Jurnal Nur dan Lis

by microbiologyj9@gmail.com 1

Submission date: 01-Apr-2023 07:17PM (UTC-0700)
Submission ID: 2053146585
File name: Jurnal_lis_dan_ibu_Nur_fix.id.en.docx (621.82K)
Word count: 5352
Character count: 29339

Survival of mangrove propagules types of Rhizophora apiculata with different media

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Abstract

The purpose of this study was how the survival of Rhizophora apiculata mangrove propagules with different media in Langge Village, Anggrek District, North Gorontalo Regency. The research was carried out in October 2020 - January 2021, taking place in Langge Village, Anggrek District, North Gorontalo Regency. Observations were made periodically every week for three months by measuring the planting height, stem width and number of leaves on mangrove plants. Plant height was measured using a ruler starting from the position of the plant stem above the ground to the tip of the stem. Plant diameter was measured with calipers at the position of the trunk circle which was 30 cm above the soil surface. The number of leaves and the number of branches were counted manually by calculating the total number and number of branches that appeared. Data analysis used in this study is for mangrove height growth (X) aims to calculate the addition of mangrove height in a certain period of time. To find out the survival rate, what percentage of the number of mangroves grows compared to the number of mangroves when planted. The formula used to determine the survival rate (Survival) of mangroves. The results showed that the successful survival of propagules in Langge Village, Anggrek District, used 17 propagules (85%) as polybags and 14 propagules (70%) without polybags. Data analysis used in this study is for mangrove height growth (X) aims to calculate the addition of mangrove height in a certain period of time. To find out the survival rate, what percentage of the number of mangroves grows compared to the number of mangroves when planted. The formula used to determine the survival rate (Survival) of mangroves. The results showed that the successful survival of propagules in Langge Village, Anggrek District, used 17 propagules (85%) as polybags and 14 propagules (70%) without polybags. Data analysis used in this study is for mangrove height growth (X) aims to calculate the addition of mangrove height in a certain period of time. To find out the survival rate, what percentage of the number of mangroves grows compared to the number of mangroves when planted. The formula used to determine the survival rate (Survival) of mangroves. The results showed that the successful survival of propagules in Langge Village, Anggrek District, used 17 propagules (85%) as polybags and 14 propagules (70%) without polybags. The formula used to determine the survival rate (Survival) of mangroves. The results showed that the successful survival of propagules in Langge Village, Anggrek District, used 17 propagules (85%) as polybags and 14 propagules (70%) without polybags. The formula used to determine the survival rate (Survival) of mangroves. The results showed that the successful survival of propagules in Langge Village, Anggrek District, used 17 propagules (85%) as polybags and 14 propagules (70%) without polybags.

Keywords: propogul, mangrove, Rhizophora apiculate, ecosystem, sustainable

Introduction

Mangrove ecosystems have very complex functions both ecologically and socio-economically, in playing their role as a buffer between terrestrial and marine ecosystems that

interact with other coastal ecosystems, such as estuaries, ponds, seagrass beds and coral reefs (Quoc et al., 2012) . According toSuwardi et al., (2013), that mangrove ecosystems have a high level of biodiversity making mangroves a very valuable asset not only seen from their ecological function, but also from their economic function. However, Indonesia has now lost around 40% of its mangrove area. Its strategic location in the coastal area makes the mangrove ecosystem the object of various development activities, so that the mangrove ecosystem continues to change formation. According to Udoh, JP (2016) presently aquaculture has recorded attractive and growing followership, with wide spread networks of urban and peri-urban fish farms, fish processors and feed producers as well as increasing capitalization and production. This trend has been identified to pose a low but increasing threat to mangroves in Africa, Nigerian inclusive. Intensification and diversification of land-based agriculture to meet sustainable food supply have tended towards exploitation of marginal lands such as mangroves, as exemplified in Asia with negative impacts, in part owing to the lack of firm policy framework. In the face of this possibility this paper advocates institutional and community preparedness.

