Similar to the plant height parameter the combination of fertilizers of D2 (10 tons/ha) was also expected to be applied.

Based on the results of the regression test on the use of organic fertilizer combination and the dosage, it was found that the accretions of wide of the leaf is in line with the increasing amount of the fertilizers in positive correlation with the formula of $\hat{Y}$ = 8.401 D + 213.2 dan r = 0.97, as seen in fig.5.

Fig.5 shown that the leaf's size was enlarged along with adding of organic fertilizer up to 15 tons/ha.

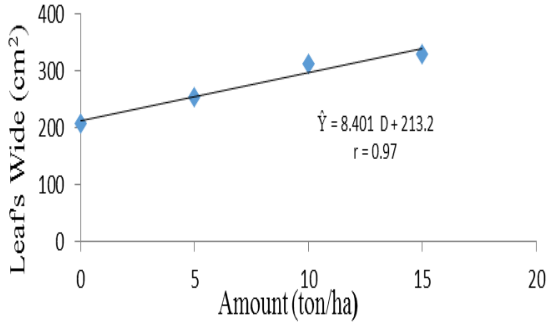

Fig. 5. Effect Amount of Organic Fertilizers to the Leaf's Wide (cm^2) of Sweet Corn

The Production

Tabel 3. The Effect of Organic Combination Fertilizer and Its Amount to Cobs Diameter (cm), Production/Sample (gr), and Total of Production/ ha (ton) at harvest time.

Treatments	Cobs Diameter (cm)	Production/ Sample (gr)		Total of Production (ton/ ha)		
Combination						
C1(100 % SOPW)	4.38	a	190.20	ab	6.27	ab
C2(50%SOPW+50% SCCW)	4.24	a	198.86	a	6.59	a
C3 (100 % SCCW)	3.75	b	170.53	b	5.96	b
Dosages (D)						
D0 (control)	3.53	c	127.92	c	4.58	c
D1 (5 tons/ ha)	4.12	bc	191.50	b	6.46	b
D2 (10 tons/ ha)	4.18	ab	208.16	a	6.77	ab
D3 (15 tons/ ha)	4.66	a	218.54	a	7.29	a

Expl: the numbers in a column with an identical alphabet are no significant differences in the level of 5% (lowercase) and 1% (uppercase)

The trial of organic combination fertilizers and its amount to cobs diameter, production per sample (gr), and total production per hectare (tons) show a statistically significant difference as presented in Table 3.

The organic fertilizer combination significantly impacted cobs diameter at harvest of time Table 3). The biggest diameter was found in C2 (50% SOPW + 50% SCCW) of average 4.24 cm, significant different to C3 (100 % SCCW) of 3.75 cm, but not to C1 (100 % SOPW) of 4.38 cm.

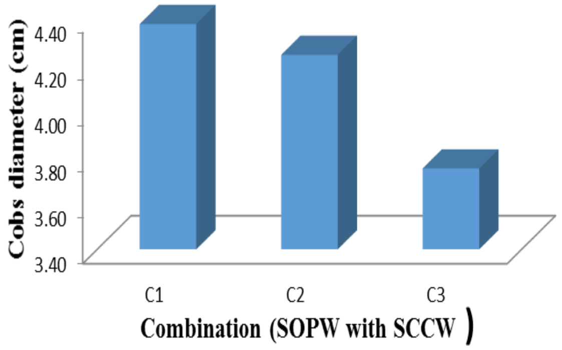

Fig 6. Graph of the Effect of Combination of Organic Fertilizer on Cob Diameter (cm)

Meanwhile, the result of the trial of organic combination fertilizer dosage to cobs size revealed that D3 (15 tons/ ha) was obtained the most significant diameter average of 4.66 cm, significantly different to D1 (5 tons/ ha) and D0 (control), but not significant to D2 (10 tons/ ha). The smallest diameter was found in D0 (control) of 3.53 cm which is no significant to D1 (5 tons/ ha) of 4.12 cm.

The production per sample (Table 3) was also found out that the C2 (50% SOPW +50% SCCW) had the highest production of 198.86 g, significantly different to C3 (100 % SCCW) of 170.53 g, but not to C1 (100% SOPW) of 190.20 g. Furthermore, the result of dosage of the combinations revealed that C2 (50% SOPW + 50% SCCW) had the highest production of 6.59 ton/ha that was also significantly different to C3 (100 % SCCW) of 5.96 ton/ha, but not to C1 (100 % SOPW) of 6.59 ton/ha. The difference in production from the effect of organic fertilizer combinations can be seen in Fig. 7.

