The Effect Of Pleurotus Ostreatus And Trichoderma In Oil Palm Empty Fruit Bunches Decomposition

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Abstract: This research aimed to analyze quality of compost produced using *Pleurotus ostretus* and Thrichoderma as decomposer on the decomposition of oil palm empty fruit bunches (EFBs) by analyzing the chemical properties of the compost. The research was conducted in Tarengge Village, Sub-district of Wotu, District of East Luwuk, South Sulawesi, Indonesia started from November 2018 to January 2019. Three dose levels of *Pleurotus ostreatus* (4 g, 8 g, and 12 g) and *Trichoderma harzianum* (2 g, 4 g, and 6 g) were used in the decomposition of the EFBs. The results show that the treatments of *Pleurotus ostreatus* 4-12 g/kg EFBs and *Trichoderma harzianum* 2-6 g/kg EFBs resulted in an adequate quality of the compost. The best dose of *Pleurotus ostreatus* and *Trichoderma harzianum* was 12 g and 6 g per kilogram of the EFBs indicated by the compost properties of 0.27% N, 0.36% P_2O_5, 2.35% K_2O, pH of 5.60, 35.33% C-organic, C/N ratio of 13.00, and CEC of 33.94 Cmol (+) kg^{-1}.

Index Terms: Empty fruit buncheses of oil palm, compost quality, chemical properties, decomposition, organic materials, *Pleurotus ostreatus*, Trichoderma.

1 INTRODUCTION

Oil palm is one of the important commodities and has significant role in supporting economy of the farmers. It is a necessary and efficient commodity in producing vegetable oil for export, hence can enhance income of farmers in Indonesia. However, during the production of the palm oil, other byproducts are produced known as solid and liquid waste with a potential in contaminating the environment. For every 1 ton processed fresh oil palm fruits will be resulted in 22-23% empty fruit bunches wastes or around 220 – 230 kg. In the factory, if there are 100 ton/hour of capacity of superintendence in the operation period as long as 6 hours, as many as 132 ton empty fruit bunches wastes is produced in a day [1]. Oil palm waste as empty fruit bunches have not been utilized optimally and it often becomes problem to societies surrounding the palm oil mill because it is only heaped throughout farm. Likewise, liquid waste especially during the rainy season will overflow and spoil environmental condition seriously. According to Hannum et al. [2], contamination that is caused by the oil palm industry and organic material to utilize its waste. This step is an effort to reduce the waste of oil palm factory. One of implementations of the oil palm factory waste can be used as fertilizer. Another product of oil palm farm industry can be wielded entirely if they can utilize it well.

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According to Firmansyah [3], empty fruit bunches of oil palm is one of kinds of solid waste produced in oil palm industry. It has significant rate because it is almost similar to raw oil palm production amount. The empty bunches of oil palm contains high fiber. The main substance of empty bunches of oil palm are cellulose and lignin. In addition, it also contains organic substance (in dry sample): 42.8% C; 0.80% N; 0.22% P_2O_5; 0.30% MgO; and 0.09% K_2O. Compost is organic substance which has experienced decomposition process done by organism. According to Trisakti et al. [4], compost is tool to change variety of organic waste to be the product that is able to use as biological fertilizer safely and advantageously. The main function of the compost is to help enhancing chemistry and biologic soil physically. The research aimed to analyze quality of compost which is produced by using *Pleurotus ostreatus* and Trichoderma as decomposer to decomposition of empty fruit bunches of oil palm by analyzing pH, C-organic, C/N ratio, CEC, and the N, P and K content.

2 RESEARCH METHODOLOGY

This research conducted in Tarengge village, sub-district of Wotu, district of East Luwu, South Sulawesi from November 2018 to January 2019. The tools used in this experiment were chopper (knife/cleaver), weighing machine, digital camera, stationary, shovel, hoe, thermometer, pH meter, tarpaulin, net, string, measuring cup, glass plastic, bucket, sprayer, and permanent marker. Materials used were barrel, oyster mushroom, Trichoderma, label paper, empty fruit bunches of oil palm, and palm oil mill effluent. The experiment was conducted using randomized blocked design. Treatments used were the application of *Pleurotus ostreatus* and *Trichoderma harzianum* in the composting process of the empty fruit bunches of the oil palm to act as decomposers. Dosage of *Pleurotus ostreatus* as the first factor consisted of three levels, namely 4 g/kg EFBs (k1), 8 g/kg EFBs (k2), and 12 g/kg EFBs (k3). While application of *Trichoderma harzianum* was set as the second factor consisted of three levels, namely 2 g (t1), 4g (t2), and 6 g (t3) per kilogram EFBs. Thus, there are 9 combinations of treatments which is repeated 3 times.

