ISSN No:-2456-2165

The Physical Characteristics and Chemical Properties of Compost Fertilizer from Leaf Sheath and Leaves Waste Palm Oil with the Addition of Cow Manure Using Effective Microorganisms

Daryono[1]
[1] Plantation Plant Cultivation Study Program
Samarinda State Agricultural Polytechnic

La Mudi[2]
[2] Plantation Plant Cultivation Study Program
Samarinda State Agricultural Polytechnic

Rusmini[3]
[3] Plantation Plant Cultivation Study Program
Samarinda State Agricultural Polytechnic

Riama Rita Manullang[4]
[4] Plantation Plant Cultivation Study Program
Samarinda State Agricultural Polytechnic

Yuanita[5]
[5]Plantation Plant Cultivation Study Program
Samarinda State Agricultural Polytechnic

Haryatie Sarie[6]
[6] Environmental Management Study Program
Samarinda State Agricultural Polytechnic
Samarinda, Indonesia

F.Silvi Dwi Mentari[7]
[7] Plantation Plant Cultivation Study Program
Samarinda State Agricultural Polytechnic

Rusli Anwar [8]
[8]Plantation Management Study Program
Samarinda State Agricultural Polytechnic
Samarinda, Indonesia

Nur Hidayat[9]
[9] Plantation Plant Cultivation Study Program
Samarinda State Agricultural Polytechnic

Jamaluddin[10]
[10] Plantation Management Study Program
Samarinda State Agricultural Polytechnic
Samarinda, Indonesia

Zainal Abidin[11]
[11] Plantation Plant Cultivation Study Program
Samarinda State Agricultural Polytechnic

***Abstract* :- The physical and chemical properties of compost are important in supporting agricultural development. The physical and chemical properties of compost are greatly influenced by the basic ingredients for making compost. Apart from that, to produce quality compost fertilizer, decomposer bacteria are needed. This research aims to determine the role of decomposers in accelerating fertilizer decomposition, and to determine the physical and chemical content of compost fertilizer from waste palm fronds and leaves with the addition of cow dung fertilizer. This research was carried out from May to July 2023, located in Kembang Janggut District, Kutai Kertanegara Regency, East Kalimantan Province. The research was structured with 2 treatments, namely P1 and P2. The variables observed include composting time, physical properties of the compost (temperature, color, smell, texture), and chemical properties of the compost (total N, total P, total K, total C, C/N ratio). The observation data was analyzed descriptively and compared with the fertilizer quality standards of the Republic of Indonesia Ministry of Agriculture number 261/Permentan/SR.310/4/2019. The results of the research showed that the length of time for composting palm oil leaf sheath and leaves waste in treatment P1 was faster, namely 42 days, while in treatment P2 it was 45 days. Physical data on compost fertilizer shows that the temperature in treatment P1 on day 39 and in treatment P2 on day 42 the temperature has begun to fall. and was declared ripe, followed by a black color change and no smell. The results of compost nutrient analysis in treatment P1 were N total (0.042%), P total (0.069%), K total (0.067), C-organic (29.176), C/N ratio (69.765%), while in treatment P2 it was N total (1.202%), P total (0.319%), K 0.096%, C-organic (28.314%), C/N ratio (23.591%). These results indicate that the P1 and P2 treatments for observing organic C and the C/N ratio have fulfilled the quality requirements for solid organic fertilizers in the Ministry of Agriculture Regulation for compost requirements number 261/MOA/SR.310/4/2019.**

Keywords:- *Decomposer Bacteria, Compost, Bio-Activators, Cow Manure, Fertilizer.*

I. INTRODUCTION

Fertilizer is the key to soil fertility because it contains one or more elements to replace nutrients that are consumed by plants. Fertilizing means adding nutrients to the soil (root fertilizer) and foliar fertilizer plants (Lingga, 2013; Yi et al., 2019).

