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The Influence Of Source, Seed Weight And Scattering Distance On The Growth Of Seaweed (Kappaphycus Alvarezii) In Mandale Waters Pangkep District, South Sulawesi

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Abstract

This research aimed to determine the effect of variety (local and kuljar), seed weight (50 gr, 75 gr, and 100 gr), and stocking distance (20 cm, 25 cm, and 30 cm). This research was carried out in June – August 2023 in the waters of Mandalle. The study used a completely randomized design (CRD) for groups of 3 factors, namely seed weight: 50 gr (P1), 75 gr (P2) and 100 gr (P3), stocking distance: 20 cm (Q1), 25 cm (Q2) and 30 cm (Q3), seed sources: local seeds (R1) and kuljar (R2). all treatments with 3 (three) replications. The research data were analyzed and continued with the Duncan BNT Test using SPSS 25. Growth measurements were carried out once a week for 35 days. The highest growth in the P3Q1R1 treatment was 3999.7 gr in week V. The results of the analysis of variance obtained the Sig (p) value for the variety variable (<0.05), the Sig (p) value for the seed weight variable (= 0.005) and the Sig value (p-value) stocking distance variable is 0.629 (>0.005). The results of the analysis of variance showed that the interaction between weight and variety had a value of sig (p) (<0.05), the interaction between weight and distance was sig (p) (> 0.05) and the interaction between distance and variety was sig (p) (>0.005). Meanwhile, the interaction of weight, distance and variety is sig (p)(>0.005). The BNT Duncan test results for the P3, Q2R1 weight treatment

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were the highest, namely 2435.93 gr and were significantly different from other treatments. The lowest P1Q3R2 treatment was 579.37 gr. The results of measuring water quality parameters show high temperature and salinity. To get optimal results, it is recommended to apply a treatment with a seed weight of 100 grams, a scattering distance of 25 cm and use local seeds.

Keywords: : interaction, variety, weight, stocking distance, growth

INTRODUCTION

Seaweed production has become one of the mainstay commodities for exporting Indonesian fishery products, even during the Covid-19 pandemic which caused a drastic decline in the global economy. Nevertheless, seaweed remains the main pillar in supporting the country's foreign exchange sources. In 2021, seaweed production in Indonesia will reach 9.12 million tons with an economic value of IDR 28.48 trillion, a decrease of 5.87% from the previous year which reached 9.68 million tons with a value of IDR 26.65 trillion ((KKP), 2019). South Sulawesi is the province with the largest seaweed production in Indonesia, reaching 3.79 million tons, followed by East Nusa Tenggara and West Nusa Tenggara with production of 1.36 million tons and 758,714.4 tons respectively (Astriana et al., 2019).

Based on production trends, seaweed production volume shows a decreasing trend from 2011 to 2021, although the production value has fluctuated during this period. This decline was caused by several factors, including seed quality, cultivation methods, climatic conditions, and problems faced by cultivators (Ismariani, 2019). One of the common problems faced by cultivators is the inconsistent availability of seeds, especially during the stocking season and when environmental conditions are less favorable. As a result, to meet cultivation needs, local seeds often have to be imported from outside the development area (Kasmi et al., 2023).

According to a report from the KKP Directorate General of Cultivated Fisheries in 2022, conventional use of seeds faces various problems. One of them is the high dependence on natural conditions for the availability of seeds. This causes the potential for a decrease in the quality of seaweed due to the repeated use of seeds. In addition, the age of the seeds often exceeds the expected standards, and there is no effort to improve the quality of the seeds.

The use of seeds obtained from nature also does not solve the problem, because variations in physiology can cause growth and agar content to be non-uniform. In addition,

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the use of leftover seeds from previous cultivation can cause other problems such as the spread of disease, which can result in a decrease in the quantity and quality of seaweed due to repeated use of seeds (Cokrowati et al., 2018). To overcome these problems, it is important to carry out stockings using genetically quality seeds. By using quality seeds, it is hoped that we can overcome various problems associated with the conventional use of seaweed seeds.

