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USING OF SOLID PALM OIL WASTE FERTILIZER TO IMPROVE GROWTH AND YIELD OF EGGPLANT (SOLANUM MELONGENA L.)

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ABSTRACT
This study aims to determine the effect of applying palm solid waste fertilizer on the growth and yield of eggplant (*Solanum melongena* L.). The study used a randomized block design consisting of 1 (one) factor, namely the palm oil solid waste fertilizer factor which consisted of 6 treatment levels, namely p0: control (without solid fertilizer); p1 (1.4 kg/m^2); p2 (2.4 kg/m^2); p3 (3.4 kg/m^2); p4 (4.4 kg/m^2); and p5 (5.4 kg/m^2) which was repeated 4 times. The results showed that the treatment of palm solid waste fertilizer had a significant effect on all parameters except flowering age. The highest yield at plant height at 84 days after planting (DAP) was obtained in the p4 treatment (4.4 kg/m^2) with an average value of 62.56 cm and the lowest in the p0 treatment (control) with an average value of 18.31 cm. The highest number of leaves aged 84 DAP was obtained in the p4 treatment with an average value of 87.50 strands and the lowest in the p0 treatment (control) with an average value of 16.00 strands. The flowering age of the control plants was slower, ie 54 DAP compared to the plants given palm solid waste fertilizer in the p4 treatment which reached 42 DAP. The highest number of fruit and eggplant weight were obtained in the p4 treatment, namely 7.31 fruit and 25.67 t.ha^{-1}, whereas the lowest was in the p0 treatment, namely 0.25 fruit and 0.88 t.ha^{-1}.

KEY WORDS
Solid palm, growth, yield, eggplant.

Eggplant is a vegetable that is well known and loved by the public. Young eggplant fruit besides being used as a vegetable is also a side dish. Kurnia, (2019) stated that eggplant plants apart from having a delicious taste, also contain lots of vitamins and nutrients such as; vitamin A, vitamin B, vitamin C, potassium, phosphorus, iron, protein, fat, and carbohydrates. In addition, it contains the alkaloids solanine and solasodin which function as raw materials for oral contraceptives.

Demand for eggplant continues to increase in line with population growth followed by awareness of the benefits of vegetables in fulfilling family nutrition so that production needs to be increased. Eggplant productivity in East Kalimantan, especially Kutai Kartanegara 1.12 t.ha^{-1} or 11.12 kw.ha^{-1} with a harvested area of 448 ha^{-1} (Central Bureau of Statistics, 2020). One of the causes of low eggplant productivity in Kutai Kartanegara Regency is due to soil fertility.

Organic matter can be used to improve soil fertility such as soil physical properties (soil structure and porosity). Basically all solid organic materials can be composted, for example household organic waste, livestock manure/waste, agricultural waste, agro-industrial waste, paper mill waste, sugar factory waste, palm oil factory waste and others (Crawford, 2003 in Ginting, 2017).

Solid is solid waste from the by-product of the processing of fresh fruit bunches (FFB) at palm oil mills into Crude Palm Oil (CPO). The raw solid has a shape and consistency like tofu dregs, has a brownish color, smells sour and still contains around 1.5% CPO oil (Ruswendi, 2008 in Ginting, 2017).

The use of palm oil solid waste fertilizer is an alternative to improve soil fertility so as to increase eggplant production and reduce farmers' dependence on inorganic fertilizers. Laboratory analysis results show that solid waste has a dry matter content of 81.65%; crude

protein 12.63%; crude fiber 9.98%; crude fat 7.12%; calcium 0.03%; phosphorus 0.003%; hemicellulose 5.25%; cellulose 26.35%; and energy 34.54 kcal.kg^{-1} (Utomo and Widjaja, 2005 in Ginting, 2017). In 1 (one) ton of palm oil solid waste contains nutrients equivalent to 10.3 kg of Urea; 3.2 kg TSP; 6.1 kg MOP; and 4.5 kg Kieserit (Pahan, 2012). This study aims to determine the effect of applying palm solid waste fertilizer on eggplant growth and yield.

METHODS OF RESEARCH

The research was carried out in the village of Siram Makmur, Bongan sub-district, West Kutai Regency, which will take place in 2021. The materials used included: water, palm solid waste fertilizer, eggplant seeds of the Mustang F1 cultivar.

