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Effect of Different Harvest Ages on Alginat ContentiIn Seaweed *Sargassum* sp Using the Longline

Pengaruh Umur Panen Yang Berbeda Terhadap Kandungan Alginat Pada Rumput Laut *Sargassum* sp Menggunakan Metode Longline

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ABSTRACT

Sargassum sp. seaweed. It is a type of seaweed that has high economic value because of its alginate content and has the greatest and abundant potential in Indonesia. The alginate content produced in the seaweed Sargassum sp. Influenced by the harvest age in the cultivation process, if it is harvested too early, low quality seaweed will be produced and the older the harvest, the higher the alginate content. To obtain good alginate content, namely by knowing the optimal harvest age in cultivation. The aim of this research is to determine the effect of different harvest ages in seaweed (Sargassum sp.) on the alginate content using the Long line cultivation method. This research was conducted in Ekas Bay, Ekas Buana Village, Jerowaru District, East Lombok, West Nusa Tenggara. This research was carried out using an experimental method using a completely randomized design (CRD), which consisted of 5 treatments by weight of Sargassum sp. namely P1 28 days of harvest, P2 35 days of harvest, p3 of 42 days of harvest, p4 of 45 days of harvest, p5 of 59 days of harvest. Cultivation using seeds weighing 100 grams was then analyzed for alginate content. The results of this study indicate that the age of harvest affects the alginate content and weight growth of the seaweed sargassum sp. the best treatment was found in the p4 treatment with an alginate content value of 1.14% and the lowest in the p1 treatment of 0.76%. The conclusion of this study is that the different harvesting ages of Sargassum sp which were reared using the long line method showed an effect on the alginate content of Sargassum sp. the best treatment was found in p4 because it showed the highest value of alginate content and growth weight.

ABSTRAK

Rumput laut Sargassum sp. Merupakan salah satu jenis rumput laut yang memiliki nilai ekonomi tinggi karena kandungan alginat yang dimilikinya serta memiliki potensi yang melimpah dan terbesar di Indonesia. Kandungan alginat yang dihasilkan pada rumput laut Sargassum sp. Dipengaruhi oleh umur panen pada proses budidaya, apabila dipanen terlalu

awal maka akan dihasilkan rumput laut berkualitas rendah dan semakin tua umur panen maka kandungan alginat semakin tinggi. Untuk memperoleh kandungan alginat yang baik yaitu dengan mengetahui umur panen yang optimal didalam budidaya.Tujuan dilakukannya penelitian ini adalah mengetahui pengaruh umur panen yang berbeda pada rumput laut (Sargassum sp.) terhadap kandungan alginat menggunakan metode budidaya Long line. Penelitian ini dilaksanakan di Teluk Ekas Desa Ekas Buana Kecamatan Jerowaru Lombok Timur Nusa Tenggara Barat. Peneliatian ini dilakukan dengan metode eksperimental menggunakan Rancangan Acak Lengkap (RAL), yang terdiri dari 5 Perlakuan berat bibit Sargassum sp. yaitu P1 Umur panen 28 Hari,P2 umur panen 35 hari,p3 umur panen 42 hari,p4 umur panen 45 hari,p5 umur panen 59 hari. Budidaya menggunakan bibit dengan berat 100gram kemudian dilakukan analisa kandungan alginat. Hasil penelitian ini menunjukkan bahwa umur panen berpengaruh terhadap kandungan alginat dan pertumbuhan berat pada rumput laut sargassum sp. perlakuan terbaik terdapat pada pelakuan p4 dengan nilai kandungan alginat sebesar 1,14% dan terendah pada perlakuan p1 sebesar 0,76%. Kesimpulan dari penelitian ini adalah umur panen yang berbeda pada sargassum sp yang dipelihara menggunakan metode long line menunjukkan pengaruh terhadap kandungan alginat sargassum sp. perlakuan terbaik terdapat pada p4 karena menunjukkan nilai kandungan alginat dan berat pertumbuhan tertinggi.