ISSN No:-2456-2165

Fertilizers are materials that are added to growing media and plants to meet the nutrient needs of plants so that they can produce well. The function of fertilizer is as a source of nutrients needed to overcome nutritional deficiencies, especially nitrogen content, phosphorus, and potassium. While the elements, such as potassium, magnesium, iron, copper, zinc, and boron, are elements that are needed in small amounts or micronutrients (Susetya, 2013; Pandelea et al., 2022).

Compost is the final result of decomposing animal and plant waste that functions as a supplier of soil nutrients so that it can be used to improve soil physically, chemically, and biologically (Daryono and Alkas, 2017; Fitriana et al., 2020; Stephen Okhumata & Rita Idowu, 2022; Supriatna et al., 2022). Physically, compost can stabilize soil aggregates, improve soil aeration and drainage, and increase the soil's ability to hold water. Chemically, compost can increase soil nutrients. While biologically, compost can be a source of energy for soil microorganisms to release nutrients for plants (Fitriana et al., 2019; Hakim, 2020a; Hastuti & Rohmiyati, 2020). Compost can be made from various organic materials derived from agricultural and non-agricultural waste (Priambodo, 2019; Fitriana et al., 2020; Hakim, 2020b; Sakiah et al., 2021; Supriatna et al., 2022).

Leaf-sheath palm oil is one of the agricultural wastes that can be used as bi-palm fronds as feed raw material. Oil palm trees can produce 22 fronds per year and if no pruning is done, it can exceed 60 fronds per year. This figure shows the great potential of palm fronds as feed, but their utilization is constrained by the low level of digestibility due to high lignin content (Rusvita, 2012). The high level of lignin in palm fronds has led to many studies conducted to reduce lignin levels, such as physical, chemical, and biological treatments. The purpose of the treatment is so that the lignocellulose bond can be broken so that the crude fiber in the form of cellulose can be utilized by rumen microbes as a source of energy (Ardiningtyas, 2013).

EM-4 stands for Effective Microorganism 4 which is a culture of live microorganisms that are very beneficial for soil fertility and beneficial for soil fertility, and beneficial for plant fertility (Daryono et al, 2022; Sembiring et al., 2021).

Cow manure is one example of organic fertilizer that comes from livestock pens in the form of solid waste (feces) mixed with food scraps and urine so the quality of fertilizer mixed varies depending on the type level and nutrient content. Organic fertilizers that are returned through manure are not only a source of organic matter but also a valuable element for plant growth (Hadi & Alwan, 2023; Okhumata, 2022; Yosephine et al., 2022). Organic matter has an important role in tropical soils because almost all elements contained in manure usually consist of a mixture of 0.5% N, 0.25 P205, and 0.5 K20. Solid cow manure with 85% moisture content contains 0.45% N, 0.2% P205, and 0.1% K20.(Sutrisno et al, 2020)

The process of breaking down organic matter in the early stages is hydrolysis because this process takes place due to the presence of water and extra-cellular hydrolysis enzymes that produce simpler and water-soluble compounds so that microorganisms can utilize them, especially under aerobic conditions. Further decomposition under aerobic conditions with the final result of CO2 and H2O (Daryono and Alkas, 2017.

II. MATERIAL AND METHODS

A. Time and Location of Research

This research was carried out from May to July 2023, located in Kembang Janggut District, Kutai Kertanegara Regency, East Kalimantan Province.

B. Tools and Materials

The tools used in this research are machetes, buckets, dippers, paddles, thermometers, scales, sacks, tarpaulins, cameras, and stationery.

The materials used in this study are leaf sheath and leaves, cow manure, EM-4, water, and brown sugar.

C. Research Design

This research design consists of two treatment levels, namely:

P1: leaf sheath and leaves palm oil waste (25 kg) + cow manure (8 kg) + EM-4 (200 ml) + water (10 l) + brown sugar (2 kg).
P2: leaf sheath and leaves palm oil waste (25 kg) + cow manure (10 kg) + EM-4 (300 ml) + water (10 l) + brown sugar (2 kg).

