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The Effectiveness of *Sargassum sp* as Liquid Organic Fertilizer in Increasing The Growth of Red Chillies

Yusnaeni, Nikmah, Maryanto C. Honin, Dionisius Bako
Biology Education, Faculty of Teacher Training and Education, University of Nusa Cendana, Jalan Adisucipto Penfui Kota Kupang, 85111
email: yusnaeni_75@yahoo.co.id

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ABSTRACT

This study aims to determine the effect of the most effective volume of watering for Sargassum sp liquid organic fertilizer on the growth of red chilli plants. The study was an experimental study using a completely randomized design with 5 treatments of the watering volume of *Sargassum sp* liquid organic fertilizer, namely 0 mL (control), 50 mL, 100 mL, 150 mL, and 200 mL. Each treatment was repeated 4 times. The variables measured were plant height, number of leaves, and number of branches. Observational data were analyzed using analysis of variance and further tested by BNT. The results of the analysis of variance showed that the organic fertilizer treatment of Sargassum sp. very significant effect on the variables of plant height, number of leaves, and number of branches, where each variable shows the value of Fcount > Ftable. Further test results showed that the best treatment was Sargassum sp treatment with a watering volume of 200 mL/polybag.

Keywords: liquid organic fertilizer, *Sargassum sp*, chilli plant growth.

INTRODUCTION

Red chilli is one of the important horticultural commodities in Indonesia which until now remains a leading commodity due to the increasing demand throughout the year. The use of red chili is not only as a fruit vegetable but also because of its potential to be developed as a processed product with more economic value. Therefore, to compensate for the high demand, one of the efforts is to increase the productivity of chilli plants through the application of fertilizers. (Emir et al., 2017) revealed that to get maximum production of chilli plants, they must be equipped with the provision of sufficient and appropriate nutrients. Plant production is closely related to its growth. Therefore, the results of this study only present the growth of red chilli plants.

The use of fertilizers in agricultural systems can increase crop yields, especially inorganic fertilizers. However, prolonged use of inorganic fertilizers will have a negative impact because it can damage the ecosystem. For that, we need the right solution to increase the growth and production of chilli plants but are environmentally friendly, in this case through the use of organic fertilizers. The same thing was revealed by (Sundari et al., 2021) that one alternative to increase the production of chilli plants is to use organic fertilizer.

Organic fertilizers are fertilizers made from organic materials such as vegetable scraps, livestock manure and so on and also from living things that have died (Pramushinta, 2018). One of the organic materials that can be used to increase the growth and production of chilli plants is seaweed. Seaweed is a plant belonging to benthic macroalgae whose life is attached to the bottom of the waters (Agustang et al., 2019).

Seaweed in Indonesian waters is abundantly produced in all kinds, and some of them are used as processed products, both in the form of beverages and foods such as paper agar, alkali-treated cottonii (ATC), jelly-products, and several cosmetic products (Basmal et al., 2015). but even then it is limited to certain types of seaweed (Bijang et al., 2018). Meanwhile, the use of grass as an organic fertilizer has not been done much.

In the waters of Kupang City, especially at Pasir Panjang Beach and Paradiso Beach, some types of seaweed are very abundant in certain months (March–August) because they are not used by the surrounding community either as food or for other purposes. Therefore, so that seaweed can provide added value, both economically and environmentally, the alternative that can be done is to use seaweed as organic fertilizer. This is possible because seaweed contains auxin, gibberellins and cytokinins, and contains other bioactive compounds, such as triterpenoids, steroids and phenolics that play a role in increasing plant growth and development (Basmal, 2009; Basmal et al., 2015; Kusumaningrum et al., 2007). In addition, it also contains a number of macro and micronutrients needed for plants (Basmal et al., 2019). Several research results on the use of seaweed have been reported by (Loppies & Yumas, 2017; Nikmatullah et al., 2014; Pamungkas et al., 2020; Utomo & Asmawit, 2012). *Sargassum sp*. is a seaweed that can be processed into organic fertilizer, and its utilization is still not widely done. According to Montano & Tupas (1990), *Sargassum sp* contains a lot of auxin, gibberellins and cytokinins that play a role in spurring the growth of other species of plants. These growth regulators play a role in almost all growth processes.

