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MACRONUTRIENT ANALYSIS OF ORGANIC FERTILIZER FROM THE MIXTURE OF *Casuarina equisetifolia* LEAF LITTER AND *Ananas comosus* RIND WASTE WITH EFFECTIVE MICROORGANISM BIOACTIVATOR

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ABSTRACT

This study aims at analyzing macronutrients of organic fertilizer from the mixture of Casuarina equisetifolia leaf litter and Ananas comosus rind waste with effective microorganism bioactivator. Research on making and analyzing the nutrient content of organic fertilizers has been carried out using a mixture Casuarina equisetifolia leaf litter and Ananas comosus rind waste which consists of three variations of the composition with two repetitions. The process of making compost is conducted by mixing small pieces of pineapple litter and rind and mixed with effective microorganism (EM4) in a container. The composting process occurs for a maximum of 31 days based on the temperature measurement of the fertilizer. In the degree of acidity test using digital pH meter, it shows that the pH level is classified as acidic, the pH variations of the fertilizer P_0U_1, P_0U_2, P_1U_1, P_1U_2, P_2U_1, *and* P_2U_2 *are 5.029 respectively; 5,026; 4,934; 4,047; 5,452; and 4,551. The results of the analysis of the elemental nitrogen content (%) of various fertilizers* P_0U_1, P_0U_2, P_1U_1, P_1U_2, P_2U_1, *and* P_2U_2 *were 0.27; 0.38; 0.39; 0.41; 0.36; and 0.39. The results of the C-organic element analysis (%) were 25.87; 29.12; 35.58; 30.77; and 29.66. The phosphorus content (%) obtained was 0.147; 0.137; 0.138; 0.136; 0.139; and 0.142. Potassium content (%) of 0.32; 0.25; 0.56; 0.78; 1.23; and 1.79. The C / N ratio of each fertilizer variation was sequential, namely 95.81; 76.63; 83.23; 86.78; 85.47; and 76.05. The analysis parameters for C, P, and K show conformity with the National standard provisions.*

Keywords: ***Ananas comosus, Casuarina equisetifolia, macronutrient, leaf litter, organic fertilizer***

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Introduction

Water areas such as seas or rivers are generally planted with large numbers of trees. The goal is that these large trees can provide shade and are not too arid. One example of such a tree is the *Casuarina equisetifolia*. *C. equisetifolia* (Casuarinaceae) popularly known as *Junglisaru* (Hindi) and *Beach She-oak* (English) is a very exotic plant species in India and native to Southeast Asia, Australia, and Polynesia. Large evergreen trees reach 50 m in height and their leaves are easily deciduous, grow ducked, shaped like needles, and grayish-green in color. Sea cypress is found along coastlines, rocky shores, limestone, dry hillsides, and open forests in India, Sri Lanka, and Australia. In India, *C. equisetifolia* is cultivated in coastal areas from Gujarat to Orissa, West Bengal, and Andaman (Kumar, et al., 2014). Likewise, many cypress plants in Indonesia are planted on the beach to prevent beach erosion (Nurkhasanah, 2021).

The leaves of the fallen plant are included as litter. Litter is a term to refer to organic waste in the form of leaves, twigs, flowers, bark, and others that have dried and changed from their original color (Sofa, et al., 2022). In the Banda Aceh area, precisely on the banks along the Pango River, these sea cypress trees grow in a row, thus shading the road from Lambhuk to the Pango area. However, as a result of the leaves of the fir tree that fall easily, then along the edge of the road overgrown with this tree is a little dirty. If this leaf litter is left alone, in rainy weather conditions these leaves will become waste and if submerged in rainwater can cause black puddles causing environmental pollution (Hastuti, et al., 2021; Hau, et al., 2021).

In addition, the presence of fresh fruit and juice traders in every corner of the city of Banda Aceh also has an impact on the increasing amount of organic waste, such as fruit rinds, especially young coconut rinds and pineapples (*Ananas comosus*). The by-product produced from the business of sellers of beverages, fresh fruit, and juice is fruit rind waste. This fruit rind waste, one of which is pineapple rind waste if left will cause an unpleasant smell, and many flies gather around the fruit rind which will cause environmental pollution. According to Zeng, et al., (2015), market waste, which is generally classified as organic, if left unchecked will produce odorous gas emissions during the biodegradation period which will cause air pollution.