Kata Kunci	*Sargassum sp, long line, alginate, teluk ekas*
Keywords	*Sargassum sp, long line, alginate, Ekas bay*
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INTRODUCTION

Seaweed is one of the commodities promoted by the government as one of the superior products from fisheries and marine products which has high economic value to improve welfare in several economic sectors of society starting from farmers, producers, processors to users (Diniarti et al. 2018). Sargassum sp. It is a type of seaweed that has high economic value because of its alginate content and has abundant potential from the largest group of brown algae (Phaeophyceae) in Indonesia. According to Fajri. (2020) that sargassum sp contains nutrients in the form of alginate and iodine which have been used in the pharmaceutical, cosmetic, textile and food industries. Then, the growth of brown algae (including Sargassum) is very dependent on ocenographic factors (physics, chemistry and the movement or dynamics of sea water). Sargassum sp. Also grows well at salinities of 32-34 ppt with depths ranging from 0.5-10 m. Sargassum sp is an example of a brown algae plant that produces alginate.

Alginate compounds can be used as emulsifiers, carriers and stabilizers (Subagan, 2020). The alginate content produced in the seaweed Sargassum sp. Influenced by the age of harvest during the cultivation process. If it is harvested at less than that age, low quality seaweed will be produced because of the alginate content of Sargassum sp. In general,

seaweed is ready to be harvested 1.5-2 months after planting. Marseno (2010). Reported that the age of harvest can influence the increase in dry seaweed soaking and alginate soaking. Apart from that, the older the seaweed harvest, the higher the soaking and sulfate levels. The alginate content of older seaweed is relatively more stable than that of young ones (Rasyid, 2010) and the older the harvest, the greater the polysaccharide content produced so that the alginate is also higher, the results of Widyartini's research (2015) which was carried out for 28 days, The highest alginate content was found at harvest age of 28 days. Apart from that, Hak (2004) states that Na-alginate levels are related to the harvest age of brown seaweed so that it can be determined when brown seaweed should be harvested which results in the physicochemical properties of Na-alginate that meet trade standards. So to obtain good alginate content in seaweed Sargassum sp. This means knowing the optimal harvest age for cultivating this type of seaweed.

Seeing the huge potential of Sargassum sp for cultivation because its content is so useful for making food and other ingredients, it is necessary to carry out research on the effect of alginate content on different harvest ages for Sargassum sp seaweed using the Long line method.

RESEARCH METHODS

The research method that will be used is an experimental method using a Completely Randomized Design (CRD), which consists of 5 treatments, namely: P1 (harvest age 28 days), P2 (harvest age 35 days), P3 (harvest age 42 days), P4 (Harvest age 45 days (Control) and P5 (Harvest age 49 days). Each treatment was carried out 4 times to obtain 20 experimental units. In this study a seed weight of 100 g was used, whereas in the study by Hulpa et al. (2021) 100 seeds were used. g produces better growth. Then the randomization method uses the lottery model randomization method.

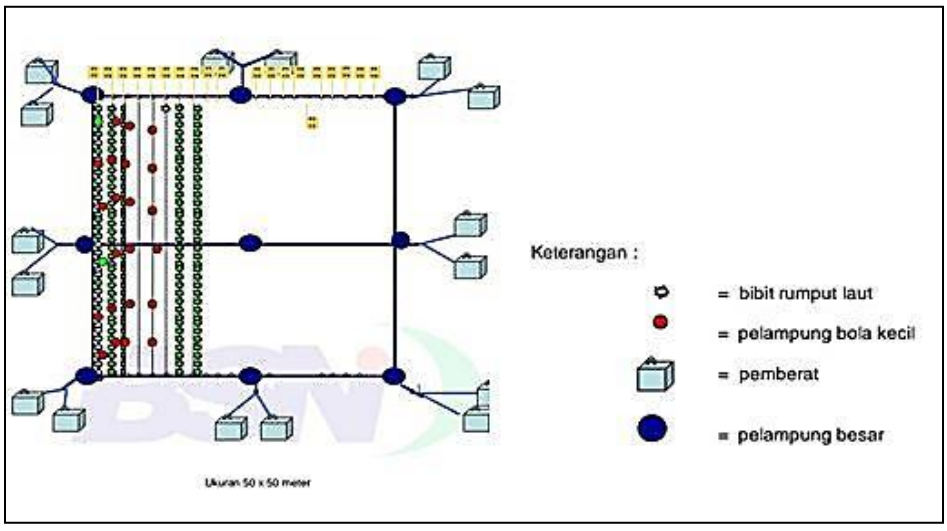


Figure 1. Framed longline construction

Long line preparation

Prepare the tools and materials that will be used to make a long line construction as a cultivation container. The construction is connected by a polyethylene main rope with a length of 50 m x 5 m. The main rope is stretched at sea and then anchors and main buoys are installed at each corner of the construction.