Utilization of *Sargassum sp.* as fertilizer can be done by composting, making flour or making extracts (liquid organic fertilizer). Based on the results of a literature search and the results of research that has been carried out by previous researchers, it indicates that there is still a lot of potential for research studies by utilizing the abundant natural resources around us that do not compete with the needs for public consumption but can support the availability of food. One of them is by utilizing the potential of seaweed as liquid organic fertilizer. The abundant nutrient content in seaweed can support plant growth and production. Therefore, the utilization of Sargassum sp. as liquid organic fertilizer is expected to encourage increased crop production, especially horticultural crops and overcome the impact of the policy of limiting horticultural imports by the Ministry of Agriculture of the Republic of Indonesia. For this reason, this study was designed to examine the effect of using Sargassum sp as a liquid organic fertilizer on the growth and production of red chilli (*Capsicum annum* L.).

METHODS

Materials

The tools used are knives, blenders, measuring cups, polybags, containers with lids, measuring instruments (scales and tape measure) and label paper, while the materials used are *Sargassum sp*, chilli plant seeds, water, sugar, soil, and EM4.

Methods

This study was an experimental study using a completely randomized design consisting of five doses of *Sargassum sp* as liquid organic fertilizer (0 ml/control, 50 mL, 100 mL, 150 mL and 200 mL) with four replications.

Research procedure

1. Production and Application of POC in Plants

   Sargassum sp was collected by combing along the coast. The seaweed samples obtained were cleaned. A total of 1 kg was blended for 5 minutes (to facilitate the process of refining when blended, added L of water). The results of the blender were mixed with 200 g

of granulated sugar and added 15 mL of EM4, then each was put in a container and then tightly closed and left for 4 days for the fermentation process.

2. Preparation of Planting Media and Seed Nursery

   Preparation of planting media is done by taking the soil that has been cleaned of dirt and rocks and then sterilising it. Furthermore, as much as 3 kg of soil is filled into polybags. While the seedling media in the form of soil mixed with manure in a ratio of 2:1. Chilli seeds are sown in seedling media for 40 days and then transferred to planting media.

3. Treatment Stage

   Watering is done 2 times a day, in the morning and evening except when it rains. To avoid pest attacks, the area around the plant is cleaned to prevent weeds or other wild plants from growing. Disease prevention was carried out by spraying Dithane M-45 0.2%, while to avoid pest attacks, Thiodan 35 EC was used. Weeding is done every two weeks or by looking at field conditions.

Research Variable

The variables measured in this study were the increase in plant height, the increase in the number of leaves and the increase in the number of branches. Additional data is obtained by subtracting the data at the time of observation from the initial data. Observations were made every 2 weeks.

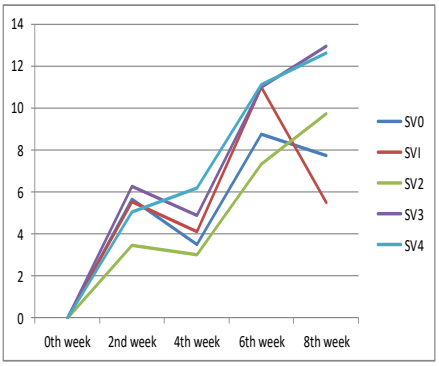
Data Analysis Technique

The data were analyzed using the one-way test of variance (ANOVA) and further testing using the Tukey test (Sastrosupadi, 1999; Sugiyono, 2012).

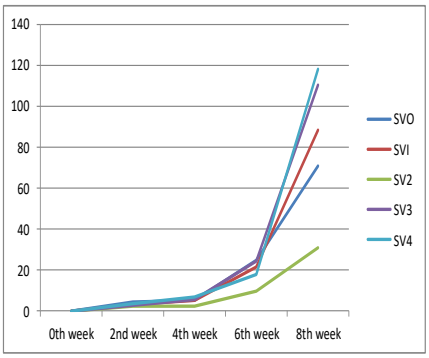
RESULT AND DISCUSSION

Descriptive Analysis of Plant Growth

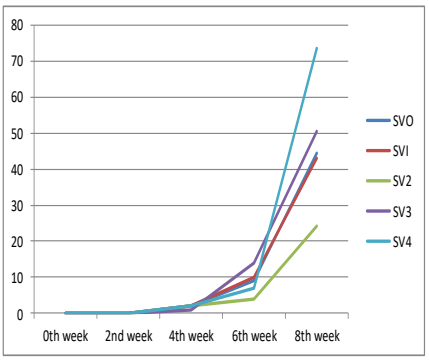
Plant growth was measured through the variable increase in plant height, the number of leaves and the number of branches. The increase in plant height and number of leaves was measured every 2 weeks, by reducing the observation data every 2 weeks with the previous data. The visualization results of the growth rate for each plant height variable are presented in Figure 1.



