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PERBANDINGAN PERTUMBUHAN JENIS MANGROVE RHIZOPHORA SPP MENGGUNAKAN MEDIA POLYBAG DAN HIDROPONIK DI TAMAN NASIONAL KARIMUNJAWA JAWA TENGAH

COMPARISON OF GROWTH OF MANGROVE TYPES OF RHIZOPHORA SPP USING POLYBAG AND HYDROPONIC MEDIA IN KARIMUNJAWA NATIONAL PARK, CENTRAL JAVA

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ABSTRAK

Mangrove merupakan salah satu ekosistem yang tumbuh di tempat-tempat yang dipengaruhi oleh lingkungan sekitar pantai dan muara sungai. Teknik penanaman dan pemeliharaan bibit mangrove berbeda-beda di setiap tempat tergantung pada media dan kondisi di lapangan. Tujuan dari penelitian ini adalah untuk membandingkan pertumbuhan mangrove jenis Rhizophora spp pada dua media pembibitan yang berbeda, yaitu media polibag dan media hidroponik. Penelitian ini dilakukan di Taman Nasional Karimunjawa, Jawa Tengah, dengan metode penelitian eksperimental. Hasil penelitian menunjukkan laju pertumbuhan bibit mangrove yang menggunakan media polybag rata-rata 0,64 cm per dua minggu, sedangkan dengan media hidroponik 0,44 cm per dua minggu. Pertumbuhan daun pertama pada media polybag terjadi pada minggu kelima setelah tanam sedangkan pada media hidroponik daun tumbuh pada minggu keenam. Tingkat kelangsungan hidup pada media polybag sebesar 92,31%, sedangkan pada media hidroponik sebesar 84,61%.

Kata kunci: Mangrove, Pertumbuhan Bibit, Media Polibag, Media Hidroponik

ABTRACT

Mangroves are one of the ecosystems that grow in places that are influenced by the around the coast and river mouths. The technique of planting and maintaining mangrove seedlings varies from place to place depending on the media and conditions in the field. The purpose of this study was to compare the growth of mangrove species *Rhizophora* spp on two different nursery media, namely polybag and hydroponic media. This research was conducted in Karimunjawa National Park, Central Java, with an experimental research method. The results showed the growth rate of mangrove seedlings using polybag media was an average of 0.64cm per fortnight, while with hydroponic media it was 0.44cm per fortnight. The first leaf growth with polybag media occurred in the fifth week after planting while for hydroponic media the leaves grew in the sixth week. The survival rate on polybag media is 92.31%, while in hydroponic media it is 84.61%.

Keywords: Mangrove, Seedling growth, Polybag Media, Hydroponic Media

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Introduction

Mangroves are one of the important ecosystems in coastal areas that grow in places that areinfluenced by tides and around river mouths. Some types of mangroves commonly found in Indonesia are Mangrove (*Rhizophora*), Api-api (Avicennia), Pedada (Sonneratia), Tanjang (Bruguiera), Nyirih (Xylocarpus). The diversity of mangrove species on the coast of Central Java is dominated by Rhizophoraceae followed by Avicenniaceae and Sonneratiaceae where the most widely distributed is Rhizophoraceae (Purwanti et al., 2013). The composition of mangrove plant species is determined by several environmental factors, especially soil type, tidal inundation and salinity (Mughofar et al., 2018).

Some of the mangrove forests in Indonesia are rehabilitated mangrove forests. The technique of planting and maintaining mangrove seedlings varies from place to place depending on the field conditions. Mangrove seeding starts from taking the seeds to watering the seedlings with brackish water or with sea water. Mangrove seeds are obtained from old mangrove fruit (propagules), both those that have fallen to the ground and those that are still hanging on the mangrove tree itself (Yona et al., 2018).

Mangrove planting can be done in two ways, namely by direct planting of mangrove fruit (propagule) into the planting area and through seedling nursery on a medium (Nur et al., 2013) . Direct planting has a low survival rate due to the influence of ocean currents at high tide and the influence of predators. Meanwhile, by means of nurseries or nurseries, the success rate of life is relatively high. Nurseries are usually carried out in special locations or on certain media. Fruit can be obtained from fruit that has fallen or picked directly from trees around the nursery. Mangrove planting still depends on the mangrove fruiting season (Jati & Pribadi, 2017).

