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Analysis of the Growth Rate of Seaweed (*Kappaphycus alvarezii*) with the Longline Method Using Tissue Culture Seed Results in Tual City

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Abstract

The availability of K. Alvarezii seaweed seeds in terms of adequate quantity, quality and continuity is one of the fundamental problems for the development of its cultivation. This study aims to determine the growth rate of seaweed tissue culture seeds, K. alvarezii with treatment on local seeds. Seaweed seedlings after being weighed are planted using the long line method and measured in weight after 30 days of maintenance. Sampling of water quality parameters is carried out every week periodically. At the end of the maintenance period, weighing is carried out to determine the absolute weight growth, daily weight and daily specific growth. The data from weighing and observation were analyzed descriptively, quantitatively, and qualitatively. The results obtained showed excellent growth and almost uniform seed size in tissue culture seed yields. All water quality parameters are in the decent to optimal range. Tissue culture seeds are considered suitable for development in the waters of Fiditan Village, North Dullah Island District, Tual City.

Keywords: *Seed culture; tissues; Kappaphycus alvarezii; longline*

Abstrak

Ketersediaan bibit rumput laut K. Alvarezii dalam hal kuantitas, kualitas dan kontinuitas yang memadai merupakan salah satu masalah mendasar bagi pengembangan budidayanya. Penelitian ini bertujuan mengetahui laju pertumbuhan bibit kultur jaringan rumput laut, K. alvarezii dengan perlakuan pada benih lokal. Bibit rumput laut setelah ditimbang ditanam dengan metode long line dan diukur beratnya setelah 30 hari pemeliharaan. Sampling paramater kualitas air dilakukan setiap minggu secara periodik. Pada akhir masa pemeliharaan dilakukan penimbangan untuk mengetahui pertumbuhan berat mutlak, berat harian dan pertumbuhan spesifik harian. Data hasil penimbangan dan observasi dianalisis secara deskriktif kuantitatif dan kualitatif. Hasil yang diperoleh menunjukkan pertumbuhan yang sangat baik dan ukuran bibit yang hampir seragam pada hasil benih kultur jaringan. Keseluruhan parameter kualitas air berada pada kisaran yang layak sampai dengan optimum. Bibit kultur jaringan dianggap layak dikembangkan di perairan Desa Fiditan Kecamatan Pulau Dullah Utara Kota Tual.

Kata Kunci: benih kultur; jaringan; *Kappaphycus alvarezii; longline*

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INTRODUCTION

The potential of Indonesian waters in producing seaweed is very high and in the eyes of the world is known as a seaweed bank. Based on the results of the land feasibility study, it is known that almost the entire coastal area of Tual City is a suitable location for the development of seaweed cultivation. Based on the results of the land feasibility study, it is known that almost the entire coastal area of Tual City is a suitable location for the development of seaweed cultivation.

One of the fundamental obstacles in efforts to develop *Kappaphycus alvarezii* seaweed in the upstream sector is the availability of seeds in adequate quantity, quality and continuity. Seeds are the first factor of production as the largest variable cost in cultivation operations. Several research results show that the rampant attack of ice ice disease is a scourge for

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cultivators, one of which is caused using poor-quality seeds because the pattern of spreading pathogenic bacteria that cause ice-ice also occurs vertically from the parent to the young cuttings/thallus which are used as seeds, (Yulianto, 2003).

Repeated use of seeds from the same source will result in "genetic bleaching", which has an impact on decreased productivity, decreased carrageenan content and gel strength and increased susceptibility to disease (Hurtado & Cheney, 2003; Mulyaningrum, 2018). The obstacle in the development of seaweed cultivation is that the quality of seaweed seeds is still low, such as: dwarf growth/slow/not optimal, susceptible to pests and diseases, easily covered with moss, not resistant to environmental stressors and the absence of standard seed production stages/processes (Baedah, 2011). One of the breakthroughs currently being made is the use of tissue culture seeds. Seaweed produced through tissue culture techniques has the advantage and advantage of being able to be cultivated in murky waters, able to survive at low salinity and one more resistant to high rainfall.

