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CONTROL OF ICE-ICE DISEASE AND GROWTH IN FARMING RED ALGAE *Kappaphycus alvarezii* (DOTY) DOTY THROUGH THE APPLICATION OF DIVERSIFICATION METHOD

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ABSTRACT

The farming of red algae Kappaphycus alvarezii (trade name Eucheuma cottonii) has grown rapidly in East Nusa Tenggara since 1999, which has contributed significantly to increasing the income of the communities and region. The biggest problem faced since a decade ago is the ice-ice disease phenomenon which attacks the farming of K. alvarezii, reducing production, and the farmer's income drastically. This experimental study aimed to minimize the ice-ice disease infestation in the farming of K. alvarezii through the application of diversification methods. This research was conducted in the farming area of K. alvarezii in Sulamu Waters from July-September 2020. An experimental method was tested in order to minimize ice-ce disease infestation. As a treatment, three longline nylon ropes were used with three replicates. The first line was placed by Gracilaria sp seeds; the second line by K. alvarezii seeds; while the third line by Sargassum polycystum seeds. The conventional farming method carried out by local farmers was used as control. The parameters tested were disease incidence and intensity as well as growth rate. The result showed that both treatment and control showed infestation of ice-ice disease. Farming with treatment using Gracilaria sp. and Sargassum polycistum gave better resistance to ice-ice disease compared to the one without (control). The treatment showed less incidence (12-38%), and intensity (0.05-0.435) of ice-ice disease compared to the control, 30-45% and 2,1-17,19% respectively. The contrary happened related to the growth rate. The control showed better daily growth (mean 4.74%) compared to the treatment (mean 4.70%).

Keywords: ice-ice disease; growth; *Kappaphycus alvarezii;* diversification; Sulamu Waters

INTRODUCTION

Farming of Red algae *Kappaphycus* spp. and *Eucheuma* spp. has developed rapidly since the demand for raw materials of carrageenan from industries such as food, cosmetics, pharmaceutical and others increased in many countries. Farming methods of *Kappaphycus* and *Eucheuma* in Indonesia started since 1985 with a bamboo raft and developed into longline since 1992. Now, longline and other methods are being developed by farmers extensively (Kasim and Asnani, 2012; Kasim *et al.*, 2016).

The farming of red algae *Kappaphycus alvarezii* (trade *name Eucheuma cottonii*) has grown rapidly in East Nusa Tenggara since 1999. It started in Kupang and Sulamu waters, which has contributed significantly to increasing the income of local communities and region.

In its development, seaweed farming in East Nusa Tenggara Province faces quite complex challenges. The main problem, identified about a decade ago, is the phenomenon of ice-ice disease. This disease attacks farming seaweed, and reduces production to about 10% remaining. As a result, the farmer's household income, even the region, has drastically decreased from this sector. This phenomenon usually occurs during the transitional season, and the peak summer season. The main cause of this problem is the decline in the quality of cultivated seaweed seeds. The seeds used by farmers have undergone thousands of times of multiplication, so that their resistance to environmental changes and pathogenic infections is decreasing. According to Aris, et al., (2013), the main disease that causes a decrease in production in all seaweeds farming development centers is ice-ice disease. The attack of these diseases not only reduces crop yields (60–70%), but can also cause crop failure (Hamsah & Patadjai, 2013 *in* Nurhidayati, *et al* 2015). Other factors that affect seaweed and can reduce its production include changes in salinity, water temperature, light intensity; these are the main factors that trigger the outbreak of ice-ice disease. When seaweed is stressed, it can facilitate ice-ice disease and epiphytic infection to attack under stressful conditions, it will release organic substances, which cause the thallus to slimy and stimulate bacteria, and the epiphyte grows abundantly (Vairappan, 2016).

Naturally, aquatic organisms including macro algae will react by releasing chemical compounds when they are stressed or are attacked by a predator or grazer. From this thinking, it is assumed that the farming of several species of seaweed in a certain location, known as diversification, is a solution to reduce the attack of ice-ice that attacks seaweed during times of stress. Several previous studies have found that the extract of *Sargassum* sp. has the potential to inhibit the growth of the *Vibrio* bacteria that caused ice-ice disease. Extract of *Sargassum* sp. is also has the potential as an antioxidant, as a raw material for making surfactants (Pakidi & Suwoyo, 2017).

