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THE EFFECT OF OIL PALM EMPTY FRUIT BUNCHES (EFB) COMPOST AND N, P, K FERTILIZERS ON THE GROWTH AND YIELD OF LOWLAND RICE (Oryza sativa L.)

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ABSTRACT

The use of chemical fertilizers can cause environmental problems. A compost of oil palm empty fruit bunches (OPEFB) is one alternative to reducing chemical fertilizers used for rice (*Oryza sativa* L.). This research to determine the effect and obtain the best dose of OPEFB compost and N, P, K fertilizers in lowland rice *Batang Piaman* Variety was conducted in *Padang Mutung* Village, *Kampar*, for six months using a factorial completely randomized design (CRD). The first factor was three levels of OPEFB (0 $t.ha^{-1}$, five $t.ha^{-1}$, ten $t.ha^{-1}$), and the second factor was four levels of fertilizer N, P and K (0-0-0 $kg.ha^{-1}$, 125-75-25 $kg.ha^{-1}$, 150-100-50 $kg.ha^{-1}$, and 175-125-75 $kg.ha^{-1}$ of Urea-TSP-KCl). The ANOVA results showed that the combination of various doses of EFB compost and N, P, and K fertilizers did not significantly affect plant height, the number of tillers, the number of productive tillers, heading days, the weight of 1,000 grains, and the harvest index. The combination of giving EFB compost at a dose of 10 $t.ha^{-1}$ and Urea fertilizer 175 $kg.ha^{-1}$ TSP 125 $kg.ha^{-1}$ increased the percentage of pithy grain to 93.91%, and the weight of dry milled grain is 2,023.3 $g.4m^{-2}$.

Keywords: *empty fruit bunches, fertilizer, growth, oil palm, rice, yield*

BACKGROUND

Riau population in 2020 was 6.39 million people. With a growth rate of 1.40 percent on average per year, it requires a rice consumption of 623,274 tons per year. Meanwhile, local production was only 147,090 tons (23.6% of local consumption). To cover the shortfall, most of which is supplied from neighboring provinces such as North Sumatra and West Sumatra. Therefore, increasing rice production is essential to meet the rice demand in Riau. Proper fertilization is one of the efforts to increase rice production because it can add nutrients plants need. So that the growth and productivity of plants are optimal, fertilization can be applied with a combination of organic and inorganic fertilizers. This combination is expected to increase productivity. Organic fertilizer contains all necessary macro and micronutrients and can enhance the soil's physical structure, improving its chemical and biological characteristics.

Oil palm empty fruit bunch compost is one of the potential organic fertilizers widely available in Riau (EFB). Oil palm EFB compost is made from residual or solid waste from palm oil mills' fresh fruit bunches (FFB) processing. Nitrogen, Phosphorus, potassium, carbon, calcium, magnesium, sulfur, and iron are all known nutrients in Oil Palm EFB compost. EFB compost can help maintain soil fertility, structure, nutrients, and water efficiency. However, using organic fertilizers from EFB is slow to be available for plant growth and has not fulfilled all the nutrient requirements plants need. For this reason, in its application, it is necessary to combine it with inorganic fertilizers to support

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plant growth. Inorganic fertilizers are chemical fertilizers, which in their application, must be balanced, effective, and efficient so that they can be able to provide a higher and quickly available nutrient to obtain a balance of nutrients for plant growth and development.

RESEARCH METHODS

The research was conducted in *Padang Mutung* Village, *Kampar* District, Riau Province. from November 2018 to March 2019. The materials used in this study were *Batang Piaman* Variety, oil palm empty fruit Bunch (EFB) compost, N, P, K fertilizers in Urea, TSP, and KCl, supertax, lindomil, two inches paralon, decis, wood, curator, clerat and dithane. The tools used were hoes, gauges, raffia rope, machetes, calculators, analytical scales, precision scales, plastic bags, sacks, envelopes, and stationery. This experiment uses a factorial, completely randomized design (CRD). The dose of oil palm empty fruit bunches (EFB) compost as the first factor, which had three levels [0 $t.ha^{-1}$ (0 kg per plot), 5 $t.ha^{-1}$ (2 kg per plot), and 10 $t.ha^{-1}$ (10 kg per plot) (4 kg per plot). The fertilizer N, P, K dose in the form of Urea, TSP, and KCl as the second factor, which was divided into four levels [0-0-0 $kg.ha^{-1}$ of Urea-TSP-KCl (0, 0, 0 grams per plot); 125-75-25 $kg.ha^{-1}$ of Urea-TSP-KCl (50, 30, 10 grams per plot); 150-100-50 $kg.ha^{-1}$ of Urea-TSP-KCl (60, 40, 20 grams per plot (70, 50, 30 grams per plot). All the data obtained were analyzed with Duncan's Multiple Range Test (DMRT) at the 5% level.

