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# Application Of Pes Fertilizer To The Growth Of *Kappaphycus alvarezii* Plantlets

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**Abstract**

This study aims to determine the growth of Kappaphycus alvarezii plantlets applied with different PES fertilizers. This research was conducted at Blitok Installation, brackish water aquaculture center, Situbondo. This study began with the preparation of water as a maintenance medium, acclimatization of plantlets in the greenhouse, maintenance of plantlets in the greenhouse (plantlet cleaning, fertilization), and checking water quality. The application dose of PES fertilizer given as treatment was 15 ml, 20 ml, and 25 ml which was repeated 3 times. The rearing design used a completely randomized design (CRD) model. The results obtained showed that the average absolute weight gain of planlets from the 15 ml treatment was 0.249 g - 0.271 g, the 20 ml treatment was 0.35 g - 0.432 g, and the 25 ml treatment ranged from 0.306 g - 0.372 g. For the specific growth rate from the first to the fifth week of rearing, the 15 ml treatment ranged from 3.162-1.693, the 20 ml treatment ranged from 3.922-4.21 and the 25 ml treatment ranged from 2.899-3.904. From the results of the study, it can be concluded that the application of a PES fertilizer dosage of 20 ml gave better growth than the 15 ml and 25 ml doses.

Keywords: growth, *Kappaphycus alvarezii*, plantlets, PES fertilizer, dosage

## INTRODUCTION

Aquaculture has been a recognized term for several decades that refers to the cultivation of aquatic organisms in freshwater, brackish, and marine environments (Pillay & Kutty, 2005). By 2020, aquaculture in Asia will reach 214 million tonnes, including 178 million tonnes of aquatic organisms and 38 million tonnes of seaweed (FAO, 2022). Seaweed is one of the most popular marine commodities in the community. Many coastal communities utilize seaweed as a cultivation commodity to generate income and process it into useful materials such as jelly, cosmetics, and food (Prabowo et al., 2018). In Indonesia, seaweed reached 11.6 million tonnes in 2016, the world seaweed production is around 30 million tonnes so Indonesia contributes almost 40% of the total world seaweed production (FAO, 2018 in Yusran et al., 2021).

Trademap data in international trade shows that Indonesia is one of the main players with an export volume in 2018 of 213 thousand tonnes (an increase of one with a contribution of 30% of total world exports). In Indonesia, the potential for marine algae or seaweed development is very large due to the availability of very large land, the diversity of marine algae species is high, the cultivation technology is simple and the capital required is relatively small (KKP, 2018).

Seaweed farmers in Indonesia still face various problems such as low productivity, low seaweed quality standards at the cultivator level, low bargaining power between traders and processors, high transport costs, and low technology levels. Low seaweed prices can also trigger a decrease in seaweed exports to various countries, especially *Kappaphycus alvarezii*, which has led to a decrease in the motivation of farmers and seaweed production. The decline in production is also caused by the low quality of seawater around the cultivation site.

Therefore, it is necessary to provide superior and quality seaweed seeds that can be pursued through the production of superior and quality seaweed seeds using tissue culture methods. Tissue culture has been widely developed to deal with the problem of seed availability in plants that are difficult to breed generatively. Tissue culture itself has the benefit of producing seeds quickly and in large quantities, the continuity of seed availability remains without having to depend on the season and the quality of the seeds produced is the same as the parent (Sulistiawati, 2015).

Seaweed is different from most land plants, seaweed does not have roots to absorb nutrients, so the availability of nutrients around the thallus will greatly affect growth. Lack of nutrients will usually cause the seaweed to be stunted, so efforts are made to add nutrients through fertilization. A common fertilizer for macroalgae is Provasoli's Enrich Seawater (PES) (Yuliana, 2013).

PES is a type of feed with nitrogen and phosphate content that is important for the process of cell growth and restoration (Karim, 2019). PES fertilizer has been applied with low concentrations ranging from 0 ml to 11 ml where the concentration of 8.5 ml gives a better effect on the growth of seaweed, *Kappaphycus alvarezii* (Rosyida et al., 2019). Another study showed that a concentration of 10 ml PES fertilizer increased the weight gain of *Kappaphycus alvarezii* propagules (Yuniarti et al., 2018). The addition of a PES fertilizer dose of 0.5 ml is believed to increase the weight of seaweed (Supriyono et al., 2022).

Based on the above review, this research was conducted to determine the growth of plantlet *Kappaphycus alvarezii* through the application of PES fertilizer.

## METHOD

This research was conducted at the Situbondo Brackish Water Aquaculture Centre (BPBAP) (Blitok Installation), Bungatan, Situbondo Regency, East Java.

