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Physical and Chemical Properties of Organic Fertilizer from Banana (*Musa Paradisiaca*) Leaf and Stem with Effective Microorganism Activactors (EM4)

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Abstract:- Organic fertilizers are fertilizers derived from weathering of organic matter in the form of plant residues, animal waste and can come from household waste or industrial waste. One of the organic materials that can be used as solid organic fertilizer is banana leaves and stems. The process of making solid organic fertilizer with the addition of dissolved effective microorganisms (EM 4) accelerates the composting process well.

This study aims to observe the physical properties of fertilizers (color, aroma, shape and temperature) and chemical properties (pH, N, P, K, C-Organic and C/N Ratio or analyze the nutrient content of organic fertilizers from banana leaves and stems with Bioactivator Effective microorganism (EM4).

This research was conducted at the Production Laboratory of the Plantation Cultivation Study Program and the Laboratory of Soil Science, Samarinda State Agricultural Polytechnic.

The results of research on the physical properties of organic fertilizer from banana leaves and stems as a basic ingredient of fertilizer are accelerated using EM 4 solution for 25 days until ripe, visible from the black color, odorless, crumb form (crushed when squeezed) and normal temperature (26OC). and chemical properties, pH 8.11, nutrient content N 0.392 %, P 0.211 %, K 0.105 %, C-Organic 12.492%, C/N 31.87 in accordance with the compost quality standard SNI 19-7030-2004

Keywords:- *Organic Fertilizer, Leaves, Banana Stems, Effective Microorganisms (EM4)*

I. INTRODUCTION

According to Funk (2014) organic fertilizers are materials that contain carbon and one or more nutrients other than H and O which are essential for plant growth, which do not contain prohibited substances and are derived from natural materials, namely from plants or animals, which are applied to plants as a source nutrient.

Organic fertilizers are fertilizers derived from dead plants, animal waste or other organic wastes that have gone through an engineering process, in solid or liquid form, can be enriched with minerals or microbes that are useful for increasing nutrient content and soil organic matter and improving physical properties, chemistry, and soil biology.

Banana tree trunks have many benefits, one of which is to fertilize plants. Therefore, banana tree trunks can be processed into organic fertilizer which has a very large role for soil fertility. Banana tree trunks can be processed into solid organic fertilizer, or used as a compost mixture by chopping it into fine pieces, then mixed with other organic materials to be processed into compost. Banana leaves can also be processed into fertilizer and as organic material and used as a planting medium. Especially the leaves that have been dried and mashed to be used as a planting medium for ornamental plants, as well as for vegetables (Abdul, 2021).

Given the importance of the function and role of organic matter for the soil and the increasingly intensive use of inorganic fertilizers by farmers, it is very important to make efforts to return organic matter to the soil. Minded chemical terms among farmers should be slowly changed. Awareness of the importance of soil fertility in the future and the negative impact of using inorganic fertilizers must be understood by every farmer. Chemicals can harm health and the environment. For this reason, it is necessary to find an alternative combination of the use of organic production facilities (organic farming technology packages) so that the production that can be achieved will not be much different from the use of inorganic materials.

Effective Microorganism Solution (EM4) is a material in the form of a fermenting liquid and consists of four main groups, namely photosynthetic bacteria, Lactobacillus sp, Streptomyces sp, and yeast (yeast). In addition to accelerating the fermentation process, EM4 can add soil nutrients by pouring it on the ground and spraying it directly on the leaves of the plants (Susetya, 2015).

This study aims to observe the physical properties of fertilizers (color, aroma, shape and temperature) and chemical properties (pH, N, P, K, C-Organic and C/N Ratio or analyze the nutrient content of organic fertilizers from banana leaves and stems with Bioactivator Effective microorganism (EM4)

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II. RESEARCH METHODS

A. Time and Place

1. Research Time

This research was conducted for 2 months, from September 2021 to November 2021,

2 Research Place

This research was conducted in two places, namely:

a. Fertilizer production is carried out at the Agronomy Laboratory of the Samarinda State Agricultural Polytechnic.
b. Nutrient testing was carried out at the Soil Laboratory of the Samarinda State Agricultural Polytechnic.