(a)



(b)



(c)

Figure 1. Graph of average increase: (a) plant height, (b) number of leaves, (c) number of branches every 2 weeks in each treatment

The graph in Figure 1 shows that the increase in plant height (figure a), *Sargassum sp* treatment with a watering volume of 200 mL/polybag gives a growth curve that tends to be stable and follows the sigmoid curve, but from the graph, it can be

seen that the *Sargassum sp* treatment with a watering volume of 150 mL/ polybag gives better height gain. As for the increase in the number of leaves and the number of branches (Figures b and c) it can be seen that the *Sargassum sp* treatment with a watering volume of 200 mL/polybag gave an increase in the number of leaves and the number of branches more.

Plant Growth Statistics Test Results

The complete recapitulation of the analysis of variance for plant height, number of leaves and number of branches can be seen in Table 1.

Table 1. Recapitulation of ANOVA test variable growth of red chili plants

Growth Variable	F_{hitung}	F_{tabel}	
		5%	1%
Plant height	10, 29**	3,06	4,89
Number of leaves	4,90**	3,06	4,89
Number of branches	28,45**	3,06	4,89

Description :**: Very significant effect (F count > F table 1%)

The ANOVA test results in Table 1 show that the treatment of liquid organic fertilizer *Sargassum sp* is very influential (the value of Fcount is greater than Ftable 1%) on plant growth as measured by the variables of plant height, number of leaves and number of branches. Because each variable shows that there is an effect, then it is continued with the BNT further test. The complete recapitulation of further test results is presented in Table 2.

Table 2. Recapitulation of BNT Test Results for Chili Plant Growth

Treatment	Rata-rata		
	Plant height	Number of Leaves	Number of Branches
Control	70,53[a]	103,00[a]	47,75[a]
A	71,60[a]	130,00[a]	69,25[b]
B	51,00[a]	90,75[a]	48,25[a]
C	147,45[b]	172,75[ab]	85,50[c]
D	163,60[b]	154,00[b]	87,50[c]
BNT value	56,050	54,991	12,766

Note: The numbers followed by the same letter do not show a difference in the different values listed for each variable
A = *Sargassum* sp 50mL
B = *Sargassum* sp 100mL
C = *Sargassum* sp 150 mL
D = *Sargassum* sp 200 mL

Based on the results of the BNT test in Table 2, it can be seen that the control plant height variable was not different from *Sargassum sp* 50 mL and *Sargassum sp* 100 mL, but different from *Sargassum sp* 150 mL. While *Sargassum sp* 150 mL is no different from *Sargassum sp* 200 mL. For the variable number of leaves, the control was not different from *Sargassum sp* 50 mL, Sargassum sp 100 mL, and Sargassum sp 150 mL, but different from *Sargassum sp* 200 mL. Meanwhile, for the number of branches, the control was not different from *Sargassum sp* 100 mL, but different from *Sargassum sp* 50 mL. Similarly, *Sargassum sp* 50 mL is different from *Sargassum sp* 150 mL and *Sargassum sp* 200 mL, but *Sargassum sp* 150 mL is no different from *Sargassum sp* 200 mL. From all treatments, it was seen that giving POC *Sargassum sp* 200 mL gave the best results for plant growth.

Referring to the results of the ANOVA test and the results of the BNT test, it was seen that the application of liquid organic fertilizer Sargassum sp with a volume of 200 mL was the best for increasing plant growth. This is because at this volume the need for nutrients needed by plants to grow has been well met, marked by an increase in height, better number of leaves and number of branches. Plants in their growth do require the presence of nutrients in the right amount so as not to cause problems in growth. Excess deficiency or excess nutrients can cause damage and disruption to plant growth. This is supported by Emir et al (2017) who revealed that to get maximum production of chili plants, they must be equipped with the provision of sufficient and appropriate nutrients.