Preparation of Sargassum sp. Seeds.

Sargassum sp seeds. The seeds used are seeds taken directly from nature. Sargassum sp seeds. weighed with the same initial seed weight of 100 g. Tie the seeds to the ris rope using raffia rope with a distance between the seeds of approximately ± 30 cm.

Planting Sargassum sp.

Take the seeds of Sargassum sp. According to the specified seed weight, namely 100 g. Tie the seeds to the ris rope using raffia rope with the same distance between the seeds, namely ± 30 cm. The seeds are tied to a rope stretched in water with the help of poles or stakes.

Maintenance of Sargassum sp.

As long as the seaweed (Sargassum sp.) is in the cultivation container, during that time several activities continue to be carried out to ensure the seaweed (Sargassum sp.) is in good condition. Some activities that are routinely carried out are controlling plants, cleaning mud, replanting plants that damaged or dead and control its growth.

Weighing Sargassum sp.

Take 1 bunch of Sargassum sp. in each treatment, namely at a weight of 100 g. Weighed Sargassum sp. using digital scales. Enter the weighing results into the measurement table. Further measurements were carried out.

Sargassum sp. Leaf Counting.

Taken Sargassum sp. which has been weighed. Count the number of leaves on 1 clump of Sargassum sp. manually. Enter the calculation results into the measurement table.

Fruit Counting Sargassum sp.

Taken Sargassum sp. whose number of leaves has been counted. The number of fruits per clump of Sargassum sp. was counted. Manually. Enter the calculation results into the measurement table.

Research Parameters

Alginate Content Analysis

Alginate extraction refers to SNI 1992 in Iskandar (2015) with the following steps. The dried Sargassum crassifolium seaweed was weighed 2 g and placed in a glass beaker. The seaweed is then soaked in 100 ml of dilute chloride acid (HCL) (0.33%), the soaking is intended to wash away the salt that is still attached to the seaweed. Drain and puree the seaweed using a blender. Then soaked in 100 ml soda ash solution (Na2CO3) 2.5% at pH 10 for 8 hours while stirring in a magnetic stirrer to obtain a thick gel (treatment was carried out at a temperature of 10oC). The gel is crushed while adding 6 volumes of hot water to it, then filtered to separate the insoluble residue. Add 50 ml of 10% calcium chloride (CaCl) solution to the filter to precipitate the calcium alginate. Add 100 ml of 5% hydrochloric acid (HCl) to obtain water-insoluble alginate. The seaweed was washed with 100 ml Aquades water. Seaweed was dried and weighed. The weight of the alginate obtained was calculated using the method of Widyartini et al. (2015), with the formula:

$$\text{Rendemen alginate (\%)} = \frac{\text{Final product (g)}}{\text{Raw material (g)}} \text{ X } 100\%$$

Absolute Weight

According to Effendi (2003), alsolute weight can be measured using the following formula:

$$G = Wt - W0$$

Information:
G : Absolute growth (g)
Wt : Weight of seedlings at the end of the study
W0: Weight of seedlings at the start of the study

Specific Growth Rate

According to Dawes (1994), specific growth rate can be measured using the following formula:

$$\text{SGR} = \frac{\ln Wt - In\ W0}{t} \text{X } 100\%$$

Information:
SG = Specific Growth
In Wt = Average weight at the end of the study
In Wo = Average weight at the start of the study
T = Observation period

Water Quality Measurement

The water quality parameters observed in this study were brightness, temperature, current speed, salinity, oxygen, nitrate and phosphate. Measurements were carried out 6 times during research activities, namely on day 0, day 28, day 35, day 42, day 45 and day 49.
Data analysis

Growth and alginate data were analyzed using ANNOVA. If there were differences in treatment, the Duncan test was continued. Alginate samples were measured and analyzed from day 0 until harvest. Water quality data is analyzed descriptively.

