

## The Effect of Organic Fertilizer with Materials Mixed by The Side of the Palm Oil Mill and Bali Cattle Manure Against Growth Sweet Corn (*Zea mays*)

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### Abstract

This research aim are to examine the effect of the treatment of organic fertilizer from waste palm oil mill and cow manure on the growth of *Zea mays* and determine the optimum dose of organic fertilizer. This research was conducted in Kapitan Village, Kumai District, West Kotawaringin Regency, Central Kalimantan. There were 4 treatments of the research: organic fertilizer with a dose of 0 tons/ha (P0), 5 tons/ha (P5), 10 tons/ha (P10) and 15 tons/ha (P15) with 3 replications. All treatments were given NPK Mutiara fertilizer at a dose of 200 kg/ha as a basic fertilizer. *Zea mays* planted in 4 plots 4 treatments with 3 plots of repetition, a total of 12 plots. The spacing was 50x40 cm, the number of corn plants is 56/plot, a total of 672 plants for 12 plots. NPK fertilizer was given 240 g plot. Organic fertilizer P0: 0 kg/plot, P5: 6 kg/plot total 3 plots 18 kg, P10: 12 kg total 36 kg, P15: 18 kg total 54 kg. Parameters observed were plant height, leaf area, fresh weight, dry weight and plant growth rate at 21, 28, 35, 42 and 49 days after planting. The design of the research used a Completely Randomized Design (CRD) in a directional pattern, performed a duncant test if there were differences. The results showed that at the age of 49 days: plant height increased 18% (P5), 20% (P10) and 38% (P15); leaf area increased 42% (P5), 71% (P10), 106% (P15); fresh weight increased by 16% (P0), 86% (P10), 96%: plant growth rate increased by 40% (P5), 248% (P10), 272% (P15) compared to P0. The conclusion is that the higher the dose of organic fertilizer given results in higher plant growth as well, with the optimal dose of organic fertilizer giving a dose of 10 tons/ha.

Keyword: *Zea mays*, waste palm oil mill, Bali cattle manure, organic fertilizer

### Introduction

Sweet corn (*Zea mays* var. *Saccharata* Sturt) is one of the most popular vegetable commodities in the United States and Canada. Consumption of sweet corn has also increased in Asia, Europe and Latin America as well as many other countries, including Indonesia along with population growth and consumption patterns. Sweet corn is popularly used as a fresh and processed vegetable (Syukur and Rifianto, 2013).

In particular, sweet corn production data in West Kotawaringin is not statistically inventoried by the local governmental agriculture and livestock service of West Kotawaringin Regency, which is different from hybrid corn production which farmers try to enter into government programs in the form of agricultural development

assistance projects. The average corn production in West Kotawaringin reaches 3.7 tons / ha (BPS Kobar, 2016) compared to national production of 4.6 tons / ha.

Many factors can affect the production of corn plants, including the ones related to soil fertility. Soils with low fertility levels such as inceptisols, ultisols, oxisols, histosols can be repaired by fertilization. For soil that reacts sour, such as inceptisols, which is caused by high Al and Fe elements, it can be done by calcification. Fertilizing NPK, organic matter, and liming acid soils play a very important role in increasing agricultural production of food crops (Nursyamsi and Suprihati, 2005).

Organic fertilizers are fertilizers which mostly or entirely consist of organic material derived from plants and or animals that have gone through an engineering process, can be in the form of solid or liquid which is used to supply organic material to improve the physical, chemical and biological properties of the soil. The definition shows that organic fertilizers are aimed more at organic C content or organic matter than the price level; the value of C-organic is what differentiates it from inorganic fertilizers (Suriadikarta and Simanungkalit, 2006). One of the organic fertilizers is solid cow manure, which is cow faeces in the form of solids which have not been composted or composted as a source of nutrients, especially N for plants and can improve the chemical, biological, and physical properties of the soil. Handling of manure by providing decomposers to speed up maturation and reduce odor (Hartatik and Widowati, 2010).

Palm oil mill effluent (PKS) is mostly found in Kotawaringin Barat because there are 9 factories in the PKS (BPS Kotawaringin Barat, 2016). The most waste produced from PKS is empty bunches or empty lengths (jangkos) of about 55% of the weight of fresh fruit, then slightly fiber and solid. Jangkos contains a lot of potassium so that it can be used as an organic fertilizer, but with an enumeration treatment first (Mudhita, 2017).

