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Utilization of PT. Hok Tong liquid waste rubber industry in making of liquid organic fertilizer with addition of eceng gondok and EM4 (Effective Microorganism 4)

Farida Ali¹, Tuti Indah Sari¹, Arina¹ and Siwitri¹

¹Sriwijaya University, South Sumatera, Indonesia

E-mail : faridaali@ft.unsri.ac.id

Abstract. The liquid waste of the rubber industry is currently not fully utilized, whereas the industrial rubber waste is the nutrient needed by plants, especially nitrogen (N), phosphate (P₂O₅), and potassium (K₂O). The presence of macro nutrients contained in the liquid waste of rubber industry is expected to be an alternative material for the manufacture of liquid compost. Water hyacinth is a plant that also contains a good macro nutrients for plants, so it can be used as an additional material to improve the nutrient elements of liquid compost fertilizer. This research aims to know the utilization of industrial rubber waste in the manufacture of liquid compost fertilizer with the addition of water hyacinth and EM4. The method used in making this liquid organic fertilizer was anaerobic fermentation process. The variables studied were addition of water hyacinth and volume of EM4 added. The results of fermentation were analyzed to obtain data of percentage of nitrogen, phosphate, and potassium content. Obtained results of liquid compost fertilizer, with the largest nitrogen content is 1.6% found in EM4 25 mL and water hyacinth 30 gr, the highest percentage of Phosphate 0.160% found in liquid compost fertilizer with addition of water hyacinth as much as 20 gr and EM4 25 mL, highest percentage of Potassium equal to 0.358% is found in water hyacinth as much as 25 gr and EM4 25 mL.

1. Introduction

The progress of the rubber industry in Indonesia is not accompanied by its waste treatment. Waste produced from the rubber industry in the form of solid and liquid waste, where these two wastes must undergo several stages of the process in order to meet the quality standard set before disposal. Rubber liquid waste creates an unpleasant odor with a total ammonia content of 29.83 mg/L. The composition of nitrogen waste contains 56.032 mg / L, carbon 200 mg/L, sulfur 33.0367 mg/L COD 25,000-100,000 mg/L, and BOD 6,900-7,500 mg/L (Budiarto et.al 2014).

Rubber waste treatment in Indonesia still uses anaerob-aerob pool systems that require extensive land and intensive care. This method requires a large operational costs and still cause odor to the surrounding environment. Rubber wastewater that is simply thrown into the environment will cause odor problems, reduce the nutrient content in the soil, and contaminate the water. One effort to overcome this is to utilize the liquid waste of rubber industry into liquid compost fertilizer. Liquid compost fertilizer is a material derived from plants and through engineering processes to improve the physical, chemical, and biological properties of the soil.

Composting is the process of decomposition or destruction of organic matter by various organisms in a particular environment, with the final result of compost and no adverse effects to the soil (Lidar and Kalista, 2016). The composting process can be assisted by biofertilizer as a decomposer to improve the



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quality of compost and accelerate the decomposition process. One of the most common types of decomposer is EM4 (Effective Microorganism 4), because it is easy to find in the market and the price is cheap. The decomposing bacteria present in EM4 are *Rhodospseudomonas* sp., *Sacharomices* sp., *Actinomycetes*, and *aspergillus* sp. where each bacterium has its own role.

Hyacinth is an alternative source of organic material that is widely available in untapped waters and at risk of causing water pollution, given the components of nitrogen, phosphorus and potassium found in water hyacinth, then this plant can be used as compost. Therefore, research needs to be done to find out the amount of EM4 addition and water hyacinth used in making liquid compost from industrial rubber waste so that it can improve the physical, chemical, and biological properties of the soil and meet the Indonesian National Standard.

The purpose of this research is as follows:

1. Knowing the effect of EM4 volume on the quality of liquid organic fertilizer produced.
2. Knowing the influence of water hyacinth variation on the quality of organic fertilizer produced.
3. Knowing the volume of EM4 and the weight of water hyacinth to produce liquid organic fertilizer in accordance with SNI (Indonesian National Standard).

