© 2018 IJSRST | Volume 4 | Issue 10 | Print ISSN : 2395-6011 | Online ISSN : 2395-602X
Themed Section: Science and Technology

Effect of Different Seed Weight and Planting Distance on the Growth Gracilaria Verrucosa (Gracilariales, Rhodophyta) Cultivated Using the Vertical Rope in the Brackishwater Pond

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ABSTRACT

Gracilaria is one type of producing agar (agarofit) seaweed which is widely found in Indonesian waters. Agar contain gelatin-based hydrocolide compounds commonly used as thickening agents in the food industry. Differences in initial biomass and spacing significantly affect the growth of seaweed. This is related to the competition of each individual seaweed in getting nutrients. The success of the planting system is influenced by the use of good quality of seeds and the appropriate weight will increase the growth. The aim of this research is to know the influence of seed weight and spacing to the specific growth of seaweed Gracilaria verrucosa by using vertical rope method. The experimental design used was Factorial Design, where factor A (weight of seed 50 g, 100 g, and 150 g) and factor B (spacing of 20 cm, 30 cm and 40 cm). The observed variable is the specific growth rate. The result of ANOVA showed that the difference of seed weight and spacing significantly influenced ($P < 0.01$) the growth of G. verrucosa. The highest specific growth was found on seed weight of 50 g, 5.4% day^{-1} and 30 cm seed distance factor of 4.2% day^{-1}.

Keywords : Gracilaria Verrucosa, Growth, Vertical Rope Method, Brackishwater Pond

I. INTRODUCTION

Cultivation Gracilaria verrucosa plays an important role in efforts to increase the capacity of Indonesian fishery production because seaweed is included in the fisheries revitalization program which is expected to play an important role in improving the welfare of the community [1]. The increase in its use is not only limited to food production but has expanded as in the use of seaweed as an ingredient of beauty products, medicines, and raw materials for other industrial activities. [2] stated that the cultivation of G. verrucosa in the pond can economically increase income and provide added value for coastal communities, because the community can utilize productive land for family welfare through seaweed cultivation. Seaweed cultivation has several advantages because it uses simple technology, can produce high value production goods with low production cost, thus becoming a commodity for coastal community empowerment. Availability of seaweed in the natural amount is increasingly limited, so it takes cultivation techniques to increase the amount of seaweed production so that demand can be met in a sustainable manner.

Seaweed has been used as a vegetable, ingredients for medicinal or pharmaceutical use, phycocolloid sources,

food and raw materials for fertilizer [3-5]. Amino acids, vitamins, and minerals content of seaweed reach 10-20 times more than the land plants. Mineral contents of seaweed found among others which are necessarily for the metabolism of the human body are iodine, calcium, and selenium [6]. [7] suggests that the marine algae of Rhodophyta (red algae) has potential as an anti-bacteria.

The main obstacle in the achievement of production amount, allegedly one of the factors from the determination of initial seed weight and spacing in the cultivation. Therefore we need a study related to seed weight and spacing is good ingrowth G. verrucosa. According to [8], the balance between the amount of nutrients and the density of the plant is needed so that the plant can grow without nutrient deficiency, the planting of seaweed with a low density of stocking equilibrium in the absorption of nutrients / kg body / hour is better than the high stocking density. Seaweed research that tested is G. verrucosa with different seed weight and spacing, because the high density of the stocking, causing the space to become narrow, consequently difficult to grow. The purpose of this research is to know the specific growth of G. verrucosa which is cultivated with different seedling weight and spacing in pond by using vertical rope method.

II. METHODS AND MATERIAL

LOCATION AND RESEARCH DESIGN

This research was conducted at Lakawali Beach Village, Malili, South Sulawesi Province. Laboratory analysis was conducted at Fisheries Laboratory, Hasanudin University, Makassar.

Research begins with the preparation of the location of ponds that meet the criteria of determining success in the cultivation of seaweed G. verrucosa.. Culture media in the form of rectangular plot made of bamboo and wood. The cultivation method uses a cultivation plot in which 1 plot contains 4 wooden stakes and 2 transverse woods as the main rope lever or rope by attaching a buoy to each end of the rope and stretch as a float buoy and weights.

CULTIVATION METHOD

This research uses vertical rope method. During the cultivation activities carried out seaweed control / maintenance every 2 days by cleaning the moss and dirt and pest disturbance. The growth rate was determined using the following formula [9-16]: DGR = $[(W_t / W_0)^{t/1} -1] \times 100\%$; DGR is daily growth rate (% day^{-1}), W_t is weight at t week, W_0 is the weight at previous week and t is the length of maintenance. Growth rate was analyzed applying Analysis of Variance (ANOVA) continued with Least Significant Difference (LSD).

