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EFFECT OF VEGETABLE WASTE AND BANANA STUMP COMPOSITION IN CASABO FERTILIZER ON NITROGEN AND PHOSPHORUS CONCENTRATION

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Abstract: Liquid organic fertilizer is a solution resulting from the decay of organic materials derived from plant waste that contains more than one element. In Karawang, precisely in Telagasari Village, is the village with the largest banana fruit producer in West Java. In the Karawang market, a lot of vegetable waste has yet to be utilized, so it only causes a bad smell which can eventually cause disease. And there is not much processing of chicken eggshells even though they have a lot of nutritional content. CASABO fertilizer is a liquid organic fertilizer made from variations in chicken eggshells, vegetables, and banana stump composition. This research aims to utilize waste and make it a useful fertilizer for plants. This type of research is quantitative research using research methods or field experiments. This study consisted of 6 variations in the composition of eggshells, vegetable scraps, and banana stump. All materials were mixed with EM-4 and sugar water in the fermentation process. The results showed that the amount of material used affected the value of nutrients: pH 7.59° in P3, moisture content 92.65 in P2, Nitrogen 0.18% in P5, and phosphorus 0.04 in P1 and P2. In P1, the C-organic nutrient content was 5.54%, the C/N ratio was 79, and the potassium nutrient content was 0.09%. Based on these results, it can be seen that variations in the composition of vegetables and banana roots affect the value of phosphorus concentration and nitrogen concentration in CASABO organic liquid fertilizer.

Keywords: *Liquid organic fertilizer, Vegetable, Banana Stump, Egg Shell.*

INTRODUCTION

Indonesia is an agricultural country, meaning many people work as farmers. Many national products also come from the agricultural sector, for example, food crops, which are very prospective commodities and have a role in meeting people's needs for nutrition. The domestic market demand for food crops is very high. Various ways must be done to meet, such as increasing agricultural production [1].

The world of agriculture cannot be separated from using chemicals for fertilization, growth promotion, and pest and disease control. Using artificial fertilizers made from chemicals by the Indonesian people looks very dominant to increase rapid agricultural yields. But the continuous use of chemical fertilizers with high doses over a long period harms soil, plants, animals, and the health of farmers and consumers who use agricultural products [2]. An alternative to the large use of chemicals that cause negative impacts is to use organic fertilizers.

Organic fertilizers are mostly or entirely composed of organic materials derived from plants and or animals that have gone through an engineering process. They can be solid or liquid, which is used to supply organic matter and improve soil's physical, chemical, and biological properties [3]. Based on its form, organic fertilizer can be divided into two types: liquid and solid [4]. Fertilizers produced from organic waste or decomposed animal waste are solid organic fertilizers. In contrast, liquid organic fertilizers can be produced from animal urine, leachate from decomposing organic waste, and fermented liquids from organic materials with good bacteria [5]. The benefits of this liquid organic fertilizer are that it can encourage and increase the formation of leaf chlorophyll to increase the ability to photosynthesize plants and absorb nitrogen from the air, increase plant vigor so that plants become sturdy and strong, increase plant resistance to drought, stimulate the growth of production branches, increase the formation of flowers and ovules, reduce fall and, flowers, and ovules [6]. Liquid fertilizers will be able to overcome nutrient deficiencies more quickly when compared to solid fertilizers. It is supported by its liquid form so that it is easily absorbed by soil and plants [7].

One of the areas in Karawang that is the largest producer of bananas is Telagasari Village, at 13,700 quintals/year [8]. Apart from the fruit that can be made into food, other parts of the banana can also be utilized. However, other parts of the banana have yet to be utilized properly, such as the banana stump. Banana pith contains nutrients N (Nitrogen), C (Carbon), P (Phosphorus), and K (Potassium) [9]. The N nutrient in banana pseudostem is very beneficial for plants. Nitrogen or nutrient N is the main nutrient for plant growth which is generally needed for the formation or growth of vegetative parts of plants such as leaves, stems, and roots [10]. Banana pith also contains microbial bacteria, namely Azotobacter sp, Bacillus sp, Aeromonas sp, Aspergillus sp, Azospirillium sp, cellulosic microbes, and phosphate solubilizing microbes (PH). Some of these bacteria have proven to be very beneficial for plants.

In the Karawang market, a lot of vegetable waste has not been utilized, so it only causes a bad smell which can eventually cause disease. So this vegetable waste must be used to reduce its negative impact. Vegetables contain many nutrients P

(phosphorus), N (Nitrogen), and K (Potassium). The element P has a very important role in cell elongation, division, and development as an activator of various enzymatic reactions [11]. The N element has a function for forming amino acids, proteins, and improving vegetative growth, while the K element is for forming starch, opening stomata, and increasing plant resistance to drought [12].

