Mineral Content Seaweed Gracilaria Verrucosa Fertilized using Vermicompost

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Abstract

Seaweed as chlorophyll plants requires nutrients to support growth. Vermicompost is 100% organic fertilizer quality and environmentally friendly, contains of various nutrients needed for seaweed to grow and produce optimal levels of agar and play an important role in stimulating the vegetative growth of seaweed. The purpose of this study is to determine the optimal dose of vermicompost fertilizer to produce the content of mineral elements such as NO_3, NH_4, PO_4, SO_4 and Mg seaweed. From the results of the Kolmogorov Smirnov (KS) and Shapiro-Wilk (SW) norms, the mineral content of seaweed in the form of nitrate (NO_3), ammonium (NH_4), phosphate (PO_4) and sulfate (SO_4) spread following normal distribution ($p > 0.05$). Levene homogenity test of mineral content of NO_3, NH_4, PO_4 and SO_4 have the same homogenity has been fulfilled ($p > 0.05$). The mineral content of nitrate (NO_3), phosphate (PO_4), magnesium (Mg) and sulfate (SO_4) seaweed Gracilaria verrucosa the highest obtained in treatment A and the lowest in treatment F while the highest mineral content of ammonium (NH_4) seaweed at treatment C and the lowest on the treatment F (without fertilizer).

Keywords- Gracilaria Verrucosa, Vermicompost Fertilizer, Nitrate, Ammonium, Phosphate, Magnesium, Sulfate

I. INTRODUCTION

The entry of materials or nutrients into the body tissue of seaweed is called diffusion process that occurs on the entire surface of the body of seaweed. The more diffused the body tissue is, the faster the metabolism process that will increase the rate of growth [1]. Vermicompost contains various nutrients needed for seaweed to grow and produce optimal levels of agar. Vermicompost plays a role in preparing plasma cells and the formation of carbohydrates and proteins. Such as Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), Magnesium (Mg), Sulfur or Sulfur (S), Chlorine (Cl), Ferum or Iron (Fe), Manganese (Mn) Cuprum or Copper (Cu), Zinc or Zinc (Zn), Boron (B), and Molybdenum (Mo) [2].

During the vermicompost process, essential plant nutrients such as nitrogen and phosphorus are required by the plants. Those nutrients in the diet are converted through the activity of microorganisms into a form that is more easily absorbed by plants. Based on the description above, it is required a study to determine optimal doses of vermicompost fertilizer to produce mineral element content of NO_3, NH_4, PO_4, SO_4 and Mg.

II. MATERIAL AND METHODS

A. Research Sites

This research was conducted in an open space in the pond area of Maliwowo Village, Angkona District, East Luwu Regency, South Sulawesi Province, and March to April 2016 for 42 days.

B. Research Design and Variable

The experimental design used in this study was completely randomized design (CRD) with 6 treatments and repeated 3 times. The treatment performed was a different dose of vermicompost fertilizer; treatment A with the dose of vermicompost fertilizer 300 g/m^3, treatment B with the dose of vermicompost fertilizer 250 g/m^3, treatment C with the dose of vermicompost fertilizer 200 g/m^3, treatment D with the dose of vermicompost fertilizer 150 g/m^3, treatment E with the dose of vermicompost fertilizer 100 g/m^3 and treatment F as control treatment (without fertilizer application).

C. Method of Collecting Data

Measurements of mineral content of nitrate, ammonium and seaweed phosphate were analyzed using H_2SO_4, while sulfate mineral and magnesium seaweed contents were analyzed using HCl [3]. Measurement of mineral content of Gracilaria verrucosa seaweed was done at the end of the study.

D. Data Analysis

Each parameter of nitrate (NO_3), ammonium (NH_4), phosphate (PO_4), sulfate (SO_4) and magnesium (Mg) was evaluated using two statistical analyzes. First, testing the normality of Kolomogorov-Smirnov (K-S) and Shapiro-Wilk (S-W), then testing the homogenity using Levene test. Second, an Analysis of Variance (ANOVA) testing if the data was normally distributed and homogenous, and then real effect wa further tested by using the Tukey test. Data that was not normally distributed and homogenous was transformed (x = log 10 (y)).