B. Tools and Materials

The tools used include machetes, sacks, rakes, sacks, digital scales, measuring cups, buckets, plastic sheeting, rulers, chopping machines, cameras, thermometers, rulers, pH meters, and stationery.

The materials used are banana leaves (25 kg), banana stems (25 kg), EM4 (100 ml), brown sugar (1 kg), water (10 l) and bran (10 kg), rice husk (10 kg).

C. Research procedure

Making organic fertilizer from banana peels and mucuna bracteata includes the following steps:

1. Preparation of EM4 solution

a. The brown sugar is mashed by being beaten with a hammer after which the sugar is dissolved in 10 l of water
b. The sugar and water solution that has been mixed is filtered through a filter and put into a bucket, add 100 ml of EM4 solution, stir until smooth or mixed, then cover the bucket and let it stand for 1 week
c. After 1 week the bucket was opened and it was seen that the solution was dark brown in color, smelled of tape, and you could see white threads, ready to use

2. Manufacture of fertilizer:

a. First, prepare 20 kg of banana leaves and 25 kg of banana stems. Then the material is chopped using a chopping machine.
b. After the banana leaf peels and banana stems are chopped, add the bran and rice husk, stir until well mixed, then flush the fermented EM4 solution evenly or until the fertilizer is moist, namely by holding it with a fist, it has formed and is solid until you feel water flowing from your grip. hand.
c. After mixing and watering, cover the organic fertilizer tightly using a tarpaulin. What if the hot fertilizer is done by reversing the fertilizer, it can be done every day. During the decomposition process lasting ± 1 (one) week, the temperature is maintained by regular turning. Maintain the temperature of the mound of dough at 40 – 50ºC, if the temperature is over 50ºC the mound of dough is turned over, then covered again with a tarpaulin.

D. Data Processing

The research data included physical observations (color, odor, texture, and temperature), measurements were made every day, and chemical properties by observing pH, N (Nitrogen), P (Phosphorus), K (Potassium), C-Organic and C/ N Ratio

III. RESULTS AND DISCUSSION

A. Physical Properties

The time needed to make organic fertilizer from banana leaves and stems is 25 days by observing the color, aroma, shape and temperature. Formation of mature fertilizer is characterized by a black or black color, odorless, crumb shape (crushed when squeezed) and temperature. normal (26ºC)

The results of physical observations of banana leaf and stem fertilizers with EM4 composting were carried out for 25 days, the results of mature fertilizers were characterized by color, smell, shape and temperature can be seen in Table 1 below;

Table 1. Daily data on changes in color, odor, form and temperature of fertilizer from banana peel and mucuna bracteata waste

Day To-	Color	Scent	Form	Temperature (^{0}C)
1	Greenish White	No smell yet	Rough	30
2	Greenish White	No smell yet	Rough	40
3	Greenish White	No smell yet	Rough	42
4	Yellowish White	Smelled	Rough	40
5	Yellowish White	Smelled	Rough	37
6	Yellowish White	Smelled	Rough	35
7	Yellowish White	Smelled	Rough	32
8	Yellowish White	Smelled	Little crumbs	32
9	Yellowish White	Smelled	Little crumbs	30
10	Light brown	Less smelly	Little crumbs Little	30
11	Light brown	Less smelly	crumbs	30
12	Light brown	Less smelly	Little crumbs	29
13	Light brown	Less smelly	Little crumbs	29
14	Light brown	Less smelly	Little crumbs Little	29
15	Light brown	Less smelly	crumbs	29
16	Light brown	Less smelly	Little crumbs	28
17	Light brown	Less smelly		28

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18	Light brown	No smell	Little crumbs Little	27
19	Light brown	No smell	crumbs	27
20	Dark brown	No smell	Crumb	27
21	Dark brown	No smell	Crumb	26
22	Dark brown	No smell	Crumb	26
23	Dark brown	No smell	Crumb	26
24	Dark brown	No smell	Crumb	26
25	Dark brown	No smell	Crumb	26
			Crumb	

Table 1 shows the time needed to make organic fertilizer from banana leaves and stems is 25 days by observing the color, aroma, shape and temperature. The formation of fertilizer takes 25 days. crumbs (crumbles when crushed) and normal temperature (26^0C)

B. Chemical Properties

The results of laboratory tests for nutrients contained in the raw materials for fertilizers from research that have matured compared with the nutrients in standard fertilizer quality SNI 19-7030-2004 can be seen in table 2.