The mixture of cow feces, fiber, boiler ash as organic fertilizer enriched with microbial waste decomposers or decomposers is expected to increase soil fertility in sweet corn plants in the study sites in the Kumai area of West Kotawaringin Regency.

## **Materials and Methods**

The research was carried out on Inceptisols (Latosol) in Kapitan Village, Kumai District, West Kotawaringin Regency, Central Kalimantan Province.

The land for planting sweet corn amounted to 12 plots of experimental demonstration plots for 4 treatments for giving organic fertilizer with three replications. Each plot is 3x4 m, with a distance between 1 m plot of plot. The sweet corn seeds planted are varieties of Bonanza F1 produced by PT. East West Seed Indonesia, as many as 2 seeds per planting hole, with a spacing of 50x40 cm, per plot there are 56 planting holes. Two weeks before planting, the demplot land was given 2.4 kg dolomite / demplot lime (2 tons / ha) to increase the soil pH. Organic fertilizer given as a treatment uses Mudhita and Saprudin (2014) method and improved the way of making organic fertilizer made from palm oil mill waste and cow feces (Mudhita et al., 2016). Composition of raw materials for making organic fertilizers is: 60% Bali cow feces, 24% empty bunches of palm oil, 6% fiber, 6% boiler ash, 4% lime and Stardec 0,6% decomposers and N-fixing microbes and P and K.

There are four treatments for organic fertilizer (PO) for sweet corn plants, namely: P1 (control) 0 tons / ha, P2 5 tons / ha, P3 10 tons / ha and P4 15 tons / ha. Giving PO for P2 as much as 6 kg / plot, P3 12 kg / plot and P4 18 kg / plot. Organic fertilizer is given 2 weeks before planting. NPK Mutiara organic fertilizer (15:15:15) is given to all treatments as much as 240 g / plot (200 kg / ha), which is given twice namely when planting and 3 weeks after planting by immersing it near the planting hole. Pest and disease control is carried out using Ampligo 50 ml / 15 l insecticide and Amstartop fungicide.

Growth parameters were observed at the age of 21 days after planting (hst), 28 days, 35 days, 42 days, and 49 days after planting: the height of sweet corn (cm), leaf area (cm<sup>2</sup>) (Sitompul and Guritno, 1995), rate plant growth (g / week) (Sitompul and Guritno, 1995). Samples for plant weight were taken 10% per plot for observation of fresh weight (g) and weight of dry matter (g). The data was analyzed statistically using a Completely Randomized Design (CRD), if there were differences followed by the Duncan test (Steel and Torrie, 1980).

## Result and Discussion

### Plant height

The average height of sweet corn plants given various doses of organic fertilizer is shown in Table 1.

Table 1. The height of corn plant with organic fertilizer treatment (cm)

Treatments	Age (hr)				
	21	28	35	42	49
P1	36,67 <sup>a</sup>	47,25 <sup>a</sup>	58,33 <sup>a</sup>	79,75 <sup>a</sup>	81,00 <sup>a</sup>
P2	59,33 <sup>c</sup>	69,17 <sup>c</sup>	75,39 <sup>b</sup>	92,67 <sup>b</sup>	95,92 <sup>b</sup>
P3	41,67 <sup>b</sup>	59,53 <sup>b</sup>	72,53 <sup>b</sup>	91,78 <sup>b</sup>	97,28 <sup>b</sup>
P4	44,50 <sup>b</sup>	60,00 <sup>b</sup>	75,67 <sup>b</sup>	99,83 <sup>c</sup>	111,58 <sup>c</sup>

<sup>a, b, c</sup> superscript in the same column shows the difference (P <0.05)