III. RESULTS AND DISCUSSION

SPECIFIC GROWTH SEAWEED

Analysis of Variance (ANOVA) Specific growth rate showed a growth difference between all treatments, growth G.verrucosa obtained during the study (Figure 1). Average specific growth G.verrucosa higheston factor A with weight seeds 50 g (5.4% day^{-1}) and weight of 100 cm (3.7% day^{-1}) seedlings and the lowest weight of 150 cm (3.0% day^{-1}) seeds. While on factor B with the highest planting distance 30 cm (4,2% day^{-1}) then spacing 20 cm (4.0% day^{-1}) and lowest at plant spacing 40 cm (3,8% day^{-1}) (Figure 2). The interaction between the two factors did not have a significant effect on the specific growth of G. verrucosa (Figure 3). Variety analysis showed that the treatment of factor A and factor B had a very significant effect on the growth of seaweed G. verrucosa. Further test results of the Smallest Real Differences (BNT) show very significant differences between treatments.

Based on the result of variance analysis, it can be seen that specific growth of factor A treatment with initial weight 50 g has better growth than treatment (100 g),

and (150 g). Allegedly low weight of seaweed at the beginning of planting causes the absorption of nutrients in the process of metabolism of seaweed can work with the maximum. In accordance with the statement [17] that nutrient fulfillment greatly affects the growth of seaweed.

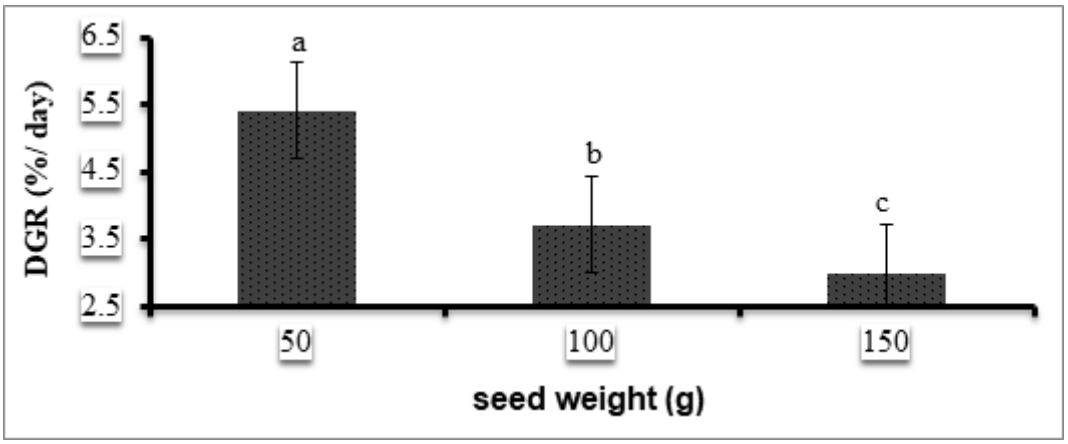

Figure 1. Specific growth rate of seaweed G. verrucosa on different seed weight with vertical rope method. Data with significant differences are indicated by different letters (Duncan test; $p < 0.05$).

The highest growth that occurred in this phase is suspected because G. verrucosa quickly adapt to the waters, nutrients are still quite a lot so it can support the growth rate of seaweed cultivated. The low rate of growth occurring in this phase is thought to be due to competition between the test plants in limited space utilization, so that branching and growth of new shoots marked by the number of branches become obstructed.

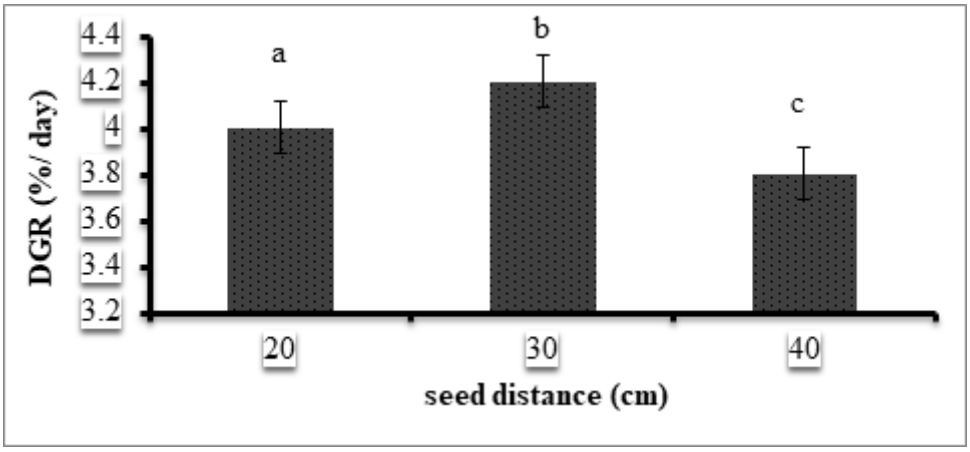

Figure 2. Specific growth rate graph of seaweed G. verrucosa at different seedlings of the vertical rope method. Data with significant differences are indicated by different letters (Duncan test; $p < 0.05$).