Chicken eggs are one of the nutritious food sources for humans and produce waste in the form of chicken eggshells. This chicken eggshell waste needs to be appropriately utilized, and it will damage the beauty of the environment; this is because it takes a long time to decompose naturally. Dried chicken eggshells contain 97% calcium carbonate, 3% phosphorus, and 3% consists of magnesium, potassium, sodium, zinc, manganese, and copper. The high calcium content is very good as a raw material for making liquid organic fertilizer and can increase the pH of soil and water media [13].

Previously, Machrodania et al. conducted a study, namely the Utilization of Liquid Organic Fertilizer Made from Eggshell Banana Peel and Gracillaria gigas on the Growth of Soybean Plants Var Anjasmoro. The concentration of nutrients is Nitrogen (N), Phosphorus (P), and Potassium (K). From the results of his research, namely N by 0.89%, P by 0.04%, and K by 1.82%. Applying liquid organic fertilizer to Anjasmoro Var Soybean Plants affects plant height and number of leaves. However, it does not affect plant biomass. The best doses given to Anjasmoro Soybean Var Plants are doses of 16.86 mL/L/polybag and 22.48 mL/L/polybag[14].

Siti Amalia Karyanto et al. also researched the manufacture of Liquid Organic Fertilizers from Vegetable Waste (kale, spinach, mustard greens). The concentration of nutrients he studied were C, N, P, and K. The kale waste POC research results were C by 9.50%; N by 1.69%; P by 2.45%; and K by 2.74%. While the results of spinach waste liquid organic fertilizer research are C by 13.65%; N by 3.06%; P by 3.18%; and K by 3.32%. And the mustard waste POC research results are C by 16.21%; N by 3.45%; P by 3.84%; and K by 4.44%. POC has fulfilled MOA No.70/Permentan/SR.140/10/2011 for spinach and mustard waste. But kale waste POC has not fulfilled MOA No.70/Permentan/SR.140/10/2011[15].

In addition 2017, Qoidani researched making liquid organic fertilizer from banana stumps. The concentration of nutrients studied was N, P, and K. With the results of his research, the most optimum nutrient content was the 3: 3 ratio and obtained N of 101.41 ppm, P of 233.84 ppm, and K of 2007.74 ppm. The resulting liquid organic fertilizer does not meet the standards of MOA No.70/Permentan/SR.140/10/2011[16].

Liquid organic fertilizer is easier to absorb nutrients or nutrient content than solid organic fertilizers. Plants can optimally utilize the nutrients in liquid organic fertilizer to have a better effect [17]. In processing waste into liquid organic fertilizer, fermentation technology utilizes organisms, namely bacteria. In making liquid organic fertilizer with waste, generally use additional activators. Bioactivators that are now often used in making liquid organic fertilizer are effective microorganisms-4 or EM-4. EM-4 is a mixture of beneficial microorganisms. The number of fermented microorganisms in EM-4 is around 80 million microorganisms [18].

Based on these data, the author aims to make liquid organic fertilizer called CASABO fertilizer. CASABO fertilizer stands for chicken eggshell, vegetable, and banana stump fertilizer. CASABO fertilizer is made by processing the three ingredients using a fermentation process. Furthermore, CASABO fertilizer is analyzed for elemental concentration to determine the quality level of the fertilizer. CASABO fertilizer has several significant positive sides, namely this fertilizer is environmentally friendly because it is made from natural organic materials produced from agricultural and plantation waste and reduces the risk of negative impacts on the ecosystem. In addition, CASABO fertilizer also has advantages in terms of low price, so farmers can use it wisely and increase crop productivity without being financially burdensome. Furthermore, this fertilizer also helps address environmental pollution by improving soil quality and increasing fertility and reducing the need for pesticides that can pollute water and soil.

With this CASABO fertilizer, it has the benefit of overcoming banana and vegetable waste and getting cheap organic fertilizer that has great benefits for agricultural crops.

RESEARCH METHODS

Materials and Tools

The materials used were chicken eggshells, banana stump from banana farm waste in Telagasari Village, Karawang, vegetable waste (spinach, tomato, and papaya leaves) from Karawang public market, Effective Microorganisms-4 (EM4), and brown sugar for the fermentation process. The equipment used is covers or cloth, knives, scales, buckets, ropes, cutting boards, filters, quality, and pH meters.

Procedure for making liquid organic fertilizer

Making fertilizer from various waste materials begins with collecting chicken eggshell waste, which is then washed and dried in the sun until the shells become smooth. Similarly, vegetable waste, including spinach, tomato, and papaya leaves, is collected and finely sliced. Additionally, banana stem waste is gathered and also finely sliced. Once all the ingredients are prepared, they are combined in a bucket, along with 250 ml of EM4 and 250 ml of brown sugar solution. The mixture is thoroughly stirred to ensure proper blending. Subsequently, the bucket is covered with a black cloth and stored in a sunlight-free location for ten days to undergo the

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fermentation process. After this period, the lid is opened, and the fermented mixture is filtered and transferred into bottles as a liquid fertilizer.