RESULT AND DISCUSSION

Alginate Content Analysis

The results of analysis of variance (ANOVA) showed that the effect of different harvest ages on Sargassum alginate content had a significantly different effect ($p<0.05$). The results of Sargassum alginate content can be seen in Figure 2. Based on research conducted using analysis of variance (ANOVA), P4 is significantly different from P1, P2 and P3 but not significantly different from P5 ($P < 0.05$). P5 is significantly different from P2 and P1 but not significantly different from P3 and P4 ($P < 0.05$). P3 is significantly different from P1, P2 and P4 but not significantly different from P5 ($P < 0.05$). P2 is significantly different from all treatments ($P < 0.05$) and P1 is significantly different from all treatments ($P < 0.05$).

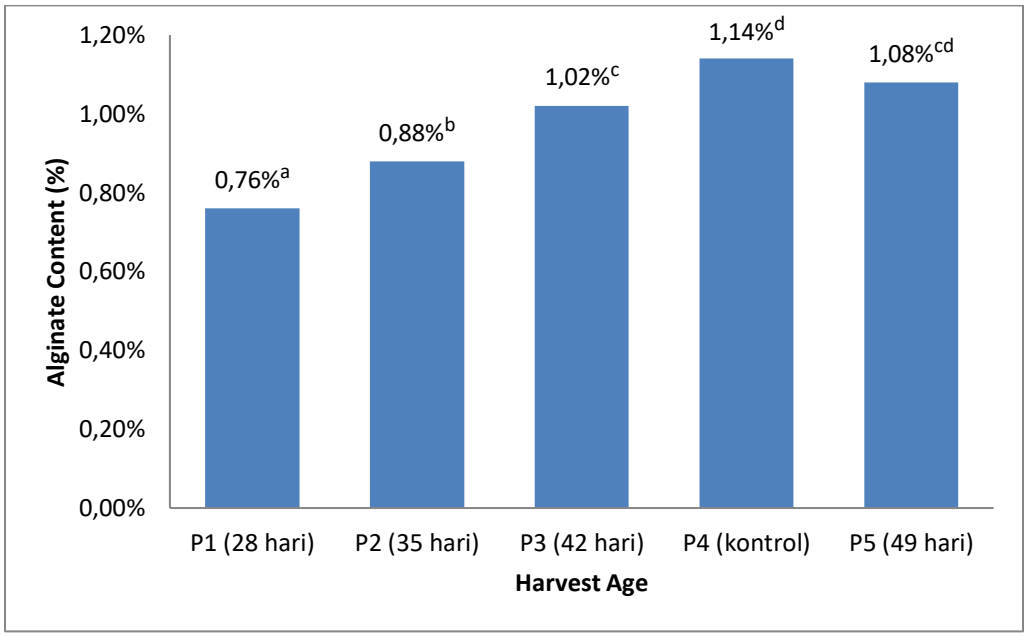
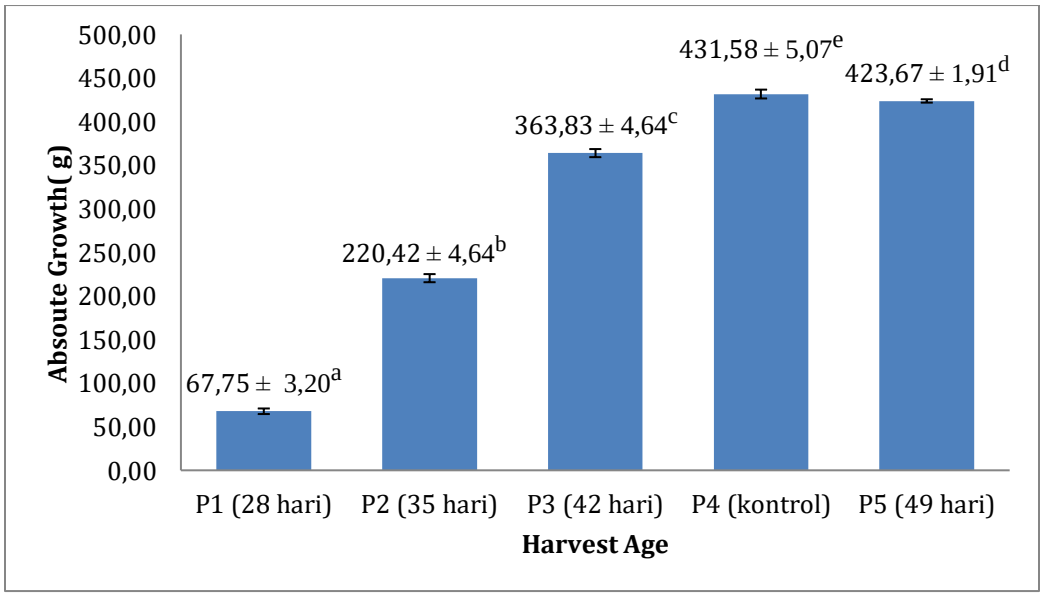