With the advantages that tissue culture seaweed has, the obstacles that have been faced in seaweed cultivation such as location, salinity, and rainfall constraints, can be overcome so that it can encourage an increase in national seaweed production, especially the K. alvarezii type. In addition, the growth of seaweed from this tissue cult is also faster than natural seaweed. In natural seaweed, the increase in the weight of seaweed was 12 times the weight of the seedlings measured at the age of 20 days, while in cultured seaweed seedlings, the weight increased by 15 times, (Soebjakto, 2013).

The seaweed seeds from the tissue culture of eucheuma Kappaphycus alvareziii were taken from the water quality laboratory of SMK Negeri 1 Tual. The seeds from this tissue culture are cultured using a simple method. Once used in cultivation activities in the sea of the city of Tual, the behih products experienced a good growth rate until harvest. However, the research on the Analysis of the Growth Rate of *Kappaphycus alvarezii* Seaweed Using the Longline Method Using Tissue Culture Seed Results in the Waters of Fiditan Village, North Dullah Island District, Tual City. has never been studied, so with this research it is necessary to carry out.

METHOD

This research was carried out in the waters of Fiditan Village, North Dullah District, Tual City, from March 30 to April 28, 2025, with the consideration that the area is the livelihood center of seaweed farmers. Seaweed seeds from tissue culture in the form of the first generation of thallus were obtained from the Laboratory of SMK Negeri 1 Tual, then weighed with an initial weight of 50 grams each according to the SNI 7673.2.2011 standard and planted as many as six clump points using the long line construction method. The seeds were randomly tied with the non-cultured seeds on three stretch ropes using a 1.5 mm diameter PE rope with a distance between clumps of 25 cm and were given a numbering code on the float bottle for easy identification. After 30 days of maintenance, each clump was weighed to calculate absolute growth, daily growth, and daily specific growth, where absolute growth was calculated using a formula (Fortes, 1989; Castell & Tiews, 1980) as presented in the table below:

Table 1.
Seaweed Growth Analysis Formula

Growth Parameters	Rumus	Information
Absolute Growth	G = Wt – Wo	G is absolute growth (g), Wo is the initial weight of seedlings (g), Wt is the weight of seedlings on day t (g)
Daily Growth	DG = (Wt – Wo) / t	DG is daily growth (g days^{-1}), t is the maintenance length (days)
Daily Specific Growth	SGR = [(ln Wt – ln Wo) / t] × 100%	SGR is daily specific growth (% days^{-1})

Sources: (Fortes, 1989; Castell & Tiews, 1980)

Growth analysis includes absolute growth, daily growth, and daily specific growth calculated using the formula as presented in Table 1 (Fortes, 1989; Castell & Tiews, 1980). Wo is the initial weight of the seedlings, Wt is the weight of the seedlings on day t, and t is the length of maintenance time. Measurement of water quality parameters including temperature, salinity, pH, and brightness is carried out periodically once every week at 12.00 WIT using thermometers, hand refractometers, digital pH meters, and secchi disks, because the quality of the waters has a direct effect on the growth rate and health of seaweed (Lobban & Harrison, 1997). Seaweed control and cleaning is carried out every day by shaking the clump to reduce epiphytic attachment, as well as observations are made for possible pest and disease attacks. Observation of seed morphology was carried out visually at the end of the maintenance period, and all data obtained were analyzed descriptively, quantitatively and qualitatively to describe the growth performance and morphological conditions of seaweed during the study period.

