The Effectiveness of Bio-decomposer EM-4 on Macro Nutrients in Water Hyacinth Compost (Euchornia Crassipes)

Hikma Yani[1] and Nisrina[2]
[1]*Prodi Agroteknologi, Fakultas Pertanian Gajah Putih, Takengon, Indonesia*
[2]*Prodi Peternakan, Fakultas Pertanian Gajah Putih, Takengon, Indonesia*

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Abstract: This study is to determine the effect of EM-4 on the result of the characteristics of nutrient macro compost of water hyacinth and to know the quality of compost that is produced based on *Standar Nasional Indonesia (SNI)*, National Indonesian Standard. The process of composting applies one replicate with three treatments (K0, K1 and K2). The method used in this study is experiment research with three treatments that is without EM-4, EM-4 20% and 10%. Grade of nutrients analyzed are C, N, P, K and the method used is thermograph, Kjehdal, Walkey and Black, Bray I, and Morgan-Wolf. Kjehdahl method is used to determine the amount of N. Walkley and Black is used to determine C-organic. Bray I method is used to detect the amount of P and Morgan-Wolf method is used to determine K metal. The result of the study shows that each compost K2, K1 and K0 has grade N: 1,72; 1,58; 1,75, the grade of C-organic: 25,78; 25,23; 28,75, the grade of P: 0,47; 0,54; 0,54 and the grade of K: 2,42;2,53;2,58. The grade of nutrient obtained is suitable with *SNI (standar nasional Indonesia),* National Indonesian Standard.

1 INTRODUCTION

Lut Tawar Lake is a water resort located in Aceh Tengah. Water plants, hyacinth, are found on this lake. Water hyacinth has rapid growth therefore it is assumed that the weeds or parasites destroy the waters. Water hyacinth in small amount can give good effect on waters as they can absorb the chemical waste; therefore, they can reduce water pollution. Hartanti, (2014) says that water hyacinth has fitoremediasi ability that can reduce chromium metal on liquid waste industry. On the other hand (Renilaili, 2015) says that water hyacinth can absorb cadmium metal, mercury, nickel, and pesticide.

A big amount of water hyacinth can cause negative effect that that it can distract the optimal utilization of water by accelerating the shallowness of the irrigation, enlarging the vapor-transpiration process, making complicated water transportation and decreasing fishery production. To decrease those problems, effort is to be made to process water hyacinth becoming more beneficial product. One of them is through composting.

The process of making compost can be accelerated by using bio-decomposer, EM-4, that can obtain good quality of compost. The process of making compost is by disentangling the organic material biologically with the result that is good to be applied for the ground. The process of making compost is aimed to decrease the carbon level towards nitrogen or called ratio C/N (Nuraini, 2009).

The fresh water hyacinth contains important compounds for both for land and the plants, consisting water 95,5%; organic material 3,5%; nitrogen 0,04%; phosphor (P_2O_5) 0,06%; and calcium (K_2O) 0,20%. On the other hand, organic material in dry situation in water hyacinth consists of cellulose 64,51%, pentose 15,61%, silica 5,56%, dust 12%, and lignin 7,69% (Forth, 2008). The height of cellulose and in water hyacinth causes these materials difficult to be decomposer naturally. Therefore, activators are used to accelerate the process of making compost; one of them is by bio-decomposer EM-4.

EM-4 consists of microorganism that can increase soil microbe, fix prosperous and quality land and accelerate the process of making compost. EM-4 consists of fermentation of microorganism and synthetic that is bacteria lactate acid (*lactobacillus*), bacteria photosynthetic (*rhodopseudomonas)*, *actinomycetes*, *streptomycetes,* and *yeast* (Siburian, 2007).

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Based on that theory, the writer is interested to conduct research on "the effectiveness of Bio-decomposer EM-4 on the macro nutrient of water hyacinth compost (*Euchornia crassipes*).

2 METHODOLOGY

2.1 Research Design

The method used in this study is experiment. In this study three treatments are applied, each of which is replicated (3x1). Treatments utilized are as follows

Treatment 1	:	water hyacinth compost without EM-4 (K0)
Treatment 2	:	water hyacinth compost with 10% concentrates EM-4 (K1)
Treatment 3	:	water hyacinth compost with 20% concentrates EM-4 (K2)

2.2 Data Collection

The method to collect the data is through observation, direct experiment and taking note systematically from the amount of macro nutrients.