1.1. Rubber Industry Waste

Rubber industry waste when viewed from the view of good production starting from raw materials derived from latex and processed materials of rubber people (bokar), then the waste formed in the rubber industry can be solid waste, liquid waste, and gas waste (Prastiwi: 2010). Liquid waste comes from human sources and natural sources, liquid waste is a combination or mixture of water and pollutants carried by water, both in the dissolved and suspended conditions that are wasted from domestic sources (housing, and trade), industrial sources, and at any moment mixed with groundwater, surface water, or rainwater. (Sihaloho, 2009).

The crumb rubber industry made from raw latex gardens produces liquid waste that comes from the process of coagulation, milling, weakening, and washing. The crumb rubber industry has liquid waste that is white and turbid, containing suspended solids, either dissolved or deposited. The industrial liquid waste of crumb rubber is acidic with pH values ranging from 4.2 to 6.3. This is due to the use of formic acid in the latex coagulation process. Chemical Oxygen Demand (COD) is high on the waste of crumb rubber liquid is an indication that the contained solids are organic compounds.

Wastewater treatment process of rubber industry according to its characteristics is divided into three, namely physics process, chemical process, and biological process. The process of physics is processing waste mechanically with or without the addition of chemicals. These processes include filtering, destruction, water leveling, agglomeration, sedimentation, and flotation. Chemical process is a waste processing using chemicals to reduce the concentration of pollutants in the waste. Activities included in the chemical process, among others, are process with lagons. (Kristanto and Philip, 2002).

Biological waste processing is waste processing by utilizing microorganisms (algae, bacteria, protozoa) to decompose organic compounds in wastewater into simple compounds. The processing of waste through biological means can be done in three ways, namely aerob, anaerob and facultative.

1.2. Liquid Organic Fertilizer

Organic fertilizers are the best and most natural soil enhancers of artificial or synthesis materials. The use of liquid organic fertilizers can improve soil fertility that is damaged by the use of inorganic fertilizers. In general, organic fertilizer contains low nutrient N, P, K, but contains sufficient amount of micro nutrients that are indispensable for plant growth.

Compost or liquid organic fertilizers generally have advantages such as no problem in nutrient leaching, can quickly overcome nutrient deficiency, and can provide nutrients quickly when compared with inorganic liquid fertilizer. In addition, organic liquid fertilizers do not damage the soil and plants although often used, and also has a binder, so that the solution of fertilizer given to the soil surface can be directly used by plants. (Hadisuwito, 2007). Based on Regulation of Minister of Agriculture Number

28/Permentan/ SR.130/5/2009 concerning minimum technical requirement of liquid organic fertilizer can be seen in table 1 below:

Table 1. Concerning Minimum Technical Requirement of Liquid Organic Fertilizer

Condition	Unit	Quality Standards
C-organic	%	≥ 4
C/N ratio	-	-
Ingredients: (plastic.glass, gravel)	%	< 2
Water content	%	-
Heavy Metal :		
- As	ppm	≤ 2.5
- Hg	ppm	≤ 0.25
- Pb	ppm	≤ 12.5
- Cd	ppm	≤ 2.5
pH		4-8
Total Levels		
- N	%	< 2
-P ₂ O ₅	%	< 2
-K ₂ O	%	< 2
Microbial contaminants:		
- <i>E.coli</i> ,	cfu/g	$< 10^2$
- <i>Salmonella sp</i>	cfu/m	$< 10^2$
	L	
Functional microbes:		
-Retarder N	cfu/g	-
-Solvent P	cfu/m	-
	L	
Grain Size	mm	-
Micro Element Content :		
- Fe total	ppm	maks 800
- B	ppm	maks 500
- Mn	ppm	maks 1.000
- Zn	ppm	maks 1.000
- Cu	ppm	maks 1.000
- Mo	ppm	maks 1

1.3. Composting Process

The composting process can be simply divided into two stages, namely the active stage and the maturation stage. Composting is the decomposition of organic materials biologically with the end result of a fairly stable product in the form of complex solids. The perfect composting process will result in unobtrusive products both during storage and application, such as foul smells, pathogenic bacteria. There are three groups that play a role during composting, namely bacteria, actinomycetes, and mold.