RESULT AND DISCUSSION

Plant Height

The analysis of variance showed that the combination of EFB compost and N, P, K fertilizers and the main factors of EFB compost and N, P, K fertilizers had no significant effect on the height of lowland rice plants.

Table 1. The Height of Lowland Rice of the Batang Piaman Variety with Various Doses of EFB Compost and N, P, K Fertilizers (cm)

EFB Compost ($t.ha^{-1}$)	Urea-TSP-KCl Fertilizer ($kg.ha^{-1}$)				Average
	0-0-0	125-75-25	150-100-50	175-125-75	
0	102.50 a	97.20 a	105.35 a	96.40 a	100.38 a
5	99.20 a	106.02 a	106.96 a	104.74 a	104.23 a
10	102.37 a	100.99 a	106.82 a	105.92 a	104.03 a
Average	101.36 a	101.43 a	106.37 a	102.35 a	

According to Duncan's Multiple Range Test, the numbers in the column and row followed by the same lowercase letter were not significantly different at the 5% level. Table 1 shows that each dose combination of oil palm EFB compost and N, P, K fertilizers produced no different plant height based on DMRT. Plants have not maximally utilized the oil palm EFB compost application at the early planting stage. This is because the application of organic matter (EFB compost) has only been carried out in 1 time this planting season, and the nutrients are not yet available for plants. Compost has many benefits but several drawbacks.Namely, the nutrient content of compost is relatively low and available slowly from inorganic fertilizers. N, P and K fertilizers application on various doses

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also did not significantly affect plant fertilizers. It is suspected that the nutrient content available in the soil has been able to support plant height growth, and in this term, the application of various doses of N, P, and K fertilizers does not increase plant height growth.

Number of Productive Tillers

The analysis of variance results in observing the number of productive tillers showed that both interactions between EFB compost and N, P, K fertilizers and single factors had no significant effect on the number of productive tillers of Batang Piaman Variety. The results of DMRT at the 5% level are presented in Table 2.

Table 2. The Number of Productive Tillers of Batang Piaman Variety with Various Doses of EFB Compost and N, P, and K Fertilizers (stem)

EFB Compost ($t.ha^{-1}$)	Urea-TSP-KCl Fertilizer ($kg.ha^{-1}$)				Average
	0-0-0	125-75-25	150-100-50	175-125-75	
0	12.88 a	11.53 a	12.36 a	12.17 a	12.23 a
5	12.48 a	14.81 a	11.94 a	13.83 a	13.26 a
10	11.81 a	12.54 a	12.12 a	15.34 a	12.96 a
Average	12.39 a	12.96 a	12.14 a	13.78 a	

According to Duncan's Multiple Range Test, the numbers in the column and row that were followed by the same lowercase letter were not significantly different at the 5% level. Table 2 shows that each combination dose of EFB compost and N, P, K fertilizers produced a comparable number of productive tillers based on Duncan's Test, as well as the main effect of giving EFB compost at doses of 5 $t.ha^{-1}$ and 10 $t.ha^{-1}$ and fertilizer doses of 5 $t.ha^{-1}$ and 10 $t.ha^{-1}$. This is presumably because different doses of EFB compost and N, P, K have failed to change the number of tillers' growth and development significantly.

Days of Heading Stage

The variance analysis showed that both the combination factor and the single factor of EFB compost and N, P, K fertilizers had no significant effect on the observation of Batang Piaman's heading stage day. Table 3 shows the results of DMRT at the 5% level.

Table 3. Day of Heading Stage of Batang Piaman Variety with Various Doses of EFB Compost and N, P, and K Fertilizers (days after planting)

EFB Compost ($t.ha^{-1}$)	Urea-TSP-KCl Fertilizer ($kg.ha^{-1}$)				Average
	0-0-0	125-75-25	150-100-50	175-125-75	
0	62.33 ab	62.33 ab	62.33 ab	67.00 b	63.50 a
5	64.67 ab	62.33 ab	63.67 ab	60.00 ab	62.67 a
10	64.67 ab	63.67 ab	56.00 a	58.33 ab	60.67 a
Average	63.89 a	62.78 a	60.67 a	61.78 a	

According to Duncan's Multiple Range Test, the numbers in the column and row that were followed by the same lowercase letter were not significantly different at the 5% level. Table 3 shows that rice needs similar days to reach the heading stage for each combination dose of EFB compost

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and N, P, K fertilizers, as well as the main effect of giving EFB compost at doses of 5 t.ha^{-1} and 10 t.ha^{-1} and fertilizer doses. 125 kg.ha^{-1} UreaUrea, 75 kg.ha^{-1} TSP and 25 kg.ha^{-1} KCl or higher. This is because genetic factors more dominantly influence the heading stage character, so the time required for the plant is the same for all treatment doses. Genetic and environmental traits strongly influence the first flowers to appear on plants. Also, genetic factors are the main factor of differences for the plant to reach the heading stage in rice.