The experimental design used was a randomized block design consisting of 1 (one) factor, namely palm oil solid waste fertilizer with 6 levels of treatment and repeated 4 times. Each planting plot consisted of 16 plants with 4 sample plants so that the number of plants required was 384 plants. p0 (control) p1 = 1.4 kg/m^2 (11.55 kg.plot^{-1}); p2 = 2.4 kg/m^2 (19.8 kg.plot^{-1}); p3 = 3.4 kg/m^2 (28.05 kg.plot^{-1}); p4 = 4.4 kg/m^2 (36.3 kg.plot^{-1}); and p5 = 5.4 kg/m^2 (44.55 kg.plot^{-1}). The effect of the treatment was tested with variance (F-test) and continued with the Honest Significant Difference (BNJ) test at a probability level of 5%.

Eggplant seed germination lasted for 21 days, after the seedlings had 3-4 leaves, they were transferred to an experimental plot measuring 250 cm x 330 cm and 20 cm high with a spacing of 60 cm x 80 cm. The application of palm solid waste fertilizer was carried out 2 (two) weeks before planting according to each treatment.

The application of palm solid waste fertilizer is carried out by sowing it evenly in each plot. Plant maintenance includes: regular watering every morning and evening, weeding and loosening the soil, pruning wild shoots that grow in the axils of the first leaves to the first flowers, controlling pests and diseases.

The first harvest is done after the fruit meets the harvest criteria. The observed variables included eggplant growth and yield variables. The observed variables were as follows: 1) Plant height (cm) was measured at 21, 42, 63, and 84 days after planting; 2) Number of leaves (strands) counted at the age of 21, 42, 63 and 84 days after planting; 3) Age of flowering 80% (days); 4) Number of fruits per plant; and crop yield per hectare.

RESULTS AND DISCUSSION

Based on the results of the analysis of variants (anova) shows that the treatment of solid palm waste fertilizer has a significant effect on the height of plants aged 20, 42, 63 and 84 days after planting. The results of the 5% BNJ test showed that there was a difference in plant height between the treatment levels from one to another. Based on the curve in figure 1, it shows that the p4 treatment level (4.4 kg/m^2 (36.3 kg.plot^{-1}) gives the highest plant height value compared to the p1 treatment (control) and other treatments.

The results of this study are in line with the results of research by Rosmadelina P. et al., (2019) on green eggplant plants with the application of palm solid waste fertilizer which had a significant effect on plant height aged 2, 4 and 6 weeks after planting; Jamaluddin (2020) on long bean plants gave a very significant difference in plant height 15, 30 and 45 days after planting; The results of the research by Syahputra, B., et al., (2022) that the administration of palm solid waste fertilizer had a very significant effect on the height of the oil palm seedlings. The treatment of palm oil solid waste fertilizer had an effect and was significantly different from the control because palm oil solid waste fertilizer contained nutrients needed by plants for growth and production. Pahan (2012) said that 1 (one) ton of solid contains nutrients equivalent to 10.3 kg of Urea, 3.2 kg of TSP, 6.1 kg of MOP, and 4.5 kg of Kieserit. In addition, the C/N Solid Ratio is only 5 (five), which means that the organic matter is easily decomposed, and contains Nitrogen, Phosphorus, and Potassium (Syahwan, 2010; Ali, M. 2008). Furthermore, Maulida et al (2000) suggested that solids contain high levels of nutrients in the form of nitrogen, phosphorus, potassium, magnesium and calcium so that the addition of solids can increase the availability of nutrients for plants.