### Material

Tools and materials used in acclimatization of *Kappaphycus alvarezii* plantlets include Gex LL aquarium size 30 cm x 30 cm x 60 cm, PUSO aeration hose diameter 8-11 mm, cylindrical aeration stone size 20x30 mm, Amara pump AA-106, hi blow RESUN LP100 Low, washing sponge, sunlight detergent, PES fertilizer, seawater with salinity 28-33 ppt.

### Procedure

### Water Preparation

The media for plantlet acclimatization uses seawater with a salinity of 28-33 ppt which is pumped and then goes through several stages of filtration/filtering. Seawater is channeled through pipes to a filter basin equipped with charcoal and silica sand and then continued to the settling basin. After the settling process, the water is channeled to the reservoir level for storage and then channeled to the reservoir in the greenhouse. Seawater contained in the reservoir in the greenhouse is usually precipitated for 1 x 24 hours before being used for rearing media.

### Plantlet Acclimatisation in Greenhouse

*Kappaphycus alvarezii* plantlets are acclimatized and reared in greenhouse aquaria before being cultivated in the open sea. The installation for plantlet acclimatization is the same as for seaweed broodstock acclimatization, which is an aquarium equipped with a recirculation system. *Kappaphycus alvarezii* plantlets originating from the tissue culture laboratory were acclimatized in a wet laboratory (greenhouse). The temperature in the rearing media must first be equalized so that the plantlets are easier to adapt to. After the temperature in the bottle is in accordance with the room temperature in the greenhouse, the *Kappaphycus alvarezii* plantlet is removed from the jar to be cleaned first by brushing the plantlet using a fine brush in order to clean the moss attached to the plantlet.

### Plantlet Maintenance in the Greenhouse

a. Plantlet Cleaning

Rearing of *Kappaphycus alvarezii* plantlets in the greenhouse is usually done by cleaning plantlets and changing water once a week. Plantlet cleaning is done to keep the seaweed clean and avoid moss attached, cleaning the plantlet is done by scraping the moss attached to the plantlet in the same direction using a soft-bristled toothbrush, cutting and removing parts of the thallus that become white because if left unchecked the seawater will quickly become cloudy and slimy.

b. Fertilization

Fertilization carried out in the plantlet acclimatization process in the greenhouse uses the immersion method. Plantlet fertilisation uses three dose categories including 15 mL, 20 mL and 25 mL. For each dose, three maintenance aquariums were used and then each dose of PES fertilizer was dissolved in a plastic bucket containing seawater with a salinity of 30 ppt. In order for the fertiliser to be homogeneous quickly the container containing the solution was aerated for ±8 hours.

**Water Quality Monitoring**

There are several measurements of water quality parameters such as temperature, salinity, pH, and dissolved oxygen (DO). Measurement of these parameters is carried out once a week before changing the water during growth observation.

**Data Analysis**

**Absolute Growth**

The absolute growth of seaweed was observed from the beginning to the end of the study absolute weight growth was measured using the formula (Effendy, 1997).

$$G = Wt - W0$$

where:
G = Average absolute growth (g)
Wt = Average weight at the end of observation (g)
W0 = Average weight at the beginning of observation (g).

**Specific Growth Rate**

The growth rate of *Kappaphycus alvarezii* seaweed was conducted once a week to determine the growth of Kappaphycus alvarezii. The daily growth rate can be calculated using the following formula (Togatorop, 2017):

$$\mathrm{SGR}(\%) = \frac{LnWt - LnWo}{T} x\ 100$$

Where:
SGR : Daily Growth Rate (%/day)
Wo : Initial weight (g)
Wt : Final weight (g)
T : rearing period (day)

Observations used a completely randomized design (CRD) consisting of 3 treatments with different doses. Treatments were repeated 3 times, resulting in 9 experimental units. Treatments in this observation include:

a. PES fertiliser (Provasoli Enriched Seawater) 15 mL
b. PES fertiliser (Provasoli Enriched Seawater) 20 mL
c. PES fertiliser (Provasoli Enriched Seawater) 25 mL.

Tabel 1. lay Out Wadah Pemeliharaan

| **P2U2** | **P3U2** | **P3U3** |
|---|---|---|
| **P1U2** | P3U1 | P1U1 |
| **P1U3** | P2U1 | P2U3 |

## RESULT AND DISCUSSION

**Growth**

**a. Absolute Growth**

The average absolute weight growth of *Kappaphycus alvarezii* seaweed plantlets obtained from the immersion of PES fertilizer with different doses can be seen in Figure 1.