Weight of 1,000 Grains

The analysis of variance results in observations of the weight of 1,000 grains indicated that the use of EFB compost and N, P, and K fertilizers in combination or as single factors had no significant effect on the weight of 1,000 grains in lowland rice plants.

Table 4. Weight of 1,000 Grains of Batang Piaman Variety with Various Doses of EFB Compost and N, P and K Fertilizers (grams)

EFB Compost (t.ha^{-1})	Urea-TSP-KCl Fertilizer (kg.ha^{-1})				Average
	0-0-0	125-75-25	150-100-50	175-125-75	
0	27.92 a	27.67 a	27.11 a	25.75 a	27.11 a
5	26.68 a	26.96 a	25.97 a	26.61 a	26.55 a
10	25.89 a	27.46 a	26.84 a	28.05 a	27.06 a
Average	26.83 a	27.36 a	26.64 a	26.80 a	

According to Duncan's Multiple Range Test, the numbers in the column and row that were followed by the same lowercase letter were not significantly different at the 5% level. Table 4 shows that each combination dose of EFB compost and N, P, K fertilizers produced a weight of 1,000 grains of grain based on Duncan's Test, as well as the main effect of giving EFB compost at doses of 5 t.ha^{-1} and 10 t.ha^{-1} and fertilizer doses of 5 t.ha^{-1} and 10 t.ha^{-1}. 125 kg.ha^{-1} UreaUrea, 75 kg.ha^{-1} TSP and 25 kg.ha^{-1} KCl or higher.

Percentage of Pithy Grain

The analysis of variance results in the observation of the percentage of pithy grain showed that both of interaction between EFB compost and N, P, K fertilizers and single factors had a significant effect on the percentage of a pithy grain of Batang Piaman Variety. The results of DMRT at the 5% level are presented in Table 5.

Table 5. Percentage of Pithy Grain of Batang Piaman Variety with Various Doses of EFB Compost and N, P, and K Fertilizers (%)

EFB Compost (t.ha^{-1})	Urea-TSP-KCl Fertilizer (kg.ha^{-1})				Average
	0-0-0	125-75-25	150-100-50	175-125-75	
0	68.83 de	64.81 de	66.77 de	61.93 e	65.59 c
5	73.49 dc	69.21de	73.63 dc	75.66 dc	73.00 b
10	67.48 de	80.32 bc	86.99 ab	93.91 a	82.17 a
Average	69.93 b	75.80 ab	71.45 ab	77.16 a	

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According to Duncan's Multiple Range Test, the numbers in the column and row that were followed by the same lowercase letter were not significantly different at the 5% level. Table 5 shows the combination of 0 t.ha^{-1} EFB compost and 175 kg.ha^{-1} Urea fertilizer, TSP 125 kg.ha^{-1}, and KCl 75 kg.ha^{-1} produced the lowest percentage of pithy grain, averaging 62%. With the application of 10 t.ha^{-1} EFB compost and 175 kg.ha^{-1} Urea fertilizer, 125 kg.ha^{-1} TSP, and 75 kg.ha^{-1} KCl, the percentage of pithy grain increased significantly. With an average of 94%, applying 10 t.ha^{-1} EFB compost and 175 kg.ha^{-1} UreaUrea, 125 kg.ha^{-1} TSP, and 75 kg.ha^{-1} KCl produced the highest percentage of pithy grain. This demonstrates that applying 10 t.ha^{-1} compost with fertilizer is 175 kg.ha^{-1} Urea, Urea, 125 kg.ha^{-1} TSP, and 75 kg.ha^{-1} KCl provides sufficient nutrients for rice growth while reducing the amount of empty grain. The decrease in empty grain indicates the response of plants to fertilization. The higher the dose of EFB compost, the more the absorption of the soil water and the relatively high nutrient content. Phosphorus absorbed by plants will be distributed to living cells, especially in the reproductive parts of plants, such as stimulating tiller development, the greater number of panicle grains, flowering, and seed formation.

Weight of the Milled Dry Grain

The analysis of variance results indicates that the interaction between EFB compost and N, P, K fertilizers and the individual effects of EFB compost and N, P, K fertilizers significantly impacted the milled dry weight of Batang Piaman. The detailed results of the DMRT at a 5% significance level are presented in Table 6.

