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Effect of Decomposer Agent on C/N Ratio, N and P Content of Empty Palm Oil Bunches Palm (*Elaeis Guenensis Jaq*)

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ABSTRACT

This research aims to determine the effect of decomposer agents (EM-4 and Herbafarm) on the C/N ratio, as well as the N and P nutrient content of empty oil palm bunches. This research was carried out starting from July 2022 at the Indragiri Islamic University Campus, Jalan Provincial Trench 1, Tembilahan Hulu District, In Dragiri Hilir Regency, Riau Province. Raw material analysis was carried out at the Soil Analysis Laboratory, Faculty of Agriculture, UNAND. The aim of this research was to see the effect of giving several decomposer agents on the C/N ratio and N and P nutrient content of oil palm empty husk compost (JKKS) and obtain agent doses. the best decomposer for the quality of oil palm empty husk compost (JKKS). This research was carried out using a completely randomized design (CRD) with 7 treatments and 3 replications to obtain 21 experimental units. The experiments to be carried out are as follows: 1). Without Decomposer. 2), EM-4 concentration 0.1%, 3). EM-4 Concentration 0.2 %, 4), EM-4 Concentration 0.3 %, 5). Herbafarm concentration 0.1%, 6). Herbafarm concentration 0.2%, and 7). Herbafarm concentration 0.3%. The observations made were analyzing the nutrients C, N, and P and looking for the C/N ratio of JKKS compost. The research results showed that treatment with decomposer agents (EM-4 and Herbafarm) from a concentration of 0.1% to a concentration of 0.3% was able to increase the quality of JKKS compost compared to treatment without decomposer. The best (optimal) treatment results were in the EM-4 treatment with a concentration of 0.2% and in the Herbafarm treatment with a concentration of 0.3%.

1. Introduction

Fertilizer is a very important need for society to increase soil and plant fertility. Organic fertilizer is the result of the change or decomposition of plant and animal remains. The results of this fertilizer contain almost all the nutrients, both macro nutrients and micro nutrients. However, these elements are usually available in small quantities.

One of the organic fertilizers is compost. Compost is organic materials (organic waste that has undergone a weathering process due to interactions between microorganisms (decomposing bacteria) that work in it. These organic materials include leaves, straw, twig residue, animal waste, urine and so on. The survival of microorganisms depends on their environment.

According to Murbandono (2007), making compost generally takes a long time, ranging from 3-4 months. Making compost is not difficult, by piling up organic materials the materials will become compost themselves. However, this process will take a long time.

One way to speed up the composting process is by adding microorganisms that destroy compost material or by treating it with additional decomposer agents such as EM-4 and Herbafarm. Sofian (2006) added that to speed up the composting process you can also add activators which are ingredients consisting of enzymes, humic acid, microorganisms (bacterial cultures) which function to speed up the composting process.

Based on the description above, there is a need for research regarding the Effect of Giving Decomposer Agent on C/N Ratio and N, P Nutrient Content of Palm Oil (*Elaeis guineensis Jaq*) Empty Shed Compost, so that the compost can be used and processed quickly and of good quality.

2. Literature Review

2.1 Empty Palm Oil Plantation

Empty palm oil stalks (JKKS) are one of the main solid wastes produced by palm oil processing factories in very large quantities. So far, its use is still

very limited, for example as ground cover mulch in oil palm plantation areas or composted and used as organic fertilizer (Wardhanu, 2009). Pardamean (2008) said that the empty oil palm bushes produced per hectare of oil palm plantations can be around 20% of the 100% fresh fruit bushes in a plantation.

Sarwono (2008), said that empty oil palm fruit bunches/cantilever waste which is organic in nature contains the elements Nitrogen 1.5%, phosphate 0.5%, Potassium 7.3% and magnesium 0.9% has quite large potential to be used as a substitute for fertilizer by applying the waste in on the land around the oil palm plantations. The nutrient content of empty palm kernels that have been decomposed can be seen in table 1.

Table 1. Contents of Empty Palm Oil Decomposition Analysis

Type of Analysis	Mark
pH	8.43
C-organic (%)	25.82
N-Total (%)	1.08
C/N	23.89
P2O5 (%)	0.000301
K2O (%)	0.018093
CaO (%)	0.102376
MgO (%)	0.010273
Rendement	58.94%

Source: Walid (2011).

