Indonesian Journal of Aquaculture Medium

https://journal.unram.ac.id/index.php/jmai/index. E-ISSN : 2798-0553

VOLUME 2, NUMBER 1, JUNE 2022

The Effect of Different Plant Treatment on Sea Growth (*Caulerpa racemosa*) which is Used by The Longline Method in Tanjung Bele Village, Kec. Moyo Hilir, Sumbawa

Pengaruh Jarak Tanam Yang Berbeda Terhadap Pertumbuhan Anggur Laut (*Caulerpa racemosa*) Yang Dibudidayakan Dengan Metode Longline Di Desa Tanjung Bele, Kec. Moyo Hilir, Kab. Sumbawa Regency

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ABSTRACT

The study aimed to determine the effect of spacing on the growth of sea grapes *(Caulerpa racemosa)* with the longline method in the village of tanjung bele, moyo sub-district downstream, Sumbawa district. The research was carried out from April to May 2018 in the waters of the village of Tanjung Bele, Moyo sub-district, downstream, Sumbawa district. The method used is the experimental method with Completely Randomized Design (CRD) which consists of three treatment spacing and repeated five times. The treatments are: A (30 cm spacing), B (40 cm spacing), C (50 cm spacing). The data obtained are analyzed using ANOVA. Different spacing treatments provide significantly different growth to absolute growth and specific growth rate Different treatment of spacing gives a significantly different effect so that a further test was carried out with the Tukey HSD. Water quality parameter data were analyzed descriptively. The results showed that the absolute growth of sea wine in treatment A namely 201.87 grams, then treatment B 140.40 grams and treatment C amounted to 130.93 grams, while the specific growth rate of sea wine *(Caulerpa racemosa),* namely spacing of treatment A has an average value of 5.86%, Treatment B 4.83% and treatment C 4.46%. After further testing of absolute growth and specific growth rate of treatment which had significant differences, namely treatment A with B, A with C, B with C, and C with A. All treatments had significant differences. Water quality measurement results are still in the normal range for the growth of sea grapes.

ABSTRAK

Penelitian bertujuan untuk mengetahui pengaruh jarak tanam terhadap pertumbuhan anggur laut (*Caulerpa racemosa*) dengan metode longline di desa Tanjung Bele, Kecamatan Moyo Hilir, Kabupaten Sumbawa. Penelitian dilaksanakan sejak Bulan April sampai dengan Bulan Mei 2018 bertempat di perairan desa tanjung bele, kecamatan moyo hilir, kabupaten Sumbawa. Metode yang digunakan adalah metode eksperimental dengan Rancangan Acak Lengkap (RAL) yang terdiri dari tiga perlakuan jarak tanam dan

diulang sebanyak lima kali. Perlakuannya yaitu : A (Jarak tanam 30 cm), B (jarak tanam 40 cm), C (jarak tanam 50 cm. Data yang diperoleh dianalisis dengan menggunakan ANOVA (analysis of variance). Perlakuan jarak tanam yang berbeda memberikan pertumbuhan yang berbeda nyata terhadap pertumbuhan mutlak dan laju pertumbuhan spesifik. Perlakuan jarak tanam yang berbeda memberikan pengaruh yang berbeda nyata sehingga dilakukan uji lanjut dengan uji Tukey HSD. Data parameter kualitas air dianalisis secara deskriptif. Hasil penelitian menunjukkan bahwa pertumbuhan mutlak anggur laut pada perlakuan A yaitu 201.87 gram, selanjutnya perlakuan B 140.40 gram dan perlakuan C sebesar 130.93 gram. Sedangkan laju pertumbuhan spesifik anggur laut (Caulerpa racemosa) yaitu Jarak tanam perlakuan A memiliki nilai rata-rata 5.86%, Perlakuan B 4.83% dan perlakuan C 4.46%. Setelah dilakukan uji lanjut pertumbuhan mutlak dan laju pertumbuhan spesifik (SGR) perlakuan yang memiliki perbedaan yang nyata yaitu perlakuan A dengan B, perlakuan A dengan C, perlakuan B dengan C, dan perlakuan C dengan A. Semua perlakuan memiliki perbedaan yang nyata. Hasil pengukuran kualitas air masih berada dalam kisaran yang normal untuk pertumbuhan anggur laut.

