

The Micronutrient Contents of Composting from Empty Bunch after Added Palm Oil Mill Effluent

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Abstract. Compost has the complete nutrient because it contains macro and micro nutrients. Palm oil mill produces the solid and liquid waste like empty fruit bunches that can be used as compost. This research aims to determine the effect of the fiber size in the empty fruit bunches of palm oil at the maturity level of compost that can produce good nutrients for the growth of palm oil. This research was conducted using the factorial completely randomize design with two treatment factors. The first factor is the three level of fiber size such: whole empty fruit bunch (M1), empty fruit bunch Press (M2), empty fruit bunch press with manual shredding (M3). The second factor is the two levels of composting time: two weeks (A1), 4 weeks (A2). The results showed that the optimal product obtained from empty fruit bunch press with manual shredding (M3) and two weeks composting time (A2). The nitrogen; phosphor (P) and Calcium (Ca) content was respectively 0,88; 1 and 9. While the potassium (K); Cuprum (Cu) and Zinc (Zn) content was at about 0,02; 2 and 238 obtained from M1 and A2 as well as Sulfur (S) was 15% obtained from M2 and A2. The conclusion of this study was the fiber size of empty fruit bunch and composting time had the significant influence on micronutrient content of compost.

1. Introduction

The demand for organic fertilizers is increasing rapidly, especially in macro and minor nutritional levels that compete with inorganic fertilizers with the same dose and intensity applications [1]. The continuous use of inorganic fertilizers beside cost and fluctuations of its supply in the market, in the long run it causes disturbed nutrient balance in the soil [2]. Oil Palm Empty Fruit Bunch (OPEFB) application has high potential as a soil enhancer, improves soil physical and chemical properties and increases palm oil production [3].

Palm Oil Mill Effluent (POME) has the high organic content, because of that POME must be processed or used as fertilizer. POME has a number of nutrients needed by plants, namely N, P, K, S, Ca, Cu, and Zn which have potential as nutrient sources for plants [4]. In order to keep soil nutrients available in equilibrium, one of the step is to utilize palm oil mill waste in the form of OPEFB and POME by composting [5]. Compost has complete nutrient content because it contains macro and micro nutrients, but the amount is relatively small and varies depending on the size of fiber raw materials, manufacturing process, additional materials, maturity level and the length of composting time. The quality of the compost can be increased by the addition of beneficial microorganisms [6].



So, the aim of this study to know the suitable empty fruit bunch and composting process in order to get the optimal micronutrient content in compost. According to the hypothesis that the size of empty bunch and composting time have significant influence on micronutrient content in compost.

2. Methodology

2.1. Research stages

The raw material of oil palm empty fruit bunches was obtained from the Begerpang Palm Oil Mill; PT. PP. London Sumatra Indonesia, Tbk. Empty Fruit Bunch Press fibers were chopped using scissors or machetes to minimize the size and expand the surface. After that, materials were grouped according to fiber size, water splashing with palm oil mill effluent (POME) will be done immediately. The incubation process was carried out by wrapping the compost using a plastic sheeting so that the temperature and humidity are maintained. During the incubation process, the compost temperature would increase sharply up to 70°C for 2-3 weeks. Mature compost could be examined using chemical methods also, where the C / N ratio initially 50-60 turns to below 25. The mature compost would be tested for nutrient content quality.

2.2. Observation of nutrient element contents

2.2.1. Total nitrogen (N) [7]. Weigh carefully the 0.5 g sample that had been mashed and then put into the kjeldhal flask. Add 25 ml of sulfuric acid-salicylate solution until flattened and leave overnight. The next day add 4 g of. The $\text{Na}_2\text{S}_2\text{O}_2 \cdot 5\text{H}_2\text{O}$ then heat at low temperature until bubbles run out. The increasing of the temperature gradually to a maximum of 300°C (about 2 hours) and let it cool. It was diluted with distilled water, transfer to 500 mL volumetric flask and shake it until the line marks. Pipette 25 mL, put in a distilled flask, adds 150 mL of distilled water and boiling stones, distilled after the addition of 10 mL of 40% NaOH solution with a distilled water container of 20 mL boric acid solution with 1% plus 3 drops of Conway indicator. Stop the distillation when distilled product reaches 100 mL. Titration with 0.05 N H_2SO_4 solution until the end point of the titration is reached (green turns pink). Make a blank solution.