Polybags are generally filled with planting media consisting of soil that has been mixed with fertilizer (Primantara et al., 2019). Meanwhile, nurseries with hydroponic media are used for nurseries by utilizing narrow land and using water as a medium. This hydroponic nursery method can be a new breakthrough for mangrove nurseries. The use of hydroponics is a model of plant cultivation by placing plant roots in a shallow layer of water filled with nutrient solution (ARDANI, 2016).

There is no mangrove nursery in the Karimunjawa mangrove forest area. This is because the mangrove forest there is still shady. Mangrove management in Karimunjawa island currently focuses on efforts to maintain the condition of mangroves by prioritizing aspects of protection, preservation and sustainable use (Kuswadi et al., 2021). However, research on mangroves in the area needs to be carried out to expand mangrove vegetation in this protected forest area. In this case the Karawang Marine and Fisheries Polytechnic conducted research on the planting and growth of mangroves and analyze the survival rate of the planted mangrove seedlings.

The purpose of the study was to plant Rhizophora spp. mangrove seedlings in 2 different media, namely polybag media and hydroponic media, then observe and compare the growth of the mangrove seedlings and see the survival rate of the mangroves. The benefits from this research are to make hydroponic media a new alternative in mangrove nurseries with fast results and good quality seeds in accordance with the specifications of ready-to-plant seeds needed in mangrove forest rehabilitation activities in coastal areas.

Materials and Methods

Study site

The research was conducted from March to June 2020 in the Karimunjawa National Park area, namely Kemujan Village, Karimunjawa District, Jepara Regency, Central Java Province. The location of observations was carried out in Kemujan Island, which is administratively located in Kemujan village, Karimunjawa district.

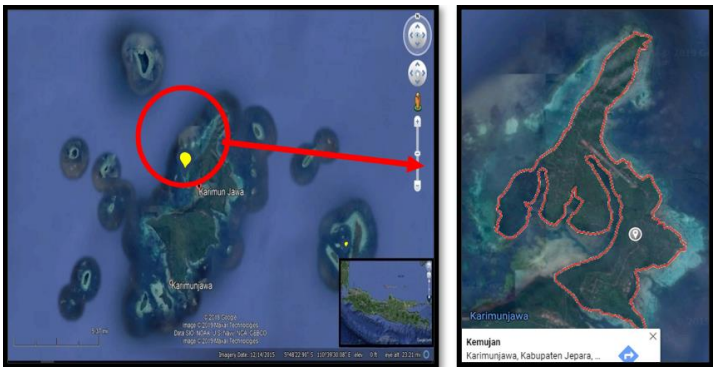

Figure 1. Research site map – Karimunjawa Islands

The Karimunjawa Islands are located between 5º40'39'-5º55'00'LS and 110º05'57"-110º31'15'BT which are administratively included in the Karimunjawa sub-district, Jepara Regency. The condition of the Karimunjawa archipelago is one of the coastal lowlands overgrown by mangrove forests.

Materials

The tools and materials used in this research include:

Table 1. Tools and materials used

No	Tools and materials		Amount	Utility
1.	General	Mangrove seedlings (propagules)	52 pieces	Main material for observation
2.		Puddle	Enough	Growing media for hydroponic systems
3.		Ruler	1 piece	Measuring propagule growth
4.		Camera	1 piece	Documentation
5.	Poly bag	Polybag	26 pieces	Place for planting with polybag media
6.		Humus sand	Enough	Planting needs with polybag media
7.	Hydroponic	Plastic cups	26 pieces	Place for planting hydroponic media
8.		Soldering tool	1 piece	Make a hole in a plastic cup
9.		pH paper	1 set	Measuring water pH
10.		Thermometer	1 piece	Measuring water temperature

Methods of Observation and Data Collection

The observation method used was the experimental method of two (2) nurseries. There are two ways to nurse mangrove seedlings carried out in this study, namely:

a. Nursery with polybag media with humus sand substrate.

b. Nursery with hydroponic media using brackish water.

