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Original Article

Culture of *Caulerpa lentillifera* on Screen Mats

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Abstract: *Caulerpa lentillifera* is one of the species of seaweeds cultivated commercially in the Philippines. *C. lentillifera* is either cultured in ponds or gathered from the wild. In this study, the use of screen mats as substrate for *C. lentillifera* was tested for small scale production in ponds or in shallow areas offshore. Seaweeds were fertilized once a day, twice a day, once a week, and after 15 days. The growth was determined after 30 days. The growth of *C. lentillifera* fertilized once a week was significantly higher at 5.65% a day than unfertilized *C. lentillifera* at 2.55% a day. The use of screen mats in ponds and shallow foreshore area for the culture of *C. lentillifera* could be recommended for small scale cultivation.

Keywords: *Caulerpa lentillifera, culture, seaweeds, screen mats*

1. INTRODUCTION

The demand for seaweeds is increasing among consumers because of its nutritional value for wellness. *Caulerpa lentillifera* is one of the species of seaweeds grown commercially in the Philippines. This has been cultured and popularly consumed as a delicacy in Cebu and Bohol, Central Visayas. *C. lentillifera* is naturally growing in the wild, in shallow areas, and also grown in ponds with very minimal input (Trono, 1988). It is sold locally and in nearby provinces of Cebu. *C. lentillifera* has the ability to adapt to environments with a salinity of approximately 25~35 ppt and water temperatures between approximately 23~33°C. Production is best in April and May. *C. lentillifera* is usually found in nutrient rich shallow areas where light is abundant. Different methods of growing *C. lentillifera* were tested to increase biomass. The use of tray, patented by Paul et al. (2014), is used in Australia for intensive culture of *C. lentillifera*. The tray is similar to a heavy-duty black box (L×W×H = 1 m × 1 m × 0.06 m) with cover. In the Philippines, *C. lentillifera* cultured in nylon baskets showed better growth than cage type box when grown in muddy substrate in the open water (Tanduya et al., 2013). Rabia (2016) compared the growth of *Caulerpa* in trays and sowing in the pond. Sowing (like rice planting) showed better result after 30 days. *Caulerpa* was efficient in reducing the total ammonia nitrogen when co-cultured with sand fish and snail (Dobson et al., 2020). Largo et al. (2016) tried growing *Caulerpa* in bamboo baskets as a biofilter in an integrated multitrophic aquaculture system, however, growth was not sustainable. The use of fertilizer was tested in *Caulerpa* by Pimolrat et al. (2022) and showed treated seaweeds had better growth than the control after 56 days (0.7% a day specific growth per day).

C. lentillifera is rich in phosphorous, calcium, magnesium copper, iodine, and dietary fiber (Ratana-Arporn & Chirapart, 2006), which made this sea-vegetable popular among weightwatchers and health enthusiasts. The increasing demand of this species could threaten the existing natural stock in the wild. Thus, this study aims to ease the pressure of harvesting or gathering of natural stock that may cause the depletion of the resource in the wild by introducing a new method of cultivation for small scale production of *C. lentillifera*. This study was conducted to determine the optimum frequency of fertilization using inorganic fertilizer using screen mat as a substrate for *C. lentillifera*.

2. METHODOLOGY

Caulerpa lentillifera was transported from Bohol Island, Philippines. The seaweeds were acclimatized for 1 week in a tank before the experiment. Culture of *C. lentillifera* was done using a polyethylene screen mat with a mesh size of 1 cm. The design of the screen mat (Figure 1) was adapted from the method used in Phetchaburi Inland Fisheries Research and Development Center (PIFDC)-Department of Fisheries, Thailand with modifications. *C. lentillifera* was spread over the screen mat (0.5 × 0.5 m^2) and covered the seaweeds with another screen mat with the same size as stated earlier, creating a “sandwich” type pattern (net-seaweed-net) and then sewing screen mats loosely together with a nylon twine from the four corners towards the center to keep the seaweed stationary and stable. The stocking density was 500 g per 0.25 m^2 screen mat.

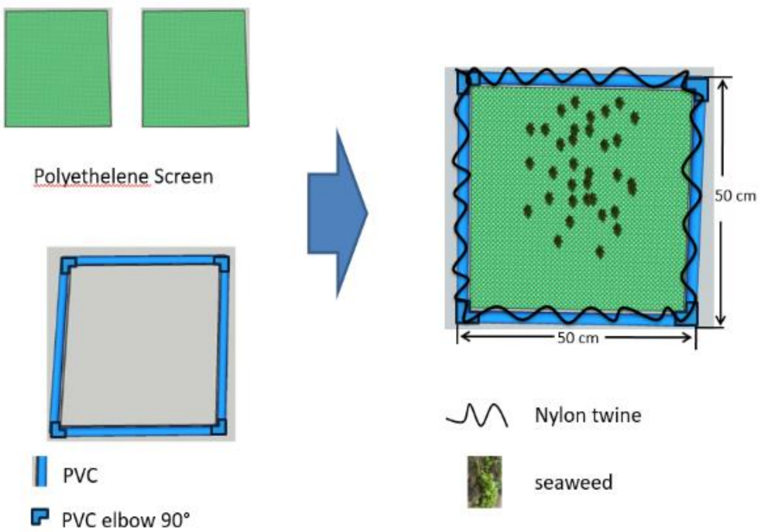

Figure 1. Prototype of the plastic screen mats with frame.