RESULT AND DISCUSSION

Population of fluorescent Vibrio bacteria

Growth data *of K. alvarezii* from tissue culture seeds using the long line method provides relatively good growth every week. Planting seeds with an initial weight of 50 gr. The weekly growth of each seed can be seen in table 2:

Table 2:
Growth data *of K. alvarezii* from tissue culture seeds using the long line method

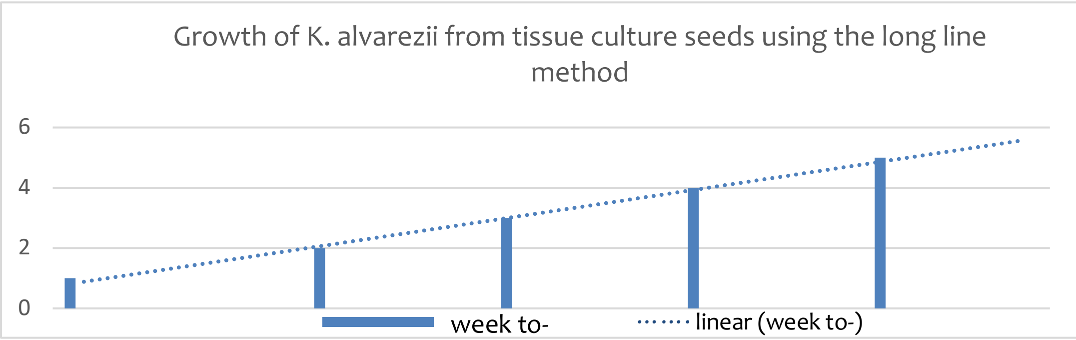
Week 1	Treatment	Growth *of K. alvarezii* from tissue culture seeds using the long line method (gr)
1	P-1	60,00 gr
	P-2	57,00 gr
	P-3	62,00 gr
2	P-1	189,00 gr
	P-2	165,00 gr
	P-3	208,00 gr
3	P-1	296,00 gr
	P-2	260,00 gr
	P-3	308,00 gr

4	P-1	352,00 gr
	P-2	331,00 gr
	P-3	389,00 gr
5	P-1	454,00 gr
	P-2	398,00 gr
	P-3	492,00 gr

Source: Weighing and Analysis Data, (2025)

The growth data of K. alvarezii from tissue culture seeds using the long line method obtained during the research is then presented in Figure 1.

Figure 1:
Growth graph of K. alvarezii from tissue culture seeds during 5 weeks of research



Source: Weighing and Analysis Results Data (2025)

The growth in week 1 experienced a relatively small increase in weight compared to week 2, because in week 1 the seaweed was still adjusting to the surrounding environment and was still in the wound healing stage due to cuts when seaweed would be used.

This is in accordance with Riris *et al.* (2019) who stated that at 7 days of planting, seaweed is still in the acclimatization stage, the acclimatization of this causes the talus in seaweed to not be able to adapt properly, so the growth is a little slow. Seaweed can grow optimally and experience relatively good weight gain in the 2nd week. This is because environmental factors in the form of temperature, salinity, pH, light intensity, planting depth, and strong currents obtained at the cultivation location have the right range for cultivation activities (Table 3).

This is in accordance with Aldoni (2011) who stated that after undergoing a good adaptation phase and supported by good environmental conditions, seaweed will experience an optimal growth increase. In addition to environmental factors that support growth in the 2nd and 3rd weeks, the pests obtained are also still at low intensity. In weeks 4 and k-5, they experienced relatively good weight gain due to environmental factors that supported growth. In this phase, seaweed has experienced a good adaptation phase, so that the growth every week has increased.

The environmental conditions at the cultivation site greatly affect the success of cultivation. Therefore, in this study, water quality observation was carried out which was observed once every 1 week for 5 weeks of research. The parameters observed include Temperature, Salinity, pH, and Depth. The results of water quality observations during the study are shown in Table 2:

Table 2:

Value of water quality parameters during the study period

No.	Water Quality Parameters			
	Temperature (°C)	Salinity (ppm)	pH	Brightness (m)
1.	29	32	7,7	7, 33
2.	28	31	7,8	7, 33
3.	28	31	7,8	6, 59
4.	28	31	7,8	7, 33
5.	29	32	7,7	7, 33