Observations made on these two media were comparisons of growth rates between seedlings grown using polybag media and seeds grown using hydroponic media. According to Nurlailli (2020) mangrove growth includes growth in height, diameter, root height, number of leaves, and others. This observation was carried out every week by documenting the occurrence of growth. The data recorded were changes in shoot height/length and the number of leaves that grew. Measurement of temperature and pH parameters was also carried out to determine the quality of the water at the observation location. Measurement of water quality is carried out to determine environmental factors that can describe the carrying capacity of the ecosystem for growth (Wantasen, 2013).

Research stages

In conducting this research, several stages were carried out, starting from preparing the tools and materials used, collecting mangrove seeds, nursery, planting and observing growth. The stages of the research can be seen in Figure 2

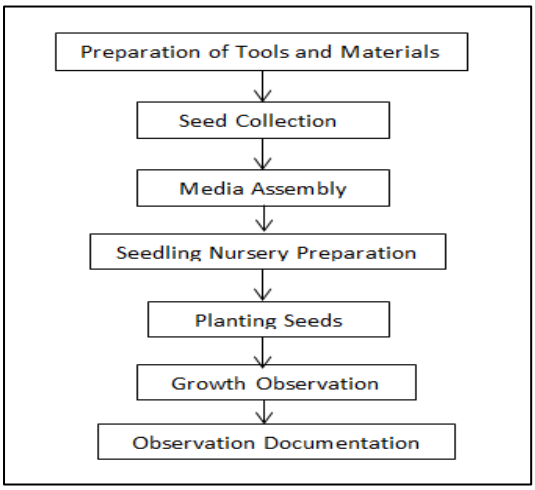

Figure 2. Research Stages

Polybag media nursery

The mangrove nursery process using polybag media is generally done traditionally. The activities carried out in the nursery of Rhizophora mangroves with polybag media are:

1. Prepare 26 mangrove seeds / propagule and polybags
2. Provide land with sufficient standing water so that it can be used for watering the seeds in the morning and evening
3. Fill all polybags with sand media two-thirds of the volume of polybags, to keep the mangrove seedlings in accordance with their environment.
4. Plug the mangrove seedlings into it, about a third of the seedling length.
5. Observing seedling growth, including shoot height and number of leaves.

Hydroponic media nursery

The nursery process using hydroponic media is carried out with brackish water as the medium. The activities carried out in the nursery of Rhizophora mangroves with hydroponic media are:

1. Prepare 26 mangrove seeds / propagule and hydroponic systems.
2. The location used is the same as the land with polybag media so that the plastic cups used will be placed side by side with the polybags.
3. Clean the plastic container to avoid chemicals that can interfere with growth and make small holes in the container for water circulation.
4. Place the propagule in a standing position, try to keep the propagule standing because the tilted propagule cannot grow properly.
5. Observe seedling growth, including shoot height and number of leaves.

Mangrove Growth

The growth of mangrove seedlings can be estimated by calculating the average growth rate (Nurlailli, 2020):

$$\text{Growth rate} = \frac{\text{final length} - \text{initial length}}{\text{observation time}}$$

Percentage of live seeds

The survival percentage of mangrove seedlings is used to determine the level of success of their lives. The percentage of life is the ratio of the number of live seeds to the total number of seeds planted in a nursery (Arifin et al., 2019), so that the percentage of life can be used the formula:

$$\text{Percentage of survival} = \frac{\text{number of live seedlings}}{\text{total number of seedlings in the nursery}} \times 100\%$$

Results and Discussion

Water quality

Water quality is an important factor for the growth of marine biota which require a certain level of water quality in order to grow healthily (Pasaribu et al., 2023). Water is an inseparable part of mangroves because water is the main component for planting mangrove seedlings, especially for hydroponic systems. Measurement of water quality needs to be done because the value of water quality is related to height growth and leaf growth (Wantasen, 2013). The results of measurements of water quality parameters carried out at the location of this *Rhizophora* spp seedbed are temperatures ranging from 27 °C to 28 °C and the pH of the water is between 5 to 6, this parameter value is in accordance with the needs for mangrove growth (Schaduw, 2018) .

Seedling growth with Polybag media

After planting mangrove seedlings in the nursery with polybag media, the next step is to observe the growth of the seedlings, namely the growth of shoot height and growing leaves. Seedling and growth of mangrove seedlings with polybag media can be seen in Figure 3 and Figure 4 below.