Previous studies have been carried out to find solutions to this problem. One way is through the development of seaweed seeds through tissue culture (kuljar) . Currently, conditions in the field show good results in the production of K alvarezii seaweed which is the result of tissue culture. Several further studies have also been carried out to evaluate the effect of K alvarezii seeds resulting from tissue culture with sowing distance, seed weight (Ria Sapitri et al., 2016), source of seeds on the growth of K alvarezii (Astriana et al., 2019)(Cokrowati et al., 2018), planting depth (Ismariani, 2019), cultivation methods and origin of Gracillaria seeds verrucosa (Puspitarini et al., 2021)(Rochmady et al., 2015), as well as a comparison of the growth of local seedlings and tissue cultured seedlings (Cokrowati et al., 2018). However, it should be noted that there has been no research that has examined the influence of seed source or variety , weight and stocking distance by comparing tissue cultured seeds with local seeds.

The waters of Mandalle District are one of the locations in Pangkep Regency that produces seaweed (Rusli et al., 2020). In this region, seaweed farmers generally use local seeds , originating from nature or from other areas provided that the seeds meet the criteria or standards for good seeds. The use of local seeds causes seaweed production to be very fluctuating. At the moment, The use of tissue culture seeds (kuljar) at this location has never been done. Several reasons that cause this are 1) difficulty in obtaining seeds , 2) doubts from farmers regarding the results, due to consideration of the water conditions of the District. Mandalle such as low fertility levels , high turbidity and high salinity, especially in the dry season (April – October) .

Based on the above , research on the influence of seed source, seed weight and scattering distance, by comparing seedlings resulting from tissue culture (kuljar) with local seedlings originating from cultivated residues, needs to be carried out. This research aims to find sources of seeds that can provide maximum results that are suitable for cultivation in the waters of Mandalle District, Pangkep Regency.

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MATERIALS AND METHODS

Time, Place of Implementation

The research was carried out in May – August 2023, located in the coastal waters of Kec. Mandalle, Pangkep Regency. Growth data is measured in the field, while water quality data is carried out in-situ and at the Water Quality Laboratory, Department of Fisheries Cultivation, Pangkep State Agricultural Polytechnic

Materials and Equipment

Material :

- Seaweed seeds from tissue culture and local seeds
- Rapiah rope PE rope No. 2 PE rope No. 6
- Plastic float
- Ballast anchor

Equipment

- Flows meter (current speed)
- Hand Rafractometer (salinity)
- Secchi Disk (brightness)
- Global Position System (location coordinate point)
- DO meter (dissolved oxygen and temperature)
- TDS meter (turbidity)
- Scales (seaweed weight)
- Spectrophotometer (NO3-N and PO4-P)
- pH meter (pH)

Implementation Method

Location survey. A location survey was carried out to determine the most ideal location for cultivation by considering the distance from the river mouth of around 500 m (Patang & Yunarti, 2013)

Procurement of Seaweed seeds. The seaweed seeds that will be used are sourced from: kuljar products (obtained from BBAP Takalar) and local seeds (selected from leftovers from previous cultivation or local seeds imported from other locations)

Tying seaweed seeds is done on land. The weight of the tied seeds is adjusted to the research unit, namely: 50 gr (P1), 75 gr (P2) and 100 gr (P3). Spreading was carried out on long lines adjusted to the research unit, namely at a distance of 20 cm (Q1), 25

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cm (Q2) and 30 cm (Q3), while the distance between the ropes was 50 cm. The seeds used come from leftovers from previous maintenance or local seeds (R1) and tissue culture seeds (R2)

Growth measurements are carried out every week to see absolute growth. Meanwhile, control of dirt, pests and disease is carried out when measuring growth so that dirt, pests and disease do not become factors that influence growth during the research

Calculated parameters:

a. Absolute Growth

The absolute growth of seaweed was observed from the beginning to the end of the study, absolute growth was calculated using the absolute growth formula (Effendy, 2003).

$$\boldsymbol{G = Wt - W0}$$

With:

G : Average absolute growth (gr);

Wt: Seedling weight at the end of the study (gr);

W0: Weight of seedlings at the start of the study (gr).