The production per hectare parameter (Table 3) shows that D3 (15 tons/ ha) was the highest of 7.29 tons/ha, significantly different to D0 of 4.58 tons/ha and D1 of 6.46 tons/ ha, but not to D2 of 6.77 tons/ha. The combination of fertilizers of the amount 10 tons/ha (D2) was also expected to be applied.

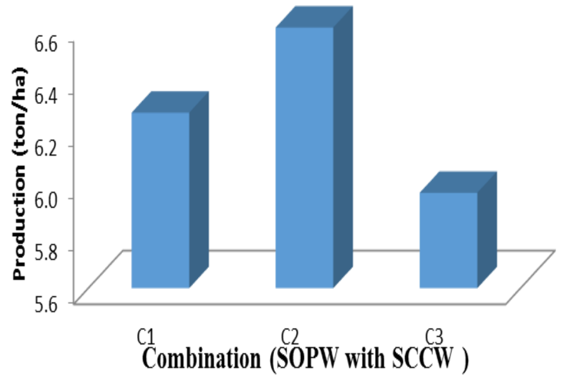

Fig. 7: Graph of the Effect of Combination of Organic Fertilizers on Production (tons / ha)

Based on the result (Table 3), organic combination fertilizers were also accretions of production in line with an increasing amount of the fertilizers in positive correlation with the formula of Y = 0.168 D + 5.009 dan r = 0.92 as seen in Fig. 8.

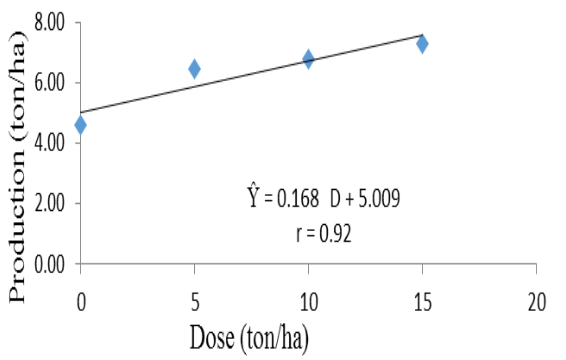

Fig.8. Effect Amount of Organic Fertilizers to the Production (ton/ha) of Sweet Corn

From the proximate analysis data, the content of the combination of organic fertilizers dramatically affects the production of sweet corn. By combining

SOPW and SCCW, the P2O5 content increases accompainied by escalation in production which can be seen in the graph Ŷ = 4.467 P2O5 + 4.876 with r = 0.98.

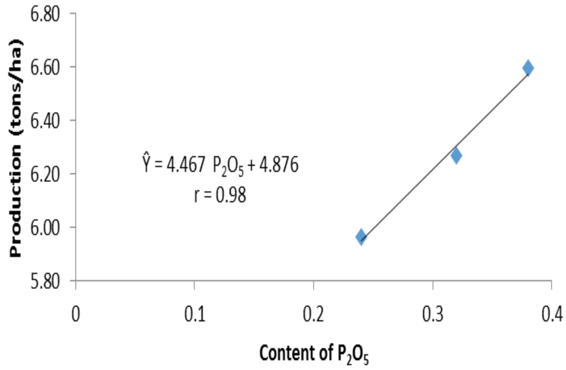

Fig 9: The Effect of P2O5 Organic Fertilizer on Production (tons / ha)

Apart from that, the diameter of corn cobs can affect the production of sweet corn. This can be seen in the correlation with the linear equation Ŷ = 0.703 D + 3.374 with r = 0.73 as illustrated in Fig 10.

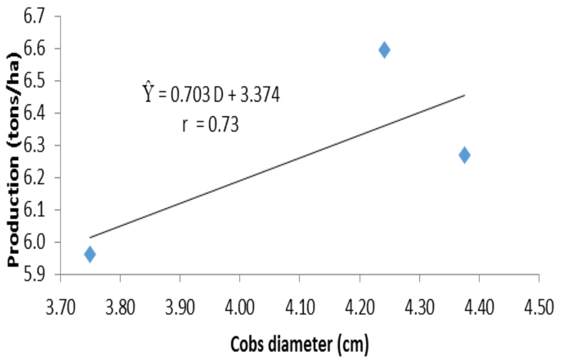

Fig. 10. Graph of the Effect of Corn cobs Diameter on Production (tons / ha)

DISCUSSION

The application of organic fertilizer combination (C) to grow and produce sweet corn had significant differences. This fertilizer is a mixture of two different kinds of waste that form a unity with completed nutrients (Lubis et al. 2018; Sembiring. 2018). The effects of the organic combination fertilizer can increase the N and P nutrients in the soil. Tambunan (2016) stated that the length increment of the leaves shown the increase of the protoplasm as the effect of size and amount of cells. N, P and K nutrients availability can increase the number of chlorophyll of the plant, and photosynthesis activities are also increased to produce more assimilate to support the plant's leaves length growth.