D. Research Procedure

- *Preparation of EM-4 solution*

- Prepare a bucket, water, and brown sugar for dissolving.
- Mixing EM4 with crushed brown sugar
- Stir until well combined then cover tightly.
- The EM4 mixture was left for 24 hours until white foam appeared and smelled like mastic.

- *Collecting palm fronds and leaves from farmers' gardens, choosing old and dry fronds to make it easier to chop, chopping is done using a machete and covered with a wooden cutting board, chopped to a size of 1-2 cm and then weighed according to the needs of the existing treatment.*

- *Cow manure mixing*

Cow manure is weighed according to the needs of treatments 1 and 2, then cow dung is pulverized and prepared for mixing composting materials.

ISSN No:-2456-2165

- *Leaf sheath and leaves of palm oil waste that have been chopped, then mixed and mixed with cow dung according to the treatment and watered with EM-4 according to the dose. Then the two treatments are stacked separately in a rectangular shape and leveled after that the compost is covered with a tarp, and the height of the pile will decrease during the composting process until it becomes compost.*

D. Variables Observed

The variables observed include composting time, physical properties of the compost (temperature, color, smell, texture), and chemical properties of the compost (total N, total P, total K, total C, C/N ratio).

The observation data was analyzed descriptively and compared with the fertilizer quality standards of the Republic of Indonesia Ministry of Agriculture number 261/Permentan/SR.310/4/2019.

III. RESULTS AND DISCUSSION

Based on the research results show that:

A. Length of time for palm frond and leaf compost to become compostable

The length of time for making compost treatment P1 is 42 days and P2 is 45 days, which is obtained from observing the making of compost with the criteria of temperature, color, smell, and texture.

B. Physical observation of compost is done during the process of making mature compost by observing temperature, smell, color, and texture. Physical observations can be seen in Tables 1 and 2 below.

Table 1: Physical characteristics of compost fertilizer of P1 level

Days	Temperature (°C)	Color	Smell	Texture
1	34	Brownish green	Very smelly	Rough
4	42	Brownish green	Very smelly	Rough
7	42	Brownish green	Very smelly	Rough
10	40	Chocolate	Very smelly	Rough
13	46	Chocolate	Very smelly	Rough
16	48	Chocolate	Very smelly	Somewhat rough
19	45	Chocolate	Somewhat odoriferous	Somewhat rough
22	41	Chocolate	Somewhat odoriferous	Somewhat rough
25	36	Blackish brown	Somewhat odoriferous	Somewhat rough
28	38	Blackish brown	Somewhat odoriferous	Somewhat rough
31	36	Blackish brown	No odor	Somewhat rough
34	34	Blackish brown	No odor	Somewhat rough
37	32	Black		Crumbs
40	31	Black		Crumbs
41	31	Black		Crumbs
42	31	Black		Crumbs

Table 2: Physical characteristics of compost fertilizer of P1 level

Days	Temperature (°C)	Color	Smell	Texture
1	34	Brownish green	Very smelly	Rough
4	42	Brownish green	Very smelly	Rough
7	42	Brownish green	Very smelly	Rough
10	40	Chocolate	Very smelly	Rough
13	46	Chocolate	Very smelly	Rough
16	48	Chocolate	Very smelly	Somewhat rough
19	45	Chocolate	Somewhat odoriferous	Somewhat rough
22	41	Chocolate	Somewhat odoriferous	Somewhat rough
25	36	Blackish brown	Somewhat odoriferous	Somewhat rough
28	38	Blackish brown	Somewhat odoriferous	Somewhat rough
31	36	Blackish brown	No odor	Somewhat rough
34	34	Blackish brown	No odor	Crumbs
37	33	Blackish brown	No odor	Crumbs
40	32	Black	No odor	Crumbs
41	33	Black	No odor	Crumbs
42	32	Black	No odor	Crumbs
43	31	Black	No odor	Crumbs
44	31	Black	No odor	Crumbs
45	31	Black	No odor	Crumbs