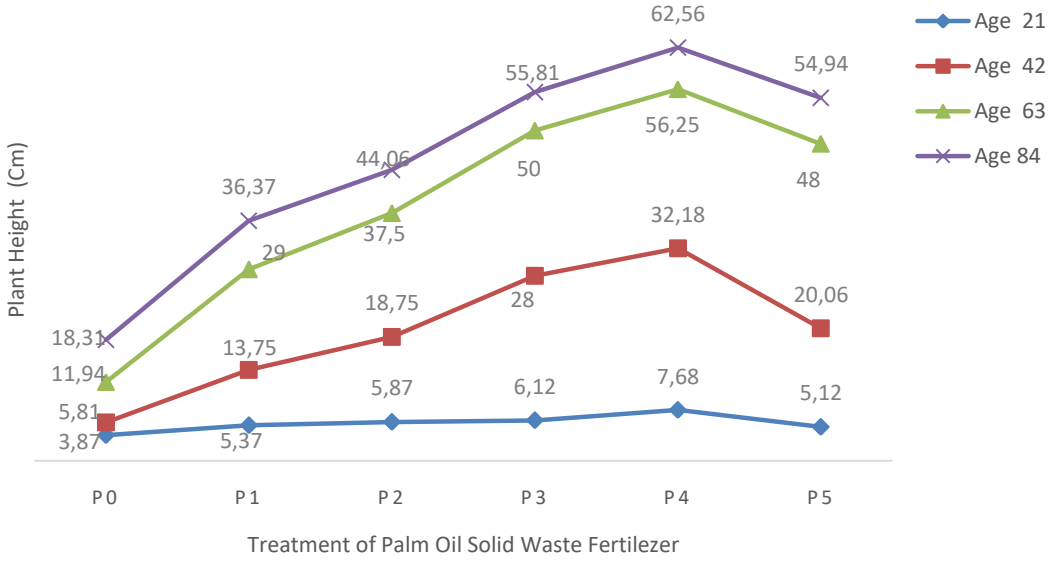

Figure 1 – Effect of palm oil solid waste fertilizer on eggplant plant height at 21, 24, 63 and 84 days after planting

Based on the results of the analysis of variance (ANOVA) it showed that the treatment of palm solid waste fertilizer had a significant effect on the number of leaves aged 20, 42, 63 and 84 after planting. The results of the 5% BNJ test showed that there were differences in the number of leaves of eggplant plants at one treatment level with another

Based on the curve in Figure 2, it shows that the p4 treatment (4.4 kg/m^2 (36.3 kg.plot^{-1}) gave the highest number of plant leaves compared to the p1 treatment (control) and other treatments. The results of this study are in line with the results of research by Rosmadelina P. *et al*., (2019) on green eggplant plants by administering palm oil solid waste fertilizer which had a significant effect on the number of leaves aged 2, 4 and 6 weeks after planting, Jamaluddin (2020) on pea plants length makes a very significant difference in the number of leaves aged 15, 30 and 45 days after planting, the research results of Syahputra B., et al., (2022) administration of palm solid waste fertilizer has a very significant effect on the number of leaves of oil palm seedlings. Oil palm waste (solid) besides functioning to add nutrients to the soil, also increases the soil organic matter content which is very necessary for the improvement of the physical, chemical and biological properties of the soil. The increase in soil organic matter results in a more stable soil structure and a better water holding capacity, improving soil physical properties has a positive impact on root growth and nutrient absorption (Ministry of Agriculture, 2006 in Rahman, 2016; Nanda 2019).

Age of flowering was not affected by the treatment of palm solid waste fertilizer, but there was a tendency that the flowering age of eggplant plants given palm solid waste fertilizer flowered faster than the control. Furthermore, the results of the analysis of variance (ANOVA) showed that the number of fruits and fruit weight per hectare (tons) were affected by the application of palm oil solid waste fertilizer. The p4 treatment (4.4 kg/m^2 (36.3 kg. plot^{-1}) had the highest number of fruits and fruit weight which was significantly different from the control treatment as presented in table 1.

The results of this study are in line with various studies that have been carried out previously both on eggplant and other plants. Simatupang, S, M., et al (2018) found that applying 34 tons ha-1 of palm solid waste fertilizer and 75 kg.ha-1 of TSP could give the best results on the growth and yield of eggplant plants. The results of research by Barlian, C., (2019) found that the treatment of palm oil solid waste fertilizer had a very significant effect on flowering age, flower diameter, flower weight and yield of cauliflower (*Brassica oleracea* var botrytis L.) per hectare. The highest yield of cauliflower was obtained in the treatment (30 t ha1) with a yield of 2.86 t ha1 and the lowest yield was in the treatment without fertilizer

with a yield of 2.0 t ha1. Furthermore Rosmadelina P., et al., (2019) found that the treatment of palm solid waste fertilizer had a significant effect on flowering age, production per plant and production per plot, the fastest flowering age (32.89 days), the highest production per plant (1748.77 g) and the highest production per plot (21.89 kg) was in green eggplant. This significantly different effect is due to the fact that palm oil solid waste fertilizer can improve soil chemical properties, being able to increase soil pH by 0.68 units; C-organic was 1.20%, P was 10.76%, K was 0.18 me/100 g of soil, otherwise it reduced the Al-dd value to immeasurable (Okalia, D., et al (2017).