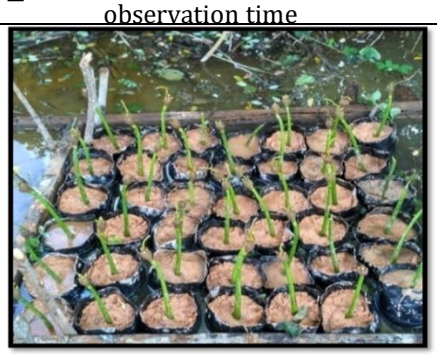

Figure 3. Planting seeds

Figure 4. Leaf Growth

Observation of the height growth of mangrove seedlings was carried out by observing changes in the height of mangrove shoots every week. The results of observations of the mangrove shoots growth height with polybag media are shown in table 2.

Table 2. Height growth of mangrove seedlings using polybag media

Mangrove Seeds	Height growth (cm)						Average growth rate (cm/2weeks)
	Initial Observation	2nd week	4nd week	6nd week	8nd week	10nd week	
1	23,5	24,5	25,7	27	27,7	28	0,9
2	22,5	23,5	24,5	25,6	26,4	26,7	0,84
3	25,5	26,5	28	30,1	30,5	30,9	1,08
4	26	27	27	27	27	27	0,2
5	19	20	20,2	21,2	21,7	22,1	0,62
6	24	25	23,5	24	24,3	24,8	0,16
7	21	22	23	23,7	24	24,5	0,7
8	24	25	22	23	25	25,6	0,32
9	22	23	24,5	25,6	26,4	26,9	0,98
10	17,5	18,5	19	19	19	19	0,3
11	25	26	27,3	28,2	28,6	29	0,8
12	18,5	19,5	20,3	20,6	20,8	21,2	0,54
13	24,3	25,3	26,3	26,6	27,6	27,9	0,72
14	17,5	18,5	18,7	18,9	19,4	19	0,3
15	17,5	18,5	19,5	21,5	22,8	23,1	1,12
16	13	14	14,7	16,1	16,7	17	0,8
17	23,5	24,5	25,7	26,9	28	28,4	0,98
18	17	18	18	18,7	18,7	19	0,4
19	29	30	30,5	31,7	32	32,5	0,7
20	19	20	20,5	21	21,8	22	0,6
21	21,5	22,5	22,6	23,7	24,6	25	0,7
22	19	20	19,6	20,2	21	21,4	0,48
23	25	26	27	28,3	29	29,7	0,94
24	20	21	20,9	21,3	22	22,3	0,46
25	23	24	24,6	25,2	25,7	25,9	0,58
26	24	25	25,2	26,1	26,6	27	0,6

Based on table 2, it can be seen that the growth of *Rhizopora* spp. shoot height every week with polybag media shows the high growth of mangrove shoots. The graph of the growth of shoots of Rhizopora Spp seedlings every week is shown in Figure 5

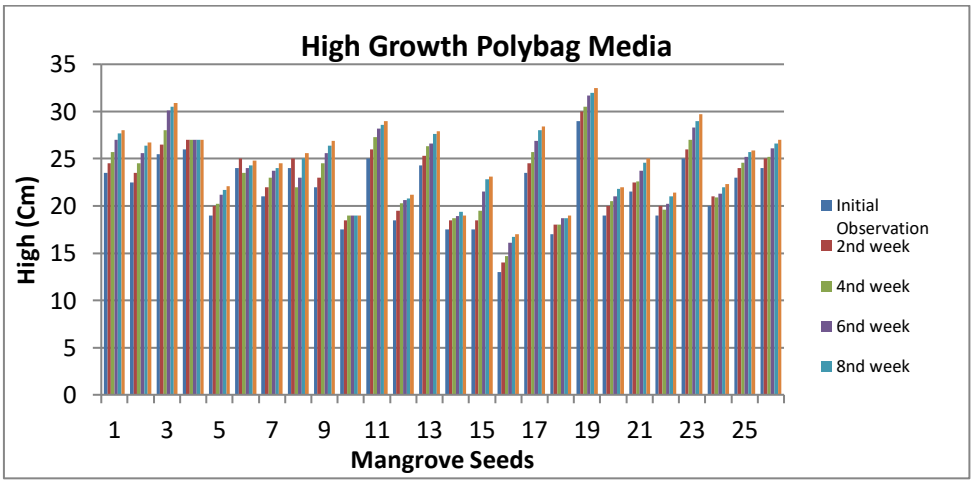

Figure 5. Graph of Magrove seedling height growth on polybag media

From the data in table 2, it can be calculated the average growth rate of the mangrove height by calculating the difference between the average final length and initial length divided by the time of growth. According to Nurlailli (2020) to determine the average rate of height growth, the following equation can be used:

$$\text{Growth rate} = \frac{\text{final length} - \text{initial length}}{\text{observation time}}$$

$$= \frac{\text{Lt} - \text{Lo}}{\text{t}} = \frac{24{,}82 - 21{,}60}{5} = 0{,}64\ (\text{cm}/2weeks)$$

From the results of the above calculations, it was found that the shoots of mangrove seedlings using polybag media had an average height growth rate of 0.64 cm per fortnight.

Growing seedlings with hydroponic media

After planting mangrove seedlings in the nursery with hydroponic media, the next step is to observe the growth of the seedlings, namely the growth of shoot height and growing leaves (Figure 6 and Figure 7).

Figure 6. Planting seeds

Figure 7 . Leaf growth

Observation of the height growth of mangrove seedlings was carried out by observing the height of mangrove shoots every week. The results of observations of mangrove shoot height with hydroponic media are shown in table 3.

Table 3. Height growth of mangrove seedlings using hydroponic media

Mangrove Seeds	Height Growth (Cm)						Average growth rate (cm/2weeks)
	Beginning	2nd week	4nd week	6nd week	8nd week	10nd week	
1	28,5	29	29,5	29,9	29,9	30,1	0,32
2	23	23,5	23,9	24,6	24,7	24,9	0,38
3	27	27,5	27,9	27,9	28	28,5	0,3
4	31,5	32	32,3	33,2	33,7	34,3	0,56
5	25,5	26	26,6	26,6	26,7	27,2	0,34
6	28,5	29	30,1	32,6	33	33,5	1
7	33,5	34	34,9	34,7	34,7	34,9	0,28
8	28	28,5	28,5	29,9	29,9	30,2	0,44
9	29	29,5	30	31	31,3	31,5	0,5
10	25,5	26	26,5	26,6	27,2	27,7	0,44
11	22	22,5	22,6	23	23,2	23,6	0,32
12	35,5	36	37	38,4	39	39,4	0,78
13	30,5	31	32,2	32,7	32,9	33	0,5
14	26	26,5	26,6	26,8	27,5	27,8	0,36
15	29,5	30	30	30,4	31,2	31,4	0,38
16	25,5	26	26,5	26,7	26,7	26,9	0,28
17	30,5	31	31,2	32,3	32,4	32,6	0,42
18	26,8	27,3	27,3	27,4	27,5	27,9	0,22

19	27,3	27,8	28,4	28,8	28,8	29	0,34
20	24,5	25	25,2	25,9	26,3	26,7	0,44
21	25,5	26	26,4	27	27,2	27,8	0,46
22	23,5	24	24,6	24,5	24,4	24,8	0,26
23	27	27,5	28	28	28,5	28,6	0,32
24	23,5	24	26	26	26,4	26,9	0,68
25	27	27,5	30	30,4	31,2	32	1
26	29,7	30,2	30,5	31	31	31,3	0,32

Based on table 3, it can be seen that the growth of mangrove shoots every week with hydroponic media shows an increase in the height of mangrove shoots.

The graph of shoot height growth of Rhizopora Spp seedlings every week is shown in Figure 8