III. RESULTS AND DISCUSSION

A. Mineral Elements of PO_4 Seaweed (Gracilaria Verrucosa)

Table 1: Average of Mineral Elements PO_4 Seaweed (Gracilaria Verrucosa) was Fertilized with Different Doses of Vermicompost Fertilizer

Dose of Vermicompost Fertilizer (g/m^3)	*Seaweed Mineral Element PO_4 (%)*
(A) 300	*$2,44 \pm 0,40^a$*
(B) 250	*$2,35 \pm 0,88^a$*
(C) 200	*$2,27 \pm 1,30^a$*
(D) 150	*$2,23 \pm 0,01^a$*
(E) 100	*$1,52 \pm 0,31^{ab}$*
(F) Control	*$0,70 \pm 0,58^b$*

Description: Different letters in the same column show significant differences between treatments at 5% level ($p < 0,05$). ± (distance of minimum and maximum value).

Variance analysis showed that vermicompost fertilizer gave significant effect ($p < 0,05$) to increase phosphate content (PO_4) in seaweed. From Tukey's further test it was found that PO4 seaweed content was significantly different ($p < 0,05$) to F (control) and D treatment (dose 150 g/m^2), C (dose 200 g / m^2), B (dose 250 g/m^2), A (dose of 300 g/m^2). From the result of research the range of mineral phosphate element (PO_4) of seaweed is 0,70-2,44%.

The statistical analysis showed that there was influence of fertilizer application with increasing PO_4 seaweed mineral contents. This concurred with [4] states that Gracilaria verrucosa requires nutrients to grow, the main elements needed by seaweed to produce maximum growth are nitrate and phosphate. Phosphorus presents in the form of phitin, nuclein and phosphatide, part of the protoplasm and nucleus of the cell. As part of the cell nucleus is very important in cell division, as well as for growth development, assist in the process of photosynthesis, protein and fat composers. So if the lack of this element will greatly affect the growth and quality of seaweed.

B. Mineral Elements of NH_4 Seaweed (Gracilaria Verrucosa)

Table 2: Average Element of NH4 Seaweed Mineral (Gracilaria Verrucosa) Fertilized With Different Doses of Vermicompost Fertilizer

Dose of Vermicompost Fertilizer (g/m^3)	*Seaweed Mineral Element NH_4 (%)*
(A) 300	*$1,63 \pm 0,54^a$*
(B) 250	*$1,47 \pm 0,24^a$*
(C) 200	*$1,64 \pm 0,65^a$*
(D) 150	*$1,43 \pm 0,26^a$*
(E) 100	*$1,48 \pm 0,40^a$*
(F) Control	*$1,40 \pm 0,51^a$*

Description: The same letter in the same column shows no significant difference between treatments at 5% level ($p > 0.05$), ± (distance of minimum and maximum value).

The results of variance analysis showed that the application of vermicompost fertilizer did not give significant effect ($p > 0,05$) to ammonium nutrient content (NH_4) in seaweed. The content of NH_4 mineral elements in seaweed obtained not much different between treatments that ranged from 1.40 to 1.64%. With the highest content obtained in treatment C (dose 200 g/m^2) and the lowest content was found in the treatment F (control). The NH_4 mineral element is only needed with sufficient quantities by the seaweed to grow, the excess of this mineral element in the waters will result in eutrophication or the presence of excessive nutrients in the waters. As [5] notes that ammonium is a nutrient element in the form of ions from ammonia (NH_3) which in the water is a major contaminant of industrial waste, agricultural waste. This ammonium contributes to accelerate eutrophication in the water, reduction of oxygen consumption and poisoning fish in the water. This can be overcome by using seaweed which is an autotroph component that requires nitrogen to photosynthesise.

C. Mineral Elements of NO_3 Seaweed (Gracilaria Verrucosa)

Table 3: Average Element of NO_3 Seaweed Mineral (Gracilaria Verrucosa) Fertilized with Different Dosage of Vermicompost Fertilizer

Dose of Vermicompost Fertilizer (g/m^3)	*Seaweed Mineral Element NO_3 (%)*
(A) 300	*$3,27\pm0,24^a$*
(B) 250	*$3,09\pm0,56^a$*
(C) 200	*$2,84\pm0,54^{ab}$*
(D) 150	*$2,79\pm0,36^{ab}$*
(E) 100	*$2,68\pm1,04^{ab}$*
(F) Control	*$1,34\pm0,36^b$*

Description: Different letters in the same column show significant differences between treatments at 5% level ($p < 0,05$). ± (distance of minimum and maximum value).

The result of variance analysis showed that the treatment of vermicompost fertilizer gave significant effect ($p <0,05$) to the increase of mineral content of nitrate (NO_3) in seaweed. From Tukey's test, it was found that treatment A (dose 300 g / m^3) was 3.27% and treatment B (dose 250 g / m^2) 3.09% gave significant difference ($p <0,05$) to F treatment (control) . The range of mineral content of NO_3 obtained was 1.34-3.27%.

