Conference Paper

Organic Fertilizer from Bioethanol Solid Waste, Agricultural Waste, and Banana Peels Waste by Bio-act EM4 and *Aspergillus niger*

Sri Rachmania Juliastuti, Delftya Enhaperdhani, and Rizka Uswatun Hasanah

Department of Chemical Engineering, Institute of Technology Sepuluh Nopember, Surabaya 60111, Indonesia

Abstract

Excessive use of chemical fertilizers may degrade the physical condition of the soil so that solid organic fertilizer was developed. Organic fertilizer was made from organic materials derived from plants or animals that had been made by the engineering process. Organic fertilizers were used to supply organic matter to improve the physical, chemical, and biological properties of soil. This experiment aimed to study the effect of a mixture of bio ethanol solid waste, corn agricultural waste and banana peels waste with bio-activator EM4 and *Aspergillus niger* (*An*) to increase the content of potassium (K) in organic fertilizer and study the response of plant growth of chillies and eggplant against organic fertilizer. Organic fertilizers were made from agricultural waste, such as bio ethanol solid waste, corn agricultural waste, and banana peels waste that still have organic content which was good for plant growth. Organic fertilizers were made by mixing bio ethanol solid waste, corn agricultural waste, and banana peels waste with a ratio (w/w) of 1:2:3. After that, a mixture of EM4 and *An* with a ratio (v/v) of 1:1, 2:3, 3:2, 1:3, 3:1 and without any bio-activator were added. Organic fertilizer produced in a rotary drum composter with air aeration 14 L · min^{-1} conducted for 15 d. The content of N, P and K on each variable of organic fertilizer will be analyzed. Then it was tested on chillies and eggplant. Furthermore, the quality and quantity of planting fruit on the plants of eggplant and chillies were measured. Based on the results of this study, it was concluded that organic fertilizer with the addition of EM4:*An* 2:3 (v/v) increased the content of K up to 0.43 %. In accordance with SNI standards: 19-7030-2004, all test variables met the standards of the levels of N, and P; all organic fertilizers met the standard C/N ratio unless at the variables EM4:*An* 1:3 (v/v) and without bio-activator. For chillies, variable with the addition of EM4:*An* 2:3 (v/v) has the greatest weight, namely 0.95 g. Another variable, EM4:*An* 3:2 (v/v) can produced the amount of fruit up to 300 %. Where at the addition of EM4:*An* 2:3 (v/v) can produced eggplant fruit that weighs 24.01 g per harvest.

Keywords: *Aspergillus niger,* banana peels waste, bioethanol solid waste, corn agricultural waste, effective microorganism, organic fertilizer.

Corresponding Author:
Sri Rachmania Juliastuti
julizainul@gmail.com

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1. Introduction

Agricultural land in Indonesia with poor soil conditions is usually overcome by the use of organic fertilizers. However, after being introduced with chemical fertilizers, Indonesian society changed course leave organic fertilizer into chemical fertilizers. In a certain period of time, the results are quickly perceived and rising sharply. There are many people who think that the more chemical fertilizers are given to the land, the greater harvest will be. Therefore, the public has the tendency to excess in using chemical fertilizers.

Using excessive chemical fertilizers is clearly unwise because it will worsen the physical condition of the soil. Being offset by the provision of humus or compost, efficiency and effectiveness absorption of nutrients by the plants will not be optimal. While organic fertilizers, including fertilizers that are environmentally friendly, have several advantages compared with other fertilizers, namely: i) improving and maintaining soil structure remains loose, so the plant roots will grow better, ii) increasing the soil ability to absorb and hold water, so the plants' need water will be adequate, iii) raising the living conditions in the soil, iv) decomposing phosphate and increasing the availability of useful nutrients [1].

Referring to the high usage of chemical fertilizers by the farmers, and an increase in the price of fertilizer and artificial fertilizer scarcity lately, we need to find an alternative to the use of chemical fertilizers without lowering the yield. The alternative is to make bio ethanol solid waste, agricultural corn waste and banana peels waste that still has elements of N, P, and K high enough as a raw material for organic fertilizer. This experiment aimed to study the effect of a mixture of bioethanol solid waste, corn agricultural waste and banana peels waste with bio-activator EM_4 and *Aspergillus niger* (*An*) to increase the content of K in organic fertilizer; and study the response of plant growth of chillies and eggplant against organic fertilizer.

2. Materials and methods

2.1. Raw material preparation

The raw material for organic fertilizer are obtained from the bio ethanol plant PT. Energi Agro Nusantara Mojokerto, agricultural corn waste from Mojokerto and banana peels waste from the banana-fried sellers found around Keputih, Surabaya.