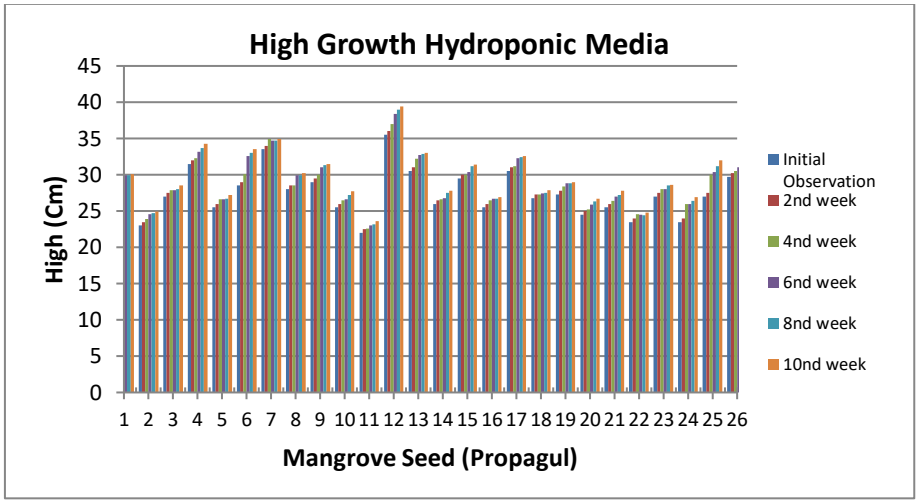

Figure 8. Graph of Mangrove seedling height growth on hydroponic media

From the data in table 3, it can be calculated the average growth rate of the mangrove height by

calculating the difference between the final length and the initial length divided by the time of growth. To determine the average rate of growth used the equation:

$$\text{Growth rate} = \frac{\text{final length} - \text{initial length}}{\text{observation time}}$$

$$= \frac{Lt - Lo}{t} = \frac{29{,}71 - 27{,}47}{5}$$

$$= 0{,}44 \text{ cm/2weeks}$$

From the calculation above, it was found that the shoots of mangrove seedlings using hydroponic media had an average height growth rate of 0.44 cm per fortnight.

Growth rate comparison

The average growth rate of mangrove height is the difference between the average final length and initial length divided by the time of growth (Nurlailli, 2020). Using the data in table 2 and table 3, a graph was made to see the comparison of the high growth rate in mangrove nurseries with polybag and hydroponic media (figure 9).

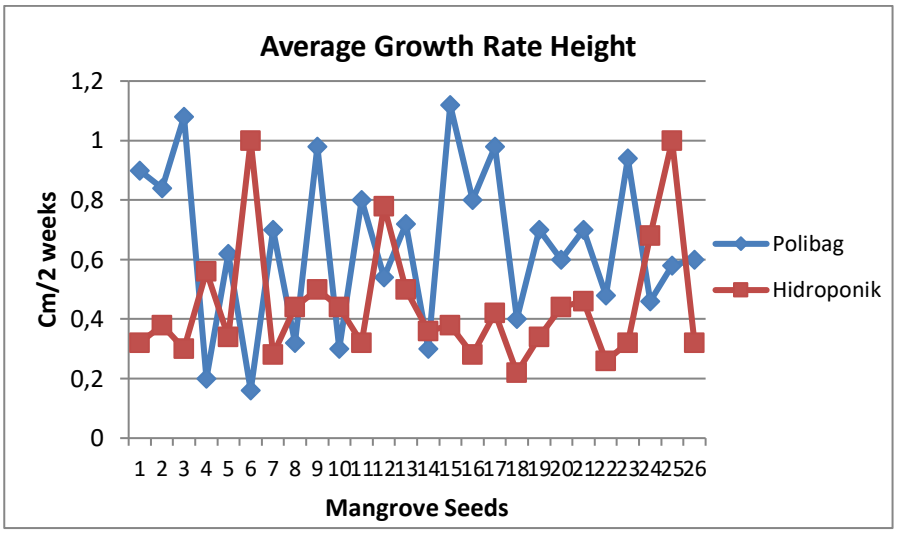

Figure 9. Graph of the average growth rate of seedling height

From Figure 9 above, it can be seen that the average growth rate of mangrove nursery height using polybag media is greater than that using hydroponic media. This shows that the growth of mangrove shoots is best done using polybag media, because propagules will grow faster. The difference in height growth is probably due to the different content in the two media, where in polybag media there is a substrate content of sand and mud which contains nutrients, while in hydroponic media there is no mud content for the growth process, only water. According to Alwidakdo et al. (2014) and Indarjo et al. (2020) the difference in the height of mangrove plant growth is caused by plants that are attacked by pests and diseases that cause leaf loss so that plant growth is inhibited and the difference in the content of mud to carry out the growth process.