This experimental study aimed to minimize the ice-ice disease infestasion, and analize the growth in farming of

Kappaphycus alvarezii through the application of diversification methods.

RESEARCH METHODS

Study Sites

This study was conducted on July to September 2020 in the one of the largest seaweed farming areas in Kupang District, namely Sulamu Village. The area which using off-bottom method covered by sand and rubbled with the average depth during low tides is 0.5 m and high tide was 1.5 m, while the area using longline method covered by sand and mud, with the average depth during low tides was 3 m and high tide was 5 m.

Seeds Preparation

Farming seaweed seedlings used was *Kappaphycus alvarezii* green variety from farmers in Sulamu Village. The seaweed seeds have just been taken from the location of farming for 35 days. The seeds that have been prepared are first cleaned of dirt or attaching organisms. The selected of seeds are young, fresh, clean and free epiphytes.. Planting was done in the morning. While the wild seaweed used were *Sargassum polycistum* and *Gracilaria* sp. (Figure. 1)

K. alvarezii

Sargassum polycystum

Gracilaria sp.

Figure 1. Seaweeds Used in The Experimental Farming

Experimental Farming

The farming method used in this study was the long line method. Seaweed seeds as much as 50 grams were tied along the length of the rope with a spacing of seaweed 25 cm. In this part, experimental method was tested in order to minimize ice- ce disease investation. For the treatment, seaweed seeds were tied to a long rope, then spread in the water. Seaweed farming techniques with this method were using a 30 meter long rope which at both ends was given a large anchor and buoy. Every 1meter distance was given a float in the form of a used bottle and at a distance of 5 m given a buoy in the form of a ball. At the time of installation of the main strap must be considered the direction of the flow in parallel positions or slightly angled to avoid the occurrence of rope winding with one another. Several longline nylon ropes were used. The first line was placed by *Gracilaria* sp seeds; the second line was placed by *K. alvarezii* seeds; while the third line was placed by *Sargassum polycystum* seeds, etc.

For the control, the set up only planted by *K. alvarezii* using standar convensional lonline method. Seawater parameters were measured in situ by using the suitable equipment such as refractometer for salinity, thermometer for temperature, current meter for current velocity, and sechii disc for depth and water transparancy. Sampling were done every 10 days for 50 days. Three replicates in each site.

Data Analysis

1. Incidence and Intensity of Ice-ice Disease
   The measurement and calculation of ice-ice disease infection that attacks *K. alvarezii* was calculated using the formula according to Tisera (2009):

$$\text{Disease Incidence (\%)} = \frac{\text{Number of Infected Plants}}{\text{Total Number of Plants}} \times 100 \quad .. (1)$$

$$\text{Disease Intensity (\%)} = \frac{\text{Number of Infected Branches}}{\text{Total Number of Plants}} \times 100 \quad (2)$$

2. Growth Increased
   Weight gained (gr.) per ten days was observed and analyzed descriptively using graphs

3. Specific Growth Rate (Daily Growth)
   Specific Growth Rates (SGR) was obtained by weighing wet seaweed seeds every 10 days for 50 days. To calculate the Specific Growth Rate the derivative of the Huisman equation (Dawes *et al.*, 1994) was used.

$$\text{SGR}=\frac{\text{LnWt} - \text{LnWot}}{\text{Total NumTber of Plants}} \times 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where: SGR = Specific Growth Rates(%);Wt = Mean of seaweed weight on certain time (gr); W0 = mean of seaweed on time ti-1(gr); T = observation time (days)