Research design

The study used a completely randomized block design with 3 factors, as treatments (independent variables) were seed weight (P), respectively: 50 gr (P1), 75 gr (P2) and 100 gr (P3), stocking distance (Q) respectively. 20 cm (Q1), 25 cm (Q2) and 30 cm (Q3), respectively, source of seeds (R) conventional seeds (R1) and kuljar (R2). all treatments with 3 (three) replications, so the total experimental units are 3 x 3 x 2 x 3 = 54 experimental units

Water Quality Parameter Measurement

As a supporting factor for seaweed growth, water quality measurements were carried out, namely: temperature, salinity, brightness, current speed (once a week), NO3-N and PO4-P, pH and Oxygen (at the beginning and end of the research). Water quality measurements are carried out in situ and in the laboratory.

Data analysis

The research data is quantitative data, namely data from absolute growth measurements (biomass) for all treatments, namely: P1Q1R1, P1Q1R2, P1Q2R1, P1Q2R2, P1Q2R1, P1Q3R2, P2Q1R1, P2Q1R2, P2Q2R1, P2Q2R2, P2Q3R2, P2Q3R2, P3Q1R1, P3Q1R2, P2Q2R1 , P3Q2R2, P3Q3R1, P3Q3R2. The data obtained were

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analyzed with 3-factor factorial RAL using SPSS 25. If different results were obtained at p<0.05, continued with the BNT further test or Duncan test

RESULTS AND DISCUSSION

Absolute growth

Data from the absolute growth measurement results of the treatment are presented in Figure 1.

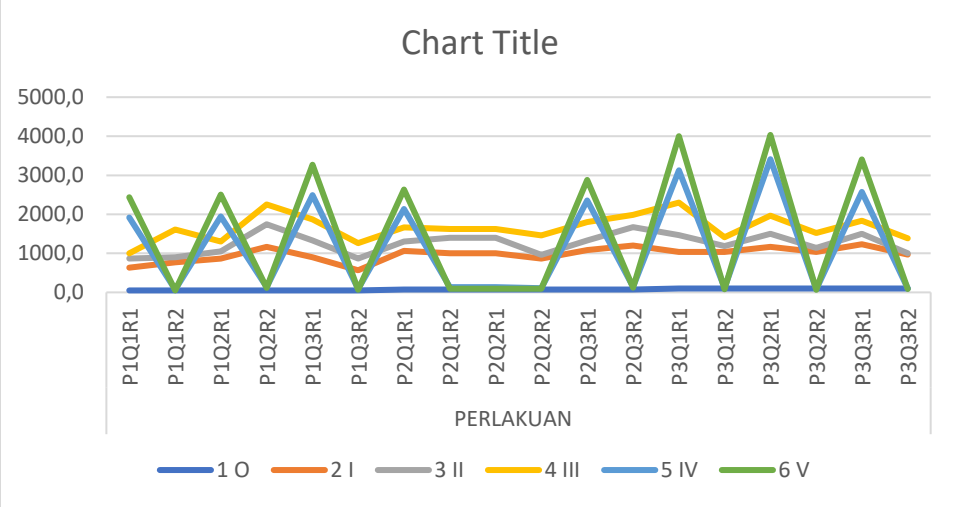


Figure 1. Absolute growth graph for each treatment for each week of observation

Based on Figure 1, it can be seen that the highest growth in the P3Q1R1 treatment was 3999.7 gr which was achieved in week V. It can be seen that the growth of K. alvarezii increased in all treatments in weeks I, II and III, but in weeks IV and V growth increased only in the seed treatment. local (R1) while cultivar seedlings (R2) have decreased growth due to seaweed thallus falling out due to ice-ice disease. The appearance of white thallus is thought to be caused by an increase in water temperature and low availability of nutrients. This is supported by previous researchers that the growth and spread of seaweed, like other aquatic biota, is influenced by physiological tolerance to external environmental factors such as substrate, salinity, temperature, light intensity, pressure and nutrition (Irfan et al., 2021). A high temperature increase causes the seaweed thallus to become pale yellowish, which makes the seaweed unable to grow properly. Therefore, a good water temperature for seaweed cultivation is 20-28°C with a maximum daily fluctuation of 4°C (Ismariani, 2019). The results of measuring water quality parameters in

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Table 10 show an increase in temperature, salinity and a decrease in the nutrients NO3-N and PO4-P in weeks IV and V.