Source: Water Quality Measurement and Analysis Results Data (2025)

Based on the data obtained, the temperature ranges from 28 -29 °C. The feasible temperature range for seaweed cultivation is 27-30°C (Neish, 2005). The salinity is between 31 - 32 ppm, where the recommended salinity range is 25 - 35 pmm. As for the pH, the range is between 7.7 - 7.8 which means that it is in the optimal pH range of 7.2 - 8.3 (Kadi & Almadja, 1988). The brightness value obtained ranges from 6.59 - 7.33 m, greater than the minimum required value of 5 m (Sujatmiko & Angkasa, 2004). Thus, based on several water quality parameters observed, it shows that the values obtained are all within the range of feasible to optimal for seaweed growth.

Growth of *K. alvarezii* Local Seed Yield Using the Long Line Method

Growth data *of K. alvarezii* from local seeds using the long line method provides relatively poor growth in a few weeks due to the continuous use of seeds and is susceptible to pest and disease. Planting seeds with an initial weight of 50 grams is the same as the initial weight of the seeds from tissue culture. The weekly growth of each seed can be seen in Table 4.

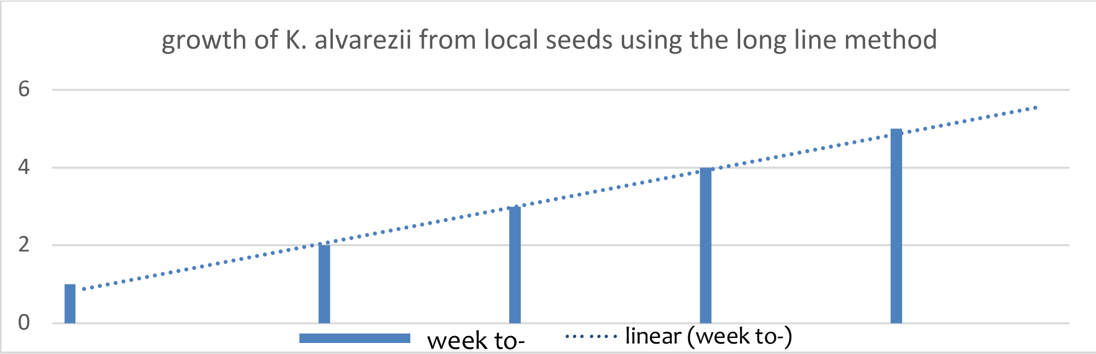
Table 4:
Local yield K. alvarezii growth data using the long line method

Week 1	Treatment	Growth of K. alvarezii from local seeds by long line method (gr)
1	P-1	55,00 gr
	P-2	65,00 gr
	P-3	60,00 gr
2	P-1	72,00 gr
	P-2	85,00 gr
	P-3	78,00 gr
3	P-1	102,00 gr
	P-2	180,00 gr
	P-3	97,00 gr
4	P-1	196,00 gr
	P-2	202,00 gr
	P-3	158,00 gr
5	P-1	230,00 gr
	P-2	287,00 gr
	P-3	200,00 gr

Source: Weighing and Analysis Results Data (2025)

The growth data of K. alvarezii from local seeds using the long line method obtained during the study are then presented in Figure 2.

Figure 2:
Growth graph *of K. alvarezii* local seed yield during 5 weeks of research



Source: Weighing and Analysis Results Data (2025)

On the growth graph of *K. alvarezii*, ocal seed yields have the same development as the growth charts *of K. alvarezii*, tissue culture seeds, but have different weight growth. The growth of tissue culture seed weight has 7 times the weight compared to the growth of local seed weight. The growth of local seed weight has decreased due to exposure to pests and diseases due to the repeated use of seedlings so that young people are attacked by pests and diseases. In contrast to tissue culture seeds, which range from pests and diseases, because the seeds are sterilized for 30 days using culture media that contains the nutrients and hormones needed for growth to produce superior seeds.

