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Effect of Oil-Palm-Empty-Fruit-Bunch Granular Organic Fertilizer on The Yield of Oil Palm Fruit

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ABSTRACT

Oil Palm has a strategic role in the Indonesian economy. The use of inorganic fertilizers in the cultivation of Oil Palm is to add nutrients to optimize the growth and yield of plants. The use of inorganic fertilizers significantly increase crop production, but the use of inorganic fertilizers in a relatively long time period has negative impact on soil conditions. The use of organic fertilizers can be an alternative in reducing the negative impact of the use of inorganic fertilizers. Compost of empty fruit bunch (EFB) of oil palm has the potential to substitute most of the nutrients needed by plants. This study aimed to determine the effect of local organic fertilizers on yields of oil palm. The research was implemented from January 2016 until March 2016, in the oil palm plantation area of PT Bio Nusantara Bengkulu, Village of Pondok Kelapa, Central Bengkulu Regency, Bengkulu. Dose of EFB was as treatment in this study, consisted of control, 4 kg EFB/plant, 8 kg/plant, 12 kg/plant, 16 kg/plant. The treatment was repeated three times with 10 plants per treatment unit in order to obtain 150 samples. The results showed that the dose 21.03 kg EFB can improve the greenish of leaves with the result of 78.65. Dose of EFB 15.38 kg/plant was able to increase the weight of loose/detached fruit to 12.22 grams. The 10.5 kg mesocarp thickness reached 0.96 cm when the plant was treated with EFB 10.5 kg/plant.

INTRODUCTION

Oil palm commodity plays a strategic role to the Indonesian economy. According to Soetrisno and Winahyu (1991), oil palm plantations have three strategic roles in the economy in Indonesia. First, the product of oil palm crop is the main raw material of cooking oil. Secondly,ᄂas one of agriculture priority commodities of non- oil and gas export. Third, in the process of production and processing can create job opportunities and at the same time improve the welfare of the community.

The development of oil palm commodities continues to increase from year to year, as shown on data that the average growth rate of oil palm area during 2004-2014 was 7.67%, while palm oil production increased by an average of 11.09% per year. The increase in area is due to the relatively stable price of CPO in the international market and proved to support the farmers' income, which are quite profitable. According to the Directorate General of Agriculture (2014), in 2014 the area of oil palm plantation reached 10.9 million ha with production of 29.3 million tons of CPO. Those areas are classified according to the status of the ownership which consist of local farmer plantations of 4.55 million ha or 41.55% of the total land area, state property of 0.75 million ha or 6.83% of the total area, private sector of 5.66 million hectares or 51.62%. Private sector ownership is divided into 2 classes namely foreign private sector of 0.17 million ha or 1.54% and the rest is Indonesian private sector (Ditjen Pertanian, 2014). In the year of 2014, there wer 42 oil palm companies in Bengkulu which comprise the total area 304,339 ha with production reaches 833,410 tons (Directorate General of Plantation, 2014)

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Anorganic fertilizers in oil palm cultivation are commonly used in order to meet the nutrients requirement for optimum growth and yield. According to Arsyad et al. (2012) the requirement of inorganic fertilizer was 3,417 ton/year. The use of inorganic fertilizers increases plant production. However, the use of inorganic fertilizers for a relatively long period of time generally has negative effect on the soil conditions such as soil is less able to store water, tend to form compacted soil and acid which will eventually decrease the productivity of the plant (Parman, 2007).

The use of organic fertilizer can be an alternative in reducing the negative impact of inorganic fertilizer usage. It is expected to improve soil fertility through the improvement of physical, chemistry, and soil biology properties. Several studies have shown that organic fertilizers can improve the efficiency of inorganic fertilizer which in turn can support maximum production. Application of organic and inorganic fertilizers (N, P and K) is an effort to meet the nutrient needs for plants. It is intended to improve the nutrient balance present in the soil (Rachman et al., 2008). Organic fertilizers can be obtained from a very abundant of oil palm waste. According to BKPM (2014) solid waste such as shell acoounts to 1.73 million tons and fiber is 3.74 million tons. These wastes are usually burned, used as oil palm mulch, processed into compost, or organic solid fertilizer.