According to CCD-IPAD (2013) in Rahim and Banderan (2019) that Gorontalo Province has a large mangrove area, one of the mangrove areas is in Langge Village, Anggrek District, North Gorontalo Regency.Many various functions and benefits producedby Mangrove forests, making this ecosystem an important component to support survival in the Anggrek District area, especially in Langge Village. The mangrove forest area in Langge has various types of vegetation that enrich biodiversity.

According to Nugroho (2006) along with the times, many mangrove forests have been damaged. Most of the causes of damage to mangrove forests are humans. Given the condition of mangrove forests which experience degradation every year, it is necessary to carry out rehabilitation in an effort to maintain ecosystem sustainability. One of the efforts in

rehabilitation activities is planting activities by taking one of the Rhizophora apiculata seeds. One of the successes in planting is the availability of seeds from several species of mangrove plants. Mangroves are a type of coastal plant that specifically thrives along beaches with tropical and subtropical climates that are protected by forming formations along the coast whose life is the result of a combination of land and sea. This plant has a prominent root system called the respiratory root (pneumatophore) which is able to adapt to oxygen-poor soil conditions (Manik, 2013). Meanwhile, according to Purnobasuki (2005) in Siahaan (2019) mangroves are forest vegetation that grows on alluvial soil in coastal areas and around river mouths which are influenced by tidal currents. Mangroves that grow on coral beaches or coral reefs with thin sand or on muddy beaches.

According to Istomo (1992) in Nugroho (2006) that in general mangroves are defined as forests that are found along the coast or estuaries that are affected by tides, inundated by sea water, but are not affected by climate. Mangrove forests are found on muddy, sandy, or sandy soils. Mangrove is a typical vegetation in the coastal zone, the flora has a bush habit and a large tree habit and is between 50-60 cm tall and has only one canopy stratum.

2.2 Mangrove Habitats

Mangroves are found on muddy sheltered shores, free from strong winds and currents. Mangrove forests can also be found in estuaries and lagoons, namely lakes on the seafront and riverbanks which are heavily influenced by tidal conditions. Mangroves can also grow on sandy and rocky beaches, coral reefs, and on small islands. Meanwhile brackish water is not essential for mangrove growth, they can also thrive if there is a good supply of sediment and in abundant fresh water (Manik, 2013).

According to Bengen (2002) in Nugroho (2006) mangrove habitat has a unique characteristic when compared to other forest characteristics. The characteristics possessed by mangrove forests include:

1) Generally grows in interdal areas with muddy, loamy or sandy soil types.
2) The area is inundated by sea water periodically, both every day and which is only inundated during full moons. The frequency of inundation determines the composition of the mangrove forest vegetation.
3) Receives an adequate supply of fresh water from land.
4) Protected from big waves and strong tidal currents. Brackish water (2-22 per mil) to salty (up to 38 per mil).

Manik (2013), stated that mangroves can be widely distributed and grow densely in the estuaries of large rivers in the tropics, but in mountainous coastal areas, mangrove forests grow along limited and narrow coastlines. The expansion of mangrove forests is much influenced by the topography of the hinterland. There is a close relationship between water conditions and mangrove forest vegetation. In some places, mangroves show marked zonation levels that tend to change from the water's edge towards the land, but sometimes depending on the undulation (height or low of the forest floor or streams).

2.3 Functions and Benefits of Mangroves

According to Aheto, D. W et al., 2016 mangrove resources can be exploited, restored and managed in a sustainable manner if local customary rules are enforced and institutional arrangements are put in place to mediate mangrove exploitation and regeneration rates. Such an approach, if well developed, can promote the conservation of coastal resources with high economic returns for their users. Mangroves have benefits as a provider of various needs of human life, social, economic and ecological functions of mangroves support in the process of sustainable development. Some of the functions and benefits of mangroves include protecting the coastline, spawning grounds for various marine biota, controlling the microclimate, producing household and industrial needs, producing fish seeds, as a raw material for medicines, tourism,

The choice of Rhizophora apiculata species considering that this type of mangrove is easy to find and widely distributed in Langge Village, Anggrek District compared to other types, besides that Rhizophora apiculata types of seeds are available in large quantities.pretty much. So the authors are interested in conducting research with the title Rhizophora mangrove growth rate*apiculata* with differences in the treatment of mangrove nurseries planted in polybags and planted directly in the field.The problem in this research activity is how is the survival of Rhizophora apiculata mangrove propagules with different media in Langge Village, Anggrek District, North Gorontalo Regency?