4. Absolute Growth.
   Absolut growth was obtained by subtracting the total weight from the initial weight

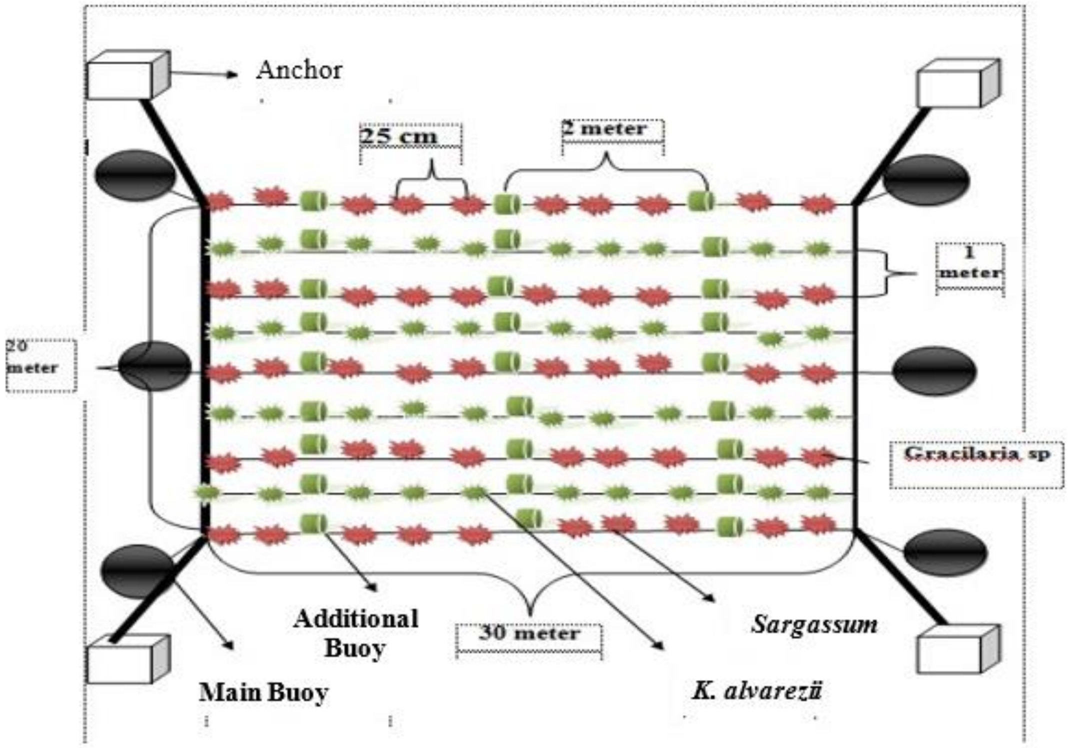

Figure 2. Experimental Method for Minimizing Ice-ice Disease

RESULT AND DISCUSSION

The result showed that farming with treatment using *Gracilaria* sp. and *Sargassum polycystum* gave better resistant to ice-ice disease compared to the one without (control). The treatment showed less incidence and intensity to ice-ice disease compared to control (fig. 3 and 4).

Figure 3 showed that the plants give zero incidence on ice-ice disease during days 10-20. Starting days 30, both treatment and control showed investation of ice-ice disease. The incidense showed higher value ranged between 30-45% with mean 22.2% for control compared to the treatment, ranged between 12-38% with mean 14.4%.

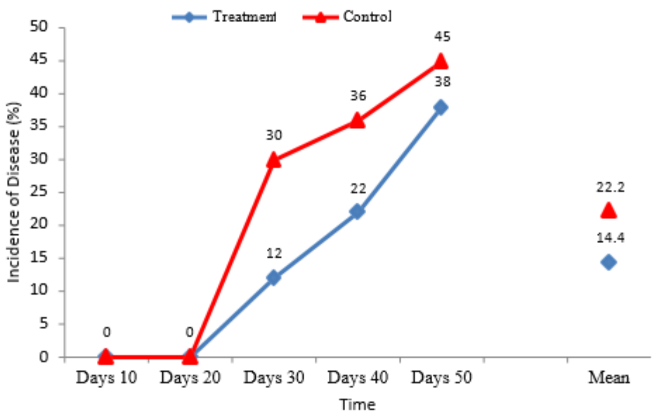

Figure 3. Incidence of Ice-Ice Disease of *Kappaphycus alvarezii* Farmed in Sulamu Waters