The screen mat had a polyvinyl chloride (PVC) pipe (½ inch diameter) frame to keep the screen mat sturdy and flat. Screen mats were suspended in tanks (1.6 m^3 capacity) at approximately 0.5 meter from the surface. The seawater in the tank was flowed through the system with a flow rate of 2 L/min. Fertilizers used were 16-20-0 and 46-0-0 at 0.3 g/L and 0.16 g/L, respectively. The experimental design was CRD (Complete Randomized Design). Fertilization was done by dissolving the fertilizer in a bucket with seawater and pouring the content into the tank: Treatment 1, once a day; Treatment 2, twice a day; Treatment 3, once a week; Treatment 4, on the 15^{th} day and; Treatment 5, without fertilization in three (3) replicates. Application was done in the morning at 0800 h and 1600 h in the afternoon (Trt 2).

The mats with seaweeds were stocked randomly in 15 tanks by draw lots and cultured for 28 days. The shortest and longest assimilator was measured from the base to the tip using a ruler after the culture. Seawater flow was shut down before the application of fertilizer and then resumed 1 hour after the application of fertilizer. Aeration was switched on during fertilization only for proper mixing. Weighing was done before the start of the experiment and after 30 days at harvest. The data obtained from the study were subjected to Analysis of Variance (ANOVA) to determine the differences between treatments and Duncan Multiple Range Test (DMRT) to determine the groupings of the treatments. Growth was computed as specific growth rate using the following formula:

$$\mu = \frac{\ln(fw) - \ln(iw)}{\text{Days of culture}} \times 100$$

where $\boldsymbol{fw}$ is the final weight and $\boldsymbol{iw}$ is the initial weight.

Light was measured using a LiCor meter. Salinity was measured using a refractometer and temperature was measured using an ordinary thermometer. Regular cleaning of the seaweeds was done.

3. RESULTS AND DISCUSSSION

The growth rate of *Caulerpa lentillifera* (Figure 2) is significantly higher when fertilized once a week (Trt 3: 5.65% day^{-1}) than the control (Trt 5: 2.55% day^{-1}) and seaweeds fertilized once a day (Trt 1: 4.32% day^{-1}). Growth rate of seaweeds fertilized once a week (Trt 3: 5.65% day^{-1}) is not significantly different when seaweeds were fertilized twice a day (Trt 2: 5.22% day^{-1}) and after 15 days (Trt 4: 4.62% day^{-1}). Growth rates of seaweeds fertilized once a day (Trt 1), twice a day (Trt 2), and after 15 days (Trt 4) are not significantly different. Growth rates of seaweeds fertilized once a day (Trt 1: 4.32% day^{-1}) and unfertilized *C. lentillifera* (Trt 5: 2.55% day^{-1}) were not significantly different.

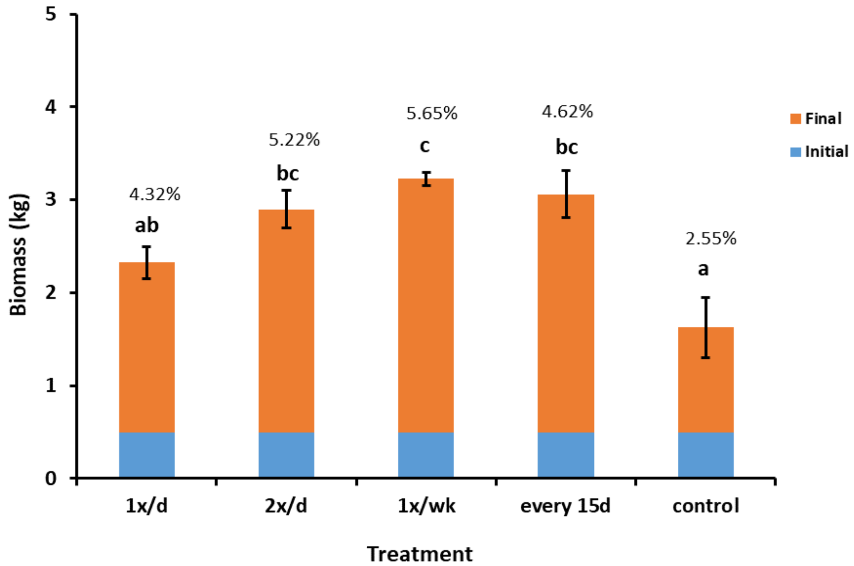

Figure 2. Growth of *Caulerpa lentillifera* at different fertilization rate. Bars with no letter(s) in common are significantly different (a and c, a and bc, ab and c) while bars with letter(s) in common are not significantly different (a and ab, ab and bc, bc and c).