Various wastes, especially organic, if not managed properly will cause environmental impacts, such as accumulating volume of waste in the landfill, causing unpleasant odors, damaging the environment, and can be a source of disease. To reduce the negative impact of these wastes, they can be processed into products that are useful and economically valuable (Willar, et al., 2014; Idayati, et al., 2016; Wakano, et al., 2016; Rambitan & Sari, 2013; Shiwakoti et al., 2020).

The results of processing organic waste, especially fruit rinds, contain macro elements nitrogen (N), phosphorus (P), and potassium (K) (Rambitan &; Sari, 2013). Furthermore, Nasution, et al. (2014) stated that fruit rinds contain K elements of 1.137%, and according to Dewati (2008), P elements are contained in fruit rinds of 63 mg / 100 grams. In addition, Nasrun, et al. (2016) reported nitrogen levels obtained in the first gallon using effective bioactivator microorganism 4 (EM-4) of 200 mL, aquades 800 mL, molasses 80 mL, and fermentation times of 7, 14, and 21 days, respectively of 1.26%, 1.82%, and 1.42%. The existence of elements contained in the waste and the results of its processing have the potential to be used as organic fertilizer (Guindo et al., 2023).

In addition, the mixture between these two makes it possible to increase the nutrient content of the resulting organic fertilizer. The process of accelerating decay can also be done by adding bioactivators or certain decomposing bacteria, such as EM-4 (Subandryo, et al., 2012; Sha et al., 2019). This is by the statement of Supadma & Arthagama (2008); Dib et al. (2021), the composting process is based on the decomposition of organic matter by a large number of remodeling microorganisms in a warm, humid, and aerobic environment which will eventually produce humus. Remodeling microorganisms greatly affect the rate of the decomposition process.

This study aims at analyzing macronutrients of organic fertilizer from the mixture of *Casuarina equisetifolia* leaf litter and *Ananas comosus* rind waste with effective microorganism bioactivator.

Research Methods

Tools

The tools used in conducting this research are composting containers, scales, water doses, basins, stirrers, and knives. The tools used in analyzing nutrient content are analytical balances, measuring flasks, dispensers, measuring pipettes, Kjedahl flasks, digester tubes, and blocks, vortex mixers, digestion apparatuses, distillators, Erlenmayer, UV-Vis spectrophotometers, flamephotometers, and AAS.

Materials

Materials for making organic fertilizers, namely *Casuarina equisetifolia* leaf litter, *Ananas comosus* rind waste, EM-4 bioactivator, and water. Materials for measuring pH, namely water and universal litmus paper, as well as pH meters. In analyzing the content of macronutrients, materials that were used are sulfuric acid (H_2SO_4), boric acid (H_3BO_3), *Conway* indicator, selenium (Se), sodium hydroxide (NaOH), ethanol (C_2H_5OH), potassium bichromate ($K_2Cr_2O_7$), glucose ($C_6H_{12}O_6$), nitric acid (HNO_3), perchloric acid ($HClO_4$), potassium permanganate ($KMnO_4$), phosphoric acid (H_3PO_4), hydrochloric acid (HCl), ammonium heptamolybdate ($(NH_4)_6Mo_7O_{24}$), potassium antimonyltrate ($C_8H_{10}K_2O_{15}Sb_2$), and ascorbic acid ($C_6H_8O_6$).

Procedure

Process of Producing Fertilizer

The initial stage is producing fertilizer. *Casuarina equisetifolia* leaf litter and *Ananas comosus* rind waste will be decomposed into fertilizer with the help of an EM-4 bioactivator within a certain time with stages, namely, preparing six composting containers that have been given holes. The materials that have been cut into pieces into a container with the composition as in Table 1.