One of the function of bacteria is breaks down protein, lipid, and fatty acid compounds in thermophilic conditions and generate heat energy. Actinomycetes and mold function during composting serves to break down complex organic compounds and cellulose from organic matter. Based on the availability of free oxygen, composting process mechanism is divided into two namely, *aerob* and *anaerob*.

At aerobic composting, oxygen is absolutely necessary. In the aerobic system approximately 1/3 of the part reacts with nitrogen in living cells while 2/3 carbon element (C) evaporates into CO₂. During the process of aerobic composting bad smell are not produced. During the composting process,

exothermic reaction occurs, producing heat due to the release of energy. The result of decomposition of aerobic organic material is CO₂, H₂O, humus and energy.

Compared to the aerobic composting process, anaerobic composting is a cold process because temperature fluctuations does not occurs and also oxygen were absence. However, in the anaerobic process it requires additional heat from the outside (30°C). *Anaerobic* composting will produce methane gas (CH₄) and carbon dioxide (CO₂) as well as low molecular weight organic acids such as acetic acid, propionic acid, butyric acid, lactic acid, and succinic acid. Methane gas can be used as an alternative fuel (biogas) and the rest of the mud that contains solids and liquid part will be a product of liquid and solid compost.

1.4. Biofertilizer

Biofertilizer is an organic fertilizer containing non-symbiotic microorganisms capable of fixing Nitrogen, mine P (Phosphorus), or functioning as a decomposer (Deshmukh, 2007). Biofertilizer adds nutrients through the natural process of fixing the nitrogen atmosphere, dissolving phosphorus, and stimulating the growth of plants by triggering the synthesis of certain substances needed, unlike chemical fertilizers generally which instantly increase soil fertility by adding nutrients.

The main components of biofertilizer are microbes that have advantages in accordance with their packaging labels, eg N fixer biofertilizer containing Rhizobia or *Azospirillum* or *Azotobacter*, or a mixture of several microbes at once. The other component is a carrier (carrier) in the form of liquid or solid material and adhesive material. The most widely used carrier types are organic materials derived from agricultural waste such as compost, manure, husk powder, corncob powder, red brick powder or charcoal powder, mixture of peat and compost (Sutariati, 2011).

Several types of biofertilizers commonly found in the market including biofertilizer nitrogen source, through its ability to bind free nitrogen to convert to ammonia which will then be utilized by plants, among others *Azotobacter*, *Azospirillum*, *Herbaspirillum*, *Rhizobium*, *Clostridium*, *Azolla*, and *Cyanobacter*. Biofertilizer sources of phosphates and other minerals (potassium, sulfur), such as *Bacillus*, *Pseudomonas*, and *Mycorrhiza*. This microbial group provides phosphate or other minerals by dissolving phosphate (P) or potassium (K) which does not dissolve into phosphate or dissolved potassium so that it can be absorbed by the plant.

The last type of biofertilizer is the provider of biohormones. Biohormone is a hormone produced by microbes for the growth and development of plants. Microbial providers of biohormones are *Azotobacter*, *Azospirillum*, *Pseudomonas*, and *Bacillus*. In general, biohormones may be auxins, cytokines, and gibberellins. These hormones are needed by plants both for germination, growth of buds and stems, root extension, flowering and fertilization.

1.5. EM4 (Effective Microorganism 4)

EM4 (Effective Microorganism 4) is an ingredient that contains several microorganisms that are very useful in the fermentation process. The microorganisms present in EM4 consist of photosynthetic bacteria (*Rhodospseudomonas* sp.), Lactic acid bacteria, yeast (*Sacharomices* sp.), Actinomycetes, and *aspergillus* sp. EM4 (Effective Microorganism 4) can increase the availability of nutrients that plants need in order to grow, increase the yield of fermentation of organic waste, and can boost the activity of insects, and pests.