2.3 Parameter of the Study

Parameter observed during the study is the grade of macro nutrients from compost containing elements of: C, N, P, and K.

2.4 Experiment Procedure

2.4.1 Preparation Phase

Water hyacinth has been dried for one day to decrease level of water. Next, it is chopped to make the size small. Water hyacinth is taken into account as many as 15 kg for each container of K2, K1 and K0; then, put into three containers having holes; each of them consists of 15 kg, Therefore, the steps are follows:

1. K2 compost.
   Container 1, using bio-decomposer 500 mL EM-4 (K2) for 2,5 L solution. For K2 with 500 mL EM-4 added with 2 L of water. Some of water hyacinth is put into container, then K2 solution is poured slightly and for the next step it is stern. Next the water hyacinth is poured into container and mixed with K2 solution slightly, and the step is repeated until the container is full.
2. K1 compost.
   Container 2, using 250 mL EM-4 (K1) for 2,5 L solution. For K1 solution added with 250 mL EM-4 and added with 2,25 L of water. Some of water hyacinth is put into container, then, K2 solution is poured slightly. The next step is stiring. Then the water hyacinth is put into container and goes hand in hand with K2 solution slightly and the step is repeated until the container full.
3. K0 compost.
   Container 3 as the control is without using bio-decomposer (K0) only using 2,5 L of water. Then, the step is like K2 for K0 compost.

The next step, is that each material is tightly closed and to let the process of making compost run for 60 days. During the process of making compost, then the condition of compost is checked in 5 day interval and the materials are turned upside down. By this the process of characterization of making compost is done.

2.4.2 Characterization

Characterization is done to know the grade of nutrients of compost of C, N, P, and K.

1) Determining the grade of N by applying Kjehdahl Method.
   The compost that has been grinded is measured to 0,25 gram and put it into storage digester of Kjehdahl and added with 0,25-0,50 gram selenium *mixture* and 3 mL concentrated H_2SO_4, mixed in the interval range of temperature of 150^oC up to maximum temperature 350^oC to obtain transparent liquid (3,0-3,5 jam). After getting cool, it is diluted with some aquades. Then, the solution is moved quantitavely into storage digester with the volume of 250 mL, then, added with non-ion water until half of volume of storage digester, and some of boiled stone to muffle the buble of water. After this is the preparing of repare storage for distillate that is 10 mL H_3BO_4 1% in Erlenmeyer volume, 100 mL by adding 3 drops Conway indicator. It is distillated by adding 20 mL NaOH 40%, the distillation is finished if the volume of liquid in Erlenmeyer is up to approximately 75 mL. Distillation titrated with H_2SO_4 0,05 N is done, until the last dot (the color of solution changes from green to soft pink)
2) Determining C-Organic by using Walkley and Black Method.
   Having been grinded, the compost is measured for 0,50-0,10 gram and put into storage with the volume of 100 mL. The next step is, in row, that is by adding 5 mL solution $K_2Cr_2O_7$ 2 N and 7 mL H_2SO_4 98% then it is mixed and kept until 30 minutes goes by and once in a while it is mixed if necessary. For standard contain of 250 ppm C, it

is taken 5 mL H_2SO_4 and 7 mL solution of $K_2Cr_2O_7$ 2 N with activity like in the above steps. It is also done for blank that is used as standard 0 ppm C; it is diluted with non-ion water until it is homogeny and kept for all night long. The next day it is measured by spectrophotometer visible with the wave of 651 nm in length.

3) Determining the grade of P by using Bray I Method.
   The compost is measured as much as 0,25 gram and put it in Erlenmeyer 100 mL. The next step is adding 25 mL solution of Bray and Kurt I (NH_4F added with HCl); they are mixed for 5 minutes and filtered. 2 mL filtrate transparent is taken into tube reaction. Compost and standard series are added with dye reagent phosphate as much as 10 mL, to be mixed and kept for 30 minutes. The next step is measuring with spectrophotometer visible that has wave of 693 nm in length. The result of measurement is compared with standard curve.
4) Determining the grade of Metal K by using Morgan-Wolf Method.
   The grade of metal K is determined by flame photometer /spectrophotometer atom absorption atom (AAS). Grinded compost is measured for 0,50 gram and put into digestion of Kjehdahl. Then it is added with 5 mL HNO_3 and 0,50 mL $HClO_4$, then mixed and kept for a night long. Then, it is burned in block digester of 100ºC, after yellow steam runs out of the temperature raises up to 200ºC. Destruction is finished if the white steam already comes out and the liquid in the digester remains about 50 mL, and then to be mixed until homogeny and kept a night or filtered with W-41 paper filter, therefore it gets transparent extract (extract A). The next step of extract A is by taking 1 mL into a chemical glass volume 20 mL, then being added with 9 mL of non-ion water (dilutor can be used), mixed in vortex mixer until homogeny. This extract is the result of 10x dilution (extract B). It is measured by the grade of metal K in extract B by using flame photometer /AAS.