Table 2. Organic Fertilizer Nutrient Content

Parameter	**Unit**	**Compost**		
		Research result	**SNI 19-7030-2004**	
			Min	**Maks**
pH	-	8,11	6,8	7,49
Nitrogen (N)	%	0.398	0,40	-
Phosfor (P)	%	0.211	0,10	-
Kalium (K)	%	0.105	0,20	-
C-Organik	%	12.492	9,8	32
C/N	-	31.87	10	20

Source : Soil and Water Laboratory, Samarinda State Agricultural Polytechnic

Table 2 shows the manufacture of organic fertilizer from banana leaves and stems which have been composted for 25 days showing the nutrient content of Nitrogen (N) of 0.398%, Phosphorus (P) of 0.211%, Potassium (K) of 0.105%, C-Organic of 12.492% C/N of 31.87

From the results of the physical analysis of organic fertilizers, this composting was carried out for 25 days. Visually, the maturity of organic fertilizer from banana leaves and stems using EM-4 solution can be identified from:

1. Color

The color of mature fertilizer is black and it takes 25 days. Color changes from green at the beginning of composting to black at the end of composting or when fertilizer matures. According to Susetya (2014), the characteristics of ripe fertilizer are black or black in color. Banana leaves and stems by adding EM 4 which are ripe are black or black in color, while at the beginning of the composting process the organic matter is greenish white so that the organic matter decomposes gradually to become yellowish, light brown, blackish brown, until finally the compost becomes black or black.

2. Scent

At the beginning of composting it smells bad and when it is ripe it smells good like earth. According to Susetya (2014), the smell of ready-made or ripe organic fertilizer gives off a pungent aroma but emits a weak aroma like the smell of earth or the smell of forest humus. While the initial smell of the composting process does not smell, it still smells of the banana leaves and stems themselves.

3. Form

Fertilizer that has been cooked is crumbly, will feel soft when crushed, when kneaded it will break easily and there will be a decrease in the volume/weight of the fertilizer along with the maturity of the fertilizer. The initial hard form then becomes soft and already resembles the shape of the soil and the basic ingredients are no longer recognized. In accordance with the opinion of Djuarnani et al (2006), mature fertilizer has a crumb form like soil. Fertilizer raw materials used in the presence of a mixture of other ingredients affect the decomposition process relatively faster than similar raw materials (Murbandono, 2013)

4. Temperature

The final temperature for composting is 26ºC, the initial temperature is 30ºC. During the composting process there is an increase in temperature at the beginning of the composting process and then decreases or stabilizes. High and low temperatures are a factor that greatly influences the success of organic fertilizer production. An increase in temperature generally occurs since the beginning of the manufacture of fertilizer. This increase can vary from 30ºC-48ºC and when the fertilizer is ripe the temperature returns to the initial temperature of 30ºC-26ºC, the fertilizer is ripe for up to 25 days.

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This statement is reinforced by Isroi (2008), where the temperature increases at the beginning of composting (≥ 30°C) and will remain high for a certain time, this indicates a very active decomposition/decomposition of organic matter. Fertilizer temperatures that are still high mean that the composting process is still active and the fertilizer is not ripe enough. After most of the material has decomposed, the temperature will gradually decrease. At that time there is maturation of fertilizer, namely the formation of humus clay complex.