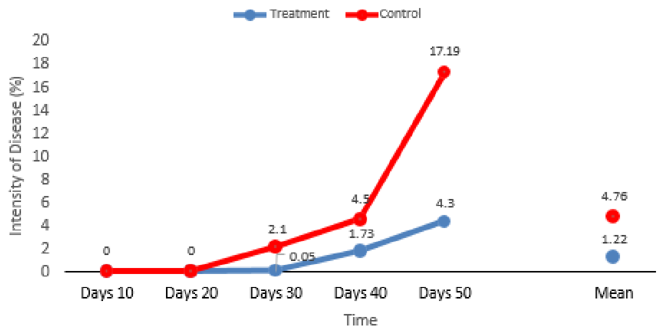

Figure 4. Intensity of Ice-Ice Disease of *Kappaphycus alvarezii* Farmed in Sulamu Waters

Figure 4 showed that the plants give zero intensity on ice-ice disease during days 10-20. Starting days 30, both treatment and control showed investation of ice-ice disease. The intensity showed higher value in control, ranged between 2.1-17.195% compared to the treatment, ranged between 0.05-4.3%.

The results of this study found that the presence of *Sargassum polycystum* and *Gracilaria* sp., mainly *S. polycystum*, can minimize ice-ice disease in farming of *K. alvarezii*. Several studies have found that seaweed has the potential to inhibit the growth of *Vibrio harveyi* bacteria, namely the extract of *Sargassum* sp. and also has the potential as an antioxidant, as a raw material for making surfactants (Pakidi & Suwoyo, 2017), hormones, vitamins, minerals, and also bioactive compounds. Where the research of Koivikko (2018) also stated that the brown algae *Sargassum* sp. found fluorotanin, a phenolic compound that acts as a source of antioxidants. *Sargassum* extract in fisheries has been applied very often. The results of the research by Kusumaningum et al. (2017) stated that *Sargassum aquifolium* contains active compounds that function as antibacterial, antiviral, and anti-fungal used as a barrier to development pathogenic bacteria so as to increase yield *K. alvarezii* grass harvest (Nasmia et al., 2016). According to Tisera and Naguit (2009), When the sea level was below the minimum, the plants were more exposed to the air. The combined effect of air and light exposure which increased the ambient temperature, stressed the seaweeds causing decrease of growth and make them susceptible to ice-ice disease.

For the growth, plants with the treatment showed lower gained weight per 10 days compared to the control (fig. 5). For Spesific Growth (Fig. 6), plants with treatment showed lower value compared to control one. The Treatment has DGR ranged between the lowest 2.0% in days 10 to 6,7% in days 20 with mean 4.70; while for control, DGR ranged between the lowest 1,3% in days 50 to 9.7% in days 40 with mean 4.74%.

For Absolut Growth, plants with treatment also showed lower value compared to control one. The Treatment reached 961.6 gram in absosut growth, while the control reached 978,6 gram (Figure 7)

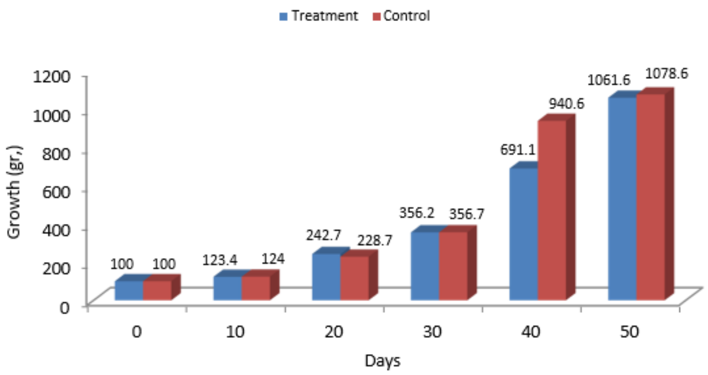

Figure 5. Weight Gained of *K. alvarezii for 50 days* between Treatment and Control in Sulamu