According to Saparinto (2007), mangroves have the main functions and benefits for the preservation of resources in coastal areas which are very closely related to meeting human needs as providers of food, shelter, health, and the environment, namely:

1. Physical function, mangrove forests physically protect and stabilize coastlines and river banks, protect against waves and currents, and accelerate the formation of new land.
2. The function of biology is as a nursery ground, a feeding ground, a breeding ground for various types of crustaceans, fish, birds, monkeys, monitor lizards, snakes, and others. As a place to grow various kinds of epiphytic and parasitic plants such as orchids, ferns, and other plants and a variety of life. Mangrove is also a producer of litter/nutrients which is quite high in productivity when compared to tropical terrestrial forests. The many nutrients contained include nitrogen, magnesium, sodium, calcium, phosphorus, and sulfur.
3. The economic function is that the mangrove area has the potential as a recreation area, research location, aquaculture area, and a foreign exchange earner with good quality industrial material products.

4. Another function (natural tourism) of mangroves is as a natural coastal tourism area with beautiful vegetation and wild animals in it that can be enjoyed by motorized boats, and as a place for research and education.

2.4 Morphology of Rhizophora mucronata

According to Noor (2012), the morphology of Rhizophora apiculata (Figure 1) is a guideline for introducing mangroves in Indonesia. The classification of Rhizophora apiculata mangroves is as follows:

Kingdom: Plantae

Division: Magnoliophyta

Class: Magnoliopsida

Order: Myrtales

Family : Rhizophoraceae

Genus: Rhizophora

Species : Rhizophora apiculata

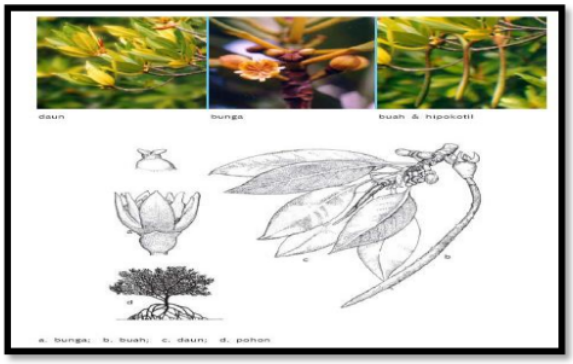

Figure 1. Rhizophora apiculata mangrove species

Rhizophora apiculata is a tree-shaped plant that can reach 15 m in height with a stilt root type. Seed type Rhizophora apiculata is viviparous seed type. The fruit of Rhizophora apiculata is elliptical with a diameter of 1.3-1.7 cm and a hypocotyl length of 20-25 cm. The fruit pulp is green to brown with red cotyledon necks when ripe. The surface of the fruit looks like a

relatively smooth or slippery skin. Another character that can be seen is the relatively small size of the leaves when compared to other Rhizophora plants. The crown leaves are 4 pieces white and the petals are 4 pieces which are yellowish green which is reddish green on the outside (Kusmana 2011).

According to Kusmana (2011) that the leaf arrangement of Rhizophora apiculata is single faced with a narrow ellipse-like strand shape where the leaf tip is apiculate (the tip of the leaf is suddenly slim and tapered). The length of each leaf blade ranges from 9-18 cm with the surface of each leaf having a yellowish green color and scattered small black spots. Propagul is a mangrove fruit that has germinated. Mangrove fruit can be categorized into two types, viviparous and cryptoviviparian. Vivipari are seeds that start to germinate while still attached to the parent tree which causes the ovary to sprout out of the fruit. Cryptoviviparies are seeds that start to germinate while still attached to the parent tree but the germination will still be covered by the seed coat.