Quality parameters of the compost were measured at the end of composting process namely pH, C-organic, C/N ratio, CEC,

and the N, P and K content. Analysis of variance was then employed on the data analysis followed by a further test of Tukey's honestly significant difference test at the level of α=0.05 if there is a significant effect of the treatments.

3 RESULTS AND DISCUSSION

Analysis of variance results show that the there was a significant interaction found between the two treatments on the quality of oil palm empty fruit bunches compost. Application of *Pleurotus ostreatus* and *Trichoderma harzianum* on the decomposition process of the oil palm empty fruit bunches affected the content of phosphor (P), potassium (K), C-organic, C/N ratio, and CEC of the compost produced (Table 1). Nevertheless, no significant differences were found on the average of Nitrogen content of the compost as affected by these two treatments.

TABLE 1

THE EFFECT OF PLEUROTUS OSTREATUS AND TRICHODERMA HARZIANUM TREATMENTS AS DECOMPOSER TO NITROGEN (N), PHOSPHOR (P), POTASSIUM (K), C-ORGANIC, C/N RATIO, AND CATION EXCHANGE CAPACITY (CEC) OF THE OIL PALM EMPTY FRUIT BUNCHESES COMPOST

Treatment	Observation parameters					
	N	P_2O_5	K_2O	C-organic	C/N	CEC
	%	%	%	%		Cmol $^{(+)}$ kg^{-1}
k1 t1	0.283	0.34^{a}	1.62^{bc}	25.87^{ab}	**27.67**^{a}	37.88^{bcd}
k1 t2	0.260	0.32^{a}	1.96^{ab}	**35.33**^{a}	25.33^{ab}	**45.14**^{a}
k1 t3	0.290	0.23^{b}	1.93^{bc}	16.00^{b}	13.00^{b}	42.56^{abc}
k2 t1	0.267	**0.39**^{a}	1.58^{bc}	21.63^{ab}	21.33^{ab}	38.75^{abcd}
k2 t2	0.287	0.36^{a}	1.53^{c}	25.33^{ab}	18.33^{ab}	36.52^{cd}
k2 t3	0.287	0.37^{a}	1.20^{d}	22.33^{ab}	14.00^{ab}	42.87^{abc}
k3 t1	0.273	0.36^{a}	1.11^{d}	16.33^{b}	19.00^{ab}	33.94^{d}
k3 t2	0.260	0.33^{a}	1.55^{bc}	22.67^{ab}	15.00^{ab}	38.20^{bcd}
k3 t3	0.270	0.33^{a}	**2.35**^{a}	25.00^{ab}	13.00^{b}	43.85^{ab}
Tukey's $_{0.05}$	ns	0.09	0.41	14.32	14.53	6.48

Numbers followed by different letter in the same column means significantly different based on Tukey's test at level α=0.05. ns = not significant.

The results of Tukey's test show that application of *Pleurotus ostreatus* 8 g and *Trichoderma harzianum* 2 g per kilogram of oil palm empty fruit bunches resulted in the highest average of P content and was not significantly different with other dosage combination except for dosage combination of 8 g/kg *Pleurotus ostreatus* and 6 g/kg *Trichoderma harzianum.* On the other hand, the compost made from empty fruit bunches of oil palm that applied with 12 g *Pleurotus ostreatus* and 6 g *Trichoderma harzianum* showed the highest potassium content that was not significantly different from dosage of 4 g/kg *Pleurotus ostreatus* and 4 g/kg *Trichoderma harzianum*. Similarly, higher quality compost particularly for properties of C-organic, C/N ratio, and CEC shown by the use of *Pleurotus ostreatus* at lower doses and dose 2-4 g/kg *Trichoderma harzianum*.

TABLE 2

THE EFFECT OF PLEUROTUS OSTREATUS AND TRICHODERMA HARZIANUM TREATMENTS AS DECOMPOSER ON PH OF THE OIL PALM EMPTY FRUIT BUNCHESES (EFBS) COMPOST.

Trichoderma /kg EFBs (t)	*Pleurotus ostreatus* /kg EFBs (k)			Mean	Tukey's $_{0.05}$
	4 g	8 g	12 g		
2 g (t1)	8.44	7.57	7.37	7.80^{a}	
4 g (t2)	7.32	6.64	5.73	6.57^{ab}	1.94
6 g (t3)	6.46	5.58	5.60	5.88^{b}	
Mean	7.41	6.60	6.23		

Numbers followed by different letter means significantly different based on Tukey's test at level α=0.05.