In the process of fermentation of organic materials, microorganisms will work well when conditions are appropriate. The fermentation process will take place in semi anaerobic condition, low pH (3-4), salinity and high sugar content, medium water content 30-40%, fermentation microorganism, and temperature around 30-50°C. (Indriani et al., 2002). Microorganisms contained in EM4 give a good influence on the quality of organic fertilizer, while the availability of nutrients in organic fertilizer is strongly influenced by the length of time that bacteria need to degrade the waste. (Yuwono, 2007).

1.6. Water hyacinth

Water hyacinth can be used as organic fertilizer because it contains organic material of 78.47%, organic C 21.23%, total N 0.28%, total P 0.0011%, and K total 0.016%. Hyacinth can absorb heavy metals, sulphide compounds, because of that, sometimes its deliberately planted in water that has been contaminated heavy metals. Other good properties of water hyacinth is, it contains more than 11.5% protein and contain cellulose higher than non cellulose such as lignin, ash, fat, and other substances. (Forth, 2008).

In the fresh state the composition of organic water hyacinth organic material 36.59%, C-Organic 21.23%, N total 0.28%, P total 0.0011%, and K total 0.016% (Kristanto, 2003). According to Rochyati (1998) the chemical composition of fresh water hyacinth stalk is 92.6% water, 0.44% ash, 2.09% crude fiber, 0.17% carbohydrate, 0.35% fat, 0.16% protein, phosphorus 0.52%, potassium 0.42%, 0.26% chloride, 0.22% alkanoid. Here is the percentage of composition of water hyacinth dry hyacinth 64.51%, pentose 15.61%, silica 5.56%, ash 12%, and lignin 7.69%. Hyacinth is difficult to decompose due to the high content of cellulose and lignin.

2. Research Methodology

2.1. Time and place

Implementation of research activities in the form of raw material preparation process, fermentation to compost liquid fertilizer composition analysis which started from November 2017 until February 2018 at Chemical Engineering Instrument Analysis and Instrument Sriwijaya University and Chemistry Laboratory of Soil Biology and Soil Fertilization Department of Soil Science Faculty of Agriculture Sriwijaya University. In this research, the raw material of industrial rubber waste from PT. Hoktong Keramasan, Kertapati, Palembang City and water hyacinth were flown in Inderalaya river, Saka Tiga village, Ogan Ilir district, Inderalaya sub-district, in South Sumatra.

2.2. Tools and material

The tool used in this research is knife, oven, erlenmeyer, cork cover, hot plate, aluminum foil, beaker, measuring cup, separator funnel, stirring rod, blender, filter paper, universal indicator, incubator, analytical balance, thermometer, spectronic 21D, flame photometer, destruction device, distillation apparatus, titration apparatus, and incubator. The material used in this research is the liquid waste of rubber industry PT. Hoktong, water hyacinth, and EM4.

2.3. Research variable

Variable Free

1. EM4 Volume is 5 mL, 10 mL, 15 mL, 20 mL, and 25 mL.
2. Heavy water hyacinth 10 gr, 15 gr, 20 gr, 25 gr, and 30 gr.

Fixed Variables

1. EM4 decomposer type.
2. Rubber industry liquid waste PT. Hoktong 100 mL.
3. Fermentation for 14 days under anaerobic conditions.
4. Temperature 30°C.

2.4. Research procedure

2.4.1. Raw Material Preparation. Raw material preparation procedure;

1. Wash water hyacinth then roughly chopped using a blender for the same size.
2. Prepare water hyacinth that has been weighed as much as 10 gr, 15 gr, 20 gr, 25 gr, and 30 gr with five repetitions.

3. Prepare 100 mL of industrial rubber waste into the erlenmeyer according to the required sample, then add EM4 5 mL, 10 mL, 15 mL, 20 mL, and 25 mL for each sample. Stir until homogeneous.
4. Add the pre-prepared hyacinths to the mixture of industrial rubber waste and EM4.

2.4.2. *Fermentation*. The fermentation process lasts for 14 days under anaerobic conditions, inside the incubator at 30 °C.