Darnoko and Ady (2006), mentioned that the compost of oil palm empty bunches (EFB) contains: P (0,022%), K (3,45%), Ca (0,2%), Mg (0,54%), C 29.76%), N (1.98%), C / N (15.03) and water (54.39%) which has the potential to substitute some of the nutrients needed by plants, and can increase soil pH from 3.5 -3.6 to 5.5 (Nurani et al., 2011). According to Prayitno et al. (2008), fertilization using empty bunch composts can increase the yield of palm oil by 70.62%.

PT Bio Nusantara Technology Bengkulu has been producing granular organic fertilizer. Granular organic fertilizer is a fertilizer made of solid and ash boiler (burnt bare blank). This organic granular fertilizer can be an alternative in reducing the use of inorganic or chemical fertilizers. The laboratory analysis of this granular fertilizer are N = 1.26%, $P_2$05 = 4.60%, $K_2$0 = 2.20%, CaO = 3.64%, MgO = 1.67%, C. Organic = 20 , 10%, CEC = 25.56 me / 100gr, pH = 9.65, C / N = 15.95, Fe = 0.41%, Cu = 0.01%, Mn = 0.05%, Zn = 0.01%, B = 0.005%. The size of organic fertilizer granular is 0,2-0,5 with moisture content 25% (Research Center of Oil Palm, 2014. This study aimed to determine the effect of granular organic fertilizer on the yield of oil palm crops.

MATERIALS AND METHOD

This research was conducted in January 2016 until March 2016, in the plantation area of PT Bio Nusantara Bengkulu, village of Pondok Kelapa, Central Bengkulu. This research used Randomized Complete Block Design method with single factor dose of granular organic fertilizer (GOF) consisting of: P0 = control, P1 = 4 kg GOF /plant, P2 = 8 kg GOF /plant, P3 = 12 kg GOF /plant, and P4 = 16 kg GOF/plant. The treatments were repeated three times with 10 plants per treatment unit so that in obtaining 150 samples. The plants samples were 5 years old plants.

Side-dressed fertilizer was applied with the dose according to the treatment. Fertilizer used was a granular organic fertilizer made from empty compost empty palm oil produced by PT Bio Nusantara Bengkulu. Weed control was done mechanically on the weeds around the plants. Once a month the trees were of pruned so that oil palm crops can produce maximally. Harvesting was done on the fruit of palm oil that were in physiological maturity characterized with reddish and shiny fruit color, 2-5 pieces of fruit fell off from the bunch.

Data were collected for the variables of : The greenishness of the leaves was measured using a SPAD meter . The number of fresh fruit bunches calculated is the fruit of oil palm that has been harvested. The weight of fresh fruit bunches, weighed using a hanging scales. Weight of of detached fruit was obtained from the average weighing 3 detached fruit trees. Weighing is done using analytic scales. The thickness of the mesocarp is measured using a ruler from the outermost layer of the shell to the deepest layer of exsocarp by means of the oil palm fruit being split using a machete first. All observation was done 3 times before fertilizer application, 1 month after application of fertilizer and end of research or 2 months after fertilizer application. The data obtained were analyzed statistically by using ANOVA based of F test at 5%. The significant variables were analyzed using orthogonal polynomial test.

RESULT AND DISCUSSION

Laboratoty analysis of pre-treatment soil condition were pH (H_2 O) 4.5 and CEC soil 11.52 me/100 g, while post-treatment analysis were pH (H_2O) 5.02 and CEC soil 16.75 me / 100 g. These results indicated the application of organic fertilizer granular can improve good enough soil fertility. According to the Agency for Agricultural Research and Development (2008) the optimum acidity (pH) for oil palm crop is 5.0-5.5. The cation exchange capacity (CEC) of soil can prevent leaching events from nutrients due to high rainfall. The soil CEC has the ability to hold / absorb plant nutrients in the form of cations available to plants, so the higher the CEC value the more nutrients can be absorbed (Harris et al., 2011).

The results of the analysis of varians (Table 1) showed that the granular organic fertilizer treatment had a significant effect on the greenishness of the leaves, the weight of detached fruit, and the thickness of the mesocarp. However, no significant effect were observed on the number of fresh fruit bunches and the weight of fresh fruit bunches.

The number of fresh fruit bunches and the weight of fresh fruit bunches have no significant effect on the application of granular organic fertilizer might be due to the physiological fruit maturity of the

Table 1. Analysis of variance on observed variables.