Figure 2. Alginate Content Analysis

Absolute Growth

The results of analysis of variance (ANOVA) showed that the effect of different harvest ages on absolute growth had a significantly different effect ($p<0.05$). The results of Sargassum alginate content can be seen in Figure 3. Based on research conducted using analysis of variance (ANOVA). That P4 was significantly different from all treatments ($P < 0.05$). P5 was significantly different from all treatments ($P < 0.05$). P3 was significantly different from all treatments ($P < 0.05$). P2 is significantly different from all treatments ($P < 0.05$). P1 is significantly different from all treatments ($P < 0.05$).



Gambar 3. Pertumbuhan Mutlak

Number of Fruits

The results of analysis of variance (ANOVA) showed that the effect of different harvest ages on the number of fruit had a significantly different effect ($p<0.05$). can be seen in Figure 4. Based on research conducted using analysis of variance (ANOVA), P4 is significantly different from all treatments ($P < 0.05$). P5 is not significantly different from P3, but is significantly different from P1, P2 and P4. treatment ($P < 0.05$). P2 is significantly different from all treatments ($P < 0.05$). P1 is significantly different from all treatments ($P < 0.05$).

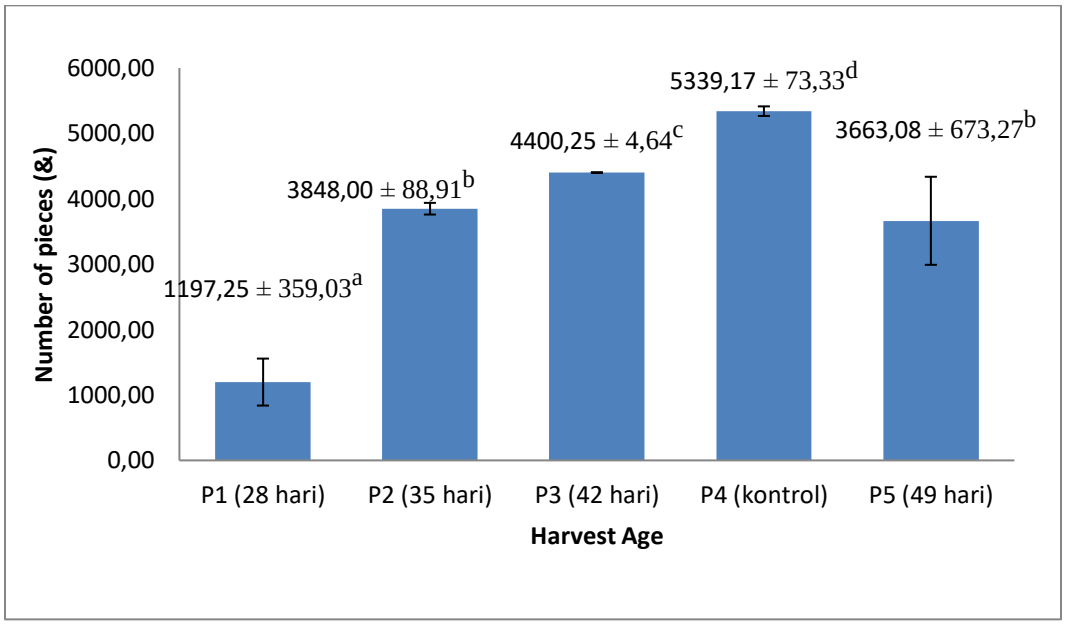


Figure 4. Number of pieces

Number of Leaves

The results of analysis of variance (ANOVA) showed that the effect of different harvest ages on the number of leaves had a significantly different effect ($p<0.05$). can be seen in Figure 5. Based on research conducted using analysis of variance (ANOVA), P4 is significantly different from all treatments ($P < 0.05$). P5 was significantly different from all treatments ($P < 0.05$). P3 was significantly different from all treatments ($P < 0.05$). P2 was significantly different from all treatments ($P < 0.05$). P1 was significantly different from all treatments ($P < 0.05$).