2.2 Organic Materials

Organic materials are materials that can be renewed, recycled, broken down by soil bacteria into elements that can be used by plants without polluting the soil and water. Soil organic matter is a buildup of plant and animal remains, some of which have undergone weathering and reformation (Sutanto, 2002).

Organic materials originating from plants and animals, as well as the remains of millions of years of small creatures and so on, undergo a process of change so that they can be used by plants. Without changes, the nutrients from these materials will remain bound so that they cannot be absorbed by plants (Murbandono, 2006)

Organic materials cannot be directly used or utilized by plants because the C/N ratio in these materials is relatively high or not the same as soil C/N. The C/N value is a ratio of carbon and nitrogen. The C/N value of soil ranges from 10-12. However, fresh organic material has a high C/N, for example: rice straw 50-70, leaves >50 (depending on the type), plant branches 15-60, and so on (Yovita, 2007).

The types of organic materials that can be made into compost can come from plants or vegetation, including: cow dung, chicken manure, offal, meat scraps, sawdust, grass left over from livestock rations, plant waste, food industry waste, natural resources. N, and inoculum or material containing microbes (Djaja, 2008).

Yovita (2003), added that composting organic material from plants will be faster if animal waste is added, some also add growth substances needed by microorganisms so that apart from organic material, microorganisms also get these materials from outside. To add cow dung, 10% of the raw material used is used and Sofian (2006), says that the appropriate water mixture for composting empty palm oil stalks is 500 liters/ton of raw material.

2.3 Decomposer Agent

Decomposers are organisms that break down the remains of dead organisms into simpler organism substances. The results of these changes are then used again by the manufacturer. Organisms including decomposers are fungi and bacteria (Aryulina et al, 2006).

2.4 EM-4

EM technology was first developed by Prof. Dr. Teruo Higa from the University of the Ryukyus, Japan in 1980. Effective microorganism (EM) is a mixed culture of fermenting (fermentation) and synthetic (combination) microorganisms that work synergistically (mutually supporting) to ferment organic materials. The organic material is in the form of rubbish, livestock manure, litter, grass and leaves. Through the fermentation process, organic materials are converted into sugar, alcohol and amino acids so that they can be absorbed by plants (Anonymous b, 2012).

Effective microorganisms (EM) or effective microorganisms are inoculum that can increase the diversity of soil microorganisms so that they can increase soil and plant fertility. Effective microorganisms contain lactic acid bacteria, photosynthetic bacteria, yeast, fermentation fungi, and actimosetes. Effective microorganisms are generally only used as inoculum. The best dose for making compost using EM-4 is 1 liter/ton of raw material (Yovita, 2003).

EM-4 agricultural product is a bacterial fermentation of organic soil material that fertilizes plants and makes the soil healthy. Made from the results of natural selection of fermentation and synthetic microorganisms in the soil packaged in a liquid medium. The packaged agricultural EM-4 is in a resting state (dormant). When inoculated by spraying it into organic material and soil or on plant stems, EM-4 agriculture will be active and ferment organic material (plant residues, green manure, manure, etc.) contained in the soil. The results of

fermentation of these organic materials are in the form of organic compounds which are easily absorbed directly by plant roots, for example sugar, alcohol, amino acids, proteins, carbohydrates, vitamins and other organic compounds (Anonymous b, 2012).

2.5 Herbafarm

Herbafarm contains beneficial microorganisms taken from medicinal plants and spices. The results of the work of these microorganisms are able to accelerate the decomposition of waste and organic waste, increase soil microbiological activity so that nutrient absorption becomes more efficient, provide essential plant nutrients, and are able to reduce the use of conventional chemical fertilizer doses by up to 50%. Herbafarm consists of Lactobacillus sp, Azotobacter sp, Azospirillum sp, phosphate solubilizing bacteria, Psedomonas sp, and cellulotic bacteria. The advantages of Herbafarm ingredients are: they contain soil microorganisms which are useful as decomposers and providers of nutrients from nature. Herbafarm also contains nutrients such as: C-Organic: 6.93% Nitrogen, 2.24% P2O5, 1.91% K2O, 1.81% Zinc (Zn), 0.002% Copper (Cu), 2.49 ppm Mangaan (Mn), 0.003% Cobalt (Co), 0.74 ppm Boron (Bo), 0.1 % Iron (Fe), 0.26% (anonymous e, 2013).