3 RESULT AND DISCUSSION

The observation on water hyacinth compost that has been produced for 60 days by the process of making compost includes the nutrients of: C, N, P, K. as Vargas et al (2005) states that the important parameter of physics and chemical measures are pH, C, N, grade of water, and organic material. Determination of the grade of nutrient is done by doing characterization on various experimented compost. Through characterizing, the quality of water hyacinth compost can be determined based on compost of *SNI (*Indonesian National Standard*)* national Indonesian Standard. The grade of nutrients of compost obtained can be seen in the following tables:

Table 1: Grade of nutrient and pH of water hyacinth compost.

Parameter (%)	Treatment		
	K2	K1	K0
N	1,72	1,58	1,75
C-Organic	25,78	25,23	28,75
P	0,47	0,54	0,54
K	2,42	2,53	2,58

3.1 Grade of Carbon (C)

Carbon is the principle element in organic material. Grade of C in the organic material will decrease after processing the compost. The changes of C-organic are caused by activity of microorganism in compost. This microorganism will consume organic material in the compost as the source of energy for composing the cell by releasing CO_2 and H_2O (Baroroh et al, 2015). The more water is produced, the less grade of carbon is got, (Lu et al, 2009). The organic compound decreases, on the other hand inorganic compound raises in amount. Moreover, extrication of carbon monoxide happens in the process of making compost as the result of activity of microorganism, and it can be the grade of C-organic. The longer time taken in process of making compost, the less of grade C-organic is received because it has been torn down to be simple compound by microorganism (Harizena, 2012)

From the table above, we know that C-organic received for each K2, K1 and K0 is 25,78; 25,23; and 28,75. The lowest grade of C-organic obtained is compost K1. This fact goes hand in hand with the result of the study conducted by Norman et al (2014), on the study of the process of making compost of peel of jackfruit. After 7 days, being, added EM-4 50%, we can receive lower grade of C-organic compared with other concentration (40% and 30%). The result of study conducted by Ameen et al (2016) shows that the grade of C-organic from the product of making compost process on organic material using inoculums is less compared with that without using inoculums. This is caused by giving EM-4 additional amount of microorganism, thus, the microorganism is more involved in decomposition of water hyacinth.

Nevertheless, the treatment on compost without EM-4 does not exist in the growth of active agent to accelerate the process of making compost, therefore, it causes the process of making compost to run naturally and the microorganism involved is less compared with the compost receiving the treatment with EM-4. At least, microorganism involved causes the energy to be less as well, thus the grade C-organic is getting higher (Gusti et al, 2013).

The result of the study shows that the grade of C-organic in water hyacinth compost is based on *SNI* (Indonesian National Standard) (9,8-32%), nevertheless the mean is high. This result goes hand in hand with study conducted by Nagerabi (2011) on the chemical quality, physic, and microbe in compost heap that with grade of C-organic received of 22-25%. The grade C-organic at the end of process of making compost remains high; it is caused by the condition of the death phase of microorganism so, it cannot tear down the organic compound (Chaerul, 2009).

3.2 Grade of Nitrogen (N)

The element of total N in compost is received from the result of degradation of organic material (water hyacinth) by microorganism. The quantity of microorganism depends on the condition of environment such as the level of water, substrate, aerobic or anaerobic, mesophilik or thermophilik. During the process of making compost, the element N is used as the maintenance and arranging cell of microorganism. The more nitrogen is got, the faster the organic material is straggled. The grade of N will keep increasing until the end of process of making compost because the process of changing mineral N-organic becomes N-mineral by microorganism (Outerbridge, 1991).