Table 1. Treatment of Processing Fertilizer

Deuteron	Variation 1	Variation 2	Variation 3
	P_0	P_1	P_2
Us 1	- 3 kg of litter - 3 mL EM-4	- 2 kg of litter - 1 kg pineapple rind - 6 mL EM-4	- 2 kg of litter - 1 kg pineapple rind - 9 mL EM-4
Us 2	- 3 kg of litter - 3 mL EM-4	- 2 kg of litter - 1 kg pineapple rind - 6 mL EM-4	- 2 kg of litter - 1 kg pineapple rind - 9 mL EM-4

During the decay or decomposition process, fertilizer is stirred every morning and evening and the temperature of the fertilizer is measured every day in the morning. Surrounded temperature was also recorded on each day of fertilizer temperature measurement as a comparison. It is noted the time it takes for each variation to produce fertilizer. The resulting fertilizer is dried and put in clear plastic to avoid contamination. Mature fertilizer has physical characteristics including a texture that is like soil, black in color, has a smell like soil, and constant fertilizer temperature. Furthermore, the resulting fertilizer will be further tested related to pH and macronutrient content.

pH testing

Fertilizer samples produced from each treatment were taken as much as 1,000 grams and put in beakers separately. To the beaker, aquades as much as 5 mL are added and stirred for ±30 minutes. Then, the pH of the fertilizer suspension is measured using universal litmus paper.

Analysis of Nitrogen Content

Analysis of nitrogen content in fertilizers is carried out using the Kjedahl method which consists of several processes, namely the process of sample destruction, distillation, and ending with titration. The test sample that has been mashed is carefully weighed as much as 0.2500 grams and inserted into a Kjedahl flask or digestor tube. 0.25 – 0.50 grams of selenium and 3 mL H_2SO_4/p was added and shaked until evenly mixed then let stand for 2 – 3 hours. Destruction to perfection with gradual temperatures ranging from 150° C to a maximum temperature of 350°C and obtained a clear liquid then cooled. After cooling, the solution is diluted with a small number of aquades so that it does not crystallize.

The solution is transferred into a boiling flask of a 250 mL distillate, then add ion-free water to half the volume of the boiling flask. Setup of distillate reservoir in 100 mL Erlenmayer containing 10 mL of 1% boric acid and three drops of *Conway* indicator. The process of distillation was done by adding 20 mL NaOH 40%, distillation is completed when the volume of solution in Erlenmayer reaches 75%. The distillate is titrated with H_2SO_4 0.05 N until the color of the solution changes from green to pink. Then, volume H_2SO_4 was recorded and the stages of work was repeated for the assignment of blanks.

The nitrogen level is calculated using the formula:

Nitrogen content (%) = $(Vc - V_b) \times N \times 14 \times fk$

Note:

V_c : volume H_2SO_4 titration (mL)

V_b : volume H_2SO_4 blank (mL)

N : normality of raw solution H_2SO_4

14 : atomic weight of nitrogen

100 : % conversion; FK: moisture content correction factor

Analysis of Organic Carbon (C-Organic) Elemental Content

Analysis of C-Organic content is carried out in stages: Samples of fertilizer that have been mashed are weighed as much as 0.05 – 0.1000 grams and then put into a 100 mL measuring flask. Add 5 mL of solution $K_2Cr_2O_7$2N and shake. Add 7 mL H_2SO_4, and leave for 30 minutes. Then, it is continued by making standard solution 250 ppm C by pipette 5 mL standard solution 5000 ppm C then put into a measuring flask 100 mL then added 5 mL H_2SO_4, and $K_2Cr_2O_7$2N with the same work as the work above. Then, it is worked on blanks that were used as a standard of 0 ppm. Each solution is diluted to the limit mark of 100 mL and shaken back and forth. The absorption of each solution was measured using a spectrophotometer at a wavelength of 651 nm. A standard solution graph is created to obtain the linear equation and determine the *x* value of the equation as the concentration value.

The C-organic level is calculated using the following formula.

C-org(%) content = ppm curve x mL x fk

Note:

ppm curve: the sample rate from the regression curve relationship between the standard series rate and the reading minus blanks

FK: Water Correction Factor = 100/(100 - % moisture content)

Analysis of Phosphor Elemental Content (P)

The measurement of phosphor element (P) is done by spectrophotometry while potassium element (K) is measured by flame photometry. Analysis of P and K element content is carried out using acarpelous fertilizer that has been mashed, carefully weighed as much as 0.5000 grams, and put into a digestion flask / kjedahl flask. Add 5 mL HNO_3 and 0.5 mL $HClO_4$ and shake. The heat on the digestor starts from a temperature of 100 o C, after the yellow steam runs out the temperature is raised to 200^{o}C. Destruction ends when white steam and liquid in the flask are left at about 0.5 mL. Cool and dilute with H_2O until the volume becomes 50 mL. It is shaked and filtered with W-41 filter paper to obtain a clear extract (extract A). Then 1 mL extract A is added and inserted in a test tube volume of 20 mL. Add 9 mL of ion-free water, and beat with a vortex mixer until homogeneous. The resulting extract is a 10x dilution extract (extract B).