Kata Kunci	*jarak tanam, pertumbuhan, anggur laut (Caulerpa racemosa)*
Key words	*planting spacing, growth, sea grapes (Caulerpa racemosa)*
Tracebility	Tanggal diterima : 14/6/2022. Tanggal dipublikasi : 30/6/2022
Panduan Kutipan (APPA 7th)	Isnawati, Waspodo, S., & Ghazali, M. (2022). The Effect of Different Plant Treatment on Sea Growth (*Caulerpa racemosa*) which is Used by The Longline Method in Tanjung Bele Village, Kec. Moyo Hilir, Sumbawa. *Indonesian Journal of Aquculture Medium*, *2*(1), 22-30. http://doi.org/10.29303/mediaakuakultur.v2i1.1278

INTRODUTION

Sea grape (*Caulerpa racemosa*) is a type of seaweed that grows in the waters of West Nusa Tenggara (NTB) and is a fisheries resource with important economic value. The increasing demand for the seaweed industry is influenced by various problems, including the lack of supply due to low seaweed production. NTB Province has a potential land area that can be developed as a seaweed cultivation area of 45,330 ha, but only 22,655 ha has been utilized (Directorate General of Aquaculture, 2009 in Sapitri, 2016).

Several types of seaweed have been used as industrial raw materials, food ingredients, medicines and others. However, seaweed cultivation is still limited to certain types such as Kappaphycus alvarezii, Gracillaria sp, Eucheuma spinosum. Meanwhile, there are still many seaweeds that are used by the community, one of which is Caulerpa racemosa. The Caulerpa racemosa type of seaweed has benefits, including as a food ingredient that has high protein levels and is a source of antioxidants. The use of Caulerpa still relies on natural products, so production is low because it still depends on the season. Therefore, to overcome this, cultivation activities are needed.

Cultivation is one of the appropriate steps in an effort to increase Caulerpa production, so that it is hoped that the supply of Caulerpa can be smoother, more regular, both in quantity and quality. Caulerpa racemosa has long been known to the public and its use only relies on taking it from nature, there are still few cultivation activities to support production needs (Aslan, 1991 in Sunaryo, 2015). Resources that still rely on natural products will generally experience many obstacles, including low production due to dependence on the season. This causes the absence of continuity in production in sufficient quantities at any time and greatly endangers the sustainability of sea grape

(*Caulerpa racemosa*) populations in nature. One way to overcome this situation is sea grape cultivation. The availability of sea grapes in nature is increasingly limited, so cultivation techniques are needed to increase the amount of sea grape production so that demand can be met sustainably.

In the process of planting sea grapes (*Caulerpa racemosa*), important factors that must be considered are the planting method and plant spacing. Several planting methods that are commonly used according to (Sunaryo, 2015) are the cultivation method on the surface of the maintenance medium, cultivation in the column of the maintenance medium and cultivation at the bottom of the maintenance medium. However, of these methods, the best for growing sea grapes is planting on the surface of the cultivation medium compared to other methods. Furthermore, Sunaryo (2015) said that this was because the reception of light from the surface planting method was more effective for the photosynthesis process which was then used in the metabolic process to produce food reserves in the seaweed. Therefore, the method used during the research was the long line method, because in this area most seaweed cultivators only use the long line method. No one is cultivating sea grapes in the Tanjung Bele area, they are only collecting them from nature. To overcome this problem, sea grape cultivation must be carried out using methods that have been mastered, so that sea grapes do not experience extinction due to continuous harvesting.

The problem experienced by cultivators using the longline method is that they do not know the appropriate planting distance for optimal growth of sea grapes. Inappropriate planting distances can affect the growth of sea grapes, and it is possible that sea grape thallus will fall out due to collisions between one thallus and another caused by high currents or waves. Apart from that, it is also related to the absorption of nutrients for the sea grapes themselves.

Plant spacing also has a big influence on the growth of sea grapes so that sea grapes can grow optimally so that the results obtained can be profitable for the cultivator. Planting distance is closely related to the competition between individual sea grapes in obtaining nutrients for their food. In accordance with the statement of Prihaningrum, (2001) in Darmawati, (2015), several factors that influence the growth of Caulerpa in cultivation include the distance between planting seeds. Seedling spacing is one of the technical factors that influences the growth of Caulerpa, which is related to nutrient absorption. The distance between planting seeds will influence the movement of water which carries nutrients so that Caulerpa growth increases. Given these problems, it is necessary to conduct research on optimal planting distances for sea grape growth.

The aim of the research was to determine the effect of different planting distances on the growth of sea grapes cultivated using the longline method in Tanjung Bele Village, Moyo Hilir District, Sumbawa Regency.

It is hoped that this research can provide information to the public and cultivators about the correct planting distance for sea grape growth so that it can be applied and used as a reference in increasing sea grape production in Tanjung Bele Village, Moyo Hilir District, Sumbawa Regency.