C. Chemical properties of compost fertilizer

Based on the results of chemical analysis of compost fertilizer from frond waste and oil palm leaves obtained organic N, P, K, C / N can be seen in Table 3 below:

Table 3. Nutrient properties of compost fertilizer

No.	Sample code	N Total	P Total	K Total	C Total	C/N ratio
		%	%	%	%	
1	P1	0,4182	0,0688	0,0670	29,1756	69,7647
2	P2	1,2002	0,3181	0,0955	28,3140	23,5911

IV. DISCUSSION

A. Length of time for making compost of palm sheath and leaves with effective organisms of EM-4 microorganisms and cow manure.

Based on the results of physical observations of compost of palm fronds and leaves using 2 treatments. P1 was declared ripe on day 42 with a temperature of 31 no smell, black color, and crumb texture, while P2 was declared ripe on day 45 with a temperature of 31 no smell, black color, and crumb texture. Compost that has finished decomposing, among others, has the characteristics of green to black color and no longer smells (Indriani, 2012; Ardiyanti et al., 2020).

B. Physical observation of composted fertilizer

➢ *Temperature*

Based on the results of composting on palm sheath and leaf waste, with EM4 bio-activator and cow manure. The composting temperature has increased and decreased. Measurements are taken every day at 16:00, this is done to determine the increase and decrease in temperature in the composting process. In this composting process, the temperature during the initial treatment P1 = 34 ºC and in the P2 treatment = 34 ºC, while the final temperature of P1 31 and P2 31 during the composting process experienced an increase in temperature at the beginning of composting then stabilized near room temperature.

Temperatures in the tropics ranging from 25-35 ºC are good enough but the optimal temperature needed is around 50-60 ºC. The optimal temperature can be helped by placing composting in a location exposed to direct sunlight (Kholis et al., 2019).

➢ *Color*

At the beginning of composting, the color of the compost is brownish green and the mature one is black. The compost of mature palm frond and leaf waste is black and smells like soil. Good compost is bokashi that has undergone sufficient weathering characterized by a different color (Dayono et al, 2022; Sembiring et al., 2021).

➢ *Smell*

At the beginning of composting, the compost smells and at the end of composting it is odorless. Compost fertilizer that no longer has a very pungent odor but emits an aroma like the smell of soil indicates successful composting (Azys et al, 2023).

➢ *Texture*

At the beginning of composting the texture of palm fronds and leaves is rough, hard, and lumpy. In the middle, namely day 20, it turned rather crumbly until at the end of the composting process the texture of P1 and P2 turned into crumbs and did not clump anymore. By the opinion of Daryono and Alkas (2017), mature compost has a crumbly and soil-like texture.

C. Compost nutrient content

➢ *Nitrogen (N)*

In Table 3 the total N content of P1 is 0.42% and the total N of the treatment P2 is 1.21%, the treatment shows the results of the total N content have not met the quality standards of solid organic fertilizers of the Minister of Agriculture Regulation on compost requirements number 261/Permentan/SR.310/4/2019.

The low nitrogen content is due to the smallest material composition of all treatments, but it can also be caused by the reduction of nitrogen substances during fermentation and preparation for testing the nutrient content in the laboratory Aqidah et al, (2022). This is reinforced by Sutrisno et al (2020). that the low nitrogen content can be caused by the removal of nitrogenous substances in the form of nitrogen gas or in the form of ammonia gas formed during the composting process and packaging before analyzing nutrients.

➢ *Pospor (P)*

Table 3 shows that the total P content of P1 is 0.07% and the total P of P2 treatment is 0.32%. Both treatments showed that the total P content did not meet the Quality Standards for solid organic fertilizers of the Minister of Agriculture Regulation on compost requirements number 261 / MOA / SR.310 / 4/2019.