Figure 1. The result of fermentation before being filtered.

CASABO fertilizer was made with three ingredients, with different vegetable variations and banana stump compositions. The vegetable variation is done to determine the nitrogen concentration, and the banana stem variation is done to determine the concentration of phosphorus in manufacturing CASABO fertilizer. Analyzing the data to measure the nitrogen element in CASABO fertilizer using a Kjeldahl method. At the same time, analyzing data to measure the phosphorus element in CASABO fertilizer using a Molibdovanadat method. Each comparison on CASABO fertilizer can be seen in the table below:

Table 1. Comparison of material composition in making fertilizer

Code	Comparison of material composition		
	Chicken eggshell	Vegetable	Banana stump
P1	1	1	1
P2	1	1	2
P3	1	1	3
P4	1	2	1
P5	1	3	1
P6	1	4	1

RESULTS AND DISCUSSION

Liquid organic fertilizer can be made through the fermentation of organic materials such as waste. Using waste in manufacturing organic fertilizer is one of the efforts to improve people's thinking in waste management [19]. The waste used in this study is chicken eggshell waste, vegetable waste, and banana stump, which are processed through the fermentation process. The fermentation process of liquid fertilizer is biologically decomposing organic matter [20]. The result of fermentation after filtering showed in Figure 2.

This fermentation process utilizes microorganisms in organic matter to convert it into fertilizer rich in nutrients. The results of the organic liquid fertilizer lab test are presented in the following table 2.

Figure 2. Liquid organic fertilizer from eggshell, vegetable, and banana stump

Table 2. Laboratory test results on liquid organic fertilizer at P1

Code	Laboratory test result	
P1	pH	7.34
	Moisture content	88.64
	C-organic	5.54%
	Nitrogen	0.07%
	C/N	79
	Phosphorus	0.04%
	Potassium	0.09%

From the data above, the pH value of liquid organic fertilizer P1 is 7.34. These results indicate that the fertilizer has an almost neutral acidity level. The optimum pH indicator for the liquid organic fertilizer manufacturing process ranges from 6.5 to 7.5 [21]. Liquid organic fertilizer with a pH close to neutral is considered good because it supports the balance of soil nutrients and plant growth without causing damage due to excessive acidity. Liquid organic fertilizer in P1 has a moisture content of 88.64. High water content can facilitate plants' application and absorption process, allowing nutrients to be quickly absorbed into the root system.

The presence of C-organic elements in liquid fertilizer is due to the activity of bacteria. The nutrient content in liquid organic fertilizer for C-organic in P1 is 5.54%. It is because, in the fermentation process by bacteria in EM-4, there is a change from carbohydrate compounds, cellulose, hemicellulose, wax, and fat to CO2 and water, which causes C-organic. The C-organic content in liquid organic fertilizer will increase if more bacteria are added [22]. From the lab test results, the nutrient nitrogen (N) value is 0.07%. Nitrogen or nutrient N is the main nutrient for plant growth which is generally needed for the formation or growth of vegetative parts of plants such as leaves, stems, and roots [23]. The C/N ratio is the carbon mass to nitrogen mass in a substance. The content of the C/N ratio in P1 was 79. So it can be stated that in P1, the C element is more than the N element. The

C/N ratio must be kept in balance to fulfill the nutrients needed by plants.

Lab test results show that the phosphorus content in liquid organic fertilizer is 0.04%. Element P has a very important role in cell elongation, division, and development as an activator of various enzymatic reactions [24]. Liquid organic fertilizer contains phosphorus that plants easily absorb to provide a quick and efficient effect in meeting plant nutritional needs. Phosphorus in liquid organic fertilizer can increase plant productivity and provide optimal nutrition for plant growth and development. Potassium is one of the important nutrients found in liquid organic fertilizers. Potassium increases plant resistance to pests and diseases that plants need [25]. Liquid organic fertilizer made in P1 has a potassium of 0.09%. The high or low potassium element is caused by the ingredients used in making fertilizer and the method used. In liquid organic fertilizer, potassium is contained in organic compounds easily available to plants.