Table 6. Weight of Dry Milled Grain of Batang Piaman variety with various doses of EFB Compost and N, P, and K Fertilizers (g.4m^{-2})

EFB Compost (t.ha^{-1})	Urea-TSP-KCl Fertilizer (kg.ha^{-1})				Average
	0-0-0	125-75-25	150-100-50	175-125-75	
0	902.3 d	938.3d	1452.0 abcd	1092.7 cd	1096.3 b
5	1195.7 cd	1742.3 abc	1170.3 cd	2023.3 a	1532.9 a
10	1306.0 bcd	1862,3 ab	1570.3 abcd	1557,3 abcd	1574.0 a
Average	1134.7 b	1514.3 a	1397.6 ab	1557.8 a	

According to Duncan's Multiple Range Test, the numbers in the column and row that were followed by the same lowercase letter were not significantly different at the 5% level. Table 6 shows that applying 5 t.ha^{-1} EFB compost combined with 175 kg.ha^{-1} urea fertilizer, 125 kg.ha^{-1} TSP, and 75 kg.ha^{-1} KCl is the best treatment for producing dry-milled grain. This demonstrates that this combination has satisfied the need for plant nutrients so that plants can develop optimally. Plants will grow and produce well if the nutrients are sufficiently available in the soil absorbed by plants and supported by good soil structure and aggregate conditions.

Harvest Index

The results of the variance analysis indicated that neither the combination of EFB compost and N, P, K fertilizers nor the individual effects of EFB compost and N, P, K fertilizers had a significant impact on the harvest index of lowland rice plants. The results of the DMRT at a 5% significance level are presented in Table 7.

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Table 7. Harvest Index of Batang Piaman Variety with Various Doses of EFB Compost and N, P and K Fertilizers (%)

EFB Compost (ton.ha^{-1})	Urea-TSP-KCl Fertilizer (kg.ha^{-1})				Average
	0-0-0	125-75-25	150-100-50	175-125-75	
0	51.46 a	52.99 a	51.29 a	48.75 a	51.12 a
5	49.94 a	54.06 a	46.81 a	59.18 a	52.50 a
10	52.63 a	51.93 a	55.38 a	50.83 a	52.69 a
Average	51.34 a	52.99 a	51.16 a	52.92 a	

According to Duncan's Multiple Range Test, the numbers in the column and row that were followed by the same lowercase letter were not significantly different at the 5% level. Table 7 shows that each combination of EFB compost doses and N, P, and K fertilizers produced a harvest index similar to the harvest index of the Batang Piaman Variety and every main effect dose. The combination of 5 t.ha^{-1} EFB compost with a dose of 150 kg.ha^{-1} UreaUrea, 100 kg.ha^{-1} Phosphorus, and 50 kg.ha^{-1} KCl resulted in approximately 47% of the total plant weight being grain weight and the remaining part being strawweight. At a dose of 5 t.ha^{-1} EFB Compost with N, P, and K fertilizers at a dose of 175 kg.ha^{-1} UreaUrea, 125 kg.ha^{-1} Phosphorus and 75 kg.ha^{-1} KCl yielded about 59% of the total plant weight. The weight of the grain and the remainder is the weight of the straw.

CONCLUSION AND SUGGESTION

Based on the result and discussion, it is concluded that:

1. Application of oil palm EFB compost at a dose of 10 t.ha^{-1} increased the percentage yield of pithy grain up to 82.17% compared to control (65.59%), and application of compost at a dose of 5 t.ha^{-1} to 10 t.ha^{-1} increased the yield of dry milled grain weight to 1,574, 0 g.4m^{-2} compared to control 1,096.3 g.4m^{-2}
2. The use of Urea fertilizer is 175 kg.ha-1, TSP 125 kg.ha^{-1} and KCl 75 kg.ha^{-1} increased the percentage yield of pithy grain to 77.17% compared to control 69.93% and increased the weight of dry milled grain to 1,557 g. 4m^{-2} compared to control 1,134.7 g.4m^{-2}.
3. The combination of giving EFB compost at a dose of 10 t.ha^{-1} and Urea fertilizer 175 kg.ha^{-1} TSP 125 kg.ha^{-1} increased the percentage of pithy grain to 93.91% compared to 68.83% control and 5 t.ha^{-1} EFB compost and fertilizers Urea 175 kg.ha^{-1}, TSP 125 kg.ha^{-1} and KCl 75 kg.ha^{-1} increased dry milled grain weight yield to 2023.3 g.4m^{-2} compared to control to 902.3 g.4m^{-2}.

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