The low content of phosphorus (P) is also due to the food reserves used by decomposing bacteria in the fermentation process being used up reacting, it is also caused by decomposing bacteria has reached the maximum condition (stationary phase that will experience the death phase) before the specified time. This shows that if fermentation continues, it will get fewer results than before to the statement of Kholis et al. (2019).

Waste palm fronds and leaves can cause phosphorus content in high solid organic fertilizer content because palm frond waste contains macronutrients such as nitrogen,

phosphorus, magnesium, iron, and potassium (Daryono et al, 2017).

➢ *Potassium (K)*

Table 3 shows that the total K content of P1 is 0.07% and the total K content of P2 is 0.010%, the treatment shows the results of the total K content have not met the Quality Standards for solid Organic Fertilizers of the Regulation of the Minister of Agriculture for compost requirements number 261/Permentan/SR.310/4/2019.

The low content of potassium is due to the palm fronds and leaves used as small pieces. The content of palm fronds and leaves should be quite high in potassium. According to (Syafri, & Simamora, (2017)), the potassium content in palm fronds and leaves is 10.25%.

Potassium contained in organic materials can dissolve in water after watering so that it will produce soaking water containing potassium elements. Potassium is a catalyst for microorganisms to accelerate fermentation. According to the opinion of Arini and Murrinie (2022) which states that potassium (K2O) is used by microorganisms in the substrate material as a catalyst, the presence of bacteria with all their activities greatly affects the increase in potassium content. Potassium is bound and stored in cells by bacteria and fungi if it is degraded again then potassium will be available again).

➢ *C-Organic*

Table 3 shows that palm frond and leaf waste P1 29.77 and P2 28.32 have met the Quality Standards for Solid Organic Fertilizers of the Minister of Agriculture Regulation on compost requirements number 261/Permentan/SR.310/4/2019.

By the opinion of Azys et al. (2023), C-organic is the regulation of the amount of carbon in the soil to increase crop production and sustainable crop life, because C-organic can increase the fertility of soil chemical, physical, and biological properties and efficient use of nutrients.

This is the opinion of Priambodo (2019), that the content of organic matter in the soil is one of the factors that play a role in determining the success of plantation cultivation.

➢ *C/N Ratio*

From the research results in Table 3 that the C / N Ratio value of P1 is 69.77 and P2 is 23.59 based on this value, the compost fertilizer from coir waste of palm fronds and leaves with EM4 bio activator and cow dung is only P2 which meets the Quality Standards for solid Organic Fertilizers of the Minister of Agriculture Regulation of compost requirements number 261 / MOA / SR.310 / 4/2019. namely minimum and maximum ≤25.

According to Susilawati et al, (2018). A good composting process produces an ideal C/N of 39-40, but the best ratio is 30. If the C/N ratio is high the biological activity of soil microorganisms that are lacking will increase. In addition, several high microorganism cycles are needed to adjust the degradation of compost material so that the composting time will be longer and the resulting organic compost will have stable quality (Rusmini and Hidayat, 2019; Bulan et al., 2021; Madusari & Firmanto, 2021).

V. CONCLUSION

- The length of time for making compost fertilizer from leaf sheath and leaves of palm oil waste in treatment P1 the fertilizer was finished on day 42 while P2 on day 45.
- Physical data on compost fertilizer shows that the temperature in treatment P1 on day 39 and in treatment P2 on day 42 the temperature has began to fall. and was declared ripe, followed by a black color change and no smell.
- The results of compost nutrient analysis in treatment P1 were N total (0.042%), P total (0.069%), K total (0.067), C-organic (29.176), C/N ratio (69.765%), while in treatment P2 it was N total (1.202%), P total (0.319%), K 0.096%, C-organic (28.314%), C/N ratio (23.591%). These results indicate that the P1 and P2 treatments for observing organic C and the C/N ratio have fulfilled the quality requirements for solid organic fertilizers in the Ministry of Agriculture Regulation for compost requirements number 261/MOA/SR.310/4/2019.