METHODS

The research was carried out for 40 days, from April to May 2018 in Tanjung Bele Village, Moyo Hilir District, Sumbawa Regency, West Nusa Tenggara Province.

Research Tools and Materials

The tools and materials used in this research are stationery, balls, plastic bottles, scissors, net bags, cameras, cassettes, wood, meters, pH meters, hard plastic,

refractometers, raffia ropes, polyethylene (PE) ropes, thermometers, scales, DO meter, sea grape seeds, sea water and fresh water.

The method used in this research was an experimental method with a completely randomized design consisting of 3 treatments and 5 replications. The treatments are A (planting distance 30 cm), B (planting distance 40 cm) and treatment C (planting distance 50 cm).

Research procedure

Preparation of tools and materials has been carried out since Sunday, April 15 2018, starting from preparing 2 main ropes and preparing 15 ris ropes, then continuing with cutting 30 cm long raffia ropes each to be used as a tool for tying sea grape seedlings. Next, the raffia rope is inserted into the ris rope. Making plastic bottle buoys that will be installed on each longline rope. The next activity is making net bags used to wrap sea grape seeds. Making numbers as sample markers using hard plastic and tied with raffia. The final activity is making ballast in the form of fresh wood. Fresh wood with a diameter of ± 10 cm is taken and the main rope is tied to the wood and then released into the waters of the cultivation area.

Installation of raffia rope is based on the number of treatment plant spacings used, namely 30 cm, 40 cm, 50 cm. Installation of the raffia rope is done by inserting the raffia rope into the ris rope by rotating the ris rope. After the raffia rope is inserted into the ris rope, it is tied using a dead knot according to the specified planting distance. Installing the raffia rope with a dead knot aims to avoid shifting of the seeds due to the shock of the waves. Each treatment and replication uses samples from several points, this aims to avoid samples being damaged or swept away by the current. Prepare sea grape seeds that have been weighed in an amount of 50 grams, then put them in a net bag. Next, a sign was placed on each sample and the sign was tied using raffia rope.

The sea grape seeds (*Caulerpa racemosa*) used came from Sumbawa residents and were taken in Saleh Bay, Jelopang Island. The characteristics of a good seedling are that when you hold it, it feels elastic, has lots of branches, has a thick stem and is free from other plants or foreign objects (Aslan, 1998 in Cokrowati, 2017).

Planting is carried out after tying the seeds and marking the samples according to the treatment. After the preparation of tools and materials is complete, the seeds are transported by boat. After reaching the planting location, ensure that the seeds and buoys used are strong, each end of the rope is spaced 1 meter apart.

Sea grape (*Caulerpa racemosa*) seedlings that are planted are inspected regularly and are well maintained through regular supervision. In general, damage to anchors and ropes caused by large waves or decreased durability must be repaired immediately. The dirt attached to the sea grapes when the sea water is calm, the sea grapes are shaken in the water so that the sea grapes are always clean from the dirt attached to them. Adherent dirt can interfere with metabolic processes so that the growth rate can decrease.

The observation parameters observed in this research consist of two, namely the main parameters and supporting parameters. Growth is the main parameter and water conditions are the supporting parameters. Observations were made on days 7, 14, 21, 28 and 40.

The main parameter is absolute growth, to calculate absolute growth you can use the formula H=Wt-W0, H=absolute growth (grams), Wt= *Caulerpa racemosa* wet weight at the end of the study (grams), Wo= Caulerpa racemosa wet weight at the start of the study (gram) (Effendie, 1979). Meanwhile, the specific growth rate can be calculated using the formula SGR = ln Wt/ W0/t × 100%, SGR= Specific growth rate (% per day), Wt= Final weight (g), W0= Initial weight (g), t= Trial time (days) (Guo *et al*. 2014).

Data Anaysis

Data that has been collected during maintenance activities is analyzed using Analysis of Variance (ANOVA). If there is a significant effect (significantly different) then a further test is carried out using the Tukey HSD further test.

RESULT AND DISCUSSION

Absolute Growth

Based on Table 1, it can be seen that the results of measuring the absolute growth of sea grapes were highest in treatment A with a value of 201.87 grams, followed by treatment B with 140.40 grams and then treatment C with a value of 130.93 grams. Based on the results of the ANOVA test (attachment 2), it shows a value (P value <0.05). This means that there is a significant difference in the absolute growth of sea grapes (*Caulerpa racemosa*) treated with different plant spacing. Because there were significant differences between treatments, further tests were carried out using Tukey HSD to see which treatments had differences. From the results of further tests it was found that treatment A was significantly different from treatment B and treatment C, treatment B was significantly different from treatments A and C. After being tested with statistics, all treatments had real or significant differences.