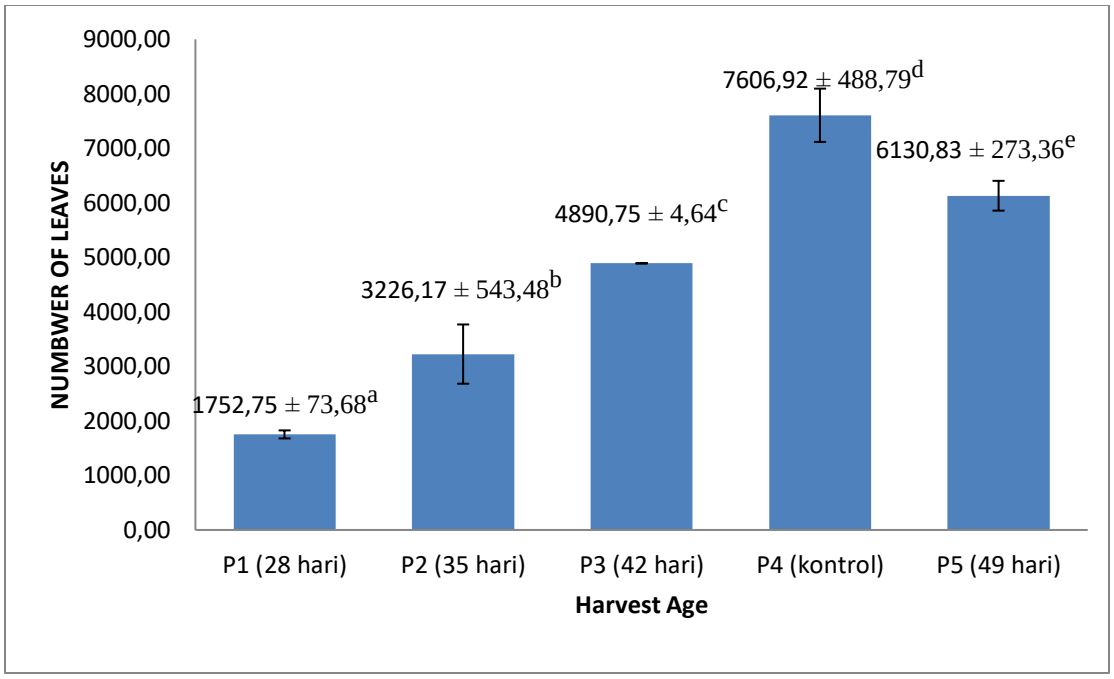


Figure 5. Number of Leaves

Water quality

During this research, water quality measurements were carried out on several parameters, namely physics, chemistry and biology. Results of water quality measurements during the research.

Table 1. Water Quality

Parameter	Day						References
	0	28	35	42	45	49	
Temperature	28.1	28.5	28.4	29.1	27.8	27.5	28-31˚C (Widyartini *et al.*, 2017)
pH	7.05	7.07	7.05	7.2	7.8	7.5	6.8-9.8 (Arjuni, 2015)
DO	6.6	6.5	6.5	6.8	6.6	6.2	3-8 mg/L (Syaqawi, 2017)
Salinity	32	33	32	33	33	32	30-37 ppt (Sapitri *et al.*, 2016)
Brightness	1	1	2	2	1	1	<5 (Puslitbangkan, 1991)
Flow Speed	25	23	26	24	25	26	20-40 (Novianti *et al.,* 2017
Nitrite	0.03	0.03	0.04	0.03	0.03	0.03	< 1.0 (Makmur *et al.*, 2010)
Nitrate	0.52	0.14	0.16	0.23	0.19	0.43	0.16-1.507 (Muslim *et al.*, 2016)
Depth	1	1	1	1	1	1	0.5-10 (Cokrowati *et al.,* 2016)

Discussion

Analysis of Alginate Yield Content of Sargassum sp.