The effect of variety on different treatments and weight and distribution distance on the growth of K alvarezii is presented in Figure 2.

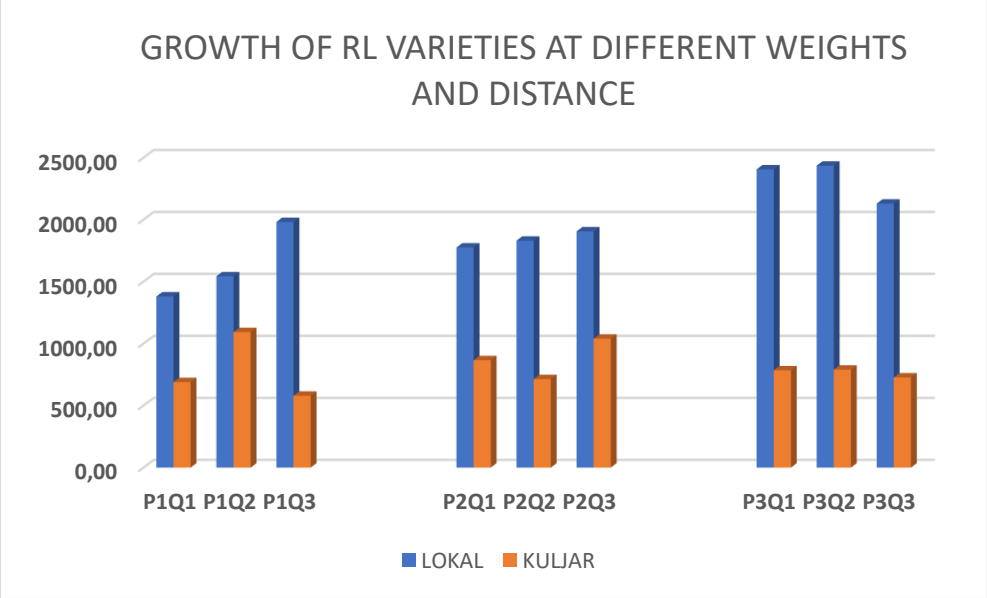


Figure 2. Growth graph of different varieties at different weights and distances

Figure 2 shows the growth of different varieties (local and kuljar) at different weights and stocking distances giving the highest yields for local seedlings in all weight and distance treatments. The highest growth was achieved in treatment (P3Q2). These results show that local seeds grow better and adapt to the waters in the district. Mandalle during the research. This is thought to be because local seeds have adapted to the environmental conditions in the waters of the district. Mandalle, while the seeds produced by kuljar are not yet fully able to adapt.

The results of the analysis of variance obtained a Sig (p-value) value for the variety variable (0.000) (<0.05) so that the Ho hypothesis was rejected and it was concluded that there was a very real difference in the influence of varieties on the growth of seaweed in Mandalle waters.

The effect of seed weight on the differences in spacing and variety treatments can be seen in Figure 3.

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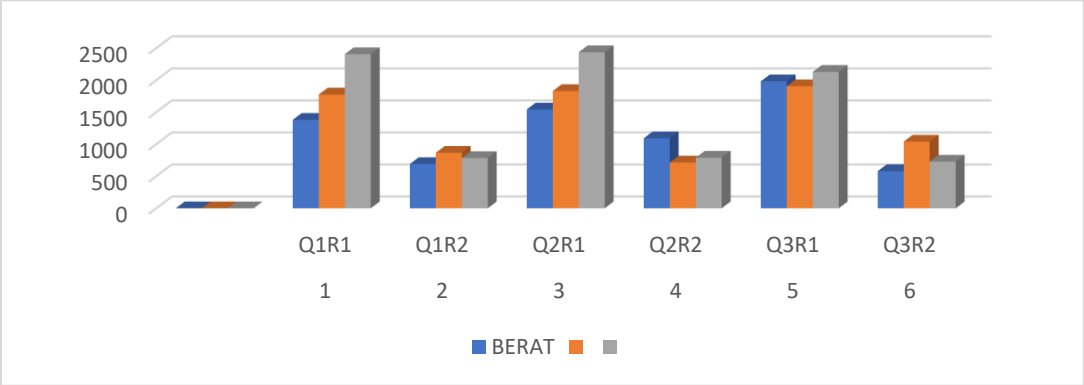