2.5 Growth of Mangrove Seeds

According to Bengen (2001), mangroves can live in brackish water between 20-22‰ to salty up to 38‰. Supriharyono (2000) added that the tolerance threshold for mangrove plants is estimated at a salinity of around 10‰ and can grow well at a salinity of around 20 – 40‰. The success of seeding can be known by the high survival rate of Rhizophora apiculata. The results showed that the number of Rhizophora apiculata leaves that were sown every month increased and the number of leaves increased by one leaf every month. The success of the nursery is supported by environmental parameters that support the growth of Rhizophora apiculata.

Khazali (2005) suggests that growth and survival are carried out by using calculations and describing the results obtained, by providing a description of the object being examined through sample data as it is. Seeding Rhizophora apiculata for 2 months has a survival rate of

100%. The success of this nursery is because the area is a plain area which is affected by tides every day so that during high tide around the nursery location it will bring nutrients for the mangrove propagules that are sown and their growth is also quite good.

Setyawan et al., (2005) stated that the organic matter in mangrove soil sediments comes from the inflow of water or river flow which empties into the mangrove location. The highest tide at the nursery was 2.54 m, so the inundation was quite stable for the growth of Rhizophora apiculata. Tide that occurs in the nursery location can affect changes in water salinity. The results obtained indicate that the salinity at the seeding location is considered suitable for mangrove growth.

The success of planting Rhizophora apiculata can be seen from the growth such as the number of leaves, but growth is slightly slower than usual. This is presumably because the substrate in the planting area is more dominant in the sand fraction. Former tin miner soil is characterized by a decrease in organic matter. The soil at the planting site experienced mixing between the mine waste soil and the original soil which was the cause of decreased physical and chemical fertility of the soil in the former tin mining area, but did not cause the death of the mangrove seedlings because it was possible for nutrients to come from tidal flow into the location. planting. The success of planting, apart from being shown by the level of survival of mangrove seedlings, can also be seen from the addition of the number of leaves each month (Pariyono, 2006).

2.5 Environmental Factors Affecting the Growth of Mangrove Seeds

Bengen (2001), environmental parameters that support mangrove growth are pH, salinity, tides, temperature and sediment texture. The results showed that the pH range in the seeding area was between 5 - 7.8 water pH and the substrate pH between 4 - 6.8. The condition of the substrate pH in the seeding area indicates an acidic soil condition. The low pH of this

substrate is probably due to physical changes at the seeding location and this change in pH is also due to the influence of animal activity around the seeding location.

According to Sukardjo (1987) in Sumekar (2002) stated that the activity of sulfur reducing bacteria and the sedimentation of acidic clay soils, the pH of the substrate is acidic and the presence of calcium from mollusk shells and offshore corals causes the substrate in mangrove ecosystems to be alkaline (alkaline). . Salinity in the seeding locations ranges from 27‰ – 29‰.

The texture of the substrate at the seeding location consisted of 68% sand, 6% silt and 26% clay, based on these texture values the substrate used for growing media for Rhizophora apiculata seedlings was dominated by the sand fraction. The organic matter content at the nursery location has a relatively low value, namely C (0.79%) and N (0.07%). The low organic matter C and N is caused by the highest substrate texture, which is the sand fraction. According to Setyawan et al., (2005) states that the organic matter content in mangrove soil sediments comes from local productivity which is largely contributed by the mangrove plants themselves.

Setyawan et al., (2005), stated that tides are one of the factors that affect mangrove life, especially the mangrove root system. Tidal waters in the planting area bring nutrients for the maintenance of the planted mangrove seedlings. The planting location is exposed to tides every day, the highest tide is up to 1.43 m and the lowest tide is 0.37 m. The high and low tide values in the estuary cause stagnation of water at the planting site thereby increasing the growth of Rhizophora apiculata seedlings, where during high tide the water currents bring nutrients for the growth of the mangrove seedlings.

III. Research methods

3.1 Time and Place of Research

The research was carried out in October 2020 - January 2021, taking place in Langge Village, Anggrek District, North Gorontalo Regency. The research location can be seen in Figure 2.