Various nutrients contained in liquid organic fertilizer Sargassum sp as revealed by Anggadiredja et al (2006) that Sargassum sp has the main content of carbohydrates in the form of fiber, also contains protein, a little fat, some are mostly sodium and potassium salt

compounds, vitamins such as vitamins A, B1, B2, B12 and C, beta-carotene, minerals such as potassium, calcium, phosphorus, sodium, iron, cobalt, molybdate, boron and iodine. Kusumaningrum et al (2007) and Basmal (2009) also added that it contains auxin, gibberellins and cytokinins, and contains other bioactive compounds, such as triterpenoids, steroids and phenolics that play a role in increasing plant growth and development.

In addition, *Sargassum sp* also contains a gel that has the ability to absorb water so that it can add moisture when used as organic fertilizer, the storage and absorption capacity of algae cells with a certain cut size is very important when associated with its application in agriculture (Montano & Tupas, 1990). Further by Trono Jr & Ganzon-Fortes (1988) added that *Sargassum* contains sodium alginate (Na-alginate), laminarin, fucoidin, cellulose, mannitol and contains antioxidants (polyphenols), iron, iodine, vitamin C and minerals such as Ca, K, Mg, Na, Fe, Cu, Zn, S, P, Mn and other minerals. Nutrient content per 2 grams of dry powder Sargassum sp. are carbohydrates 17.835%, protein 0.776%, and polyphenols 24.58 % (491.5 mg).

Various compounds contained in seaweed *Sargassum sp,* are very possible to be utilized properly by chili plants when it has been fermented into liquid organic fertilizer. The content of these compounds will be properly degraded when undergoing a fermentation process with microbes contained in effective microorganisms. Some of the nutrients in POC, especially phosphorus, are very supportive of plant growth. This element goes through a mineralization process by the phosphatase enzyme produced by phosphate solubilizing bacteria in EM4 solution so that it becomes a dissolved phosphorus element and is easily absorbed by plants (Stofela & Brian 2001 in Pappang, 2018). Phosphorus (P) helps accelerate the growth of mature plants and stimulates the growth of plant parts during generative reproduction. This element is able to stimulate the growth of many flowers and fruit so as to produce a large number of fruit (Sutedjo, 2002)

The contribution of nitrogen (N) nutrients from POC is also very supportive of plant growth. N can be derived from protein breakdown by the activity of protease enzymes secreted by lactic acid bacteria and Actinomycetes present in EM4 solution. This is in accordance with what is described by Yuwono (2006) that lactic acid bacteria and Actinomycetes are able to produce protease enzymes that can break down proteins into their constituent polymers. Munawar (2011) explained that nitrogen is one of the macronutrients that is generally needed for the vegetative growth of plants such as roots, stems, and leaves. The supply of nitrogen in sufficient quantities will facilitate the metabolic process in plants so that the growth of root organs, stems, and leaves will be better.

In addition to nitrogen, the nutrient content of calcium (Ca) in POC also affects the growth of tomato plant stems. This calcium element is thought to come from the dissolution of calcium carbonate by lactic acid produced by lactic acid bacteria in EM4 solution. One of the functions of these nutrients in plants is to strengthen stems and activate the formation of root hairs (Munawar, 2011). This is very beneficial for plants because stronger and larger stems are able to support the overall mass of the plant so it is not easy to fall, and the expansion of root hairs is able to absorb nutrients in maximum quantities so as to increase plant growth.

CONCLUSION

Based on the results of the study, it can be concluded that the application of liquid organic fertilizer *Sargassum* sp. affects the growth of red chili (*Capsicum annum* L.) in terms of plant height increase, the number of leaves, and the number of branches. The best treatment was *Sargassum* sp with a watering volume of 200 mL/polybag. *Sargassum* sp. Effectively used as a liquid organic fertilizer because it contains a number of organic compounds and macro and micronutrients needed for

plant growth, namely carbohydrates, protein, fat, vitamins, and mineral salts needed for the growth and production of red chili plants.

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