2.2.2. Total phosphorus (P) as P_2O_5 [7]. Sample was titrated 5 mL and each standard phosphate solution into a 100 mL measuring flask. Add 45 mL of distilled water, let stand for 5 minutes. Add 20 mL of molybdovanadate reagent and dilute with distilled water until the tera-mark and shake. Let color develop for 10 minutes. Made a blank solution. Optimize the spectrophotometer at 400 nm long term. Read the absorbance of sample and standard solutions on the spectrophotometer. Created a standard curve. Calculate the level of P_2O_5 in the sample.

2.2.3. Potassium (K) as K_2O [7]. The 2.5 g sample was weighed and tested in 250 mL beaker glass. Add 50 mL $(\text{NH}_4)_2\text{C}_2\text{O}_4$ 4%, 125 mL distilled water and simmer for 30 minutes, cool it. Move into a 250 mL measuring flask, right up to the tera mark with distilled water. Strain or let stand clear. Take 15 mL of the solution, put in a 100 mL measuring flask. Add 2 mL NaOH 20 %, 5 mL HCHO; add 1 mL STPB for each 1% K_2O , add 8 mL for the rest. Apply until tera mark with distilled water, stir and leave for 5 - 10 minutes, strain with Whatman no. 12. Take 50 mL filtrate insert into 125 mL erlenmeyer, add 6 - 8 drops yellow Titan indicator and titrated with standard BAC solution.

2.2.4. Sulfur (S) [8]. The 2 ml extract and standard S series was titrated into chemical tube. Added each 7 ml of mixed acid and 2.5 ml of BaCl_2 -tween solution then shake with tubular shaker until homogeneous. Left for 5 minutes and then measured with a spectrophotometer at a wavelength of 432 nm.

2.2.5. *Calcium (Ca) [8]*. The 1 ml of the extract and standard series was pipette into a chemical tube and add 9 ml of La 0.25% solution. Shake using a tube shaker until homogeneous. Ca is measured by AAS.

2.2.6. *Copper (Cu) and Zinc [8]*. The each 1 ml of sample extract and standard series of Cu and Zn was mixed into chemical tube. Added 9 ml of ion free water and shake (10 times dilution). Cu and Zn are measured directly from the sample extract using AAS.

3. Results and discussion

3.1. Characteristics of compost nutrients

The increasing in decomposing process of empty fruit bunches (EFB) equal with the decreases of EFB sizes that added with Palm Oil Mil Effluent (POME). The compost that had been decomposed due to the addition of POME, then characterized by the micronutrient components present in the compost. As for the result of micronutrient characterization of nutrients on the compost shown in the following table 1:

Table 1. Characteristics of nutrients on compost.

Material	N (%)		P (%)		K (%)		S (%)		Ca (%)		Cu (%)		Zn (%)	
	A1	A2	A1	A2	A1	A2	A1	A2	A1	A2	A1	A2	A1	A2
M1	0,72	0,72	0,865	0,805	0,01	0,025	7,725	14,35	8,35	7,335	2,34	1,975	30,175	23,85
M2	0,77	0,685	0,91	0,795	0,01	0,004	10,405	15,025	5,275	6,485	0,51	0,005	22,525	23,4
M3	0,795	0,885	0,895	0,985	0,01	0,015	10,39	6,41	4,7	8,94	0,005	0,995	12,855	48,675

Information: A1 = 2 weeks
A2 = 4 weeks

M1 = Empty fruit bunches
M3 = cut up EFBP

M2= EFBP

Table 1 showed that each fiber size used had different nitrogen values at each time of composting. The highest Nitrogen (N) was obtained in the treatment of M3 equal to 0.840% which differed significantly from M1 and M2 treatment. Composting time of A2 (4 weeks) treatment, resulted the highest nitrogen (N) content as much as 0.765% which was not significantly different with A1 treatment (2 weeks). Nitrogen values in M1 and M3 treatments increased along with the increasing of incubation period. However, in M2 treatment there was a decrease in the incubation period of A2. This was caused by the surface area of the compost too large, resulted in the increasing rate of compost decomposition. The highest phosphor nutrient (P) element was obtained in the treatment of M3 equal to 0.940% which was significantly different from the treatment of M1 and M2. The composting time of A1 (2 weeks) treatment, resulted the highest phosphorus (P) nutrient as much as 0.890% significantly different from treatment A2 (4 weeks). The highest potassium (K) nutrient was obtained in the treatment of M1 equal to 0.018% which differed significantly from the treatment of M2 and M3. Composting time of A2 (4 weeks) treatment, resulted highest potassium (K) nutrient equal to 0.015% which was not significantly different with treatment A1 (2 weeks). The highest sulfur nutrient (S) element was obtained at treatment of M2 equal to 12,715% which was significantly different with treatment of M1 and M3. Composting time of A2 (4 weeks) treatment, resulted highest sulfur (S) nutrient as much as 11,928% which was significantly different with treatment A1 (2 weeks). The highest calcium (Ca) nutrient was obtained at treatment of M1 equal to 7,843% which was significantly different with M2 and M3 treatment. Composting time of A2 (4 weeks) treatment, resulted the highest calcium (Ca) nutrient equal to 7,587% which is significantly different with treatment of A1 (2 weeks). The highest copper nutrient (Cu) was obtained in the treatment of M1 equal to 2.158% which is significantly different from the treatment of M2 and M3. Composting time of A2 (4 weeks) treatment, resulted the highest copper (Cu) nutrient equal to 0,992% which was not significantly different with A1 treatment (2 weeks). The highest element of