The absorbance K in extract B and standard solution K and recorded the absorbance value. A pipette of 1 mL of B extract and each of the P standard solutions, is then inserted in a 20 mL test tube separately. The 9 mL of phosphate color-giving reagent is added to each sample and standard solution. Then it is beat with a vortex mixer until homogeneous. In addition, it was stayed on for 15 – 25 minutes. The absorbance of each sample and P standard solution was measured at a wavelength of 693 nm and the absorbance value was recorded. A standard curve is created for samples K and P so that a linear equation is obtained. Then the concentration (ppm) is determined.

Result and Discussion

Process of Producing Fertilizer

The litter and pineapple rind waste is cut into smaller pieces. Then these two ingredients are mixed according to the composition in Table 1. During the composting process, what happens is a physical change or form of the raw materials used. These changes are natural characteristics in any process of decomposition or decomposition of organic matter into nutrients again.

The initial form of leaf litter and pineapple rind waste in the early stages is still very visible, the litter is brownish and pineapple rind is greenish-yellow. After a few days, such organic matter begins to decompose and emit a pungent odor. This pungent smell comes from pineapple rind waste that is undergoing decay. After going through the composting process for about ±3 weeks, the litter color begins to turn yellowish and part of the pineapple rind turns white. The pungent smell produced by the decay of pineapple rind has also begun to disappear. In each process that occurs day by day, organic fertilizer is stirred to help speed up the decay process.

The physical form of organic matter changes. The litter and rind of the pineapple begin to crumble and form a loose organic matter that is black in color. Based on the change in form, variations of P_2U_1 and P_2U_2 fertilizers (2 kg of litter + 1 kg of pineapple rind and 9 mL EM-4) change into the soil within 24 days, followed by variations of P_1U_1 and P_1U_2 fertilizers (2 kg of litter + 1 kg of pineapple rind and 6 mL EM-4) take 28 days, and fertilizer variations P_0U_1 and P_0U_2 (3 kg litter + 3 mL EM-4) take 31 days so that their form turns into soil.

The temperature of organic fertilizer is measured every day at 09.00 a.m. This temperature measurement is carried out using an alcohol thermometer. The acquisition of temperature measurement data is converted into a graph that shows the temperature range of compost (y-axis) against the length of time for organic fertilizer to be formed (x-axis).

In the composting process that has been carried out, the increase in temperature in variations P_0U_1 and P_0U_2 is not too drastic. In variations, P_1U_1, P_1U_2, P_2U_1, and P2U_2 fertilizer temperatures reach their highest points respectively, namely at temperatures of 34^{0}C, 34^{0}C, 37^{0}C, and 38^{0}C. This temperature increase can occur due to the decay process of pineapple rind and also differences in the concentration of EM-4.