Table 1. Absolute growth of sea grapes (*Caulerpa racemosa)* (gram)

Treatment	Test	Initial weight gr	Final weight gr	Absolute growth gr	Average gr
A (30 cm)	1	50	250.67	200.67	201.87[a]
	2	50	251.67	201.67	
	3	50	249.33	199.33	
	4	50	261.00	211.00	
	5	50	246.67	196.67	
B (40 cm)	1	50	195.33	145.33	140.40[b]
	2	50	190.67	140.67	
	3	50	188.33	138.33	
	4	50	189.33	139.33	
	5	50	188.33	138.33	
C (50 cm)	1	50	180.33	130.33	130.93[c]
	2	50	182.00	132.00	
	3	50	183.33	133.33	
	4	50	177.00	127.00	
	5	50	182.00	132.00	

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Specific Growth Rate

Based on Table 2, it shows that the results of measuring the specific growth rate (SGR) of sea grapes showed that the highest results were in treatment A with an average value of 5.86%, followed by treatment B with an average value of 4.83% and in treatment C with an average value of 4.46%. Based on the results of the ANOVA test, it shows a P (-value <0.05). This means that there is a real (significant) difference between the differences in planting distance and the specific growth rate of sea grapes, because there are real differences between treatments so a further Tukey HSD test was carried out to see which treatments had differences. Further test results showed that the treatments were significantly different, namely treatment A (30 cm) and treatment B (40 cm), treatment B and C, as well as treatment C and A.

Table 2. Specific growth rate of sea grapes *(Caulerpa racemosa)* (%)

Treatment	Average specific Growth Rate (%)	Signifikan
A (30 cm)	5.86 ± 0.05^{a}	S
B (40 cm)	4.83 ± 0.10^{b}	
C (50 cm)	4.46 ± 0.11^{c}	

S=Signifikan

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The absolute height of growth and specific growth rate in the 30 cm planting distance treatment is thought to be influenced by sunlight and currents or waves. Sunlight is closely related to the photosynthesis process carried out by sea grapes which is used for growth. Meanwhile, currents are closely related to the movement of water which carries nutrients or nutrients that can be used as food reserves for optimal growth of sea grapes so that sea grape growth becomes more optimal. Sudjiharno (2001), stated that planting distance affects the movement of water that carries nutrients and will avoid the accumulation of dirt in the thalus which will help with ventilation so that the photosynthesis process needed for seaweed growth can take place and prevent large fluctuations in salinity and temperature. water.

The low absolute growth value and specific growth rate of sea grapes (*Caulerpa racemosa*) in the 50 cm planting distance treatment is thought to be because the 50 cm planting distance is too sparse so that the movement of water (currents) carrying nutrients is partially used for sea grape growth. However, some of these nutrients are used by sea grapes to induce thallus production of secondary metabolites in order to strengthen the thallus of the sea grape itself so that it does not fall out. Because the nutrients or food reserves from sea grapes are mostly used for secondary metabolite processes, the growth of sea grapes becomes slower, but the thallus of sea grapes is more elastic. Apart from that, the low growth of sea grapes in the 50 cm planting spacing treatment was thought to be due to the spacing being too sparse, which made growth

lower than in other treatments. Distances that are too far apart actually provide space for phytoplankton to grow rapidly, resulting in competition between sea grapes and phytoplankton in utilizing nutrients. This is in accordance with the opinion of Septiawan (2009) who stated that the wider the seaweed planting distance, the higher the abundance of phytoplankton. Competition between phytoplankton and seaweed occurs in the diffusion of O_2 and CO_2 for respiration and photosynthesis, while competition between individual seaweeds usually occurs in the diffusion of nutrients and light capture, as well as whether or not thallus cover each other. The competition mentioned above is what makes seaweed's absorption of CO_2 and O_2 limited so that photosynthesis results will also be limited and result in low fresh weight yields of sea grapes.

Based on the results of the ANOVA test, it shows that the higher the planting distance does not guarantee that sea grapes will grow better. However, growth may occur at the planting distance between treatments B (40 cm) and C (50 cm). This is due to the process of nutrients brought by the optimal direction of water movement for the growth of sea grapes (*Caulerpa racemosa*) so that they can provide growth over a wide distance. This is reinforced by the opinion of Sapitri (2016) who states that increasing the planting distance may not provide better seaweed growth, because the movement of water carries nutrients so that seaweed growth can increase. Afrianto and Liviawati (1993) stated that the planting distance for seaweed seeds is still considered good if it is not less than 20 cm. The optimum planting distance for seaweed varies according to the type of seaweed being cultivated (Anggadiredja et al., 2008).