Figure 3. Growth graph of differences in weight at different distances and varieties

Figure 3 shows the effect of seed weight on stocking distance and different varieties gave the highest results in the 100 gr (P3) weight treatment compared to the 75 gr (P2) and 50 gr (P1) treatments.

The results of the analysis of variance (Table 1) obtained a Sig value (p-value) for the seed weight variable (0.005) so that the Ho hypothesis was rejected and it was concluded that there was a very real difference in the treatment of seed weight on the growth of seaweed in Mandalle waters.

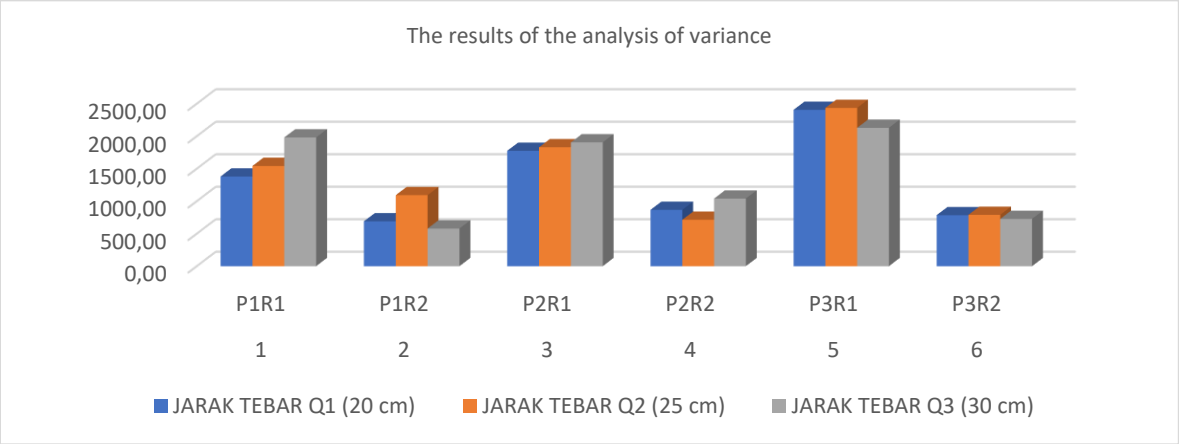


Figure 4. Growth graph of distance variables for different weights and varieties

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Figure 4 shows the effect of seed weight on stocking distance and different varieties give varying results. High growth at a spreading distance of 30 cm. This is possibly thought to be due to the correct planting distance and supported by the right current speed so that it is able to carry the nutrients needed for seaweed growth (Ismariani, 2019)

The results of the analysis of variance obtained a Sig (p-value) value for the stocking distance variable of 0.629 (>0.005) so that the Ho hypothesis was accepted and it was concluded that there was no significant difference in the treatment of stocking distance on the growth of Kappaphycus alvarezi seaweed in Mandalle Waters.

Interaction effects

The interaction effect of treatment weight, distance and variety or seed source was analyzed using SPSS. The results of the analysis of variance showed that the interaction between weight and variety had a sig value (p-value) = 0.002 (<0.05) so that the hypothesis was rejected and it was concluded that there was a real difference between the initial weight treatment and the seed source on the growth of K. alvarezi.

The interaction between weight and distance has a sig (p-value) = 0.259 (> 0.05) so that Ho is accepted and it is concluded that there is no real difference and the influence of weight and distance on the growth of K alvarezii in Mandalle Waters

The interaction of distance and variety has a sig (p-value) = 0.665 (>0.005) so that Ho is accepted and it can be concluded that there is no real difference in the effect of distance and variety on the growth of K. alvarezi in Mandalle Waters.