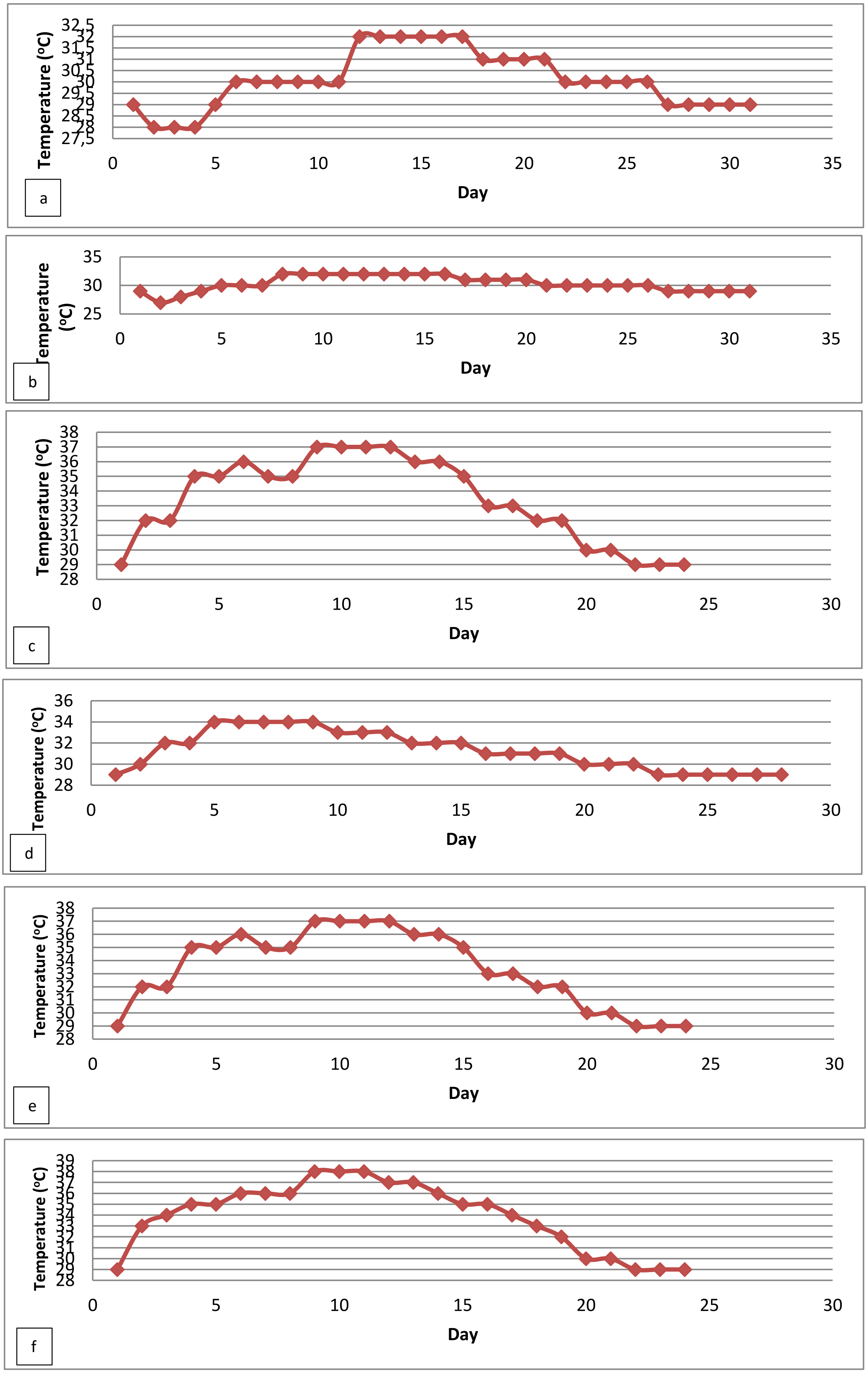
Temperature (ºC)
Day
a
b
c
d
e
f

Figure 1. (a) Fertilizer P_0U_1; (b) Fertilizer P_0U_2; (c) Fertilizer P_1U_1; (d) Fertilizer P_1U_2; (e) Fertilizer P_2U_1; (f) Fertilizer e P_2U_2

Measurement of pH

This measurement of organic fertilizers is carried out using universal litmus and digital pH. The accuracy of pH measurement with litmus is very low because it depends on the viewing subject's sense of sight. Therefore, pH measurement is also carried out using a pH meter. pH measurement is carried out at the Chemistry Unsyiah Laboratory. The pH measurement results obtained are shown in Table 2.

Table 2. pH of Organic Fertilizer

pH Measurement with Universal Litmus						
Variation	**P_0U_1**	**P_0U_2**	**P_1U_1**	**P_1U_2**	**P_2U_1**	**P_2U_2**
pH	6	6	6	6	6	6
pH measurement with digital pH						
Variation	**P_0U_1**	**P_0U_2**	**P_1U_1**	**P_1U_2**	**P_2U_1**	**P_2U_2**
pH	5,029	5,026	4,934	4,047	5,452	4,551

Note:
P_0U_1: fertilizer variation 1 repetition 1
P_1U_2: fertilizer variation 2 repetition 2
P_0U_2: fertilizer variation 1 repetition 2
P_2U_1: fertilizer variation 3 repetition 1
P_1U_1: fertilizer variation 2 repetition 1
P_2U_2: fertilizer variation 3 repetition 2

Based on Table 2, it can be concluded that the organic fertilizer formed is acidic, this can be seen from the pH measurement data obtained located at level 6 of pH 14. Referring to the SNI provisions for organic fertilizers set by BSN, the organic fertilizers formed have not met the standards because SNI sets the pH standard for organic fertilizers normally is 6.5 – 7.5 (normal pH). The increase in soil acidity can be caused by low nitrogen content in the soil.