Leaf growth

The results of observations in the nursery showed leaf growth on mangrove seedlings every week. The growth of mangrove seedlings is influenced by the speed of leaf formation which is very sensitive to the quality of the place to grow (Rusdiana et al., 2016). Based on observations of leaf growth in mangrove nurseries using polybag media and hydroponic media, the following conditions were obtained:

a. The first week, after planting the mangrove fruit has been released from the propagules
b. The second week, the propagules planted have started to grow roots
c. The fifth week, the seeds on the polybag media have started to grow leaves and in the sixth week on the hydroponic media the leaves have just started to grow.
d. The seventh week, there is a change in leaf color from light green to dark green
e. The tenth week, in the hydroponic system there are new buds for the next leaf growth
f. On the eleventh week all plants on both media had grown 4 leaves.

From the description above, leaf growth in nursery seedlings with polybag media produced leaves in the fifth week, while seedlings on hydroponic media grew in the sixth week. The average number of leaves that grew on both nursery media during the observation was 4 strands/3 months, but for seedlings grown using hydroponic media the leaf growth rate was slower than those using polybags. According to Winata & Yuliana (2016) the indicator to measure the growth rate of mangroves is the number of leaves, because the leaves photosynthesize sunlight into food, so the number of leaves determines the productivity of food for growth. According to Manurung et al. (2019) and Herteman et al. (2011) the availability of sunlight for photosynthesis determines the level of plant production and development, because the intensity of light affects the production of flowers and leaves and the formation of shoots.

Percentage of live seeds

The survival percentage of mangrove seedlings is used to determine the success rate of mangrove planting. Mangrove planting activities are said to be successful if mangroves thrive as indicated by the growth of new leaf shoots and vice versa, mangrove planting activities are said to fail if the planted mangroves die, which is indicated by dried or yellowed and withered leaves and stems (Sari & Rosalina, 2014).

The percentage of live is calculated by looking at the number of live and dead seeds from all the seeds planted. According to Arifin et al. (2019) to calculate the percentage of life, the following equation can be used:

$$\text{Percentage of survival} = \frac{\text{number of live seedlings}}{\text{total number of seedlings in the nursery}} \times 100\%$$

For nurseries with polybag media, based on table 2, it can be seen that the number of seeds

planted was 26 seeds, of which there were 2 seedlings that did not develop (4.6 seeds) so that the percentage of viable seedlings with polybag media was:

$$\text{Percentage of survival} = \frac{24}{26} \times 100\% = 92{,}31\ \%$$

From the results above, it can be seen that the percentage of survival using polybag media reached 92.31%. This shows the survival rate of Rhizophora spp mangrove seedlings planted in nurseries with polybag media shows a good survival rate.

For nurseries with hydroponic media, based on table 3, it can be seen that the number of seeds planted was 26 seeds, of which there were 4 seeds that did not develop (7,16,18,22 seeds) so that the percentage of viable seedlings with polybag media was:

$$\text{Percentage of survival} = \frac{22}{26} \times 100\% = 84{,}61\ \%$$

From the results above, it can be seen that the percentage of life using hydroponic media reaches 84.61%. This shows the survival rate of mangrove seedlings planted in nurseries with hydroponic media shows a fairly good survival rate.

If we compare the survival percentage of mangrove seedlings in polybag nursery media and hydroponic media, it can be seen that the survival percentage of seedlings with polybag media is greater than the percentage of survival with hydroponic media. This shows the success rate of mangrove nurseries with polybag media is better than those using hydroponic media. The difference in the survival rate of seedlings from the two media is probably due to the weather in the area, where the standing water used for hydroponic media is reduced due to low tide and not enough water and low mud content to carryout the seedling growth process. In case of strong currents and high waves, seedlings are easily lifted and die because the dominant sand substrate is not suitable for seedling growth. According to Ukkas dan Zulkifli (2008) the success rate of seedlings planted in tidal areas is very low, this is due to the presence of a substrate condition that contains a small amount of mud which is needed for the growth of the planted seedlings.

Conclusions

Based on experiments and observations on mangrove seeding activities using polybag media and hydroponic media, there were differences in the growth rate, leaf growth and survival percentage of the seedlings. The results of observations and measurements obtained that the average growth rate of mangrove height with polybag media was 0.64cm per fortnight, while using hydroponics was 0.44cm per two weeks, while the growth of the first leaves of plants on polybag media occurred in the fifth week after planting and at sixth week for hydroponic media. Then the percentage of survival rate on polybag media is 92.31%, while in hydroponic media is 84.61%.

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