3. Method

The research was carried out starting in July 2022 which will take place at the Indragiri Islamic University Campus, Jalan Provincial Trench 1, Tembilahan Hulu District, In Dragiri Hilir Regency, Riau Province. Raw material analysis was carried out at the Soil Analysis Laboratory, Faculty of Agriculture, UNAND, PadangWest Sumatra.

The ingredients in this experiment were empty palm kernel shells, water, sugar, EM - 4 and Herbafarm. Meanwhile, the tools used are gloves, measuring tape, laboratory equipment, scales, hoes, machetes, spades, plastic buckets, kegs, pipes and writing tools.

This research was conducted using a completely randomized design (CRD) with 7 treatments and 3 replications to obtain 21 experimental units. The experiments to be carried out are as follows:

1. NoDecomposer
2. EM-4 concentration 0.1%
3. EM-4 concentration 0.2%
4. EM-4 concentration 0.3%
5. Herbafarm concentration 0.1%
6. Herbafarm concentration 0.2%
7. Herbafarm concentration 0.3%

To determine the differences between treatments, the Tukey HSD test was carried out at the 5% level. Meanwhile, data analysis for observing compost odor, compost color and compost structure was carried out organoleftically.

This research was carried out by making compost with the composting time limited to 3 months. The details of the activities in this research can be described in several activities including the following:

The material used is empty palm oil stalks which are taken from palm oil sales agents, then selected one by one, then cut using a machete or ax so that they are 1cm-2cm in size, then stacked on a tarpaulin or kembes to be dried in the sun so that they become dry. and then stack them into several separate piles on the tiles with a weight of 1 pile totaling 20 kg when dry.

The method for making compost is as follows:

- Raw materials that have been chopped and dried are stacked 20 kg per treatment.
- Give a dose of EM-4 and Herbafarm according to the treatment and dissolve it in 10 L of water.
- After mixing, cover the raw materials using a tarpaulin /kembes.

Compost treatment includes:

1. Maintain an ideal temperature (40-60ºC) by inserting a temperature thermometer. If the temperature rises, the covering tarpaulin will be opened and the material will be turned over and the material will be allowed to return to its original temperature.
2. Improve aerase by turning the compost.

The parameters observed during the research consisted of: Analyze C, N, P levels and C/N ratio (compost analysis after 3 months of age).

4. Result

4.1 C content

Table 2. Effect of Several Decomposer Agents on the C Content of JKKS Compost

TREATMENT	AVERAGE
No Decomposer	38.64 a
EM-4 Concentration 0.1 %	36.63 ab
EM-4 Concentration 0.2 %	33.64 bc
EM-4 Concentration 0.3 %	30.36 c
Herbafarm Concentration 0.1%	36.49 ab
Herbafarm Concentration 0.2%	35.26 b
Herbafarm Concentration 0.3%	33.56 bc

Note: The numbers in columns and rows followed by different lowercase letters in the same column are significantly different at the 5% tukey HSD level.

Table 2 shows that the application of decomposer agents (EM-4 and Herbafarm) significantly reduced

the C content of JKKS compost, although not significantly at a concentration of 0.1% to 0.3% by 8.28 units when compared to treatment without decomposer. The decrease in organic C increased with increasing doses of EM-4 and Herbafarm. This is because the microorganism content contained in JKKS compost increases with increasing decomposer dosage so that the breakdown of organic C in JKKS compost becomes faster. The highest reduction in organic C was obtained in the EM-4 treatment with a concentration of 0.2%, the reduction in JKKS compost C due to the administration of decomposer agents was 30.36% which met compost quality standards (attachment 2).

The carbon content in compost depends on the breakdown of organic material by the microorganisms in the compost. The more active and the more microorganisms there are, the less carbon will be caused by breakdown (Djaja, 2008). Anonymous c, 2012 stated that Em-4 and herbafarm both contain Lactobasillus sp bacteria which are bacteria that produce lactic acid as a decomposer of sugar and carbohydrates in collaboration with photosynthetic bacteria and yeast. This lactic acid is a strong sterilizing agent that can suppress dangerous microorganisms and can break down organic materials quickly. The lactobacillus content in EM-4 and Herbafarm can be seen in Appendix 3.