Analysis of Elemental Nitrogen (N) Content

Analysis of the content of element N was carried out using the Kjedahl method. The Kjedahl method is the simplest in determining the total nitrogen element in a nitrogen-containing compound. The n-total analysis is based on the change of N-organic to N-ammonium. Based on the results of the analysis, the N-total obtained after the calculation process is shown in Table 3.

Table 3. Content of N-total

N-Total	**Sample Variations**					
	P_0U_1	P_0U_2	P_1U_1	P_1U_2	P_2U_1	P_2U_2
	0,27	0,38	0,39	0,41	0,36	0,39

Note:
P_0U_1: fertilizer variation 1 repetition 1
P_1U_2: fertilizer variation 2 repetition 2
P_0U_2: fertilizer variation 1 repetition 2
P_2U_1: fertilizer variation 3 repetition 1
P_1U_1: fertilizer variation 2 repetition 1
P_2U_2: fertilizer variation 3 repetition 2

Based on Table 3, the organic fertilizers with N element content that reaches the standard requirements are P_1U_2 variation fertilizers of 0.41%. The minimum nitrogen content based on SNI provisions is 0.4%. The availability of nitrogen in fertilizer samples is obtained as a result of bacterial activity through the processes of amination, ammonification, and nitrification.

Analysis of Organic Carbon (C-Organic) Elemental Content

The content of organic carbon (C-organic) in the organic matter has an important role in agriculture. According to Amir et al. (2012) C-organic acts as a source of energy and food for soil microbes so that microbial activity can increase for the provision of plant nutrients. Analysis of C-organic content in fertilizers made is carried out by oxidizing carbon with a yellow solution of potassium chromate so that an orange solution is formed. The results of the analysis obtained are presented in Table 4.

Table 4. C-Organic Level

C-Organic Level (%)	**Sample Variations**					
	P_0U_1	P_0U_2	P_1U_1	P_1U_2	P_2U_1	P_2U_2
	25,87	29,12	32,46	35,58	30,77	29,66

Note:
P_0U_1: fertilizer variation 1 repetition 1
P_1U_2: fertilizer variation 2 repetition 2
P_0U_2: fertilizer variation 1 repetition 2
P_2U_1: fertilizer variation 3 repetition 1
P_1U_1: fertilizer variation 2 repetition 1
P_2U_2: fertilizer variation 3 repetition 2

Based on Table 4, the C-Organic content in organic fertilizers that have been made is very high. Especially for P_1U_2 variations, C-organic levels even exceed SNI provisions for organic fertilizers. According to the provisions, the standard range of C-organic levels that must be contained in organic fertilizers is 9.8 – 32%. C-organic content does not affect the quality of plants grown, but plant quality is more dominantly influenced by nutrient intake given at the time of fertilization (Purnomo, et al., 2017).

Analysis of Phosphor Elemental Content (P)

Measurement of phosphor (P) levels in fertilizers are carried out using UV-Vis. Absorbance measurement is assisted with color-generating reagents. The level of phosphor content can be qualitatively seen from the color of the resulting solution. The deeper the color of the solution, the higher the phosphor content in the sample tested.

Phosphors are needed by plants in the process of cell division and tissue development. The content of phosphorus in the leaf is inversely proportional to the age of the foliage, the older the age of the leaf, the less phosphorus content in the foliage (Wardati, et al., 2015). The results of the analysis showed the content of elemental phosphorus (P) shown in Table 5.