High yields of corn plants with organic fertilizer treatment every week of observation from week 3 or age 21 days to age 49 days or week 7 showed significant differences (P <0.05). Plant height at the age of 21 days and 28 days showed that the highest plants in P2 (5 tons PO / ha), and the lowest at P1 (without PO), at the age of 35 days, 42 days and 49 days showed the highest at P4 (15 tons PO / ha) and the lowest on P1. The percentage increase in plant height with the addition of organic fertilizer varies with each plant age, at the age of 21 days, the highest increase on P5 was 59%, then P15 45%, and P10 42%. At the age of 49 days the increase in plant height in succession at P5, P10 and P15 was 18%, 20% and 38%. The average increase in the height of corn plants is due to the provision of organic fertilizers between 25-32%. This shows that the effect of organic fertilizer is very visible after plants aged 35 days, the more POs are given the more real the plant's height. Subekti et al. (2002) report that plants aged between 18-50 days after germination enter the phase V3-V5, V11 – V18, where plants begin to absorb more nutrients, plants grow rapidly, accumulation of dry matter

increases, and water requirements are very high to support the rate of plant growth. Tola et al., (2007) stated that the provision of organic fertilizer due to the influence of microbial activity in it has a positive influence on soil conditions, namely as a driving motor of the nutrient cycle through the process of decomposition of organic and inorganic soils that produce nutrients that can be utilized by plants. decomposition of organic matter produces humus which is capable of increasing the binding capacity of the soil to water so that it will ensure good air conditioning indirectly enhancing the nutrients of the legume. It is seen that the development of growth from week 4 to week 8 shows that plants that were only given NPK fertilizer had the lowest plant height.

### Leaf area

The average leaf area of sweet corn given the treatment of various organic fertilizers is shown in Table 2.

Table 2. The extent of leaves of sweet corn given organic fertilizer made from palm oil mill waste and cow feces

Treatments	Ages (hr)				
	21	28	35	42	49
P0	208,77	347,21	596,78	657,43a	1.179,05a
P5	284,76	411,06	607,46	785,93b	1.669,61ab
P10	327,70	319,09	796,46	1.375,29c	2.017,18ab
P15	290,41	352,60	810,75	1.440,62c	2.424,13b

<sup>a, b, c</sup> supercript in the same column shows the difference (P <0.05)

The results of the treatment of organic fertilizer gave a significant increase in leaf area (P <0.05) at plant age 42 days and 49 days after planting, whereas the previous results had no significant difference but the increase in leaf area was seen from the age of 35 days. At the age of 42 days treatment P5 leaf area is different and increases compared to control (P0), and increases again at P10 and P15 and differs between P0 and P5. The increase in leaf area at the age of 42 days by giving organic fertilizer P5, P10 and P15 was 20%, 109% and 119% and at the age of 49 days at 42%, 71% and 106% with variations in the average increase of 20-119%. This shows that the more doses of organic fertilizer will produce more leaf area, but the increase starts to be seen since the age of 35 days. Organic fertilizers from oil palm plantations and cow manure include fertilizers that are slow to work, but after giving effect due to the effects of various microbes in them, the results look significant. This is in agreement with Budiyanto (2014) which states that the role of organic matter in soil physical properties is indicated by its ability to improve soil structure (water holding capacity, stabilization of soil aggregates) and its role in soil chemical properties in providing nitrogen, phosphorus and sulfur its biological role is seen from the activity of microflora and microfauna organisms, so that organic matter can improve soil quality in binding water and nutrients to the soil. This is in accordance with Belfield and Christine (2008) who stated that corn plants at week 5 to 7 were the most critical phase in corn plants. Stems and roots grow quickly with nutrient and water requirements are quite high because at week 5 leaf growth is perfect. The high leaf area in treatments P15 and P10 is estimated

to influence the microbes present in organic fertilizers because there are some microbes that function as N-fixers from the air. Samekto (2008) reported that the nitrogenase enzyme produced by N-fixing microbes would convert to NH<sub>3</sub> then assimilated into the plant then convert to glutamine by glutamine synthase. Ammonia (NH<sub>3</sub>) is transported out of bacteroid before being further metabolized by the host plant. Nitrogen is absorbed by plants in the form of nitrates and ammonium.

### Fresh weight

The fresh weight of sweet corn plants which are given additional various doses of organic fertilizer are listed in Table 3.