The high DGR in the treatment of seed distance 30 cm compared with the treatment of seedlings of 20 cm and 40 cm, it is suspected the distance between the seeds one with other seeds are close together so that competition to get very small nutrients that result directly to low growth, as well as treatment distance 40 cm seeds allegedly planted seeds do not get the optimal intensity of sunlight that resulted in low growth.

Seaweeds can grow optimally if they have sufficient nutrient supply and continuously get good sun intensity to help the photosynthesis process. According to [18] the amount and quality of light is very influential in the process of photosynthesis

because it can spur cell division activity resulting in the process of widening and extension where eventually the seaweed tends to grow well.

In addition, seaweed can utilize sunlight more optimally as an energy source for photosynthesis and can help seaweed to obtain nutrients or nutrients because the increase in photosynthesis process can improve the ability of seaweed to obtain nutrients or nutrients [19].

If the optimal spacing of seedlings will provide opportunities and more space for seaweed to absorb nutrients in the water as a source of nutrients. In addition, with optimal distance will help facilitate the process of photosynthesis because each branch has the same opportunity to obtain sunlight. This is in accordance with [20] that the spacing of seedlings on rope generally ranges from 20 to 35 cm. If the spacing is too short, there will be plenty of seaweed bonds, so the opportunity of each seaweed branch to obtain nutrients as a food source is needed a bit and this will slow the growth [21]. This is in accordance with the statement [22] a seaweed cultivation is said to be good if the average daily growth rate of at least 3%.

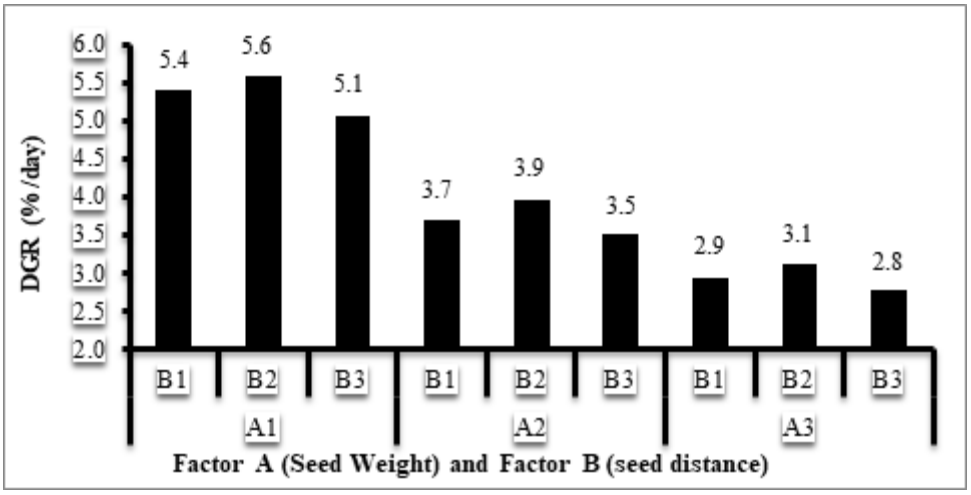

Figure 3. Specific growth rate interaction seaweed G. verrucosa factor A (seed weight) and factor B (seed distance) vertical rope method. Data with significant differences are indicated by different letters (Duncan test; $p < 0.05$).

IV. CONCLUSIONS

Different seedlings and spacing have an effect on the specific growth of G. verrucosa maintained by vertical rope method. The seed weight of 50 g and the spacing of 30 cm gives the best specific growth G verrucosa maintained by the vertical rope method

V. ACKNOWLEDGMENTS

Thanks to General Directorate of Higher Education of Indonesia that has provided the doctoral program scholarship. Thanks also goes to Raudi Madus as the technical assistance during the field

VI. REFERENCES

[1]. Handayani, T. Protein In Seaweed. Oseana, 2006. 31 (4): 23-30.