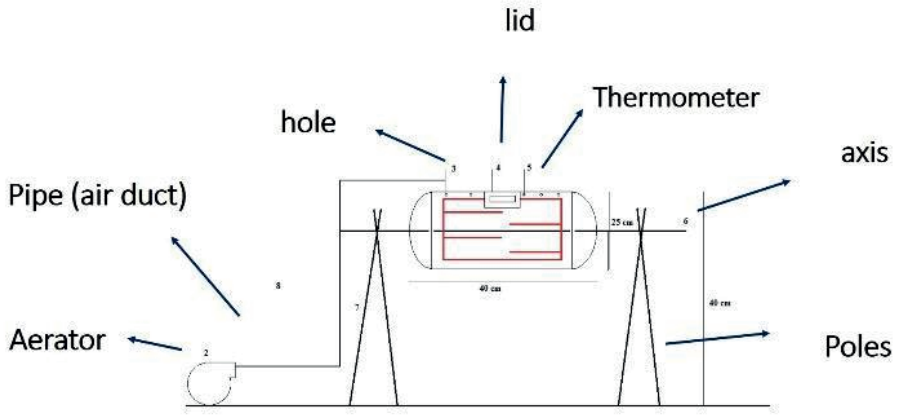

Figure 1: Rotary Drum Composter.

2.2. Microorganism preparation

Aspergillus niger were added at the concentration between (2.225 to 2.475) × 10^6 cell · mL^{-1}. Where the total volume of EM4 and *Aspergillus niger* is 15 mL per 1 kg raw material.

2.3. Rotary drum composter preparation

This experiment used a drum with stirrer for mixing, two holes for aeration processes and pH-temperature measurements. Compressor was added for oxygen supplier for the bacteria needs

2.4. Experiment variables

- Bio ethanol solid waste, agricultural corn waste and banana peels waste with the ratio sequentially (1:2:3) (w/w).
- Microorganism EM4 and Aspergillus niger were added with the ratio sequentially 1:1 (v/v); 1:3 (v/v); 2:3 (v/v); 3:1 (v/v) ; 3:2 (v/v) and without bio-activator. This is a limitation of our experiment. There is no indicators of control to *A. niger.*
- It will be tested on chilies and eggplant with the parameters weight and amounts of the fruits.

2.5. Operation method

- Batch process
- Operating temperature: (30 to 37) °C

- pH: 6 to 8
- Aeration rate: 14 L · min^{-1}
- Composting process period: 15 d
- Mixing process was three times a day, with each agitation was 15 times rotation
- Temperature and pH were checked each day
- Organic fertilizer formed was analyzed for the level of nitrogen (total nitrogen method), total phosphate (as P_2O_5 with colorimetric analysis), potassium (as K_2O with titrimetric analysis), cellulose (Chesson analysis) and the water content (gravimetric analysis).

2.6. Composting process

- Resize the corn agricultural waste and banana peels waste into small size
- Analyze the content of N, P, K, cellulose, and water content of bioethanol solid waste, corn agricultural waste, and banana peels waste
- Put the bioethanol solid waste, corn agricultural waste, and banana peels waste into Rotary Drum Composter along with the addition of EM4 and an accordance with the predefined variables
- Flow the Rotary Drum Composter with air as much as 14 L · min^{-1} using aerator to support the aerobic process
- Measure the temperature, pH, and water content every day during the composting
- Rotate the agitator in the drum three times a day until fertilizer is formed
- Analyze the content of N, P, K, cellulose, and water content of fertilizer

3. Results and discussion

3.1. The content of organic fertilizer

During the composting process, the temperature of organic fertilizers had increased and subsequently decreased to room temperature that was 29 °C. It means the organic fertilizers were at mature phase or ripening stage. First the pH was decreased, then it would rise until it reached a neutral pH, where the highest temperature is 33.5 °C with an average pH organic fertilizer produced was 7. The value was in accordance with SNI: 19-7030-2004 that is between pH 6.8 to 7.49. In physical terms, the result of organic fertilizer were loose and black like soil. The water content is one factor that influence the activity of the microorganisms to decompose organic matter. Water has

Minimun technical requirment for organic fertilizer based on the regulation from Ministry of Agriculture Republic of IndonesiaNo. 28/Permentan/SR.1305/5/2009 dated: 22 May 2009 conerning organic fertilizer			
No.	**Parameter**	**Requirements**	
		Solid	**Liquid**
1	C-Organic	> 12	≥ 4
2	C/N ratio	15 to 25	
3	Total content (%) N P_2O_5 K_2O	< 6 < 6 < 6	< 2 < 2 < 2

Table 1: Standard value of C/N, P & K based on Permentan.