Analysis of growth weights and percentage growth rate *of K. alvarezii* from tissue culture seeds

Data on initial weight, final weight and absolute growth analysis, daily growth and daily specific growth of K. *alvarezii seedlings* from tissue culture seeds are presented in table 5.

Table 5:
Initial Weight, Final Weight, Absolute Growth, Daily Growth and Daily Specific Growth of Seaweed Seeds Tissue Culture After 30 Days of Maintenance

Treatment	Wo (gr)	Wt (gr)	G (gr)	DG (gr/day)	SGR (%)
P-1	50,00	454,00	404,00	13,47	7,35
P-2	50,00	398,00	348,00	11,60	6,91
P-3	50,00	492,00	442,00	14,73	7,62
$\bar{X}$	50,00	448,50	398,50	13,27	7,31

Source: Data Analysis Results, (2025)

Based on Table 4. It can be seen that at the age of 30 days the average absolute growth (G) is 398.50 grams or around 7.31 times the weight of the initial seedlings The daily growth (DG) obtained shows that every day the average weight gain is 13.27 grams. Meanwhile, the daily specific growth (SGR) ranges from 6.91 – 7.62%. The growth rate that is considered favorable is above 3% of weight gain per day (ICECRD 1991; Anggadiredja et al., 2006). Based on the G, DG and SGR values show almost uniform growth, where the values obtained are higher and the minimum limit is required. This indicates that tissue cultured seaweed seeds are able to adapt well to the aquatic environment of Fiditan Village, North Dullah Island District, Kota Tua.

Analysis of growth weights and percentage growth rate *of K. alvarezii* local seed yields

Data on initial weight, final weight and absolute growth analysis, daily growth and daily specific growth of K. *alvarezii seedlings* from local seeds are presented in table 6:

Table 6:

Starting Weight, Final Weight, Absolute Growth, Daily Growth and Daily Specific Growth Seaweed Seeds Local seed yield After 30 days of maintenance

Treatment	Wo (gr)	Wt (gr)	G (gr)	DG (gr/day)	SGR (%)
P-1	50,00	230,00	180,00	6,00	5,09
P-2	50,00	287,00	237,00	7,90	5,82
P-3	50,00	200,00	150,00	5,00	4,62
$\bar{X}$	50,00	239,50	189,50	6,30	5,22

Source: Data Analysis Results, (2025)

Based on Table 4.5, at the age of 30 days, the average absolute growth (G) is 189.50 grams or around 5.22 times the weight of the initial seedlings. The daily growth (DG) obtained shows that every day the average weight gain is 6.30 grams. Meanwhile, the daily specific growth (SGR) ranges from 4.62 – 5.82%. The growth rate that is considered favorable is above 3% of weight gain per day (ICECRD 1991; Anggadiredja et al., 2006). Based on the values of G, DG and SGR showed uniform growth and reached the minimum limit but the value obtained was smaller compared to the value of the seeds from tissue culture. This indicates that local *K. alvarezii* seaweed seeds can adapt to the aquatic environment of Fiditan Village, North Dullah Island District, Tual City, but have a smaller weight growth value compared to the growth of *K. alvarezii seaweed* seeds resulting from tissue culture due to the continuous use of seeds.

CONCLUSION

Based on the results of the research that has been conducted, it can be concluded that *Kappaphycus alvarezii* seeds from tissue culture show better growth performance compared to local seedlings. This is indicated by higher initial and final weight values, as well as the results of the analysis of absolute growth, daily growth, and daily specific growth that are consistently larger in tissue culture seedlings. These differences indicate that tissue culture seedlings have more adaptability and a more optimal growth rate during the maintenance period, which is thought to be related to the physiological quality of the seedlings being more uniform, disease-free, and having a more stable growth potential than local seedlings. These findings confirm that the use of *K. alvarezii seeds* from tissue culture has the potential to increase the productivity of seaweed cultivation, especially in long line cultivation systems in controlled waters, so that it can be an alternative source of sustainable superior seeds for the development of seaweed cultivation business.

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