C. Hasil Analisis Kimia Pupuk

1. pH

In this study the range of pH during the composting process was 8.11, already meeting the Quality Standards for Organic Fertilizers, according to the Minister of Agriculture No. 28/Permentan/OT.140/2/2009. The increase in fertilizer pH is due to the activity of microorganisms in the decomposer which provides OH ion input from the decomposition process of fertilizer materials, thus supporting an increase in basicity which in turn increases the organic pH value (Djuarnani et al, 2017). Composting that lasts for days will affect changes in the pH of organic matter, the initial pH of organic fertilizers begins to be slightly acidic due to the formation of simple organic acids, then the pH increases during further incubation due to the decomposition of proteins and the release of ammonia.

2. Nitrogen (N)

The content of Nitrogen (N) in organic fertilizer from banana leaves and stems using EM4 is 0.392%, based on this value, this fertilizer does not meet the Indonesian National Standard (SNI) 19-7030-2004 of 0.40%. This is presumably because the element N present in the fermentation process is too little so that the administration of EM4 decomposing bacteria does not produce a fast process when the fermentation process contains Nitrogen (N) which does not meet the SNI. (Pranata, 2009)

3. Phosfor (P)

The value of phosphorus (P) in the fertilizer is 0.211%, based on this value the fertilizer from banana peel waste and mucuna bracteata using EM4 solution already meets the Indonesian National Standard (SNI) 19-7030-2004 of 0.10%. This is presumably the activity of microorganisms in decomposing organic matter with EM-4 solution into lactic acid, so that it becomes acidic causing phosphorus bound in long chains to dissolve in organic acids produced by these microorganisms, and more phosphorus nutrients (Pranata, 2009).

4. Kalium (K)

The value of Potassium (K) in banana peel and mucuna bracteata waste fertilizer with EM-4 solution is 0.320%, based on this value it meets the Indonesian National Standard (SNI) 19-7030-2004 of 0.20%. This is presumably because the use of EM4 solution has more microorganisms to carry out the degradation process which causes a simpler carbon chain, the breaking of the carbon chain causes the element of potassium to increase. At the ripening stage, the microorganisms will die and the K content in the microorganisms will mix in the compost material and increase the K content in the compost. The addition of EM4 containing Actinomycetes can directly increase the potassium content by increasing the number of bacteria present in the compost ingredients (Djaja, 2018)

2. C- Organik

The C-Organic value is 12,492% based on this value and meets the Indonesian National Standard (SNI) 19-7030-2004 of 9.8 - 32%. C-organic content is an important factor determining the quality of fertilizer. Organic materials play a very important role in terms of making fertilizer and to increase the availability of nutrients in the fertilizer. The higher the quality the better. It already contains sufficient nutrients and other elements are added to speed up composting which is broken down by microorganisms, so the decomposition process will speed up composting. This is because organic matter can increase the chemical, physical and biological fertility of the soil. Determination of organic matter content is carried out based on C-organic (Novizan, 2002)

3. C/N Rasio

Fertilizer maturity test is carried out by laboratory tests, one criterion for fertilizer maturity is the C/N ratio. If the C/N ratio of compost is 20 or less, it means that the compost is ready for use (Sutanto, 2002). Fertilizer from research made from waste banana peels and mucuna bracteata with EM4 solution is mature enough because it has a C/N ratio of 31.00. In comparison with the fertilizer quality standards of SNI 19-7030-2004, the results of the research have met the requirements. A good composting process will produce an ideal C/N ratio of 10-20. The higher the C/N ratio of organic matter, the longer the composting or material decomposition process will take. If organic matter has a C/N ratio close to or equal to C/N, then the material can be used for plants (Setyorini et al, 2011)

IV. CONCLISION

1. The results of the physical properties of organic fertilizer from banana leaves and stems as the basic ingredients of fertilizer are accelerated by using EM 4 solution for 25 days until ripe, visible from the black color, odorless, crumb form (crushed when squeezed) and normal temperature ($26^{O}C$)
2. Fertilizer from banana leaves and stems produced is ripe and ready to use has a pH of 8.11, a nutrient content of 0.392% N, 0.211% P, 0.105% K, 12.492 C-Organic, 31.87 C/N

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