Variables	F- value	F -Table 5%
Greenishness of leaves	186.288*	3.84
Number of Fruit Bunch	0.520ns	3.84
Weight of Fruit Bunch	0.092ns	3.84
Weight of Detached Fruit	15.883*	3.84
Thickness of mesocarp	4.023*	3.84

Note: * = significant effect on level 5%, ns = no significant effect on level 5%.

oil palm plant takes 5-6 months after the pollination process. Fruit is formed after pollination and fertilization. The time required from pollination until the fruit is ripe and ready for harvest is approximately 5-6 months. Anatomically, the palm fruit consists of two main parts: the first part is the pericarpium consisting of epicarpium (slippery and hard fruit skin) and mesocarpium (pulp and oil-containing flesh). The second part is the seed, consisting of the endocaprium (shell black and hard), endosperm (palm kernel oil producer), and embryo (Fauzi, 2004). The granular organic fertilizer was may be not fully dissolved into the soil because organic fertilizer has slow release properties so that the applied fertilizer is still not dissolved optimally.

Table 2 presents the means of yield components of oil palm fruits i.e. greenishness of leaves, detached fruit weight, mesocarp thickness, number of fresh fruit bunches and weight of fresh fruit bunches. The highest greenishness of leaf data was obtained at 12 kg fertilizer treatment. This level of treatment also resulted the highest means of the number of fresh fruit bunches, the weight of fresh fruit bunches, the weight of brondol, and the mesocarp thickness. It indicates that the nitrogen in the granular organic fertilizer can increase the chlorophyll content in the leaves to support the process of photosynthesis. According to Noveita (2005) nitrogen is the raw material of chlorophyll constituents in the process of photosystesis. Damanik et al. (2011) states that the element of nitrogen increases the protoplasm, causing some consequences, such as an increase in the size of leaf and stem cells. Element N is the main constituent of young plant biomass. The photosynthates serve as carbohydrate and energy to increase plant height and the number of leaves. Organic fertilizer of EFB contains the main nutrients N, P, K, and Mg which help to support the increase of crop production. The content of soil N, P, K after application of granular organic fertilizer were N total = 0.13%, P2O5 = 6.25 ppm and K = 2.19 me / 100 g. Nasution et al. (2014) stating that EFB fertilizer is not only be able to improve the efficiency of fertilization but can also reduce the supply of nutrient elements of oil palm from inorganic fertilizers. Application of EFB fertilizer improves fertilizer efficiency and saves fertilizer costs.

Figure 1 showed that the dose of granular organic fertilizer dosage form a postive quadratic curve with the equation y = -0.018x2 + 0,757x + 70,70 with value R^2 = 0,788. The higher the dosage of the granular organic fertilizer given the higher the greenish yield of the leaves, but 21.03 kg of granular organic fertilizer is the optimum dosage to produce the greenishness of leaves 78.65. The greenishness of the leaf shows the amount of chlorophyll possessed by the plant. Growth will be better if the leaves have a higher chlorophyll content (Lintang Ayu, 2012). According to Sumenda et al. (2011), stated that the growth and development of plants is influenced by external and internal factors. Internal factors such as genes, hormones, anatomical structures and plant organ morphology and chlorophyll content, while major external factors such as soil, moisture, light and water.

The orthogonal polynomial test in Figure 2. formed a postive quadratic curve with the equation y = $-0.030x^2 + 0.923x + 5.125$ and R^2 = 0.784. The higher the dose of organic fertilizer granular the greater the weight of detached fruit. It is shown on the curve line that still increases the application of organic fertilizer granular 15.38 kg planting is the optimum dose in producing detached fruit weight reaches 12.22 grams per fruit. According to Nyakpa et al. (1988), the element of nutrients also stimulate the process of photosynthesis, so that when

Table 2.Means of Yield Components of Oil Palm as Affected by Dosage of GOF.

Dosage of Organic Fertilizer (kg)	Variables				
	Leaf Greenness	Number of Fruit Bunch per plant	Weight of Fruit Bunch (kg)	Weight of Detached Fruit (g)	Thickness of Mesocarp (cm)
0	71.37	1.87	8.47	5.73	0.50
4	72.47	1.70	9.20	7.07	0.90
8	74.57	1.77	8.57	10.70	0.67
12	79.57	2.10	9.23	12.87	1.13
16	77.20	2.03	8.90	11.50	0.70