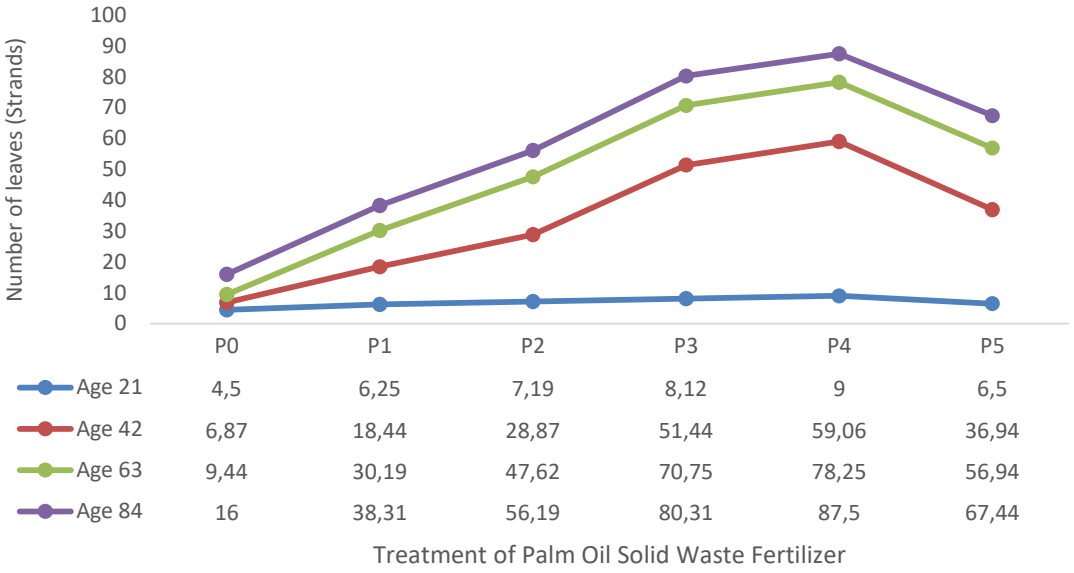

Figure 2 – The effect of palm solid waste fertilizer on the number of eggplant leaves at the age of 21, 24, 63 and 84 days after planting which was significantly different in the 5% BNJ Test

Table 1 – Effect of palm oil solid waste fertilizer treatment on flowering age, fruit number and fruit weight of eggplant plants

Treatment	Generative parameters		
	Flower Age	Number of Fruit	Yield (ton/ha)
P_0	54.00 a	0.25 a	0.88 a
P_1	50.00 a	1.81 a	6.41 ab
P_2	47.00 a	3.06 ab	10.84 ab
P_3	44.00 a	5.44 ab	19.45 ab
P_4	42.00 a	7.31 b	25.67 b
P_5	51.00 a	3.44 ab	12.17 ab
BNJ 5 %	26.86	5.43*	19.50*

Note: Numbers followed by the same letter in the same column are not significantly different in the 5% BNT Test.

The nutrient content contained in the mustard greens solid waste fertilizer is sufficient for nutrient intake which supports the increase in the number of fruits and fruit weight of eggplant so that both the number and weight of eggplant fruit increases. The increase in the number and weight of eggplant fruit was also due to the addition of height and number of leaves at the p4 treatment level which supported better plant growth and thus increased eggplant fruit weight (Ginting, 2017; Dona J. Nadeak, 2021).

CONCLUSION

The treatment of palm oil solid waste fertilizer had a significant effect on all parameters except the age of flowering. The highest plant height at 84 DAP was obtained in the p4 treatment (4.4 kg/m^2) with an average value of 62.56 cm and the lowest in the p0 treatment

(control) with an average value of 18.31 cm. The highest number of leaves aged 84 DAP was obtained in the p4 treatment with an average value of 87.50 leaves and the lowest in the p0 (control) treatment with an average value of 16.00 leaves. Giving palm solid waste p4 (4.4 kg/m^2) flowered earlier than p0 (control). The highest number of fruit and eggplant weight were obtained in the p4 treatment, namely 7.31 fruit and 25.67 ton.ha^{-1}, on the other hand the lowest was in the p0 treatment, namely 0.25 fruit and 0.88 ton.ha^{-1}.

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