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Physical and Chemical Properties of Various Products of Composting Process on Palm Oil Middle Waste

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Abstract: Many oil palm plantation produce organic waster. The processing of soild organic waste such as oil palm plants is by composting, because the process is quite easy and the cost is relatively cheap. Determine the decomposition rate of the oil palm midrib by using tipes of bioactivator. Different types of bioactivator affect on the rate of decomposition in the midrib of oil palm plants. The purpose of the study was to determine the physical and chemical properties of oil palm fronds in various composting processes. The research was carried out from April to June 2019 in the Soil Science laboratory, Faculty of Agriculture, Mulawarman University, Samarinda. Descriptive research consisted of five types of composting treatment and each treatment was repeated five times, namely: oil palm midrib compost (p0), oil palm midrib compost with vegetable waste bioactivator (p1), oil palm midrib compost with golden snail bioactivator (p2), oil palm midrib compost with pineapple bioactivator (p3) and oil palm midrib compost with EM-4. The research implementation activities are as follows: (1) collection of materials used, (2) manufacture of activator, (3) manufacture of compost, (4) analysis of several physical and chemical properties of various composting treatments in the laboratory. The results showed that: (1) oil palm fronds required composting time of 4 weeks; and (2) the results of composting oil palm fronds waste with a bioactivator (golden snail or pineapple) and composting with EM-4 are better than ordinary composting and composting with vegetable waste bioactivator.

Keywords: Physical and Chemical Properties, Palm Oil Midrib Waste, Compost

1. Introduction

As the largest producer and exporter of palm oil in the world, Indonesia has a massive area of plantations and palm oil mills. As of 2018, there are at least 12.8 million hectares of oil palm plantations and more than 850 palm oil mills, most of which are concentrated in the islands of Sumatra and Kalimantan. The superior products from palm oil processing are Crude Palm Oil (CPO) and Palm Kernel Oil (PKO).

Palm oil products are not only produced as food ingredients, cosmetics, and household cleaning supplies, but have also become one of the mainstays in the development of new and renewable energy (EBT) in the country.

In carrying out its production, each palm oil mill (PMKS) will produce waste materials that must be managed in accordance with Government Regulation no. 101 of 2014 concerning Management of Hazardous and Toxic Waste. The production of solid waste and liquid waste from Indonesian palm oil processing factories tends to increase, this is directly proportional to the increase in the production of fresh fruit bunches (FFB) and the area of oil palm plantations. Currently, oil palm biomass such as midrib, stem, shell, mesocarp fiber, oil palm empty fruit bunches and PKM, has been utilized, but its utilization has not been optimal.

Solid and liquid waste produced by palm oil mills is organic material that is rich in nutrients. One of the solid wastes is in the form of palm fronds and liquid waste in the form of POME solution. Oil palm fronds have the potential to be used as compost to fertilize the soil. [1] stated that the amount of oil palm fronds produced by oil palm plantations reached approximately 2.3 tons/ha of material 2,3 ton/ha dry, even production can reach 40 – 50 fronds/tree/year weighing 4.5. According to [2] the content of oil palm fronds consists of 24% hemicellulose, 40% cellulose, 21% lignin, and other components. Components consisting of materials that are difficult to decompose require the need for a fast way that can break down these components in order to increase plant nutrients. Application of high-potential waste as a soil amendment, improving soil physical and chemical properties, and increasing oil palm production [3]. In an effort to handle the palm oil waste produced and improve soil quality, it is necessary to make an effort to use the waste into compost.

Seeing the existing conditions and potential, the solution that can be done to utilize palm oil frond waste is to process it into compost. Composting techniques can use bioactivators to break down complex organic compounds into simpler compounds that can be used by plants. Bioactivators are not fertilizers, but materials that contain effective microorganisms that can help the decomposition process, ferment organic waste, and improve the quality of organic matter [4]. Some of these bioactivators are made in factories such as EM-4, but there are also bioactivators that can be made yourself by utilizing natural materials such as vegetable waste, animal waste and fruit waste so that they are not wasted.

2. Research Methods

2.1. Time and Place

The research was carried out from April to June 2019 at the Soil Science Laboratory, Faculty of Agriculture, Mulawarman University, Samarinda, East Kalimantan Province.