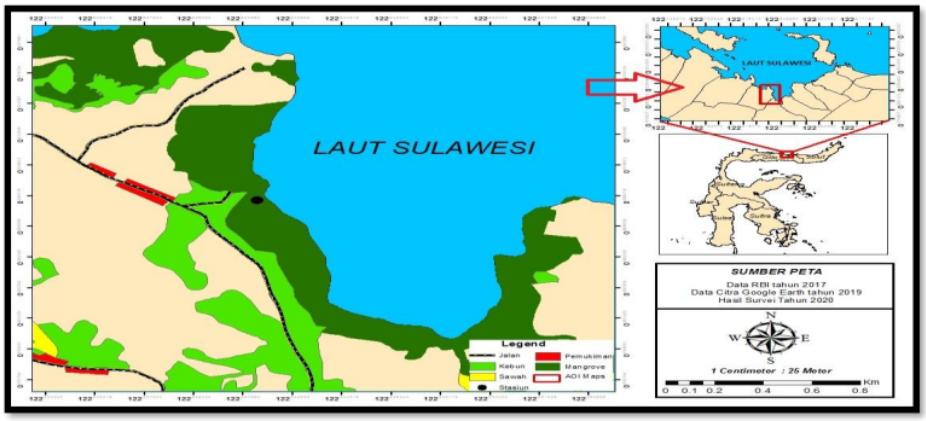

Figure 2. Research Locations

3.2 Tools and Materials

The tools and materials used in research activities can be presented in Table 1 below.

Table 1. Tools and materials used during research

No	Tool	Material
1	GPS	Tissues
2	Refractometer	Mangrove Propagules
3	PH meter	Poly bag
4	thermometer	Mineral water
5	Meter	
6	camera	
7	ATK	
8	String of raffia	
9	Bamboo	

3.3 Research Stages

The stages of the research include the following:

1. Preparation of planting medium

The land used in the research on mangrove nurseries uses two different lands or media, where the first media uses land that is still affected by tides which can accommodate 20 seedlings. As for the second media, use polybags which are filled with the same substrate as the first media and are still affected by tides.

2. Preparation of mangrove seeds

The seeds used in this study were healthy seedlings measuring 25-40 cm. The seeds are taken from near the nursery or can be taken from other areas

3. Planting mangrove seedlings

The activity of planting seeds is carried out in the morning, this aims to keep the substrate conditions used as the media stable and the seeds planted are still fresh because they have not been exposed to sunlight, after planting the seeds must be fenced to keep trash from entering the planted mangrove seeds. A total of 40 seeds were taken which were divided into two parts, where 20 seeds were planted on the direct substrate around the mangroves (nursery location), while the 20 seeds were planted on a substrate filled in polybags, but all of these seeds became

material. research is still influenced by tides. Planting seeds between those with a distance of 50 cm.

4. Observation of seedling growth

Observations were made periodically every week for three months by measuring the planting height, stem width and number of leaves on mangrove plants. Plant height was measured using a ruler starting from the position of the plant stem above the ground to the tip of the stem. Plant diameter was measured with calipers at the position of the trunk circle which was 30 cm above the soil surface. The number of leaves and the number of branches were counted manually by calculating the total number and number of branches that appeared.

3.4 Data Analysis

Data analysis used in this study is for mangrove height growth (X) aims to calculate the addition of mangrove height in a certain period of time. To find out the survival rate, what percentage of the number of mangroves grows compared to the number of mangroves when planted. The formula used to determine the survival rate (survival) of mangroves is using the following equation (Effendi 1978 in Haryanto, 2013):

$$S = \times 100\% \frac{Nt}{No}$$

Information:

S = Survival rate (%)
Nt = Number of mangroves at time t (time of observation/research)
No = Number of mangroves at the beginning of planting

Mangrove growth is calculatedusing the following equation (modification from Zhu et al., 2002 in Haryanto, 2013):

$$X = \frac{Ta - Tb}{t}$$

Information:

X = growth rate (cm/year)
Ta = Initial height of mangrove at the beginning of planting
Tb = Mangrove height at time t (time of observation/research)
t = Length of planting period (time interval t with planting time)

IV. Results and Discussion

4.1 Description of the Research Location

Anggrek District is a sub-district that has 15 villages, one of which is Langge Village. Langge Village is a village that was expanded from the village of Lilino in 2011, where most of the residents are fishermen and traditional farmers. The name of Langge Village is taken from the Gorontalo language which means "NANGKA". Langge Village was opened by migrants from the Minahasa, Sangir Talaud and Gorontalo tribes whose goal was to open agricultural land (RPJM_Desa, 2017). Based on data from BPS Anggrek District in 2017, the village was formed or expanded based on the provisions of the North Gorontalo Regency Regional Regulation Law (PERDA_GORUT), Number 43 of 2010.

Langge Village is located in the northern part of the village of Lilino (Main Village) which has an area of ± 543.5 Ha. Geographically, Lamggula Village has the following regional boundaries:

- North :bordering the Sulawesi Sea Village
- East :bordering the village of Tutuwoto
- South side : bordering the village of Lilino
- West Side : bordering Ilodulunga Village

Langge Village is one of the villages that has a coastal area which is always used by the community for their daily activities, such as fishing activities. The village is located at coordinates 00 48' 32" LU and 1220 50'16" E, and is at an altitude of 16m/asl. The village consists of three hamlets including Dusun I Palowa, Hamlet II Tengah and Hamlet III Pantai Timur (RPJM_Desa, 2017).

4.2 Water Quality Parameters

According to Wantasen (2013), water quality needs to be studied because it is very influential for the continuity of ecological processes (nutrient cycles, environmental stability,

and life support systems). Water quality measurements are carried out at high tide. The results of measuring water quality at the study site for different treatments can be seen in Table 2.

Table 2. Water Quality Parameters

No	Water Quality Parameters	Treatment	
		No Polybags	Polybag
1	Temperature	30	30,1
2	pH	6,6	6,7
3	Salinity	29,7	29,9

Source: Processed Personal Data, 2021

The measurement results obtained range of water temperature at the study site ranged from 29.7-29.90C. However, in contrast to the results of research by Reynhard et al., (2013) in the intertidal zone in the mangrove ecosystem of Jago-Jago Village, the water temperature ranged from 27.5-28.5 0C. The temperature range for both is still in the range for mangrove growth. As found by Gillman et al., (2008) that the optimal temperature range for mangrove photosynthesis is 28-32°C, while temperatures >38°C result in the cessation of the photosynthesis process in the leaves.

According to Mansyur (1992) in Reynhard (2013), the maximum water pH range for the life of marine organisms is 6.5-8.5. Based on the results of measurements at the research location, the range of water pH for the two treatments was 6.6-6.7. This pH range is different from the results of research by Andarani et al., (2016) where the pH range in the study ranged from 8.12 - 9.49. According to Sadat (2004), mangroves can grow well in waters that have a pH range between 6.0 – 9.0.

Based on the results obtained that the salinity at the nursery location is considered suitable for mangrove growth. Where the Salinity value at the nursery location ranges from 29.7‰ – 29.9‰, based on the salinity value it is suitable for mangrove growth. As stated by Aksornkoae (1987) in Sumekar (2002) states that the salinity of mangrove areas varies, namely 28‰ - 34‰.

4.3 Survival Rate

According to Mustika et al., (2014), propagule is a mangrove fruit that has germinated. Planting activities use 2 types of treatment, namely direct seeding and propagules planted in polybags. Based on the results of observations of the success of propagules in the study locations, it can be seen in Table 3.

Table 3. Propagul Life Success

Treatment	Propagul		Amount
	Life	Dead	
Polybag	17	3	**20**
No Polybags	14	6	**20**

Source: Processed Personal Data, 2021

The table above shows that of the 20 propagules planted in polybags, 17 of them survived, while 14 of them survived without polybags. The large number of live propagules using the polybag treatment is suspected of having different tidal differences in each treatment. As explained by Priyono (2010) that mangrove growth is influenced by sea tides. Umroh (2015) added that the tides in the nursery area bring nutrients for the maintenance of planted mangrove seedlings..According to Mustika et al., (2014) thatPercent alive is the percentage of fruit that is alive at the end of the observation compared to the total number of fruit planted.The results of the live percentage of mangrove propagules can be seen in Figure 1.