4.2 N content

Table 3. Effect of Several Decomposer Agents on the N Content of JKKS Compost

TREATMENT	AVERAGE
No Decomposer	0.54 d
EM-4 Concentration 0.1 %	0.66 cd
EM-4 Concentration 0.2 %	1.24 a
EM-4 Concentration 0.3 %	0.93 b
Herbafarm Concentration 0.1%	0.74 c
Herbafarm Concentration 0.2%	0.88 bc
Herbafarm Concentration 0.3%	0.89 b

Note: The numbers in columns and rows followed by different lowercase letters in the same column are significantly different at the 5% tukey HSD level.

Table 3 shows that treatment with a concentration of 0.1% to 0.3% decomposer agent increased the N content of JKKS compost compared to without decomposer treatment. Increase in N content of JKKS compost by 0.70 units. All treatment results in JKKS compost have met the compost quality standard (attachment 2), namely 0.40%. The increase in JKKS compost N occurred due to the contribution of N and microorganisms from decomposer agents. The content of EM-4 and herbafarm can be seen in appendix 3. In addition, microorganisms contributed by decomposer agents increase the breakdown of organic material. The higher the breakdown of organic material, the mineralization of nutrients, especially N, will increase.

Novizan (2005), states that in the composting process, carbohydrates, proteins and lignin are broken down into simple compounds, namely NH 3, CO2, H 2 and H 2 O. At this time, microorganisms absorb nutrients from the surrounding environment for their growth, while after that the decomposing microorganisms will die, as a consequence the nutrients that make up the microorganism's body will be released. At this stage C/N will be low due to C evaporation while there is an increase in nitrogen availability.

Giving herbafarm at a concentration of 0.2% increased JKKS compost N which was higher than giving herbafarm at a concentration of 0.1% but was not significantly different from giving herbafarm at 0.3%. Giving EM-4 treatment with a concentration of 0.2% also gave the highest value, giving EM-4 with a concentration of 0.3% actually decreased the N content of JKKS compost. This is related to the nutrient immobilization process in the breakdown of organic material in the JKKS compost, even though there are more microorganisms in the EM-4 treatment of 0.3% compared to the EM-4 treatment of 0.2%, so the microorganisms contained in the empty palm kernel compost utilize the elements. N for his own needs.

Sutanto (2002), states that Immobilization is a process where the microorganisms contained in compost compete to break down organic material into nutrients needed by plants, but most of the N and P elements are used as nutrients for the reproduction of the microorganisms themselves, so that the nutrients (N and P) contained in the compost are reduced.

The process of JKKS compost N availability in this study can also be linked to the maturity of JKKS compost which can be seen from the C/N ratio value (table 4). The C/N ratio when giving EM-4 at a concentration of 0.2% is lower than when giving EM-4 at a concentration of 0.3%, which means that by giving EM-4 at a concentration of 0.2%, composting runs faster compared to other doses of decomposer.

The availability of N in compost is also assisted by Photosynthetic bacteria in EM-4 which can synthesize nitrogen compounds, sugars and other bioactive substances (Ananimous d, 2012) and Azotobacter bacteria in Herbafarm which are able to fix free nitrogen from the air so that there is an increase in the availability of existing N in the compost. (Ananimous c, 2012). The content of photosynthetic bacteria in EM-4 and Azobacter bacteria in Herbafarm can be seen in Appendix 3.

4.3 C/N Ratio

The results of the variance analysis of the influence of several decomposer agents were significantly different on the C/N content of JKKS compost (attachment 6). Data that has been further tested with Tukey HSD at the 5% level is presented in Table 4.

Table 4. Effect of Several Decomposer Agents on the C/N Content of JKKS Compost

TREATMENT	AVERAGE
No Decomposer	72.33 a
EM-4 Concentration 0.1 %	55.98 b
EM-4 Concentration 0.2 %	27.43 d
EM-4 Concentration 0.3 %	32.66 d
Herbafarm Concentration 0.1%	50.05 c
Herbafarm Concentration 0.2%	40.17 cd
Herbafarm Concentration 0.3%	37.85 cds

Note: The numbers in columns and rows followed by different lowercase letters in the same column are significantly different at the 5% tukey HSD level.