Table 3. Fresh weight of sweet corn plants that is given organic fertilizer made from palm oil mill waste and cow feces

Treatments	Ages (hr)				
	21	28	35	42	49
P0	9,33	58,67a	72,67a	144,33a	182,33a
P5	6,37	85,00b	100,33b	157,67b	210,67a
P10	4,76	85,67b	146,33bc	236,33c	338,67b
P15	5,16	86,00b	176,67c	256,00c	356,67b

<sup>a, b, c</sup> superscript in the same column shows the difference (P <0.05)

The fresh weight of corn plants given organic fertilizer gave significant results since the age of 28 days (P <0.05), the best results on each week of observation showed that treatment P15 (15 tons / ha organic fertilizer) was the heaviest, then at P10, P5 and lowest in control treatment. At the age of 42 days and 45 days the results of fresh weight showed no difference in P10 and P15. Percentage of increase in fresh weight by giving organic fertilizer at P5, P10, P15 at age 28 hst on average 46% (45-47%), age 35 hst on average 94% (38-143%), age 42 hst on average average 50% (9-77%) and age 49 hst on average 66% (16-96%) compared to P0. This is due to the continuous application of organic matter to produce increased activity of microorganisms in releasing nutrients contained therein, this is because organic matter is a source of energy, carbon, and nutrients for microorganisms (Hanafiah, 2013). Organic sources that exist in organic fertilizers are jangkos, fiber and cow dung, besides that, fish and fiber also contain high P and K. Another influential factor is the addition of lime and boiler ash (derived from the rest of the burning of palm shells for power plants in palm oil mills), limestone increases the soil pH which was originally 4.4 to 6.5 after the demonstration plot land was given lime. The fresh weight of plants is positively correlated with plant height (Table 1), where wet weight is influenced by plant height, the higher the plant height, the higher the fresh weight of the corn plant.

### Dry weight

The dry weight of sweet corn plants which were given additional various doses of organic fertilizer are listed in Table 4.

Results of dry weight of corn plants given organic fertilizer gave significant results at age 28, 42, 45 days (P <0.05), the heaviest results at that age were obtained by

treatment P15, then P10, P5 and lowest P0. Percentage of increase in dry weight by giving organic fertilizer at P5, P10, P15 at age 28 hst on average 50% (19-84%), age 42 hst on average 37% (5-70%), and age 49 hst average 100% (5-181%) compared to P0. Dry weight is influenced by water content in plants and weather factors. The results showed that the dry weight of plants was positively correlated with the fresh weight of plants, where dry weight was influenced by plant wet weight (Table 3), the higher the wet weight, the higher the dry weight of plants.

Table 4. Dry weight of sweet corn plants that is given organic fertilizer made from palm oil mill waste and cow feces (g)

Treatments	Ages (hr)				
	21	28	35	42	49
P0	0,85	6,74a	12,54	28,53a	44,04a
P5	0,67	8,05b	15,88	29,82a	46,24a
P10	0,53	9,80b	16,09	38,47ab	93,77b
P15	0,62	12,38c	18,92	48,54b	123,94c

<sup>a, b, c</sup> supercript in the same column shows the difference (P <0.05)

### Plant growth rate

The average growth rate of sweet corn plants with the treatment of various doses of organic fertilizer is shown in Table 5.

Table 5. Growth rates of sweet corn plants that is given organic fertilizer made from palm oil mill waste and cow feces (g / mgg)

Treatments	Ages (hr)			
	21-28	28-35	35-42	42-49
P0	0,84	0,83	2,28a	2,22a
P5	1,06	1,39	2,60bc	3,11ab
P10	0,90	1,40	3,53c	7,71bc
P15	0,58	1,36	5,33d	8,25c

<sup>a, b, c</sup> supercript in the same column shows the difference (P <0.05)

Giving organic fertilizer shows the growth rate of sweet corn plants is different (P <0.05) at age 35-42 HST and 42-49 HST, the fastest rate at age 35-42 HST occurs with treatment P15, at P5 and P10 the growth rate is no different, while the age of 42-49 hst the fastest rate in P15 did not differ in P10, the lowest rate was in the control treatment. Percentage of increase in plant growth rate by giving organic fertilizer at P5, P10, P15 at ages 35-42 on average 67% (14-133%), age 42-49 hst on average 187% (40-272%) compared to P0. The plant growth rate was positively correlated with the fresh weight of the plants (Table 3).

## Conclusion

Giving the organic fertilizer with a mixture of palm oil mill effluent and Bali cow manure given decomposer microbes produced the highest growth of sweet corn at a dose of 15 tons per ha, although the optimum treatment was obtained at a dose of 10 tons / ha, because plant growth was not statistically different from with a dose of 15 tons / ha and is related to production costs.

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