2.2. Materials and Toolst

The materials used are: oil palm fronds, vegetable waste, pineapple, golden snail, EM-4, granulated sugar, coconut water and rice washing water. The tools used are: machetes, buckets, knives, scissors, stirrer, cutting boards, mineral water bottles, spoons, jerry cans, filters, scales, cameras and stationery.

2.3. Treatment Design

This research is descriptive, the treatment design consists of 5 kinds of composting process and each treatment is repeated 5 times, namely:

p0 = ordinary composting;
p1 = composting with vegetable waste bioactivator;
p2 = composting with golden snail bioactivator;
p3 = composting with pineapple bioactivator;
p4 = composting with EM-4.

2.4. Research Implementation

The research implementation activities are as follows: (1) collecting the materials used, (2) making bioactivators, (3) making compost, (4) analyzing some of the physical and chemical properties of oil palm fronds in various composting treatments in the laboratory. Observations on the physical properties of the compost were observed at 1, 2, 3, and 4 weeks after composting, while the yield and some chemical properties were observed at 4 weeks after composting.

2.5. Data Collection

Compost physical properties data: color, particle size and yield; and chemical properties of compost: pH, C-organic, N-total, and C/N ratio.

3. Results and Discussion

3.1. Physical Properties of Compost

The results of several studies on the physical properties of oil palm fronds in various composting treatments are presented in Table 1.

Table 1. *Physical Characteristics (Color, Particle Size, Yield) of Palm Oil Midrib Waste in Various Composting Treatments.*

Composting Treatment	**1 Weeks**	**2 Weeks**	**3 Weeks**	**4 Weeks**
Ordinary Composting (p0)	DISCOLORATION Green	Yellowish Green	Brown	Dark Brown
composting with vegetable waste bioactivator (p1)	Green	Yellowish Green	Brown	Dark Brown
composting with golden snail bioactivator (p2)	Green	Brown	Dark Brown	Black
composting with pineapple bioactivator (p3)	Green	Yellowish Green	Brown	Dark Brown
composting with EM-4 (p4)	Green	Brown	Dark Brown	Black
Composting Treatment	CHANGING PARTICLE SIZE (cm) 1 Weeks	2 Weeks	3 Weeks	4 Weeks
Ordinary Composting (p0)	2,4	2,0	1,4	1,2
composting with vegetable waste bioactivator (p1)	2,4	1,8	1,6	0,5
composting with golden snail bioactivator (p2)	2,4	1,5	0,9	0,2
composting with pineapple bioactivator (p3)	2,4	1,7	1,3	0,4
composting with EM-4 (p4)	2,4	1,6	1,1	0,3
Composting Treatment	CHANGES OF RENDMENT (kg) 1 Weeks	2 Weeks	3 Weeks	4 Weeks
Ordinary Composting (p0)	2	-	-	1,84
composting with vegetable waste bioactivator (p1)	2	-	-	1,38
composting with golden snail bioactivator (p2)	2	-	-	1,76
composting with pineapple bioactivator (p3)	2	-	-	1,68
composting with EM-4 (p4)	2	-	-	1,94

Source: Primary Data Processed.

The results of the research on color (Table 1) show that before being given the composting treatment everything was green, but after various kinds of composting for 1 to 4 the color changed to yellowish green, brown, blackish brown and black resembling the color of the soil. This situation indicates that the waste of oil palm fronds has become compost. As stated by [5] that the color of ripe compost is blackish brown, if it is still green or still similar to the raw material (original material) it means that the compost is not yet ripe.

The results of the study on particle size (Table 1) also showed a change, which was originally + 2 cm in size, but after doing various kinds of composting for 1 to 4 it became 0.2 - 1.2 cm in size. The use of various bioactivators and EM-4 resulted in smaller particle sizes (0.2 – 0.5 cm) compared to the usual composting treatment (1.2 cm). The composting results have complied with the provisions of the International Quality Standards that the particle size of a good compost is < 25 mm. The change in particle size is due to the decomposition process of oil palm fronds by various microorganisms. As stated by [6] that the physical form of mature compost is crushed and not similar to the original form, odorless and dark brown-black in color.