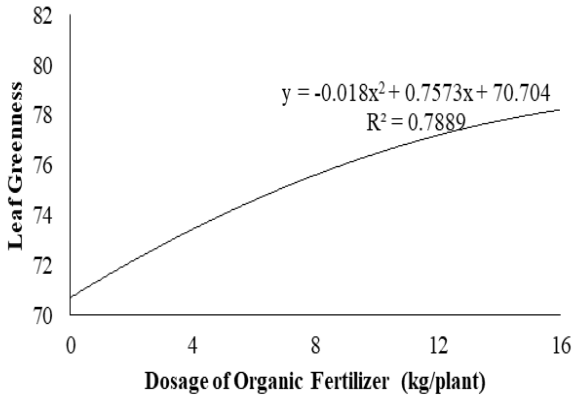

Figure 1. Effect of granular organic fertilizer dose on leaf greenishness.

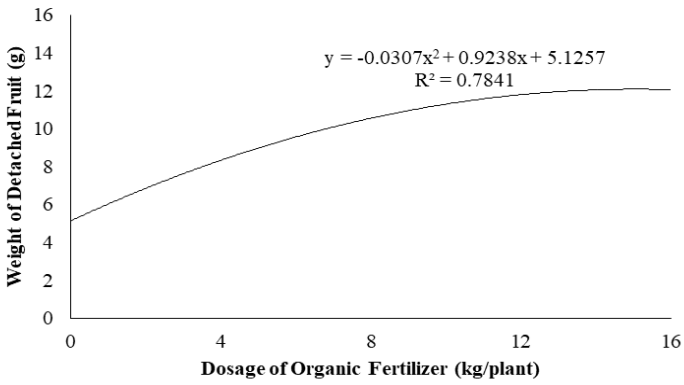

Figure 2. Effect of granular organic fertilizer dose on detached fruit weight of palm oil plant.

photosynthesis increases then photosynthate also increased and will ditranslokasikan to other organs. This might be affect the weight of detached fruits. Hakim et al. (1986), stated that the high organic matter will optimize the process of nutrient uptake and the more photosynthate produced by plants. The curve of granular organic fertilizer on mesocarp thickness can be seen in Fig. 3. It formed a postive quadratic curve with the equation $y = -0.004x^2 + 0.084x + 0.515$ and $R^2 = 0.301$. Viewed on the line of the appropriate granular organic fertilizer curve can increase the mesocarp thickness of the palm fruit giving the optimum dose for mesocarp thickness of 10.5 kg resulting in 0.96 cm mesocarp thickness. The thickness of the mesocarp is indicated to be influenced by the P element, since the element P is the nutrient component of the cell's enlargement in the plant. This is in line with Kartika (2015), pospor is an important nutrient element in plants for photosynthesis, respiration, energy transfer and storage, cell division and enlargement. Excess nutrient P causes absorption of other elements, especially micro elements such as iron (Fe), copper (Cu) and zinc (Zn) disrupted and resulted in dwarf plants.

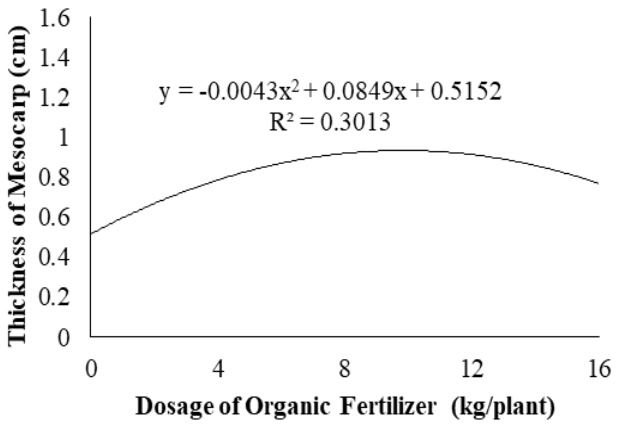

Figure 3. Effect of granular organic fertilizer dosage on mesocarp thickness

CONCLUSIONS

The local fertilizer dosage significantly influenced the leaf greenness, the weight of brondol and mesocarp thick, but no significant effect on the number of fresh fruit bunches and fresh fruit weight. The optimal dosage of local organic fertilizer 21.03 kg is able to produce the greenishness of leaf 78.65. Optimal dosage of local organic fertilizer 15.38 kg can produce weight of palm oil brondol 12.22 gram. Optimal dose of local organic fertilizer 10.5 kg able to produce thickness of mesocarp 0.96 cm.

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