The results in Figure 1 show that the average absolute weight growth of treatment a ranged from 0.249 g - 0.271 g, treatment b between 0.35 g - 0.432 g, and treatment c with a range of 0.306 g - 0.372 g. It can be seen that treatment a (15 ml/L) was lower than the other two treatments. It can be seen that treatment a (15 ml/L) is lower than the other two treatments. It is suspected that the fulfillment of nutritional needs in this treatment is not sufficient to support the growth of seaweed plantlets. The highest growth was obtained in treatment b (20 ml/L) which is thought to be due to the dose of fertilizer given being able to meet the needs of nutrients to support the growth of seaweed plantlets (Kappaphycus alvarezii). Nutrient needs can be fulfilled properly, if the addition of nutrients in seaweed is adapted to the


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needs of the seaweed itself (Nurfebriani et al., 2015). Nutrients needed by seaweed are not sufficient if it only comes from the maintenance media, but also require the addition of fertilizers to get optimal growth. Lack of nutrients will inhibit the growth of seaweed while excess nutrients will affect the growth of seaweed (Yuliana et al., 2013).

The growth process will not be separated from various factors, both internal and external factors to the plantlets are maintained. Internal factors that influence, among others, the type of seaweed, body parts (talus), and the age of the plantlet, while external factors that influence, among others, the physical and chemical state of the waters (Nursyam, 2013) include water movement, temperature, salinity, nutrients, and light.

**b. Specific Growth Rate**

The results of observations on the specific growth rate of plantlets are presented in Figure 2

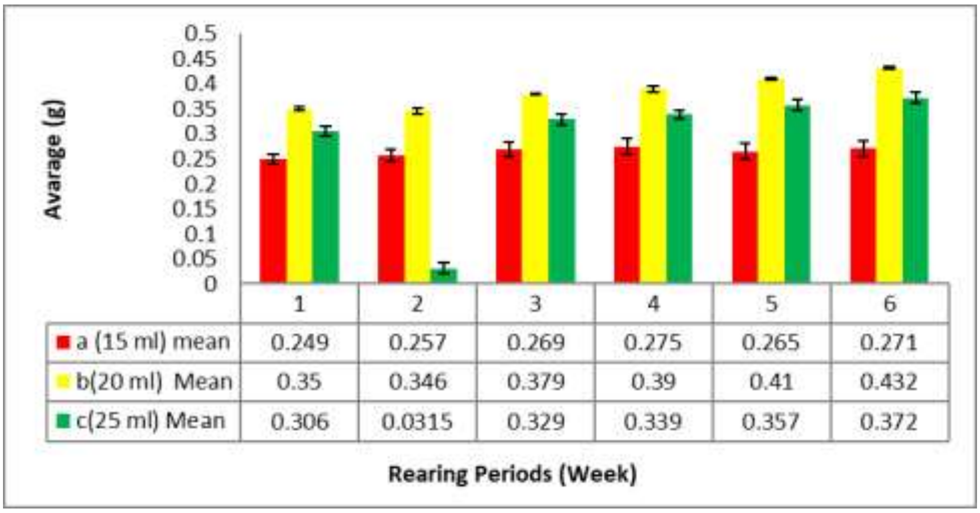


Figure 1. Absolute Weight Gain of seaweed plantlets

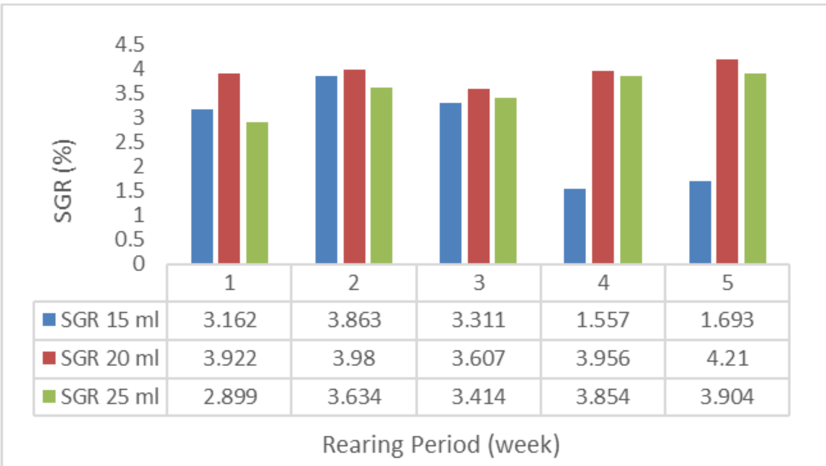


Figure 2. Specific Growth Rate (SGR) of *Kappaphicus alvarezii* plantlets

Based on Figure 2, it can be seen the growth rate in plantlets every week from several treatments. For the 15 ml dose treatment, the specific growth rate reached a range of 3.162-1.693, the 20 ml treatment between 3.922-4.21, and the 25 ml dose treatment with an interval of 2.899-3.904. The best specific growth rate (SGR) is treatment b (20 ml) which every week experienced a higher growth of 3.9% in the first week to 4.21% in week 5.