Analysis of variance result shows that the application of Trichoderma harzianum had a significant effect on the pH of the compost produced from empty fruit bunches of oil palm (Table 2). Tukey's test (α=0.05) shows that application of 2 g/kg *Trichoderma harzianum* during the decomposition of oil palm empty fruit bunches into compost resulted in highest pH value of the compost produced (7.80) and was not significantly different from the use of 4 g/kg Trichoderma but different from the highest dose of Trichoderma (6 g/kg empty fruit bunches of oil palm). The results of this experiment shows that the treatment of *Pleurotus ostreatus* (k) 4-12 g/kg empty fruit bunches of oil palm and *Trichoderma harzianum* (t) 2-6 g/kg empty fruit bunches of oil palm as decomposer resulted in a passable quality and grade of compost. The best treatment was the dose of *Pleurotus ostreatus* 12 g/kg and *Trichoderma harzianum* 6 g/kg (k3t3) indicated by value of 0.27% N, 0.33% P_2O_5, 2.35% K_2O, 25% C-organic, 14.5 C/N ratio, and 43.85 Cmol(+) kg^{-1} CEC. This results confirmed study of Susanto et al. [5] that the empty fruit bunches of oil palm is organic substance that contains 0.80 % N, 0.22 % P_2O_5, and 2.90 % K_2O. The nutrient content of the empty fruit bunches of oil palm compost produced using *Pleurotus ostreatus* and Trichoderma as decomposer can be categorized medium to high. Nutrient analysis on the compost show the content of macro nutrients of the compost was categorized as medium for the N nutrient and high for the P and K nutrients. Previous studies have reported that empty fruit bunches of oil palm contain 4.2-45.3% C, 2.4-2.7% K_2O, 0.8-1.2% N, 0.05-2.6% P_2O_5, 0.4-0.5% MgO, C/N ratio of 45-70 [6],[7],[8]. In the recent study, the highest C-organic was shown by compost that applied with the combination of *Pleurotus ostreatus* of 4-12 g/kg and *Trichoderma harzianum* 2-6 g/kg as decomposer with adequate C-organic around 16.00% - 35.33%. Erwan et al. [9] found that the percentage of organic C could influence the macro level of the compost. The high compound of C-organic in empty fruit bunches of oil palm compost can restore chemical and physical characters of the soil. One of chemical characters of the soil affected by the c-organic is cation exchange capacity (CEC). Quality of compost also determined by the extent of the C/N ratio of the compost [10]. The ratio of C/N is an important parameter when utilizing the compost as fertilizer in the soil because high C/N can detain the disintegration process and the availability of the nitrogen in the soil. The ratio of the carbon to nitrogen (percent of dry weight) is a key indicator of the compost's suitability as a growth

medium [11]. Ideal C/N ratios for a compost used as a growth medium is 12–18 [12]. Composting process will decrease the C/N ratio by conversing C-organic to CO_2, and disappearance of the nitrogen in form nitrate-nitrogen [13]. In this research, the ratio of C/N was in around 13-27 in the empty fruit bunches of oil palm compost which is produced in the use of *Pleurotus ostreatus and Trichoderma harzianum* as decomposer, and it means that the compost produced was mature. The mature compost has C/N approximately 25 [14]. The result of the research shows that all of the C/N ratio in the combinations of the treatments is in around optimum level. It is appropriate to be suggested that the C/N ratio for compost has to be in around 16-21 [15]. The result of the experiment in the pH observation is shown in Table 2. The pH produced in the composting process applied with *Pleurotus ostreatus* and *Trichoderma harzianum* as decomposer approximately 5.58-8.44. These values found in this experiment is adequate and fulfilled the optimum pH. It is appropriate to that the optimum compost is 6.5-8 [16].

4 CONCLUSIONS

Use of *Pleurotus ostreatus* 4-12 g/kg and *Trichoderma harzianum* 2-6 g / kg of EFBs of oil palm as decomposer can degrade the EFBs organic materials and produce good quality compost. From the combination treatments, the best result obtained is in dose of *Pleurotus ostreatus* 12 g and *Trichoderma harzianum* 6 g per kilogram of EFBc indicated the chemical compost properties of 0.27% N, 0.36% P_2O5, 2.35% K_2O, pH of 5.60, 35.33% C-organic, C/N ratio of 13.00, and CEC of 33.94 Cmol (+) kg^{-1}.

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