[2]. White, W. L. and P. Wilson. World seaweed utilization. Seaweed Sustainability, Food and Non-Food Applications. 2015. Pp: 7-25

[3]. Armisen, R. World-wide use and importance of Gracilaria. Journal of Applied Phycology. 1995. 7: 231-243

[4]. Arano, K. G., Trono Jr, G.C., Montano, N.E., Hurtado, AQ. and Villanueva, R.D. Growth, agar yield and quality of selected agarophyte species

from the Philippines. Botanica Marina. 2000. 43: 517-524.

[5]. 5McHugh, DJ. A guide to the seaweed industry. FAO Fisheries Technical Paper 2003. No. 441 : FAO

[6]. Burtin, P. Nutritional Value of Seaweed. Electronic J. Environ. Agric. Food J. Chem. 2006. 5 (3): 6

[7]. Choudhury, S., Sree, A., Mukherjee, S.C., Pattnaik, P., Bapuji. M. In Vitro Antibacterial Activity of Extracts of selected Marine Algae and mangroves Against Fish Pathogens. Journal of Asian Fisheries Science, 2005. 18: 185294.

[8]. Wang, M., L. Chen, Y. Li., L. Chen., S. Qin. Responses of soil microbial communities to a short-term application of seaweed fertilizer revealed by deep amplicon sequencing. Applied Soil Ecology. 2018. 125: 288-296

[9]. Mtolera M.S.P., Collen J., Pedersen M., Semesi A.K. Destructive hydrogen peroxide production in Eucheuma denticulatum (Rhodophyta) during stress caused by elevated pH, high intensity and competition with other species. Eur J Phycol. 1995. 30: 289-297

[10]. Gerung G.S., Ohno M. Growth rates of Eucheuma denticulatum (Burman) Collins et Harvey and Kappaphycus striatum (Schmitz) Doty under different conditions in warm waters of southern Japan. J Appl Phycol. 1997. 9: 413-415

[11]. Aguirre-von-Wobeser E., Figueroa F.L., Cabello-Pasini A. Photosynthesis and growth of red and green morphotypes of Kappaphycus alvarezii (Rhodophyta) from the Philipines. Mar Biol. 2001. 138: 679-686

[12]. Bulboa C.R., Paula E.J., Chow F. Laboratory germination and sea out-planting of tetraspore progeny from Kappaphycus striatum (Rhodophyta) in subtropical waters of Brazil. J Appl. Phycol. 2007. 19: 357-363

[13]. Hayashi L., Oliveira E.C., Bleicher-Lhonneur G., Boulenguer P., Pereira R.T.L., Seckendorff R., Shimoda V.T., Leflamand A, Vallee P., Critchley AT. The effects of selected cultivation conditions on the carrageenan characteristics of Kappaphycus alvarezii (Rhodophyta, Solieriaceae) in Ubatuba Bay, Sao Paulo, Brazil. J Appl Phycol. 2007a. 19: 505-511.

[14]. ayashi L., Paula E.J., Chow F. Growth rate and carrageenan analyses in four strains of Kappaphycus alvarezii (Rhodophyta, Gigartinales) farmed in the subtropical waters of Sao Paulo State, Brazil. J Appl Phycol. 2007b. 19: 393-399

[15]. Hung LD., Hori K., Nang HQ., Kha T., Hoa L.T. Seasonal changes in growth rate, carrageenan yield and lectin content in the red algae Kappaphycus alvarezii cultivated in Camranh Bay, Vietnam. J Appl Phycol. 2009. 21: 265-272

[16]. Yong YS, Yong WTL, Anton A. Analysis of the formula for determination of seaweed growth rate. J Appl Phycol. 2013. 25: 1831-1834

[17]. Erpin, Abdul Rahman and Ruslaini. Effect of Harvest Age and Seed Weight on Growth and Content Carrageenan Seaweed Eucheuma spinosum Using Long Line Method. 2013. Vol. 03 (12):156– 163. SSN : 2303-3959.

[18]. Qin, Y. Seaweed Bioresources, Bioactive Seaweeds for Food Applications. Natural Ingredients for Healthy Diets. 2018. pp. 3-24

[19]. Fernández-Segovia, I., M. J. Lerma-García, A. Fuentes, J. M. Barat. Characterization of Spanish powdered seaweeds: Composition, antioxidant capacity and technological properties. Food Research International. 2018. 111: 212-219.

[20]. Romimohtarto. Seaweed (Type, Reproduction, Production, Cultivation and Post Harvest). Oceanology-Research and Development Center-LIPI, Jakarta. 1987.

[21]. Widiastuti, I. and Novalina S., . Growth and Seaweed Production Eucheuma cottonii With Different Thallus Numbers. J. Scientific Agri Sains. 2010. Vol. 11 No. 1 April 2010.

[22]. Supratno, T.K.P. Proceeding of fisheries technology administration. center for brackishwater aquaculture development, Jepara. 2007.