REFERENCES

[1]. Aqidah N, Ibrahim B, Nontji M, (2022). Analisis Unsur Hara Makro Pupuk Organik Berbahan Dasar Serbuk Gergaji Kayu Dan Limbah Kotoran Ayam Dengan Berbagai Konsentrai Effective Mikoorganisme-4 (EM-4). Jurnal Indonesia,Jurnal ilmu pertanian Volume 3 No.1 https://jurnal.fp.umi.ac.id /index.php/ agrotekmas /article/view/197

[2]. Ardiningtyas, T.R., (2013). Pengaruh Penggunaan Effective Microorganis 4(EM4) dan Molase terhadap Kualitas Kompos dalam Pengomposan Sampah Organik Rsud Dr. R. Soetrasno Rembang ,Skripsi,Universitas Negeri Semarang, Semarang.

[3]. Ardiyanti, A. D., Adhitama, L., & Wahyutiyani, R. (2020). *Efficient Compost Fertilizer with Addition of Fatty Acid Results of Used Cooking Oil Saponification Reaction*. *3*, 125–128.

[4]. Arini N, Murrinie D, E, (2022). Pengaruh Jenis Bahan Campuran Dan Dosis Kompos Ampas Tahu Terhadap Pertubuhan Tanaman Kangkung Darat (Ipomoea reptans). Jurnal Pertanian Agros Vol. 24 No.1: 115 - 121 hlm.

[5]. Azys A, F, F, Widodo K, Arsana B,B, Radianto, O, D. (2023). Pemanfaatan Limbah Ampas Tahu, Pelepah Pisang Dan Cangkang Telur Menjadi Pupuk Organik Papica Gua Mensejahterakan Rakyat. Jurnal Multidisiplin Ilmu, 2 (1). e-ISSN: 2828-6863

[6]. Bulan, R., Sitorus, A., & Ruslan. (2021). Effect of the compost mixer machine on the quality of compost made from shredded oil palm fronds (OPF). *IOP Conference Series: Earth and Environmental Science*, *644*(1). https://doi.org/10.1088/1755-1315/644/1/012077

[7]. Daryono dan Alkas, R.T., (2017). Pemanfaatan Limbah Pelepah Dan Daun Kelapa Sawit (Elaeis guineensis Jacq) Sebagai Pupuk Kompos. Jurnal Hutan Tropis UNLAM Volume 5 No.3: 188-195 hlm.

[8]. Daryono, Rusmini, Yuanita, Hidayat N, Riama Rita Manulang R, R, Rahman A, Anwar R dan Syauqi A., (2022). Pemanfaatan Limbah Sabut Kelapa (*Cocos nucifera* L.) Sebagai Kompos Dengan Menggunakan Bioaktivator EM4. Jurnal Agriment 7(1):70-77. doi.org/ 10.51967/ jurnal agriment.v7i1.1173.

[9]. Fitriana, M., Sodikin, E., & Sulaiman, F. (2020). The use of oil palm empty fruit bunches compost, rice husk charcoal and chicken manure to reduce npk fertilizer doses on the growth and yield of cauliflower (*Brassica oleraceae var. Botrytis* L.). *Russian Journal of Agricultural and Socio-Economic Sciences*, *98*(2), 161–165. https://doi.org/10.18551/rjoas.2020-02.19

[10]. Fitriana, M., Sulaiman, F., & Sodikin, E. (2019). Organic farming technology of utilizing oil palm empty fruit bunch compost and leguminosae plant compost to reduce npk fertilizer dosage on growth and yield of brown rice (*Oryza nivara*). *Russian Journal of Agricultural and Socio-Economic Sciences*, *87*(3), 260–265. https://doi.org/10.18551/rjoas.2019-03.30