2.5. Analytical Procedure

2.5.1. *Nitrogen Content Analysis (N)*. Nitrogen content analysis procedure :

1. Measure 10 mL sample using measuring cup, and transfer it into Kjeldahl flask.
2. Add 1.9 ± 0.1 g Na_2SO_4 , 40 ± 10 mg HgO , and 2.0 ± 0.1 mL H_2SO_4 . Add a few boiling stones, and simmer the pumpkin with samples 1 to 1.5 hours or until the liquid becomes clear.
3. Then cool and add water slowly, then cooled again.
4. Move the contents of the flask into the distillation device. Washing 5 to 6 times with 2 mL of aquadest, and move the washwater into the distillation apparatus.
5. Erlenmeyer 125 mL containing 5 mL of H_2BO_3 solution and 2 to 4 drops of indicator (0.2% methyl red in alcohol) place under the condenser on a distillation device set.
6. Add a solution of $\text{NaOH-Na}_2\text{S}_2\text{O}_3$ of 8 to 10 mL, then distill it until it is accommodated approximately 15 mL of distillate in Erlenmeyer.
7. Rinse the condenser tube with water, and hold the rinse in the same Erlenmeyer.
8. Dilute to about 50 mL then titrated with HCl 0.02 N until the color change becomes gray.
9. Also do a blank assignment. Calculate the nitrogen content with the following formula (1):

$$N = \frac{(\text{Vol.sampleHCl} - \text{Vol.blankHCl}) \times N \text{ HCl} \times 14,007 \times 100}{\text{mg sampel}} \quad (1)$$

2.5.2. *Phosphate Content Analysis (P_2O_5)*. Phosphate content analysis procedure :

1. Preparation of Total P_2O_5 Extract. Measure 10 mL sample using measuring cup, dissolve with 10 mL HClO_4 p.a and 6 mL HNO_3 p.a. Heat the mixture (± 2 hours) until white smoke is exposed for 5 minutes, cool and then transfer quantitatively into a 30 mL flask, implant it with distilled water until the mark is till, shake until homogeneous. Then strain the extract with the Wh. 40 into a dry place.
2. Pipette each 1 mL of extract solution (P_2O_5 Total, water soluble) into 3 different 30 mL gourds.
3. Dilute with 8 mL of distilled water, then add 1 mL of ammonium molybdovanadate reactant, then implant with distilled water until the mark is tera and shake.
4. Dissolve the blank solution work for each of the assignments as zero standard.
5. Let the color develop for 10 minutes, then read the color intensity at wavelength 420 or 440 nm with a spectrophotometer.

Read sample concentrations based on standard curves. Calculate the levels of Phospat (P_2O_5) with the following formula (2) for percentage of P_2O_5 , and formula (3) for percentage total of P_2O_5 :

$$\% \text{P}_2\text{O}_5 = 2.29 \times 2P \quad (2)$$

$$\% \text{P}_{\text{Total}} = \frac{\frac{V \text{ pengenceran } 1}{V_1} \times \frac{V \text{ pengenceran } 2}{V_2} \times F \times A}{10.000} \quad (3)$$

2.5.3. Potassium Content Analysis (K_2O). Potassium content analysis procedure :

1. Preparation of Total K Extract

Measure 10 mL sample using measuring cup, dissolve with 10 mL $HClO_4$ p.a and 6 mL HNO_3 p.a. Heat the mixture (\pm 2 hours) until white smoke is exposed for 5 minutes, cool and then transfer quantitatively into a 30 mL flask, implant it with distilled water until the mark is till, shake until homogeneous. Then strain the extract with the Wh. 40 into a dry place.

2. Pipette each 5 mL of extract solution (K Total, soluble in water) to dilute 25 mL, dilution continue to be done until in accordance with standardization of flame photometer that is 10 ppm.