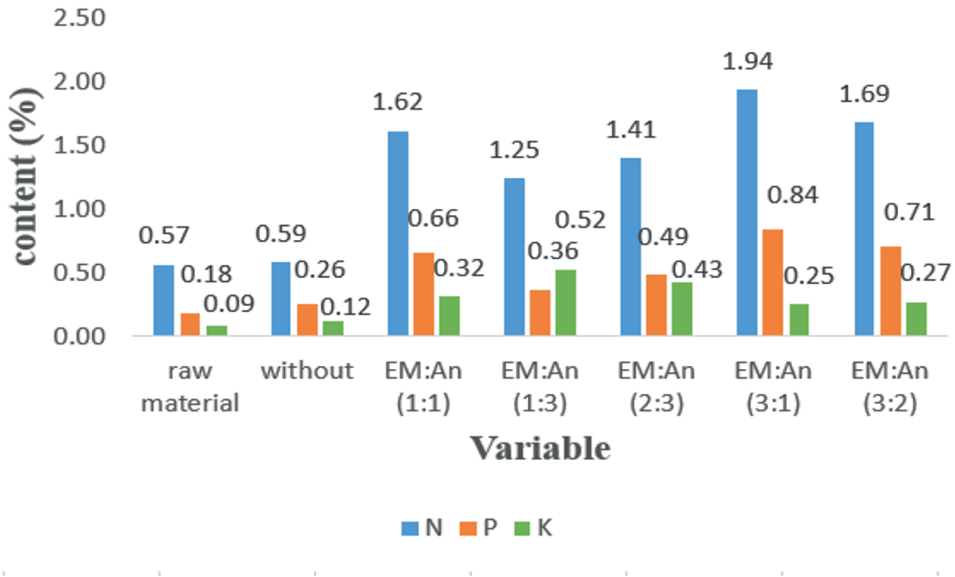

Figure 2: The content of N, P, and K of organic a variety of variables.

a role in dissolving nutrients so they can be easily diffused into the cell. According to SNI: 19-7030-2004, mature compost has a water content below 50 %. All variables are in accordance with that conditions.

The following, listed in Table 1 is the standard value of C/N, P & K based on Permentan (Regulation of Ministry of Agriculture, Republic of Indonesia) .

Figure 2 shows that the content of N, P and K increased from raw materials. Fig. 3 shows that the ratio C/N of the variables composting has fulfilled SNI: 19-7030-2004 except composting variable EM:*An* 1:3 v/v which has a value 23.02 and variable without bio-activator at 44.88. Ideally, at the end of composting, when the fertilizer was at maturation phase ratio value C/N will be decrease if it was compared to the condition of the raw material. This is in accordance with the results obtained. According to A&L Canada Laboratories [2], the use of compost with too high ratio C/N can cause a deficiency of N so that plant growth were not normal, stunted, leaves turn yellow and dry [3].

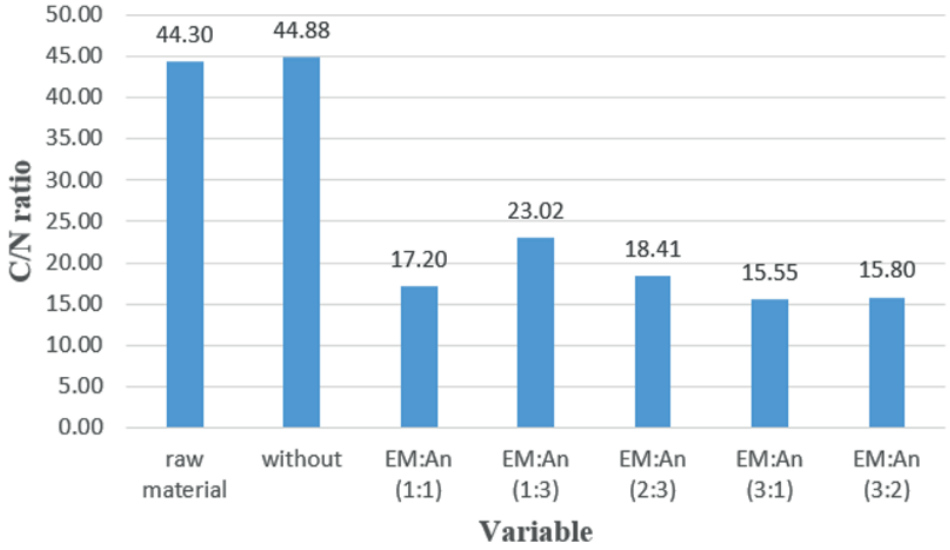

Figure 3: The result of C/N ratio of organic a variety of variables.