Table 4 shows that the administration of decomposer agents (EM-4 and Herbafarm) from a concentration of 0.1% to a concentration of 0.3% reduced the C/N content of JKKS compost by 44.90 units compared to treatment without decomposer, the decrease in the C/N ratio did not meet the standard Compost quality (attachment 2) is 15 – 25. This is due to the decrease in organic C of JKKS compost and the availability of compost N is not good enough so that the decrease in C/N does not meet the compost quality standards.

In the EM-4 treatment, the lowest C/N content was obtained in the EM-4 treatment with a concentration of 0.2% and was not significantly different from the EM-4 treatment with a concentration of 0.3%. This is related to the level of compost maturity which can be seen from the C/N value. The C/N ratio when giving EM-4 at a concentration of 0.2% is lower than when giving EM-4 at a concentration of 0.3%, which means that by giving EM-4 at a concentration of 0.2%, composting runs faster compared to other doses of decomposer.

Suastika (2001), states that during the decomposition process there will be a decrease in C/N of organic material and an increase in N-total, P, and K. This decrease in the C/N ratio is caused by the decomposition process by micro-organisms because organic material is a source energy and nutrient sources for microorganisms in the process of assimilation and cell formation. The end result of weathering causes the C-organic content and C/N ratio to decrease while the content of N, P and other elements increases.

According to Wahyono, et al 2011. A good C/N ratio of granular fertilizer is 15-25, and even then it is stated to be high because a good C/N ratio is close to the range of soil C/N ratios, namely 10. A high ratio level indicates that the compost is not yet mature. and a low C/N ratio indicates that the compost is truly mature, then it can be defined that if the C/N ratio is high then the compost will take a long time to ripen, whereas if the C/N ratio is low then the compost ripening process will be fast.

4.4 P Content

Table 5. Effect of several decomposer agents on the P content of JKKS compost.

TREATMENT	AVERAGE
No Decomposer	0.15 a
EM-4 Concentration 0.1 %	0.2 ab
EM-4 Concentration 0.2 %	0.21 a
EM-4 Concentration 0.3 %	0.21 a
Herbafarm Concentration 0.1%	0.19 ab
Herbafarm Concentration 0.2%	0.2 a
Herbafarm Concentration 0.3%	0.21 a

Note: The numbers in columns and rows followed by different lowercase letters in the same column are significantly different at the 5% tukey HSD level.

Table 5 shows that the application of decomposer agents (EM-4 and Herbafarm) from a concentration of 0.1% to a concentration of 0.3% increased the P content of JKKS compost by 0.06 units compared to without treatment, this is because the P nutrient increased due to the breakdown process that occurred. In compost, this increase occurs because the microorganisms in the compost work to break down the compost raw materials so that the C content decreases and as a result the N and P elements increase (Lingga et al., 2008).

The best treatment is EM-4 treatment with a concentration of 0.2% with a value of 0.21 and when compared with the compost quality standard (attachment 2) the P value is > 10, so all treatments have met the compost maturity standard. However, in the EM-4 treatment the concentration of 0.2% was not significantly different from the EM-4 treatment with a concentration of 0.3%. This can be seen from the C/N ratio (table 4) produced by JKKS compost. The C/N ratio when given EM-4 at a concentration of 0.2% is lower than when given EM-4 at a concentration of 0.3%, which means that by giving EM-4 at a

concentration of 0.2%, composting runs faster compared to other doses of decomposer.

The availability of P in compost is assisted by yeast in EM-4 which can help the process of development or division of microorganisms such as actimomycetes and lactic acid bacteria which are bacteria that help to meet the availability of P in compost (Ananimous d, 2012) and Pseudomonas sp. at Herbafarm which is able to help regulate the availability of P in compost (Ananimous c , 2012).

5. Conclusions

Based on the results of the research " The Effect of Providing Decomposer Agents on the Quality of Palm Oil Empty Bed Compost (Elaeis guineensis Jaq)" several conclusions were drawn as follows: Providing decomposer agents (EM-4 and Herbafarm) with a concentration of 0.1% to 0.3% was able to improve the quality of compost compared to treatment without decomposer, which was indicated by a decrease in the C value and C/N ratio of JKKS compost, as well as increasing the availability of N and P. Moreover, providing EM-4 with a concentration of 0.2% and Herbafarm 0.3% is the best (optimal) dose in improving the quality of empty palm kernel compost for 3 months.

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