The interaction of weight, distance and variety has a sig (p-value) = 0.075 (>0.005) so that Ho is accepted and it is concluded that there is no real difference in the effect of the interaction of seed weight, stocking distance and variety on the growth of K. alvarezi in Mandalle Waters.

Analysis of variance (ANOVA) results of measuring the absolute growth of K alvarezi seaweed are shown in Table 1.

Table 1. Analysis of variance (ANOVA) by weight treatment, stocking distance and variety

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	20774078.513 a	19	1093372.553	13,190	,000
Intercept	101449070.945	1	101449070.945	1223.812	,000
DISTANCE	77808.989	2	38904.495	,469	,629
VARIETY	17005706.907	1	17005706.907	205.145	,000

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HEAVY	1012057.656	2	506028.828	6.104	,005
TEST	73945.938	2	36972.969	,446	,644
WEIGHT * DISTANCE	460447.543	4	115111.886	1,389	,259
WEIGHT * VARIETIES	1300483.014	2	650241.507	7,844	,002
DISTANCE * VARIETY	68416.690	2	34208.345	,413	,665
WEIGHT * DISTANCE * VARIETY	775211.776	4	193802.944	2,338	,075
Error	2818463.762	34	82895.993		
Total	125041613.220	54			
Corrected Total	23592542.275	53			

a. R Squared = .881 (Adjusted R Squared = .814)

The results of the analysis of variance showed that the interaction between weight and variety had a sig value (p-value) = 0.002 (<0.05) so that the hypothesis was rejected and it was concluded that there was a real difference between the initial weight treatment and the seed source on the growth of K. alvarezi.

The interaction between weight and distance has a sig (p-value) = 0.259 (> 0.05) so that Ho is accepted and it is concluded that there is no real difference and the influence of weight and distance on the growth of K alvarezii in Mandalle Waters

The interaction of distance and variety has a sig (p-value) = 0.665 (>0.005) so that Ho is accepted and it can be concluded that there is no real difference in the effect of distance and variety on the growth of K. Alvarez in Mandalle Waters.

The interaction of weight, distance and variety has a sig (p-value) = 0.075 (>0.005) so that Ho is accepted and it is concluded that there is no real difference in the effect of the interaction of seed weight, stocking distance and variety on the growth of K. alvarezi in Mandalle Waters.

To find out which treatment gave the smallest significantly different results, Duncan's further test was carried out as can be seen in Table 2.

Table 2. Results of Duncan's least significant difference (BNT) follow-up test

TREATMENT		Subsets							
		1	2	3	4	5	6	7	8
6		579.37							
2		690.23							
10		714.06							
18		727.49							
14		784.80							

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16		**789.89**							
8		**866.43**	**866.43**						
12		**1040.19**	**1040.19**	**1040.19**					
4		**1092.80**	**1092.80**	**1092.80**					
1			**1380.40**	**1380.40**	**1380.40**				
3				**1542.80**	**1542.80**	**1542.80**			
7					**1775.40**	**1775.40**	**1775.40**		
9					**1830.40**	**1830.40**	**1830.40**		
11					**1905.40**	**1905.40**	**1905.40**	**1905.40**	
5						**1981.47**	**1981.47**	**1981.47**	**1981.47**
17							**2129.20**	**2129.20**	**2129.20**
13								**2405.47**	**2405.47**
15									**2435.9**
Sig.		**,069**	**,052**	**,057**	**,052**	**.104**	**,189**	**,058**	**,085**

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = 82896.953.

a. Uses Harmonic Mean Sample Size = 3,000.

b. Alpha = 0.05.

Based on the table above, it can be concluded as follows:

Based on Duncan's BNT test, it was concluded that the P3 weight treatment, Q2 distance and R1 variety gave the highest growth yield, namely 2435.93 gr and was significantly different from other treatments, but not different from P3Q1R1 (2405.47 gr), P3Q3R1 (2129.20 gr) and P1Q3R1 (1981. 47 gr). Meanwhile, the P1Q3R2 treatment gave the lowest yield, namely 579.37 gr. To get optimal results, the recommendation that can be applied is to use the P3Q2R1 treatment

Water quality parameters

Data from measurements of water quality parameters during the research are shown in Table 3.