The grade of total N is used as indicator to know the expediency of compost. The grade of total N based on table 1 above for each K2, K1 and K0 is 1,72; 1,58 and 1,75. The highest grade of N is compost K0 (without adding EM-4). This matter is suitable with the result study done by Ratna (2013) on the process of making compost for the waste of hospital. It is shown that the compost without being added EM-4 has higher grade of N-total (1,3%) compared with compost by adding EM-4 (0,9%). Then , the result of the study conducted by Astuti et al (2008) on the process of making compost for sheep's fesses, shows that the mean of N-total is higher if the compost is without EM-4 compared with by adding EM-4. From the table 4.1 above, it is known that the grade of N-total in K2, K1 and K0 is based on *SNI* (Indonesian National Standard) (N-total $\geq$ 0,1%)

3.3 Grade of Fospor (P)

The element total of P is the element that is hard to be diluted but it is needed by microorganism for synthetic nucleate acid. The availability of P-organic for plants depends on the activity of microbe to change it into mineral. Therefore, the existence is important for surviving of the microorganism (Havlin et al., 1999). The process of changing element mineral P is helped by enzyme fosfatase causing the microbe in compost to grow and blossom well. The level of phosphor in compost depends on the amount of phosphor contained from the basic material and the quantity of microbe involved in the process of making compost. The grade of element P is getting higher because of corrosion of organic material. In the maturity phase, microbe will die and P in the microorganism will blend in the compost material that will directly increase the phosphor in the compost (Kurnia et al, 2017). Stofela and Khan (2001) states that the content of P depends on the content of N with more multiplicity of microorganism tearing down P, thus the content of P will increase in consequences.

From table 1 above, it is known that the grade of P for each K2, K1, K0 is 0,47; 0,54; and 0,54. The highest grade of P is obtained by compost K0 and K1 that shares the same score. Based on the result of study conducted by Karyono et al (2017) on the process of making compost of organic waste, it is obtained that the highest grade of P is in compost with concentration EM-4 30% in it, followed by the compost with other concentration (40%, 50% and 60%). Then , the result of study conducted by Manuputty et al (2012) on the process of making compost from the waste of city, shows that compost without EM-4 in it has the highest grade of P compared with other treatment (adding EM-4 150 mL and 300 mL).

From the table 1 above, it is known that the grade of P in K2, K1 and K0 have little difference. The result of the study conducted by Fan (2016) shows that there is no apparent difference among compost added by activator or not. Nevertheless, the water hyacinth compost (K2, K1 and K0) is suitable with the *SNI* (Indonesian National Standard) that the minimum grade of phosphor is 0,10%.

3.4 Grade of Potassium (K)

The compost material consists of potassium in the form of complex organic that cannot be used directly

by plants for its growth. Because of being decomposed by microorganism, K element in form of organic complex can be changed into simple K organic in the form of K^+ that can be absorbed by the plants. The bacteria solvent of phosphate generally can dilute the element potassium in the organic material. The element potassium in the basic material of compost is used for metabolism of microbe and for catalisator (Iliyin et al, 2012). This causes the increasing grade of K at the end of the process of making compost at the beginning of the process.

From the table 1 above, it is known that the grade of K obtained for each K2, K1and K0 is 2,42; 2,53; and 2,58. The highest grade of K is accepted in compost K0. The condition may be because the basic material has the chemical element in it that is water hyacinth containing the nutrient K, thus it can influence the activity of bacteria during the process of making compost. This goes in line with the study conducted by Yenie and Andesgur (2016) that the highest grade of K-total is in the compost without adding EM-4, then the grade of k decrease in treatment EM-4 0,9%, 0,7% and 0,5%. Then, the result of the study conducted by Pangestuti (2008) shows that the grade of K after 40 days of the process of making compost heap without adding bio-decomposer is higher than that in compost by adding the bio-decomposer in it. From table 1 above, it is apparently seen that the grade of K in compost K2, K1 and K0 is based on *SNI* (Indonesian National Standard) (the grade K ≥ 0,2%). The grade of nutrient in compost that is based on the *SNI* Indonesian National Standard will influence positively if it is applied for land and plants.

4 CONCLUSIONS

Bio-decomposer EM-4 is effective on the grade of carbon (C) and phosphor (P) in the water hyacinth composting. The grade of nutrient that consists of: C, N, P, K in the water hyacinth compost has been appropriate with *SNI (*Indonesian National Standard*)* National Indonesia Standard.

5 RECOMMENDATION

For the highwater level of water hyacinth at the beginning of process of making compost, sunbathing is needed in longer time (more than two days if the day is blazing). Through this way the process of making compost is done faster and can decrease the high level of humidity for the product of compost. Moreover, because of the limitation of means, for the next time, pH and temperature for certain interval is needed to be measured.

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