Calculation by the formula (4) for percentage of K_2O , and formula (5) for percentage total of K_2O :

$$\% K_2O = 1.21 \times 2K \quad (4)$$

$$\% K_{Total} = \frac{V_{pengenceran\ 1}}{V_1} \times \frac{V_{pengenceran\ 2}}{V_2} \times T \quad (5)$$

3. Result and discussion

3.1. Effect of EM4 Voume on Nitrogen (N) In Each Heavy Hyacinth Weight

Changes in nitrogen content in the composting process occurs due to the decomposition of organic materials by microorganisms that produce ammonia and excess nitrogen and then trapped in the compost pile. The compost pile has small pores so that the excess ammonia and nitrogen can not be released into the air (Light and Nugroho, 2004). The change of nitrogen content of liquid organic fertilizer from liquid waste of rubber and water hyacinth in fermentation at each treatment can be seen in Figure 1.

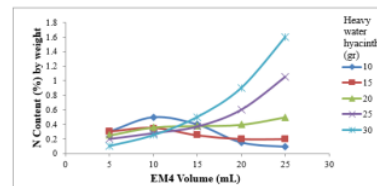


Figure 1. Effect of EM4 volume on Nitrogen (N) content on each water hyacinth weight

From the picture above we can see that the relationship between the volume of EM4 to the percentage of nitrogen content in liquid organic fertilizer at each of the following water hyacinth weight. The greatest nitrogen content is found in 25 mL EM4 volumes and water hyacinth 30 g 1.6%, while the smallest nitrogen content is in EM4 5 mL volume and water hyacinth 30 g with a percentage of about 0.1%. The low nitrogen content of 0.1% can be due to the lifting of nitrogen in the form of nitrogen or ammonia gas, which is formed during the composting and packing process prior to the analysis. The addition of excess nitrogen in the improvement of the quality of liquid organic fertilizer can increase the loss of nitrogen through the process of volatilization in the form of ammonia gas (NH_3) because the denitrification process run faster, resulting in loss of nitrogen in the form of gas N_2 and N_2O (Sutanto, 2006).

The content of nitrogen produced in liquid organic fertilizer always increased in addition of water hyacinth by 20 gr, 25 gr and 30 grams along with the increase of EM4 volume, but on addition of water hyacinth of 10 gr and 15 gr it decreased during the addition of EM4 volume of 15 mL, 20 mL, and 25 mL. Nitrogen is used by microbes as a source of food and nutrients during the composting process. According Purba (2013), nitrifying bacteria convert ammonia into nitrate which causes the element of nitrogen in fermentation to increase. Microbes break down C compounds as energy sources and use N for protein synthesis (Yulianto, 2010). The decrease in nitrogen content is due to the influence of metabolism which results in nitrogen being assimilated and lost through volatilization as ammonia or lost due to the denitrification process.

3.2. Effect of EM4 Volume on Phosphate Content (P_2O_5) on Each Weight of Water Hyacinth

Yulianto (2010) states that phosphate compounds have a role in stimulating early growth in roots, ripening fruit, can accelerate and strengthen the growth of young plants into mature plants, fruit formation and seed production. Phosphate content of liquid organic fertilizer from liquid waste rubber and water hyacinth can be seen in Figure 2.

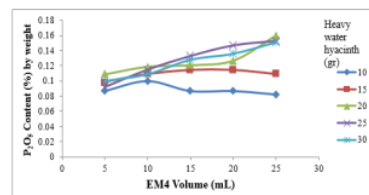


Figure 2. Effect of EM4 volume on Phosphate content (P_2O_5) on each water hyacinth weight

Phosphate content depends on the large presence of nitrogen elements. Wahyono (2003) suggests that in the composting process if nitrogen is available in sufficient quantities then other nutrients are also available in sufficient quantities. In fresh organic materials usually nutrient, phosphate is present in complex organic form that is difficult to be utilized directly by the plant for its growth. Phosphate decomposition by microorganisms can convert the complex nutrient form into PO_4^{2-} which is easily absorbed by plants.

In the figure 2. it can be seen that the highest phosphate (P_2O_5) content of 0.160% is found in liquid organic fertilizer with water hyacinth weight as much as 20 gr and EM4 25 mL, while the lowest is found in liquid organic fertilizer with EM4 25 mL volume and water hyacinth 10 gr ie 0.0824%. Phosphate content (P_2O_5) in the result of liquid organic fertilizer always increases in addition water hyacinth 20 gr, 25 gr and 30 grams along with the increase of EM4 volume. Increased phosphate content is also influenced by high nitrogen content, the higher the nitrogen contained, the multiplication of microorganisms that overhaul phosphate will increase, so that the phosphate content increases (Yuli et al., 2011).