Table 5. P-Total Content

P-Total (%)	Sample Variations					
	P_0U_1	P_0U_2	P_1U_1	P_1U_2	P_2U_1	P_2U_2
	0,147	0,137	0,138	0,136	0,139	0,142

Note:
P_0U_1: fertilizer variation 1 repetition 1
P_1U_2: fertilizer variation 2 repetition 2
P_0U_2: fertilizer variation 1 repetition 2
P_2U_1: fertilizer variation 3 repetition 1
P_1U_1: fertilizer variation 2 repetition 1
P_2U_2: fertilizer variation 3 repetition 2

Based on the results above, the content of phosphor elements in fertilizers that have been made in exactly the smallest limit of the standard provisions. According to the SNI provisions of organic fertilizer, the minimum level of phosphorus that is good for fertilizer is 0.10.

Analysis of Potassium (K) Elemental Content

The potassium element in fertilizer results from the decomposition by bacteria of the organic matter used. According to Widarti, et al. (2015), the fresh organic matter used as compost contains potassium in a complex form that cannot be utilized directly by plants. However, the decomposition process by these microorganisms can turn the complex into simpler organics to produce potassium elements. Measurement of potassium (K) levels is carried out by measuring the absorbance of the sample solution and standard with a flame photometer. The results of the analysis of the potassium content in fertilizers are shown in Table 6.

Table 6. Elemental Content of Potassium (K)

Potassium (%)	Sample Variations					
	P_0U_1	P_0U_2	P_1U_1	P_1U_2	P_2U_1	P_2U_2
	0,32	0,25	0,56	0,78	1,23	1,79

Note:
P_0U_1: fertilizer variation 1 repetition 1
P_1U_2: fertilizer variation 2 repetition 2
P_0U_2: fertilizer variation 1 repetition 2
P_2U_1: fertilizer variation 3 repetition 1
P_1U_1: fertilizer variation 2 repetition 1
P_2U_2: fertilizer variation 3 repetition 2

Based on data in Table 6, the potassium content in organic fertilizers meets the minimum value set by SNI, which is 0.20%. The lowest potassium content is found in the P_0U_2 fertilizer variation and the highest potassium content is found in the P_2U_2 variation fertilizer.

Carbon – Nitrogen Ratio (C/N)

The ratio of carbon to nitrogen (C/N) is an indicator of the quality and maturity level of compost. Each organic matter has a different C/N ratio. The higher the C/N ratio of an organic matter, the longer the time needed in the decomposition process. Based on the results of carbon and nitrogen analysis, it can be seen the C/N ratio of each variation shown in Table 7.

Table 7. C/N ratio

Ratio of C/N	Sample Variations					
	P_0U_1	P_0U_2	P_1U_1	P_1U_2	P_2U_1	P_2U_2
	95,81	76,63	83,23	86,78	85,47	76,05

Note:
P_0U_1: fertilizer variation 1 repetition 1
P_1U_2: fertilizer variation 2 repetition 2
P_0U_2: fertilizer variation 1 repetition 2
P_2U_1: fertilizer variation 3 repetition 1
P_1U_1: fertilizer variation 2 repetition 1
P_2U_2: fertilizer variation 3 repetition 2

Based on findings in Table 7, the C/N ratio of organic fertilizers exceeds the threshold set by SNI, which is 10 – 20. This is due to the low nitrogen content and carbon content in fertilizers is high. According to Ismayana et al. (2012), the effective C/N ratio in the decomposition process ranges from 30 – 40. In this range, microbes will get enough carbon intake for energy and N for protein synthesis. If the C/N ratio is too high, the microbe will lack N for protein synthesis so that decomposition runs slowly. Organic matter that has a C/N ratio of 50 – 70, takes a matter of months to decompose. While young leaves that have a C/N ratio of 10 – 20 can decompose in a matter of days.

Conclusion

This study aims at analyzing macronutrients of organic fertilizer from the mixture of *Casuarina* *equisetifolia* leaf litter and *Ananas comosus* rind waste with effective microorganism bioactivator. Based on the research that has been conducted, it can be concluded that the pH test on fertilizer shows the pH of the fertilizer in an acidic state, which is in the pH range of 6, so follow-up is needed to make the pH of the fertilizer within the neutral pH range. The content of macronutrients C, P, and K in organic fertilizers has reached SNI requirements. The nutrient content of nitrogen (N) is still within a low number limit, so it needs to be followed up to increase the N content in fertilizer. The C/N ratio of each fertilizer variation shows too high a yield, so it takes longer in the composting process for good nutrient quality. Therefore, it needs further handling to minimize time so that the composting process becomes faster.

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