Table 3. Laboratory test results on liquid organic fertilizer pH and moisture content

Code	pH	Moisture content
P1	7.34	88.64
P2	7.30	92.65
P3	7.59	89.75
P4	7.11	88.04
P5	6.75	89.58
P6	7.14	87.94

The pH indicator is one of the factors that affect the activity of bacteria in the decomposition of organic matter. From the lab test data above, it can be seen that the pH of liquid organic fertilizer in P1 is 7.34 °, P2 is 7.30 °, P3 is 7.59 °, P4 is 7.11 °, P5 is 6.75 °, and P6 is 7.14 °. The largest pH indicator is in P3, which is 7.59°. It is due to the comparison's large amount of banana pomace content. Banana pith contains organic compounds and minerals that can increase the solution's pH. Banana pith contains 66% carbohydrates, protein, water, and important minerals [26]. The moisture content of liquid organic fertilizer is an important factor that needs to be considered in the production and use of fertilizers. The water content in liquid organic fertilizer P1 was 88.64, P2 was 92.65, P3 was 89.75, P4 was 88.04, P5 was 89.58, and P6 was 87.94. Liquid organic fertilizer has a high water content because the ingredients in the fertilizer have naturally high water content. Plant roots also easily absorb Liquid organic fertilizers with high water content.

This research aims to determine the effect of phosphorus and nitrogen in liquid organic fertilizer made from chicken eggshells, vegetable waste, and banana stump. This liquid organic fertilizer has great potential to naturally improve soil fertility and plant growth. Still, it is important to know the contribution of nutrients such as nitrogen and phosphorus in this fertilizer. Therefore, we varied the composition of banana stalks to determine the effect of phosphorus and vegetable waste to determine the effect of nitrogen on this CASABO fertilizer.

Table 4. Laboratory test results of liquid organic fertilizer phosphorus nutrient content

Code	Phosphorus
P1	0.04%
P2	0.04%
P3	0.02%

Phosphorus (P) is a macro essential nutrient for plants that is required in the third large amount after Nitrogen (N) and Potassium (K) [27]. The liquid organic fertilizers that have been made each contain phosphorus between 0.02% - 0.04%. The phosphorus nutrient in this liquid organic fertilizer comes from banana pith. Banana pseudostem has high levels of phenolics and helps bind Al, Fe, and Ca ions to help the availability of P (phosphorus), which is useful in the process of flowering and fruit formation [28]. The content in P1 is 0.04%, the content in P2 is 0.04%, and the Phosphorus content in P3 is 0.02%. The phosphorus value obtained is quite good because the research on making liquid organic fertilizer conducted by Harimbi Setyawaty et al. in 2022 obtained the highest phosphorus value of 0.03% and the lowest phosphorus value of 0.01%[29].

The phosphorus nutrient content in the three comparisons has a different value because it uses a different ratio of ingredients. The phosphorus content in P1 and P2 is higher than in P3, possibly due to the use of different banana stems. Phosphorus is less valuable than other nutrients because the amount of vegetable waste also determines it. Phosphorus elements are less contained in vegetable waste. Generally, vegetables are part of the leaves and stems of plants [30]. Although the value of phosphorus in fertilizer is small, the presence of phosphorus is very beneficial for plants. Phosphorus is needed in cell division, tissue development, and growing points in plants [31].

Table 5. Laboratory test results of liquid organic fertilizer nitrogen nutrient content

Kode	Nitrogen
P1	0.07%
P4	0.07%
P5	0.18%
P6	0.17%

Nitrogen is one of the nutrients needed by plants. This nutrient element is obtained from vegetable waste. Vegetable waste that microorganisms have decomposed produces organic

elements in liquid organic fertilizer that help provide nitrogen for plants [32]. N (nitrogen) content in liquid organic fertilizer P1 is 0.07%, P4 is 0.07%, P5 is 0.18%, and P6 is 0.17%. The nitrogen value obtained is quite good. Conducted research on making liquid organic fertilizer, then tested the nitrogen nutrient content, and some samples obtained nitrogen values of 0.01%, 0.05%, 0.08%, 0.12%, 0.15%, and 0.18% [33].

The N nutrient content in P4, P5, and P6 increased rapidly due to the use of more vegetable waste than P1. Vegetable waste is a nutrient source rich in nitrogen, so with more use of vegetable waste materials in this liquid organic fertilizer, the nitrogen element increases. The nitrogen content is smaller than the carbon content because bacteria use carbon elements as energy and nitrogen elements to build cell and bacterial structures [34]. The N content in P5 and P6 has a large value because the amount of vegetable waste influences it. Vegetable waste itself is rich in nutrients, including nitrogen. The element N has a function for the formation of amino acids, proteins and the improvement of vegetative growth [35].

CONCLUSION

Based on the analysis results, CASABO fertilizer code P1 exhibits favorable levels of pH value, moisture content, C-organic, Nitrogen, Phosphorus, and Potassium, making it a suitable choice for organic plant fertilization. Codes P1 and P2 notably boast the highest phosphorus concentration value of 0.04%, while code P5 displays the highest nitrogen concentration value of 0.18%. Additionally, it is important to note that the composition variations among vegetables and banana stump impact the phosphorus and nitrogen concentration levels in CASABO organic liquid fertilizer.

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