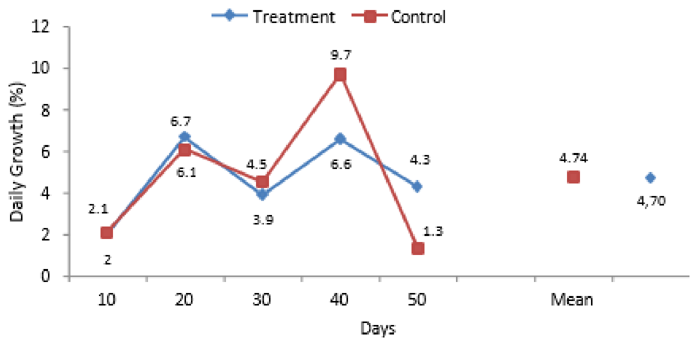

Figure 5. DGR of *K. alvarezii for 50 days* between Treatment and Control in Sulamu

The decline in the Specific Growth Rate due to the low growth rate was the addition of a lower thallus weight along with the increasing age of maintenance of seaweed which causes competition in obtaining nutrients and absorption of sunlight in photosynthesis, so that the growth rate of seaweed decreases. According to Yusnaini *et al.,* (2019) that a decrease in the specific growth rate is thought to be due to the rapid saturation of cell division. Seaweed that has undergone an adaptation process then undergoes a rapid growth phase and then decreases the ability of cell growth to cause slow growth.

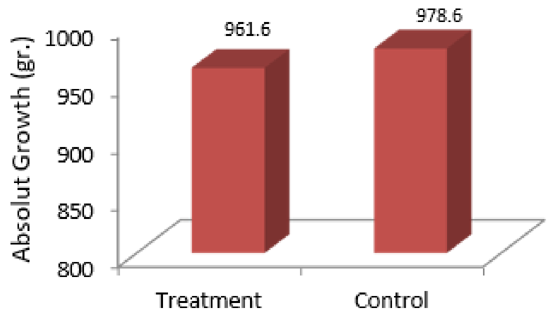

Figure 6. Absolut Growth of *K. alvarezii for 50 days* between Treatment and Control in Sulamu

Kasim et al (2016); Kasim and Mustafa (2017) found that differences in farming methods of *Kappaphycus alvarezii* would have an impact on differences in growth rates. The average growth rate of *Kappaphycus alvarezii* farmed by the floating confinement method was higher than the longline method. Sulaeman et.al., (2017) found that in season dry, the green variety of *Kappaphycus alvarezii* grows better than the brown variety.

The water quality in terms of temperature, salinity, current, depth, light intensity, pH and nitrate were given in Figure 7.

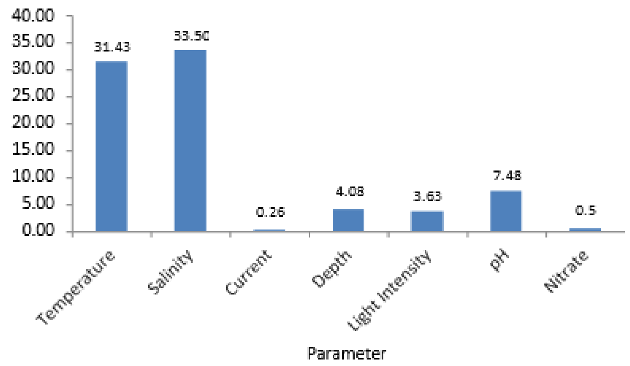

Figure 7. Mean of Physical and Chemical of Water Parameters in Sulamu Waters

Figure 7 showed that the water parameters in farming location were in optimal ranged for growth of *K. alvarezii*. According to Utojo dkk (2007), the quality of sea waters in the optimal range for the farming of *K.alvarezii* are : temperature ranging from 26-32^{0}C, salinity between 28-34^0/oo, currents between 0.25-0.40 m/sec, Transparancy > 5 m, depth between 4- 6 m, pH range between 7.5-8.5 and nitrate between 0.5-0,8 mg/L.

CONCLUSIO

Kappaphycus alvarezii farmed using diversification method or without were Both infected by bactery caused ice-ice disease In term of Disease, *K. alvarezii* farmed using diversification method showed higher resistance to ice-ice disease; while in terms of Growth, *K. alvarezii* farmed without diversification method showed higher growth rate.

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REFERENCES

Arisandi, A. & Farid, A. (2013). *Dampak Faktor Ekologis Terhadap Sebaran Penyakit Ice-ice*. Jurnal Kelautan: Indonesian Journal of Marine Science and Technology, 7(1), p. 20-25.