Generally, this fertilizer can fix the physical, chemical, and biological of the soil. The organic fertilizer full of nutrient contains beneficial microorganisms function as decomposers of organic matters in the soil. So, organic fertilizer can change the soil to be better and created a proper growing environment for plants (Hidayati, et al. 2008).

The organic combination fertilizer can fix the soil's physical and created morsel soil and aeration becomes better by adding the porosity.The excellent aeration of soil will increase the nutrient and easily caught water, O2, N2, and CO2. The nutrients are very important to root growth and soil microorganisms and add organic matters. Subowo (2010) pointed out that the soil with high organic matter is easily to tillage than less one. The organic combination fertilizer besides maintaining soil fertility, repairing soil structure, increasing the soil organic matter and neutralising the soil chemical or toxic and reducing the use of chemical fertilizer up to 50% by the farmer (Hartatik, et al. 2015). Adding organic fertilizer into the soil is excellent strategy to speed up the bio decomposition process of organic matter by microbe parser lignin and cellulose (cellulolytic) that commonly of fungus and as most significant bio decomposition (Alexander, 1989).

Agromedia (2007) thought that using organic fertilizer to the plants significantly influence either the composition or form. Wahyudi (2009) and Embrandir, (2013) pointed out that nitrogen (N) availability of organic combination fertilizer is very decisive in the vegetative growth of the plants. The result of this study proved that the N-total in the combination of organic fertilizer is the highest Nitrogen of 0.53 % and the highest plant growth.The result SCCW of this study showed that the combination of C2 (50% SOPW +50% SCCW) had the highest plant growth of 170.33 cm and the average of production was 6,59 tons/ha, which is the best for sweet corn. Lubis, A.R. et al. (2018) reported using organic combination fertilizer of SOPW and SCCW in an equal percentage producing height growing and production a little bit better than those of not using them.The proper amount of fertilizer can be determining the availability of soil nutrients that are needed by plants. Sinulingga (2015) studied the application of organic fertilizer to the sweet corn in the low land area and found out that the amount of 10 tons/ ha had given the highest production than others, which is similar to this research.

The result of testing the combination of 50 % SOPW with 50 % SCCW (C2) obtained the best results in planting sweet corn, this is close to the result of research by Lubis, A.R. and Sembiring, M. (2019). The use of organic fertilizers was also tested on Amaranthus hybridus plants by Koura WT al. (2015). It concluded that the composting of these wastes with manure under shelter improved their decomposition significantly. The compost made with poultry manure under shelter gave the highest plant growth and yield. The compost application rate of 20 t/ha was not enough to increase plant growth but increased its yield (20.1 t/ha versus 17.9 t/ha). Application of findings : Palm oils mills waste can be composted and used to grow Amaranthus hybridus. However, it is better to compost these wastes with poultry manure than cow dung under shelter. In addition, farmers need to apply at least 20 tons/ha to have high yields.

Moreover, types and amounts of fertilizers are the key factors of the increase in plant growth and production. Applyimg organic fertilizers to the plants to supply esential nutrients in required and the amount should be adequate. Less input of organic fertilizer, making the soil is less of nutrients, as the effect of theplant's hampered growth can reduce the production, particularly compared to the area that using a tolerable amount of organic fertilizer (Hasudungan, 2008., Schuchardt et al. 2008). For that reason, the fertilizers and their application to upsurge the production had become common knowledge and inseparable with their farming activities (Embrandiri, 2013; Mardani et al. 2017). The adequate amount of organic fertilizer in the soil can be a source of nutrients available for long dates to absorbed them under the requirements. Sutedjo (2002) believed that the nutrients requirements in every phase of growth are different.

Moreover, organic manures application along with fertilizers also induced alterations in soil physico-chemical properties of soil. The addition of organic manures, regardless of its nature, abridged soil pH. Similar findings were also reported by Yaduvanshi (2003) that a reduction of soil pH occured when green manure or farmyard manure was used in alkaline soils.

CONCLUSION

The combination of solid oil palm waste (SOPW) 50% and Solid Cow Cattle Waste (SCCW) 50% (C2) were the better organic fertilizers to the growth and production of the sweet corn compared to C1 (100% of SOPW) and C3 (100% of SCCW). The organic fertilizer combination application upsurge the growth of sweet corn of 170,33 cm and 6,46-7,29 tons/ha production. The amount of 10 tons/ha (D2) of the organic combination fertilizer was expected to be applied. However, this research was carried out at the low lands soil needed to conduct similar research in different elevations.

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