The research results revealed that nitrate mineral content (NO_3) was more absorbed by seaweed than ammonium mineral content (NH_4). This is due to the nitrification process in the water conducted by nitrifying bacteria that overhaul the ammonia or ammonium (NH_4) ions accumulates to nitrate (NO_3). This is in accordance with the statement [4] states that the most important elements to produce maximum growth are nitrate and phosphate. Then there is an active role of worm in vermicompost fertilizer and nitrification bacteria that make organic material reshuffle, so that seaweed on the treatment of vermicompost fertilizer absorbs more nitrogen in the form of nitrate (NO_3) than ammonium (NH_4). [6] vermicompost is a process of decomposition of organic matter involving cooperation between earthworms and microorganisms (bacterial decomposers).

D. Mineral Elements of SO_4 Seaweed (Gracilaria Verrucosa)

Table 4: Average Mineral Elements SO_4 Seaweed (Gracilaria Verrucosa) Fertilized with Different Doses of Vermicompost Fertilizer

Dose of Vermicompost Fertilizer (g/m^3)	*Seaweed Mineral Element SO_4 (%)*
(A) 300	*$2,17\pm0,42^a$*
(B) 250	*$2,16\pm0,56^a$*
(C) 200	*$1,85\pm0,40^a$*
(D) 150	*$1,76\pm0,20^a$*
(E) 100	*$1,77\pm0,84^a$*
(F) Control	*$0,91\pm0,5^a$*

Description: The same letter in the same column shows no significant difference between treatments at 5% level ($p> 0.05$), ± (distance of minimum and maximum value).

The analysis of variance indicated that the treatment of vermicompost fertilizer did not give significant effect ($p> 0,05$) to the increase of mineral sulphate element (SO_4) in seaweed. The range of mineral sulphate element (SO_4) obtained during the study was 0.91-2.17%, with the highest content obtained in treatment A (dose 300 g/m^2) and the lowest on F (control) treatment. Sulfur is absorbed by plants in the form of SO_4, this substance is a part of the protein contained in the form of cysteine, methionin and thiamine. Water-soluble sulfur is soon absorbed by plants, as it is indispensable for plants (especially young plants) for beginner growth and development and contributes to the formation of chlorophyll [7].

E. Mineral Elements of Mg Seaweed (Gracilaria Verrucosa)

Table 5: Average Mineral Elements Mg Seaweed (Gracilaria Verrucosa) Fertilized with Different Doses of Vermicompost Fertilizer

Dose of Vermicompost Fertilizer (g/m^3)	*Seaweed Mineral Element Mg (%)*
(A) 300	*$0,189\pm0,07^a$*
(B) 250	*$0,175\pm0,16^a$*
(C) 200	*$0,135\pm0,08^a$*
(D) 150	*$0,078\pm0,02^a$*
(E) 100	*$0,074\pm0,04^a$*
(F) Control	*$0,049\pm0,04^a$*

Description: The same letter in the same column shows no significant difference between treatments at 5% level ($p> 0.05$), ± (distance of minimum and maximum value).

The result of variance analysis showed that the treatment of vermicompost fertilizer did not give significant effect ($p> 0,05$) to the increasing amount of magnesium mineral (Mg) element in seaweed. The range of mineral content of Mg seaweed obtained in each treatment is 0.049-0.189%. Mg is needed by seaweed to photosynthesize protein, carbohydrate and fat formation resulting in better growth and quality. From the results of the study it is found that seaweed requires magnesium elements with sufficient amounts of maintenance media, from sufficient quantities already can produce a good breeding of seaweed. According

to [8] states that, Mg in the talus becomes a part of chlorophyll and has an important role to the metabolism of nitrogen and phosphorus. The higher the plant absorbs Mg, the higher the protein content in the plant.

IV. CONCLUSION

The highesth mineral content of nitrate (NO_3), phosphate (PO_4), magnesium (Mg) and sulfate (SO_4) in seaweed Gracilaria verrucosa is obtained in treatment A, while the lowest is in treatment F. Moreover, the highesth mineral content of ammonium (NH_4) seaweed is shown in treatment C, whilethe lowest is in treatment F. Gracilaria verrucosa cultivation in ponds using vermicompost fertilizer is recommended to be elaborated from the results of this study on the different scale of vermicompost for seaweed farming Gracilaria verrucosa in ponds.

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