Dawes, C.J., Mathieson, A.C. and Cheney, D.P. 2014. Ecological studies of Floridian Eucheuma (Rhodophyta, Gigartinales). I. Seasonal growth and reproduction. *Bulletin of Marine Science*. 24 (2) : 235-273. Kasim *et al.,* 2016

Kasim, M. and Asnani, 2012. Penentuan musim reproduksi generative dan preferensi perekatan spora rumput laut *Eucheuma cottoni*. Ilmu Kelautan 17 (4), 209–216.

Kasim, M. and Mustafa, A. 2017. Comparison growth of *Kappaphycus alvarezii* (Rhodophyta, Solieriaceae) cultivation in floating cage and longline in Indonesia. *Aquaculture Reports*. 6 : 49–55.

Kasim, M., Mustafa, A. and Munier, T. 2016. The growth rate of seaweed (*Eucheuma denticulatum*) cultivated in longline and floating cage. *AACL Bioflux.* 9 (2) : 291–299.

Koivikko, R. 2018). Brown algal phlorotannins improving and applying chemical methods. Departement of Chemistry, University of Turku, Finlandia.

Kusumaningum, I., Nasruddin, & Noor, A. (2017). Pengaruh konsentrasi KOH terhadap karakteristik karagenan dari *K. alvarezii*. *Jurnal Fakultas Perikanan dan Ilmu Kelautan Universitas Mulawarman*, Samarinda.

Nasmia, N., Natsir, S., & Rosyida, E. (2016). Potensi aktivitas dari ekstrak rumput laut *Sargassum cinereum* terhadap bakteri patogen *ice-ice* pada *Gracilaria verrucosa. Prosiding Seminar Nasional Hasil Penelitian*.

Nurhidayati, N., Faturrahman dan G. Mursal. 2015. Deteksi Bakteri Patogen yang Berasosiasi dengan *Kappaphycus alvarezii* (Doty) Bergejala Penyakit Ice- Ice. *Jurnal Sains Teknologi & Lingkungan*, 1 (2) : 25- 30

Pakidi, C.S. & Suwoyo, H.S. 2017. Potensi dan pemanfaatan bahan aktif alga cokelat *Sargassum* sp. Octopus. *Jurnal Ilmu Perikanan*, 6(1), 551-562.

Sulaeman, Parenrengi A., Suryati E., and Rosmiati. 2017. Genetic, Coloration, and Growth Performance of Two Different Varieties Of *Kappaphycus alvarezii*.*Indonesian Aquaculture Journal.* 2 No.1

Tisera. W. L., C. Paulus, Ambariyanto, and A.S. Tanody. 2019. Growth of red algae *Eucheuma denticulatum* (BURMAN) Collins & Hervey, farmed using different methods and different strains in Letbaun Village, Semau Island. *Ecology. Environment. & Conservation.*vol. *25 (August Suppl. Issue) : 2019; pp. (S123-S127)*

Tisera, W.L. and Naguit, M.R. 2009. Ice-ice Disease Occurrence in Seaweed Farms in Bays Bay, Negros Oriental and Zamboanga Del Norte. *The Threshold.* 4(1).

Utojo, Malik. A. T., Hasnawi. 2017. Pemetaan Kelayakan Lahan Untuk Pengembangan Budidaya Rumput Laut Di Teluk Sopura, Kabupaten Kolaka Propinsi Sulawesi Tenggara. Jurnal Ilmu Kelautan dan Perikanan Torani. Makassar.

Vairappan, C.S. 2016. *Seasonal Occurrences of Epiphytic Algae on The Commercially Cultivated Red Alga K.alvarezii (Solieriaceae, Gigartinales, Rhodophyta). Journal of Applied Phycology*, 18, 611-617.

Yusnaini, Ramli, and Pangerang, U.K. 2019. Budidaya Intensif Teripang Pasir *Holothuria scabra* dengan Menggunakan Alga *Eucheuma cottoni* Sebagai Shelter. Laporan Hasil Penelitian Lembaga Penelitian. Universitas Haluoleo. Kendari.