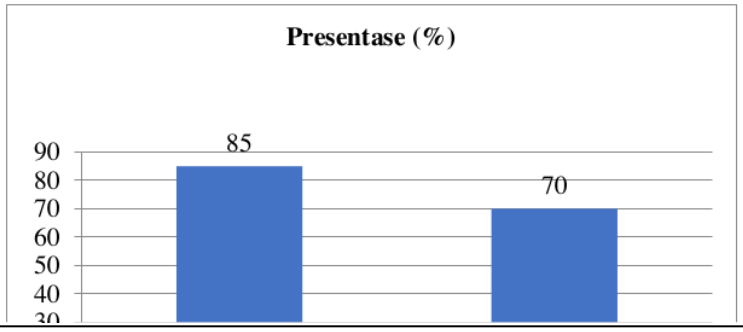

Figure 1. Percentage of Propagul Survival

The graph above shows that the percentage of survival in both treatments was 85% for treatment with polybags and 70% for treatment without polybags. However, the Rhizophora mucronata propagule nursery can be said to be successful, where it can be seen that the percentage survival rate is more than 55%. Elly (2008) states that a mangrove survival rate that exceeds 55% is considered successful. Rusdiana et al., (2015) reported on the mangrove nursery of Muara Village, Teluk Naga District, Tangerang Regency that the survival percentage of red mangrove propagules (Rhizophora mucronata) based on the results of research that had been conducted, obtained the highest results in the PTH treatment, namely 72.80%. While in the PAH treatment it was obtained as much as 51.20%.

4.4 Growth of Propagules

Based on the research conducted, it was found that the growth of Rhizophora apiculata propagules experienced growth in height and diameter of the propagules (Attachment). From the attached data, there is no difference between the first and second measurements between the polybag treatment and without the propagule polybag. But in the third measurement there was a difference in the length and diameter of the propagules. This may be due to the root adjustment in the balance system to adapt.

According to Harahap et al., 2015 revealed that the survival rate of mangrove vegetation is significantly influenced by organic materials, N-total and CEC at a = 0.05. The determination coefficient (R2 = 0.730) indicated that the 73% variation in the survival rate of

mangrove vegetation was explained by the independent variables in the model. Moreover, the research findings suggest that reforestation of mangroves should consider the characteristics and texture of the soil in which the location of reforestation will be made.

According to Bengen (2002), how to adapt when oxygen levels are low Rhizophora has many roots that help breathing. So that the increase in the height and diameter of the propagules makes the roots adapt to support the stem above them so that the roots will increase and there will be very rapid growth between treatments. As stated by Nybakken (1988) shallow roots often extend to the soil surface which makes it possible to obtain oxygen in the mud in which this plant lives.

Based on the observations that the propagules already had leaves in the sixth week of treatment onwards. The number of leaves in each treatment experienced rapid changes, especially in the treatment without polybags compared to those without polybags. This is because, the difference in water intake that enters the propagule nursery is different. The following is an example of propagules that already have leaves on the 8th week of observation.

Figure 3. Propagules with 2 leaves (a. Polybag, b. Without Polybag)

Conclusion

Based on the results of the discussion, it can be concluded that the success of the survival of propagules in Langge Village, Anggrek District, used 17 propagules (85%) as polybags and 14 propagules (70%) without polybags.

Author contributions

Lis M Yapanto: Conceptualisation, methodology, formal analysis, review
Sitti Nursinar: Data interpretation, review
Fandrianto was cheated: writing – original draft preparation

Declaration of Competing Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper

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PAGE 12

PAGE 13

PAGE 14

PAGE 15

PAGE 16

PAGE 17

PAGE 18

PAGE 19

PAGE 20

PAGE 21