zinc (Zn) was obtained by treatment of M1 equal to 134,338% which significantly different with M2 and M3 treatment. Composting time of A2 (4 weeks) treatment, resulted in the highest zinc (Zn) concentration equal to 173,725% which was significantly different from the A1 treatment (2 weeks).

The factors that affect the decomposition rate of compost were particle size, Nutrition, C/N ratio, humidity, temperature, acidity (pH), nutrient content, hazardous ingredients and composting time [9]. The length of the incubation period is determined by the compost base material and living organisms involved in the composting process [5].

Novizan [10] stated that nitrogen was required in relatively large amounts for each plant growth, especially at the vegetative growth stage, such as an increase in the number of leaves. Lakitan [11] stated that the N content contained in the plant would be utilized by plants in cell enlargement. Nitrogen played a role in the process of photosynthesis. So, when the process of photosynthesis was reduced it would be able to inhibit growth, both vegetative growth and generative growth. Phosphor also played a role in the development of roots of a plant that could supply nutrients and minerals that were used by plants to grow and develop. This was in accordance with the literature of PTPN IV [12] which stated that the P element was a major component of nucleic acids that affect the development of roots, respiration and fruit maturity.

Generally, sulfur was needed by plants in the formation of cysteine, sitein, and methionine amino acids. Besides that, S was also part of biotin, thiamine, coenzyme A and glutathione [13]. It was estimated that 90% of S in plants was found in the form of amino acids. One of the main functions was to construct protein in the forming of disulfide bonds between peptide chains [14].

Sulfur was also associated with the formation of chlorophyll closely related to the process of photosynthesis and participate in several metabolic reactions such as carbohydrates, fats and proteins. Sulfur can also stimulate the formation of roots and fruits and could reduce disease attacks [14].

Based on the Criteria for Assessment of Soil Chemical Properties [15] which showed very low (<0.2), low (2-5), moderate (1-5), high (11-20) and very high calcium (> 20). It is reported in a plant that Ca nutrients were needed for the development of cells for the growth and development of plants. This was in accordance with the literature of PTPN IV [12] which stated that Ca nutrients play a role in the development of meristematic tissue and root development. Physiologically, the Ca element of the plant inhibited the activity of K element and increased the absorption of element N. Copper element was absorbed by plant roots in the form of Cu^{++} . In general, soil was rarely lack of Cu, but if it happened, would make the leaves become striped, and the tip of the leaves was white. If Cu deficiency was sustained, the plant will wither and die. Copper (Cu) has an important role in the formation of green leaves (chlorophyll).

Zinc (Zn) was absorbed in the form Zn^{++} . Plants require a small amount of zinc. Although needed in small amounts, the presence of zinc is very important for plants. Zinc benefits for plants to help the formation of carbohydrates and help formatting the root growers (auxin).

4. Conclusions

Characteristics of the best nitrogen, phosphor and calcium nutrients on compost in the chopped palm oil empty fruit bunches treatment (M3) with 4 weeks composting time applied with palm oil mill effluent (A2) i.e. Nitrogen (0.88%), Posfor (1%), Calcium (9%). While the best compost nutrient characteristics based on potassium, copper and zinc components in the treatment of palm oil empty fruit bunches (M1) with 2 weeks composting time applied with palm oil mill effluent (A1) i.e. Potassium (0.02%), Copper (2%). The best compost nutrient characteristics based on the sulfur component on the treatment of the dipped empty fruit bunches (M3) with 4 weeks composting time applied with palm oil mill effluent (A2) i.e. was Sulfur (15%).

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