[11]. Hakim, T. (2020a). Management of Liquid Organic Waste from Palm Oil Plant and Compost Cow to the Growth and Production of Sweet Corn (*Zea mays* saccharata Sturt). *Asian Research Journal of Agriculture*, 1–8. https://doi.org/10.9734/arja/2020/v12i330082

[12]. Hakim, T. (2020b). Management of Liquid Organic Waste from Palm Oil Plant and Compost Cow to the Growth and Production of Sweet Corn (Zea mays saccharata Sturt). *Asian Research Journal of Agriculture*, 1–8. https://doi.org/10.9734/arja/2020/v12i330082

[13]. Hastuti, P. B., & Rohmiyati, S. M. (2020). Application of Empty Fruit Bunches Compost and Types of P Fertilizer on the Growth and Phosphorus Uptake in Oil Palm Seedlings. *Agrotechnology Research Journal*, *4*(2), 59. https://doi.org/10.20961/agrotechresj.v4i2.40784

[14]. Indriani, 2012. Membuat Kompos Secara Kilat. Penebar Swadaya, Jakarta.

[15]. Kholis, N., Nusantoro, S., & Awaludin, A. (2019). Pembuatan Pupuk Organik Padat (Pop) Berbasis Bahan Kotoran Ternak Dengan Memanfaatkan Bioaktivator Isi Rumen Sapi. Prosiding.

[16]. Lingga, P. Dan Marsono. (2013). Petunjuk penggunaan Pupuk. Edisi Revisi.Jakarta: Penebar Swadaya.

[17]. Madusari, S., & Firmanto, Z. (2021). Enhancing the Quality of Compost from Oil Palm Residue by Inoculating Nitrogen-Fixing Bacteria: Impact on Brassica rapa v. chinensis Growth. *Agrointek : Jurnal Teknologi Industri Pertanian*, *15*(3), 806–816. https://doi.org/10.21107/agrointek.v15i3.9562

[18]. Mounir Abdel Hadi, A., & Mahmoud Alwan, B. (2023). Effect of Adding Levels of Palm Fronds Compost and Mineral Fertilizer on Fertile Soil Characteristics, Quality, and Productivity of Maize Yield (Zea Mays L.). *Bionatura*, *8*(CSS 4), 1–9. https://doi.org/10.21931/rb/css/2023.08.03.29

[19]. Okhumata, D. S. (2022). Comparative effects of mineral fertilizer, compost and compost – mineral fertilizer on biological, chemical and physical properties of soil. *Journal of Wastes and Biomass Management*, *4*(2), 73–77. https://doi.org/10.26480/jwbm.02.2022.73.77.

[20]. Pandelea (Voicu), G., Stefan, D.-S., Calinescu, M. F., (Mazilu), I. C. E., & Ungureanu, C. (2022). *The Benefits of Applying Compost in Agriculture as Aronia Crops Fertilizer*.8.https://doi.org/10.3390/chemproc2022007008.

[21]. Permentan. (2019). Peraturan Menteri PertanianNo.261/ KPTS/ SR.310/M/4/2019 tentang Pupuk Organik, Pupuk Hayati, dan Pembenah Tanah..

[22]. Priambodo, S. R., Susila, K. D., & Soniari, N. N. (2019). Pengaruh pupuk hayati dan pupuk anorganik terhadap beberapa sifat kimia tanah serta hasil tanaman bayam cabut (Amaranthus Tricolor) di tanah inceptisol Desa Pedungan. Jurnal Agroekoteknologi Tropika (Journal of Tropical Agroecotechnology), 8(1), 149– 160. https://ojs.un

[23]. Rusmini dan Hidayat, N. (2019). Potensi Kulit Udang sebagai Kompos untu Mendukung Pertanian Organik. Buku Ajar. Garis Putih Pratama. Makassar.