The results of the research on the yield (Table 1) showed a change, namely that the weight was originally 2 kg, but after doing various kinds of composting for 4, the weight became between 1.38 - 1.94 kg. The biggest change in yield occurred in composting with vegetable waste bioactivator (p1), while the smallest change in yield occurred in composting with EM-4 (p4). As stated by [7] that the duration of composting is influenced by the material from which the compost comes from, the more diverse the compost material, the longer the composting process, which can affect the yield in the compost. Further reported by [8] that different decomposers do not affect the yield in compost.

3.2. Chemical Properties of Compost

The results of research on some of the chemical properties of oil palm midrib waste in various composting treatments are presented in Table 2.

Table 2. *Chemical Properties (pH, C-Organic, N-Total, C/N Ratio) Palm Oil Palm Waste in Various Composting Treatments.*

Composting Treatment	pH	C-Organic (%)	N-Total (%)	C/N Ratio
Ordinary Composting (p0)	8,24	40,58	2,76	8,64
composting with vegetable waste bioactivator (p1)	7,24	38,58	1,47	15,22
composting with golden snail bioactivator (p2)	8,50	36,70	2,47	8,62
composting with pineapple bioactivator (p3)	7,81	56,71	2,48	13,27
composting with EM-4 (p4)	8,23	44,85	3,18	8,18

Source: Primary Data Processed.

The results (Table 2) show that the pH of the various composting treatments ranged from 7.24 to 8.50 (classified as neutral to alkaline). Variations in pH changes are caused by various composting processes causing organic matter in oil palm midrib to decompose and produce organic acids and release basic cations. Organic acids can form chelates with Al and Fe cations so that the solubility is reduced, and basic cations produce OH anions, so that the pH becomes neutral and alkaline. As stated by [9] that organic acids can bind H^+ and Al^{+++}. ions through the carboxyl group which has a negative charge. Furthermore [10] stated that the rise and fall of soil pH is a function of H+ and OH- ions. Decomposed organic matter will produce OH- ions which can neutralize the activity of H+ ions. Organic acids will also bind Al^{+++} and Fe^{++} which can form complex compounds (chelates), so that Al^{+++} and Fe^{++} is not hydrolyzed again.

The results (Table 2) showed that the organic C content of various composting treatments ranged from 36.70 to 56.71%, the highest organic C content in composting with pineapple bioactivator (p3) was 56.71%, and the lowest was the composting treatment with gold snail bioactivator (p2) is 36.70%. The increase in C-organic content was due to the addition of organic matter from compost. As stated by [11] that the application of organic matter can increase it can be stated that differences in the number and types of microorganisms will also affect the content of organic matter and C-organic. As stated by [12] that the particle size of organic matter, availability of C, N, P and K, pH, temperature and soil moisture, aeration, the presence of inhibitory compounds as well as the characteristics and number of microorganisms are some of the main factors affecting rate of decomposition of organic matter.

The results of the study (Table 2) show that the total N content of the various composting treatments ranged from 1.47 to 3.18%, the highest total N content was in composting with EM4 (p4) which was 3.18%, and the lowest was in the treatment composting with vegetable waste bioactivator (p1) is 1.47%. Thus it can be stated that the different composting methods (usually, with bioactivator and with EM-4) have an effect to the N-total compost content. As stated by [13] the process of mineralization and immobilization of N is largely determined by the activity of good microorganisms, fungi, bacteria, actinomycetes and so on. It was also stated that the rate of mineralization of organic matter in addition to determining the number and type of microorganisms was also highly dependent on the type of material and environmental conditions. The results of the study reported [14] that the total N content in the soil after the application of oil palm midrib compost increased in all treatments compared to N in the initial soil with the highest N from 0.20% to 0.58% (high).

The results (Table 2) show that the C/N ratio yields various composting treatments ranging from 8.18 to 15.22, the highest C/N ratio produced by composting with vegetable waste bioactivator (p1) is 15.22, and the lowest is the composting treatment with EM-4 (p4) is 8.18. Thus, it can be stated that the different composting methods (usually, with a bioactivator and with EM-4) have an effect on the C/N ratio of the compost. The results showed that the C/N ratio yields from various composting processes were all < 20. [15] stated that the critical value for the C/N ratio so that it can be decomposed immediately is < 20. According to [5] that sufficiently mature compost has C/N ratio < 20, if the value of C/N ratio is higher, then the compost is not yet ripe and requires a longer decomposition time.