Alginate content of Sargassum sp. which was obtained from the results of research on the coast of Ekas Bay which had been dried first with an initial weight of 2 g. Figure 4 shows that treatments with different harvest ages have an influence on the alginate content of Sargassum sp. cultivated during the research process. The highest value of alginate content was found in treatment P4 (control) with a harvest age of 45 days, namely 1.14% and the lowest value was found in treatment P1 with a harvest age of 28 days, namely 0.76%. It is suspected that the yield of alginate contained in the Sargassum sp sample. influence on harvest time. Apart from that, the age of harvest will also influence the photosynthesis process, thereby affecting the alginate produced. This is in line with the statement of Buriyo et al, (2003) in Miftakhul (2018), explaining that alginate content can also be influenced by the production process, type, harvest season and cultivation location. Apart from that, factors that influence the yield of alginate content of Sargassum sp. also depends on the environment where Sargassum sp. grows. Rasyid (2001) further explained in Ode (2014) that the characteristics of the waters influence the alginate content in the seaweed Sargassum sp. The rippling and dynamic characteristics of sea water in Ekas Bay also influence the alginate content of Sargassum sp. cultivated during the research process. This is relevant to the statement by Ode (2014), that brown algae that grow in rippling and dynamic waters will generally have an alginate content that tends to be higher when compared to those that grow in calm waters.

However, when the harvest is more than 45 days, the productivity and weight of seaweed cultivated using the long line method tends to decrease. This is possibly because seaweed has reached optimal cell growth at the age of 45 days. Rasyid (2003) stated that cells have optimum cell enlargement under certain conditions.

Absolute Growth

Absolute growth is the growth of seaweed observed from the start of the research until harvest. Based on the absolute growth results carried out, it shows that the highest value was found in the p4 treatment (45 days) with a value of 431.38 g, followed by the p5 treatment (49 days) with a value of 423.67 g, after that the p3 treatment (42 days) with a value of 363 .83 g, then treatment p2 (35 days) with a value of 220.42 g, and the lowest treatment was treatment p1 (28 days) with a value of 67.75 g. This is thought to be the harvest age of p4 (45 days) in Sargassum sp. adequate distribution of nutrients and photosynthesis processes and providing optimal intake to increase the growth rate of seaweed. According to Erpin et al., (2013), seaweed growth is influenced by various things, one of which is the environment. Seaweed is a microalgae that is very dependent on the availability of nutrients and sufficient light for its growth. However, the harvest age that exceeds the optimum production capacity of seaweed also cannot grow optimally. This is strongly suspected because seaweed has achieved optimal cell growth in treatment p4 (control) with a harvest age of 45 days, so that treatment p5 with a harvest age of 49 days does not provide optimum growth. According to Rival et al., (2020) stated that cells have optimum cell enlargement under certain conditions.

Number of Fruits

The results showed that the number of seaweed fruits Sargassum sp. ranges from 5610-7413. The highest number of fruit was obtained in the p4 treatment (45 days) with an average number of fruit of 5339.17 fruit (Figure 6). differences in the number of fruits in Sargassum sp. It is thought that optimal absorption of nutrients occurs at 45 days of age and at more than 45 days of age, the ability of seaweed to absorb nutrients is no longer optimal. This is because cell growth in seaweed does not provide optimum growth. According to Rival et al., (2020) stated that cells have optimum cell enlargement under certain conditions.

Number of Leaves

The results showed that the number of leaves of the seaweed Sargassum sp. ranges from 5084-7843. Good growth with the highest number of leaves was obtained in treatment p4 (45 days) giving an average number of leaves of 7606.92 pieces. Setyanti et al., (2013) explained that leaf growth occurs due to active cells undergoing division that are distributed randomly and cause an increase in leaf size which will be followed by growth. Factors that influence leaves are environmental factors, namely nutrients, temperature, pH and nitrogen. These factors can stimulate leaf growth, sufficient nitrogen availability will increase leaf area, because nitrogen can stimulate the growth of shoots and leaves, especially in the vegetative growth phase.