[24]. Rusvita, L. (2012). Kualitas kompos tandan kosong kelapa sawit dengan pemberian berbagai sumber dekomposer berbeda pada konsentrasi yang berbeda. Skripsi mahasiswa pada Program Studi Agroteknologi Fakultas Pertanian dan Peternakan Universitas Islam Negeri Sultan Syarif Kasim Riau Pekanbaru

[25]. Sakiah, Saragih, D. A., Sukariawan, A., Guntoro, & Bakti, A. S. (2021). The quality of compost made from mixture of Mucuna bracteata and oil palm empty fruit bunch. *IOP Conference Series: Earth and Environmental Science*, *762*(1). https://doi.org/10.1088/1755-1315/762/1/012082

[26]. Sembiring, M., Lubis, A. R., & Armaniar. (2021). Effective combination of palm oil plant waste and animal waste with bio-activator em4 produces organic fertilizer. *Communications in Mathematical Biology and Neuroscience*, *2021*. https://doi.org/10.28919/cmbn/5434

[27]. Stephen Okhumata, D., & Rita Idowu, E. (2022). Comparative effects of compost – mineral, npk and urea fertilizer and time of application of compost - mineral fertilizer on the yield of maize. *Journal of Wastes and Biomass Management (JWBM)*, *4*(1), 64–67. https://doi.org/10.26480/jwbm.01.2022.64.67

[28]. Supriatna, J., Setiawati, M. R., Sudirja, R., Suherman, C., & Bonneau, X. (2022). Composting for a More Sustainable Palm Oil Waste Management: A Systematic Literature Review. In *Scientific World Journal* (Vol. 2022).Hindawi Limited. https://doi.org/ 10.1155/2022/5073059

[29]. Susetyo, N, A. (2013). Pemanfaatan Urin Sapi Sebagai Pupuk Organik Cair (POC)Dengan Penambahan Akar Bambu Melalui Proses Permentasi Dengan Waktu Yang Berbeda. Http:eprints.ums.ac.id/26749/24/NASKA PUBLIKASI. Pdf.

[30]. Susilawati M,Adiwirman A, Nurbaiti N, 2018 Pemanfaatan Pupuk Organik Cair Limbah Tahu Dan Air Kelapa Terhada Pertumbuhan dan Produksi Tanaman Kacang Hijau (Vigna radiata L.) Jurnal Online Mahasiswa (JOM) Bidang Pertanian.

[31]. Sutrisno E, Wardhana I,W, Budihardjo M,A,Hadiwidodo M, and Silalahi R, I, (2020). Pembuatan Pupuk Kompos Padat Limbah Kotoran Sapi Dengan Metoda Fermentasi Menggunakan EM4 dan STARBIO Di Dusun Thekelan Kabupaten Semarang. Jurnal Pasopati,vol. 2, no. 1, https://doi.org/10.14710/pasopati.2020.6619

[32]. Syafri, R., & Simamora, D. (2017). Analisa Unsur Hara Makro Pupuk Organik Cair (Poc) Dari Limbah Industri Keripik Nenas Dan Nangka Desa Kualu Nenas Dengan Penambahan Urin Sapi Dan Em4. Jurnal Photon. 8(1); 4-9.

[33]. Yi, L. G., Wahid, S. A. A., Tamilarasan, P., & Siang, C. S. (2019). Enhancing sustainable oil palm cultivation using compost. *Journal of Oil Palm Research*, *31*(3), 412–421. https://doi.org/10.21894/jopr.2019.0037.

[34]. Yosephine, I. O., Wijaya, H., & Lubis, E. J. (2022). Effect of Market Waste Compost and Compound Fertilizer Application on The Vegetative Growth of Oil Palm Seedling (Elaeis guineensis Jacq) in Ultisol Growing Media. *Jurnal Teknik Pertanian Lampung (Journal of Agricultural Engineering)*, *11*(3), 438. https://doi.org/10.23960/jtep-l.v11i3.438-450.