While the decrease of cellulose content from raw material is 40.05 %. This shows that *A. niger* was able to produce various enzymes. One of cellulose enzymes was able to break down cellulose and hemicelluloses. Cellulose can be broken down into cellubiose and further decrease into two clusters of glucose so that the cellulose content decreased. The less the content of cellulose in organic fertilizers, more cellulose were degraded [4].

3.2. Discussion of fertilizer in plant test

3.2.1. Chillies

The amount of fruits

The result shows that all the variables have been fruitful so that the effect of P and K can be seen clearly in accordance with the results of the research. It is known that potassium content in plants serves to affect the quality (taste, colour and weight) of fruit and flowers [5]. In addition to potassium, phosphate also affects the production of the fruit produced [4]. The content of P and K lows of 0.26 % and 0.12 % on a variable without microorganisms produce the least amount of chillies that was three pieces. The most number of chillies were produced at variable EM:*An* 3:2 % (v/v) that was nine pieces. This is due to the high phosphate content in the mature was 0.71 %. The results showed that the fertilizer with the addition of EM:*An* 3:2 (v/v) was 300 % more fruitful than fertilizers without microorganisms. However, most of the fruits produced were still very small. The results showed that the addition of EM4 has no significant effect on the amount of fruit, but *A. niger* has affected the amount of fruits.

Plant	Best variable organic fertilizer	Amount of fruits	Fruit's weight
Chilies	EM : *An* 3:2 (v/v)	9 chilies	0.95 g / harvest
Eggplant	EM : *An* 2:3 (v/v)	1 eggplant	24.01 g / harvest

Table 2: Data for the plant test result.

The fruits weight

The results shows that weight of chilli crop yields on variable EM:*An* 2:3 (v/v) was 0.95 g. That was because the content of K in the variable addition of EM:*An* 2:3 (v/v) is higher by 0.43 % compared to a variable without a microorganism which is only 0.12 %. Potassium can improve the quality of fruit for the form, content, and better colour [7].

3.2.2. Eggplants

The amount of fruits

It can be seen tha;t the variable EM:An 1:1 (v/v) contains phosphate (P) and potassium (K) sequentially 0.66 % and 0.32 %. While the variable EM:*An* 2:3 (v/v) contains P and K sequentially 0.49 % and 0.43 %. According to Huwaina [5], the content of potassium in plants serves to affect the quality (taste, colour, and weight) of fruit and flowers. In addition, phosphates also affect the production of the fruit produced [3]. The difference was shown by the content of plants with variable EM:*An* 2:3 (v/v). It has the result (fruitful) faster than other variable. In other words, a fertilizer with variable EM:*An* 2:3 (v/v) has the ability to produce fruit 18 times faster than the variable EM:*An* 1:1 v/v. The content of K fertilizer with the addition variable EM:*An* 2:3 (v/v) give a balance effect, both on nitrogen and phosphate which is important especially in the fertilizer mixture [6].

The fruits weight

Based on the research results, two pieces of eggplant were obtained: that was from the variable EM:*An* 1:1 (v/v) and EM:*An* 2:3 (v/v). For EM:*An* 2:3 (v/v) variable, after 41 d of fertilization, the eggplant can be harvested with a weight of 24.012 6 g. While the fruit of fertilization outcome from variable EM:*An* 1:1 (v/v) still green so it has not been enough time to harvest. Heavy fruits of these variables cannot be identified because the eggplant fruit obtained cannot be harvested. Weight of the fruit can not be compared between variables because the eggplant fruit harvested is only one piece in the variable EM: *An* 2:3(v /v).

4. Conclusions

- Organic fertilizer with the addition of EM:*An* 2:3 (v/v) increased the potassium level up to 0.43 %.
- Organic fertilizer for all variables met the standard N and P based on SNI:19-7030-2004
- Organic fertilizer for all variables met the potassium standard from SNI:19-7030-2004 except the without microorganism variable
- All variables met the C/N ratio standard from SNI:19-7030-2004 except the variable with the addition of EM:*An* 1:3 (v/v) and without microorganism variable.
- Organic fertilizer with the addition of EM:*An* 3:2 (v/v) was the best fertilizer for chillies that produces nine fruits, 300 % more than without microorganism and the heaviest fruits was 0.95 per harvest.
- Organic fertilizer with the addition of EM:*An* 2:3 (v/v) was the best variable for eggplant with the weight of 24.01 g per harvest.

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