Table 3. Results of measuring water quality parameters during the research

PARAMETER	WATER QUALITY RANGE VALUES	DECENT RANGE	REFERENCE
TEMPERATURE (oC)	27.3-32.4	27 - 30	Kusnender (2002)
SALINITY (PPT)	29-33	28 - 35	Aslan (1998)

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BRIGHTNESS (CM)	0.4 - 0.5	0.5 - 1.0	Astriana (2019)
CURRENT SPEED (m/s)	0.6 - 0.9	0.2-0.4	Mamang (2008)
NO3-N (ppm)	0.0513 -0.0279	0.9 - 3.5	Atmadja et al. (1996)
NH3-N (ppm)	0.0003-0.0004	0.01 - 0.7	Aslan (1998)
PO4-P (ppm)	0.0035 - 0.0066	0.1 - 3.5	Kapraun (1978)
DO (ppm)	6.5-6.9	5.1 - 6.6	Aslan (1998)

Phosphate (P)

The nutrients P and N are needed by seaweed for its growth. Generally, the P element that can be utilized by aquatic plants is in the form of ortho-phosphate (PO4-P), while the nitrogen that can be absorbed is in the form of nitrite (NO2), nitrate (NO3), and ammonium (NH4), but it is mostly absorbed by plants are in the form of ammonium (NH4), because it can be utilized directly by plants. Nitrate (N) levels in unpolluted waters are usually higher than ammonium (N) levels. Nitrate (N) is the main form of nitrogen in natural waters and is the main nutrient for plant and algae growth, because nitrate is very soluble in water and is stable (Effendi, 2003).

Nitrate (NO3)

According to Aslan (1998), nitrate (NO3) and phosphate (PO4) levels affect algae reproduction if these nutrients are abundant in the waters. A good range of nitrate in the ocean for living organisms is 0.01-5 mg/l (Luning, 1990). According to Susanto (1999), one effort that can be made to stimulate the growth of seaweed is by adding organic fertilizer. Widyastuti et al. (2007) stated that cell enlargement in plants is due to the addition of nutrients. These nutrients cause cells to grow. Sea water has limited nutrient content which is not sufficient for the needs of aquatic plants and must be supplemented with the addition of N and P elements so that it meets needs (Yufdy and Jumberi, 2002)

CONCLUSIONS

The highest growth in the P3Q1R1 treatment was 3999.7 gr which was achieved in week V. The results of the variance analysis obtained a Sig value (p-value) **for the variety variable** (0.000) (<0.05) so that the Ho hypothesis was rejected, the results of the variance analysis Sig value (p-value) of the **seed weight variable** (0.005) so that the Ho hypothesis is rejected and the results of the analysis of variance obtained a Sig value

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(p-value **) of the stocking distance variable** of 0.629 (>0.005) so that the Ho hypothesis is accepted

The results of the analysis of variance showed that **the interaction between weight and variety** had a sig value (p-value) = 0.002 (<0.05) so the hypothesis was rejected. **The interaction of weight with distance** has a sig (p-value) = 0.259 (> 0.05) so that Ho is accepted and **the interaction of distance and variety** has a sig (p-value) = 0.665 (> 0.005) so that Ho is accepted. Meanwhile, **the interaction of weight, distance and variety** has a sig (p-value) = 0.075 (>0.005) so Ho is accepted.

Duncan's BNT test results concluded that the P3 weight treatment, Q2 distance and R1 variety gave the highest growth yield, namely 2435.93 gr, and was significantly different from other treatments, but not different from P3Q1R1 (2405.47 gr), P3Q3R1 (2129.20 gr) and P1Q3R1 (1981. 47 gr). Meanwhile, the P1Q3R2 treatment gave the lowest yield, namely 579.37 gr.

SUGGESTION

To get optimal results, it is recommended to apply a treatment with a seed weight of 100 grams, a scattering distance of 25 cm, and use local seeds.

Further research needs to be carried out to see the influence of differences in seed sources or varieties cultivated during the rainy season.

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