Unlike the case of liquid compost, adding water hyacinth weighing 10 grams and 15 grams for EM4 volume of 15 mL, 20 mL, and 25 mL resulting a decrease of phosphat. This is because the composition of water hyacinth vary so that the composting process runs slowly and the availability of nutrients decreases while the microorganisms increase according to the length of the composting process. In the initial phase, 5 mL EM4 volumes of each heavier microorganisms adapt and perform their metabolism and increase cell size activity. Furthermore, cells use carbon from water hyacinth as a source of energy and multiply.

At the time the volume of 15 mL EM4 microorganisms reach equilibrium ie the number of microorganisms produced equal to the number of dead microbes. At this time microbial activity will decrease. This is due to lack of food or nutrients, in this case carbon-containing substance. According to Graves (Mashita et al, 2008), changes in C and N levels that occur during composting are due to the use of carbon as an energy source and lost in CO_2 form. This is an indication of the decrease in phosphate content because the reduction of carbon content causes microorganisms to eat phosphate elements found in liquid organic fertilizer.

3.3. Effect of EM4 Volume on Potassium Content (K_2O) on Each Weight of Water Hyacinth

Potassium is the second most common element after nitrogen in plants and is needed by plants to strengthen the plants by forming carbohydrates, hardening of the stems, improving the quality of seeds and leaves. Element K is absorbed in K^+ form, especially in young plants. Pamata (2004) states that potassium deficiency can inhibit the growth of the plant, the leaves appear curly and shiny and can cause the petiole is weak so easily drooping and wrinkled seed skin. The potassium content of liquid organic fertilizer from the liquid waste of rubber and water hyacinth fermented with EM4 in each treatment can be seen in Figure 3.

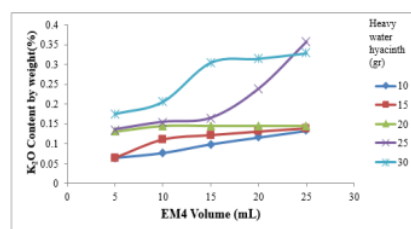


Figure 3. Effect of EM4 volume on potassium content (K_2O) on each water hyacinth weight

From Figure 3 it can be seen that the highest potassium (K_2O) content of 0.358% is found in liquid organic fertilizer with water hyacinth weight 25 gr and EM4 25 mL and the lowest one with the same value is present at 5 mL EM4 volume in each water hyacinth at 10 gr and 15 gr ie 0,065%. The content of K_2O after fermentation is increased because weathering results release K^+ ions from cation exchange sites and decomposition of dissolved organic matter in liquid fertilizer (Foth, 1994) in (Indriani et al, 2013). Potassium is used by microorganisms in the substrate material as a catalyst, in the presence of bacteria and its activity greatly affect the increase of potassium. Potassium is bound and stored in cells by bacteria and fungi (Purba, 2013).

The binder of the element of potassium is derived from the decomposition of organic matter by microorganisms in the compost pile. The compost material which is a fresh organic material containing potassium in a complex organic form can not be utilized directly by the plant for its growth. However, with the activity of decomposition by microorganisms then the organic complex can be converted into a simple organic that eventually produces potassium elements that can be absorbed by plants.

4. Conclusion

1. Increasing the volume of EM4 will increase the percentage of N, P, and K content in the resulting liquid organic fertilizer.
2. Increasing the weight of water hyacinth will increase the percentage of N, P, and K content in the resulting liquid organic fertilizer.
3. Highest nitrogen content of 1.6% at 25 mL EM4 volume and 30 g of water hyacinth, the highest phosphate content of 0.160% at 25 mL EM4 volume and 20 g of water hyacinth, and the highest potassium content in 25 mL EM4 and 25 gr of water hyacinth 0.358%.

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