The size of the value of C/N ratio of various composting processes is closely related to the C-organic and N-total content. In the p4 treatment, although the compost material contained high organic C but because the total N content was also high, it resulted in a low C/N ratio, while in the p1 treatment it was because it contained lower organic C, but because the total N content was low, it resulted in millet. High C/N ratio described by [16] that when the C/N ratio is < 20, it means that there is a release of N from organic matter due to the decomposition process, in such a state most of the organic matter has been weathered, the energy has been reduced and the assimilation of N by bacteria has also been reduced.

4. Conclusions and Suggestions

4.1. Conclusion

1. Oil palm frond waste requires composting time of 4 weeks.
2. The results of composting oil palm fronds waste with a bioactivator (golden snail or pineapple) and composting with EM-4 are better than ordinary composting and composting with vegetable waste bioactivator.

4.2. Suggestion

1. It is necessary to carry out similar research accompanied by more complete data collection, namely chemical properties (Cation Exchange Capacity, basic cations), biological characteristics (number and types of decomposer microorganisms).
2. It is necessary to do about the effect of giving compost on the growth and yield of plants as well as the physical and chemical properties of the soil.

References

[1] Suryanto, T. 2018. Use of Counting Palm fronds waste as a Planting Media against Oil Palm Seed Growth in Early Nursery. Journal of Citra Widya Edukasi Vol X No. 2 August 2018 ISSN. 2086- 0412.

[2] Haji GA. 2013. Components of liquid smoke waste from coconut solid waste pyrolysis palm. Journal of Chemical Engineering and Environment. 9 (3): 109 – 116.

[3] Darmosarkoro, W., and S. Rahutomo. 2003. Oil palm empty fruit bunches as soil improvement material, p. 167-179. in W. Darmasarkoro, E. S. Sutarta and Winarna (Eds.). Palm Oil Land and Fertilization. Palm Oil Research Center. Medan.

[4] Allo, M. P. R., 2014. The Effect of Types of Bioactivators on the Decomposition Rate of Leaf Waste Ki Rain Samanea saman from the Unhas Campus Area. Biology Department FMIPA Hasanuddin University. Makassar.

[5] Isroi. 2008. Compost. Indonesian Plantation Biotechnology Research Institute, Bogor.

[6] Wahyono. 2003. Processing Waste Into Compost. Center for the Assessment and Application of Environmental Technology BPPT, Jakarta.

[7] Gunawan, R., R. Kurniadi., E. Prasetyo. 2015. Study on the Utilization of Organic Mustard Greens and Crab Waste for Making Liquid Organic Compost. Journal of Agriculture and Environment Volume 8 (1): 37-47.

[8] Sidauruk, I., R. Aoinun., dan B. D. Saipul. 2015. Test of Types of Decomposers in Making Compost from Durian Skin Waste on the Quality of the Produced Compost. Journal of Food and Agricultural Engineering Volume 5 (1): 166-167.

[9] Scnitzer, M. 1991. Soil Organic Matter. The Next 75 Year Soil Science.

[10] Bayer C, Martin-Neto LP, Mielniczuk J, Pillon CN, Sangoi L. 2001. Changes in Soil Organic Matter Fractions Under Subtropical No-Till Cropping Systems. Soil Sci. Soc. Am. J. 65: 1473-1478.

[11] Utami, S. N. H. and S. Handayani. 2003. Chemical Properties of Entisols in Organic Agriculture. Journal of Agricultural Science Volume 10 (1): 63-69.

[12] Rao, N. S. S. 1994. Soil Microorganisms and Plant Growth. UI Press, Jakarta.

[13] Winarso, S. 2005. Soil Fertility, Basic Health and Soil Quality. Gava Media, Yogyakarta.

[14] Zainudin, T. Nugrahini, and R. Kesumaningwati. 2020. Compost of Palm Oil Leaves with Bioactivator Mol of Palm Oil Mill Liquid Waste to Improve Chemical Properties of Sub-Optimal Soil. Journal of ZIRAA'AH 45 (1): 54-61.

[15] Sutanto, R. 2002. Organic Agriculture: Towards Alternative Agriculture and. Sustainable. Kanisius, Yogyakarta.

[16] Nurhayati Hakim et al. 1986. Fundamentals of Soil Science. Lampung University, Lampung.