Water Quality Parameters

Water quality measurements were carried out 6 times, namely on days 0, 28, 35, 42, 45 and 49. Water quality measured during the research included brightness, DO, temperature, pH, salinity, depth, nitrate and current speed.

Dissolved oxygen is a limiting factor for all living organisms in water. During the research, the range of DO values obtained was 6.2 – 6.8. It is known that the highest DO was obtained on the 42nd day, namely 6.8. In accordance with the statement of Syarqawi et al., (2017), the range of DO content that is good for the continuity of seaweed cultivation is 3-8 mg/L. The DO content obtained in this study is included in the optimal range for the growth of Sargassum sp seaweed.

Temperature is a factor that can influence the seaweed reproduction process and help the photosynthesis process in waters. The temperature range in this study was 27.5 – 29.1 ºC. According to Widyartini et al., (2017), the growth of Sargassum sp. can achieve optimum growth at temperatures of 28 - 31 ºC. So the temperature obtained in this research is still considered optimal and is in accordance with the standards issued by SNI, namely between 26-32 ºC. Temperatures outside the optimal range can cause poor growth for Sargassum sp.

The degree of acidity or pH during research activities ranged from 7.2 – 7.8. pH measurement is used to determine the intensity of the acidic or basic conditions of a solution. pH is closely related to photosynthesis. Absorption of CO2 from water during the photosynthesis process will increase the pH to become more alkaline. This pH value meets the standards for cultivating Sargassum sp seaweed. This is in accordance with the statement by Arjuni et al., (2018), explaining that 6.8-9.6 is a suitable pH value for Sargassum sp.

Water salinity functions to regulate the osmotic pressure that exists in the bodies of marine organisms and their environment. The salinity of the waters obtained during research activities ranged from 34-36 ppt. According to Sapitri et al., (2016), a good salinity range for cultivating Sargassum sp is 30-37 ppt.

The brightness of waters is a reflection of the ability of light to penetrate the water layer at a certain depth. In this research, the water brightness value was found to be 1-2 meters. According to (Effendi, 2003), the brightness of waters is closely related to the penetration of sunlight, good brightness is more than 1 meter. Clear water conditions with a transparency level of not less than 5 meters are good enough for seaweed growth (Puslitbangkan, 1991). Seaweed growth can be optimal at a brightness of 1-2 meters. At the research location, the brightness of the waters is influenced by currents and the amount of rubbish. The more organic material dissolved, the more turbidity increases. According to Muslimin (2018), the brighter the water, the better the growth of seaweed. To get maximum growth, relatively high light is needed.

Current speed is a determining factor in the length of time that gaseous substances, dissolved nutrients and solid particles exist in a habitat and biota column in the waters. The current speed during the research ranged between 23-26 cm/s, which is still the ideal current speed. According to Novianti et al., (2015) explained that the current speed is considered good for the growth of Sargassum sp. which ranges from 20-40 cm/s.

Nitrite levels obtained during the research ranged from 0.03 – 0.04. This is in accordance with Makmur et.al., (2010) that the appropriate nitrite range for seaweed growth is <1.0 mg/l. Nitrite (NO2) is usually found in very small amounts in natural waters, the levels are smaller than nitrate because nitrite is unstable in the presence of oxygen. Generally, nitrites are not absorbed directly by seaweed.

Nitrate levels obtained during research in Ekas Bay ranged from 0.14 – 0.52. According to BSN (2011) nitrate levels must be more than 0.04 for good seaweed growth. Nitrate and phosphate are the main nutrients needed by seaweed. In the preparation of proteins and the formation of chlorophyll in the photosynthesis process, nitrate and phosphate are needed. According to Ode (2014), the average nitrate content in sea waters is 0.5 and the phosphate content is lower than that, both compounds can exceed the limit in surface water areas.

CONCLUSSION AND SUGGESTION

Analysis of the effect of different harvest ages on seaweed Sargassum sp. using the long line method in Teluk Ekas, Jerowaru sub-district, East Lombok district, had a significant effect. Based on the results obtained, it can be concluded that the harvest age of 45 days is the optimal result for the alginate content, namely 1.14% of the total weight of sargassum and growth compared to other growth.

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