Water Quality Parameters

Water quality measurements are carried out once a week at 10.00 WITA. The measurement results can be seen in (Table 3). Based on the results obtained in Table 5, water quality data during cultivation of sea grapes (*Caulerpa racemosa*) has salinity values ranging from 29-310C, pH ranging from 7.5-7.83, dissolved oxygen (DO) 3.3-5.21 mg/l, brightness 2- 3 m, and current 10.5-24.83 cm/sec. The results of water quality measurements for each treatment showed that the temperature range was still in suitable conditions for sea grape growth *(Caulerpa racemosa)*.

Table 3. Water quality parameters

No.	Parameter	Measurement results (Kisaran)	Water quality standards	Unit
1.	Salinity	29-31	25-35[a]	Ppt
2.	Temperature	28-31	25-31[b]	^{0}C
3.	DO	3.3-5.21	3-8[c]	mg/l
4.	Brightness	2-3	2-5[d]	M
5.	pH	7.5-7.83	7.0-8.5[e]	-
6.	Current	10.5-24.3	20-40[f]	cm/detik
7.	Phosphate	0.01	0.01- 4[g]	mg/l
8.	Nitrate	0.05	0.01-<0.1[h]	Ppm

Notes: a: Carruters et al., (1993), b: Burhanuddin, 2014, c: Ditjenkanbud (2008), d: Anggadireja et al., 2008, e: Aslan, 1991, f: Sediadi, 2000, g: Ruyitno et al., 2003, h: Ariyati et al., 2007.

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24.83 cm/sec. The results of water quality measurements for each treatment show that the temperature range is still in suitable conditions for the growth of sea grapes (*Caulerpa racemosa*), in accordance with the opinion of Burhanuddin (2014) that the water temperature range to support the life of *C. racemosa* is between 25 - 310C.

Several environmental factors that influence the growth of sea grapes at each planting distance are different, namely temperature, current speed, dissolved oxygen (DO), pH, sunlight and so on. The absorption of nutrients and absorption of sunlight used for the photosynthesis process for sea grapes can be influenced by the planting distance of the sea grapes themselves. This is reinforced by Sapitri's (2016) statement that environmental factors that influence the growth of seaweed include sunlight, nutrients in sea waters, water temperature, current speed, water pH, pests or diseases including the presence of large fish. Setting seaweed planting distances can affect competition for nutrients and will affect the absorption of sunlight.

The current speed at the time of the research ranged from 10.5-24.3 cm/sec. With this value, sea grapes are still said to be able to grow, but at different planting distances they grow differently. The growth of sea grapes in treatments B and C was lower than in treatment A. This may have happened because it was influenced by the weather at that time, such as the current speed being less than the optimum range, resulting in the growth of sea grapes being lower than in treatment A. This could have happened because of the current. less than optimum can result in low levels of nutrients needed for sea grape growth. According to Anggariredja et al. (2008) a good current range for sea grape cultivation is 20–40 cm/s. Current speed affects the oxygen supply in the waters. Currents that are too strong will cause a high oxygen supply, but plants will become damaged, broken and washed away. Meanwhile, currents that are too calm will inhibit the growth of sea grapes due to a lack of nutrient supply, and they will be covered by sediment or other debris. Furthermore, the Lombok Marine Cultivation Center (2012) stated that the survival of seaweed depends on the intensity of sunlight in photosynthesis and the magnitude of currents and waves which can cause the thallus to fall out or break.

CONCLUSSION

Based on the research results, it can be concluded that different plant spacings cultivated using the longline method have a significantly different effect on the growth of sea grapes (*Caulerpa racemosa*), both absolute growth and specific growth rates. The absolute growth value in treatment A averaged 201.87 grams, treatment B averaged 140.40 grams and treatment C averaged 130.93 grams. Meanwhile, the specific growth rate value in treatment A averaged 5.86%, treatment B averaged 4.83%, and treatment C averaged 4.46%. The different planting distances were in treatment A and treatment B, treatment B and C, and treatment C and A.

ACKNOWLEDGEMENT

Thanks are expressed to the fisheries service of Sumbawa Besar district and the residents of Tanjung Bele Village, Moyo Hilir District, Sumbawa Regency who have provided research in this place in 2018.

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