The high value of this growth rate is thought to be due to the dose of fertilizer given is able to suffice nutrients in the talus to support the growth of plantlets Kappaphycus alvarezii. Seaweed growth requires nutrients for the formation of new tissues or talus in order to maintain its survival (Yuliana, 2013). Seaweed living in media that has sufficient nutrient content has the potential to form new talus (Nursyam, 2013). In treatment a (15 ml) the specific growth rate in week 2 was 3.86% in week 3 was 3.31%. In the following week, the growth of plantlets decreased by 1.55%, this occurred because the plantlets experienced death and were broken during cleaning. In the 5th week, the plantlets increased but the value was not much different from the previous week.

Plantlet death can occur because the nutritional needs of this treatment are not met to support its growth. *Kappaphycus alvarezii* seaweed grown on maintenance media enriched with PES fertilizer with adequate nutrient requirements will increase its survival in the range of 40-80% supported by a high specific growth rate (Suryati et al., 2010). Nutrient deficiencies will inhibit seaweed growth while excess nutrients will affect seaweed growth (Yuliana, 2013). On the other hand, it is possible that the low growth rate is also caused by broken talus during handling in the cleaning process. A broken talus will result in the death of plantlets that facilitate the invasion of bacteria or pests in the maintenance media.

**Water Quality**

The results of water quality measurements during the study conducted once every 1 week are listed in Table 1.

Table 1. Water quality of seaweed (*Kappaphycus alvarezii*) plantlet maintenance media

| Treatment | Water Quality Range | | | |
|---|---|---|---|---|
| | Temperature (°C) | Salinity (ppt) | pH | DO (mg/l) |
| a | 28-31 | 30-32 | 7,0-7,3 | 5,73-5,8 |
| b | 28-31 | 30-31 | 7-7,3 | 5,59-5,89 |
| c | 28-30 | 29-31 | 7,1-7,6 | 5,43-5,76 |

The range of water quality parameter values during the observation is still in the normal range to support the life of seaweed plantlets (Kappaphycus alvarezii) in both temperature, salinity, pH, and DO.

Temperature is one of the important factors for the growth of seaweed plantlets (Nurfajri and Nasmia, 2023). Temperatures that are too high or too low can affect the growth rate of seaweed and can even cause death in seaweed. The temperature obtained in the maintenance media during the 6 weeks of observation ranged from 28-31oC and is still within the tolerance range by seaweed. Generally, Kappaphycus alvarezii can live and thrive in the temperature interval between 24-35oC (Mairh et al., 1986). Water temperature that meets the requirements for seaweed ranges from 20-30°C (Ruslaini, 2016).

Salinity can also affect the spread of seaweed in the waters. Seaweed generally lives in the sea with salinity between 30%-32%. Salinity plays an important role in the life of seaweed, salinity is too high or too low will cause disruption to the physiological processes of seaweed (Yuliana, 2013). Salinity can affect seaweed fertility during the maintenance period (Ruslaini, 2016). Salinity during the observation period of 6 weeks ranged from 29-32 ppt and can be said that salinity is in a condition that can still be tolerated by seaweed (*Kappaphycus alvarezii*). Salinity with a range of 30-33 ppt is the standard quality of suitability of salinity waters for seaweed cultivation (Sahoo and Yarish, 2005). The range of salinity that is feasible for seaweed growth is 33-35 ppt with an optimal salinity of 33 ppt (Ruslaini, 2016).


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The degree of acidity (pH) is a chemical factor that plays a role in determining the good or bad growth of seaweed (Ruslaini, 2016). Conditions pH maintenance media suitable for the development of seaweed *Kappaphycus alvarezii* is 7.3-8.4 (Sudrajat, 2009; Nursyahran and Reskiati, 2013). The good pH value for seaweed growth ranges from 6-9 (Ruslaini, 2016).

Dissolved oxygen (DO) is a limiting factor for all living organisms and a basic requirement for the life of living things in the water (Susilowati et al., 2012). Aquatic organisms always depend on the availability of oxygen dissolved in these waters. Dissolved oxygen during the pemelharaan period ranged from 5.43-5.8 mg/L. The amount of dissolved oxygen required by seaweed *Kappaphycus alvarezii* for growth is 2-4 mg / L, but oxygen above 4 mg / L will provide better growth for seaweed (Sulistiawati, 2015).

## CONCLUSION

Treatment b with a PES fertilizer dose of 20 ml gave higher absolute growth and specific growth rate of *Kappaphycus alvarezii* plantlets at 0.35 g - 0.432 g and 3.9 - 4.21%, respectively.

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