The branches or assimilators are the branches arising vertically from the horizontal stolon in *C. lentillifera*. The branches were measured after 28 days (Table 1). The length of the branches in Trt 1 (fertilized once daily) was between 2 and 12.5 cm; Trt 2 (fertilized twice daily) was between 3.5 and 14.5 cm; Trt 3 (fertilized once a week) was between 4 and 13.5 cm; Trt 4 (fertilized after 15 days) was between 1 and 8.5 cm; and Trt 5 (unfertilized) was between 1.5 and 8 cm. The growth rates and the length of the branches of *C. lentillifera* (Figure 3) with fertilization were apparently higher than without fertilization. Longest branch was observed at 14.5 cm when *C. lentillifera* was fertilized twice a day and, at 13.5 cm when seaweed was fertilized once a week (Trt 3). The longest branch of *C. lentillifera* was 130 mm or 13 cm in the study of Estrada et al. (2020) from Coron, Palawan and 70 mm or 7 cm from Iloilo, Philippines. The branches of *C. lentillifera* enriched once a week (Trt 3 – 13.5cm) had the same length as the longest branch in the collection of Estrada et al. (2020) and is longer than the branches of *C. lentillifera* collected in Iloilo. The growth rates of seaweeds enriched once a day (Trt 1), twice a day (Trt 2), and once a week (Trt 3) were not significantly different. From the results of this study, enrichment done once a week (Trt 3) is cheaper compared to fertilizing the seaweeds once a day or twice a day. The growth rates were not significantly different, but the cost of production will be less if fertilizing is done once a week. This will translate to bigger profit or income. Salinity was 29-32 ppt and temperature was 27-29°C. Irradiance was 1008-1104 photon/m^2/sec at noontime. Salinity and temperatures during the culture was within the range given by Trono (1988) and Guo et al. (2015 a, b) showed good growth in this study.

Table 1. Length of assimilators of *C. lentillifera.*

Treatment	Length of branches (cm)
1×/day	2.0 - 12.5
2×/day	3.5 - 14.5
every 7 days	4.0 - 13.5
15 days	1.0 - 8.5
Control	2.0 - 12.5

Short-term fertilization was also effective in other seaweeds, e.g., *Kappaphycus* (Luhan et al., 2015) and *Gracilaria* (Santander et al., 2015). Pond culture is the traditional way of growing *C. lentillifera*. Pond preparation is done before the culture. The sizes of *C. lentillifera* ponds in Bohol, Philippines and Cebu, Philippines were one hectare and bigger. Pond management requires so much time to maintain the seaweeds in big ponds. Harvesting of *C. lentillifera* is done by manually picking the seaweeds from the pond bottom. Stepping on the seaweeds in ponds is one source of losses during harvest because the seaweeds are not visible to the harvester due to murky pond water. Harvesting *C. lentillifera* using this method is easier because the screen mat can be lifted, and harvesting is done by cutting the branches that grew above the surface of the screen mat. The screen mat could be cleaned and replanted again with the new batch of stolon with rhizoids. This can be installed in shallow areas offshore with sufficient sunlight or in ponds. The mats could be installed in ponds cultured with shrimp for water conditioning, like in Thailand (PIFDC). Growing *C. lentillifera* in the sea has advantages over pond culture. Nutrients are replenished naturally and continuously. It has low maintenance, and there is no need for pond preparation because fertilization could be done by soaking the seaweeds in enriched water. Less labor is involved because there will no dikes to maintain. In this study, the seaweeds planted on screen mats could resist water movement created by waves in shallow areas offshore. The seaweeds are not easily dislodged because they are sewn on the mat. The cost of materials is cheap and easy to fabricate.

Figure 3. Growth of *C. lentillifera* at 7 days (left) and 30 days (right).

4. CONCLUSIONS

To conclude, fertilization of *C. lentillifera* once a week has better growth rate than application of fertilizer once a day, twice a day, once a month, and unfertilized seaweeds. *C. lentillifera* grown in screen mats were fertilized with 16-20-0 at 0.32 g/l and 46-0-0 at 0.12 g/l. The conditions in the tanks during the culture were salinity: 29-32 ppt; temperature: 27-29 ^{o}C; and irradiance: 1008-1104 photon/m^2/sec at noontime.

5. ACKNOWLEDGMENT

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