Anchor for Mangrove *Rhizophora sp* Propagules

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Abstract. Mangrove *Rhizophora sp* has propagules that are elongated in shape, which after reaching into the sediment will grow into saplings. Propagules Rhizophora sp. tends to release after hitting the sediment when exposed to waves, so that by being anchored, propagules can survive until they grow into saplings. Anchors for tubular propagules with a length of 20 cm with diameters of 0.5, 1, 2, and 4 inch were tested, the analysis using one way Anova showed the difference was $p<0.001$ followed by the tukey post hoc test which showed that the anchor with a length of 20 cm with a diameter of 4 inches had the ability to withstand high the highest with a weight of 9,618.33+96 g. The results of the application in the field showed that an anchor model D with a length of 20 cm with a diameter of 4 inches was able to hold 4 saplings compared to propagules without an anchor.

Keywords: Anchor, Mangrove, Propagules, *Rhizophora sp*

1. Introduction

Mangrove *Rhizophora sp* preferably within intertidal wetland conditions above mean sea level elevations in tropical regions [1], it has propagules that are elongated in shape, which after reaching into the sediment will grow into saplings. The propagules *Rhizophora sp*. tends to release after hitting the sediment when exposed to waves, so that by being anchored, propagules can survive until they grow into saplings. The interplay between propagule traits and surface water conditions determine the fate of each propagule and its capacity to escape the local forest and reach open water [2], the propagule chance to be seedlings and saplings naturally without human intervention [3], The protection using bamboo fence is the best technique that can be used in *Rhizophora sp* planting [4]. The developing models of anchor for *Rhizophora sp* propagule is in order to achieve the effective and efficient in in *Rhizophora sp* planting.

2. Method

2.1 Treatments
The treatments are using 4 anchors:

a) Model A anchor diameter 0.5-inch, height 20 cm
b) Model B anchor diameter 1-inch, height 20 cm
c) Model C anchor diameter 2-inch, height 20 cm
d) Model D anchor diameter 4-inch, height 20 cm

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2.2. Procedures

a) The 4 anchor models made from PVC materials
b) The anchors placed to the sediment in 20 cm deep
c) The breaking load measured using digital hanging scales, and recorded in video
d) The result analysis using one-way Anova to get the best model
e) The Propagule were chosen from the selective mature propagule [5]
f) The propagules attached to the best anchor model using tie cable in real condition for 2 months
g) The propagules is attached to best models for 2 month with 3 replication for the survival rate observation

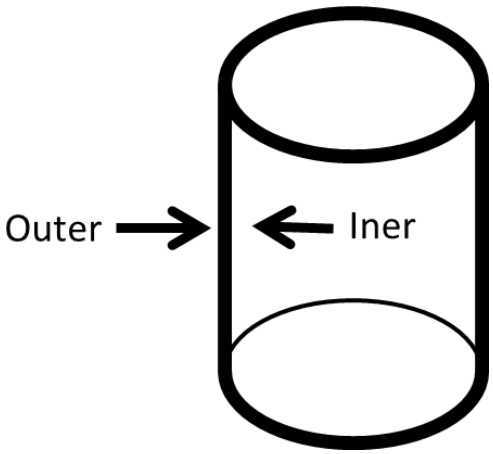

Fig 1. The anchor models

Fig 2. The measured using digital hanging scales

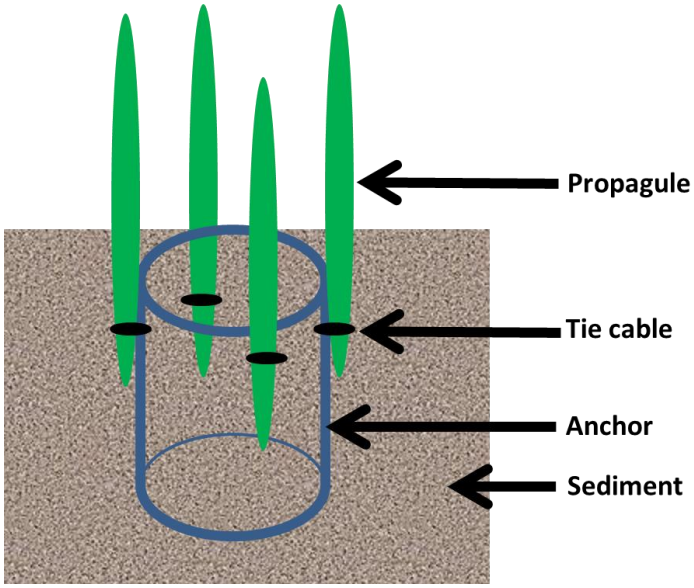

Fig 3. The schematic implementation of anchor for propagules

3. Result and Discussion

Anchors for tubular propagules with a length of 20 cm with diameters of 0.5, 1, 2, and 4 inch were tested, the analysis using one way ANOVA showed the difference was $p<0.001$, followed by the Tukey post hoc test which showed that the anchor with a length of 20 cm with a diameter of 4 inches had the ability to withstand high the highest with a weight of breaking load 9,618.33+96 g.

Table 1. The Rates weight of breaking load of 4 anchor models

Models (D Inch)	Inner surface area (cm^2)	Outer surface area (cm^2)	Total surface area (cm^2)	Rates weight of breaking load (g)
0.5	100.48	125.6	226.08	1265
1	157	200.96	357.96	2386
2	314	395.64	709.64	4355
4	628	690.8	1318.8	9618.333

The survilan rate using Anchor model D diameter 4 inch height 20 cm is 100%, the protectors, such as PVC pipes, may increase survival rates [6][7]. In the natural the propagule need 5,4 day

to be able sink to reach the sediment [2], the result shows higher percentage than the natural propagules dropped into the vegetated area were retained and survived to the seedling stage over 50% [8], many of the propagules which do not succeed in establishing themselves are carried away by the tide [9]. The survival of the propagule having protection is higher that non protection [10], the direct propagule planting give higher growth compare to that grow in the polybag [5].

Fig 4. The 2-month sapling attach to the 4-inch anchor

4. Result and Discussion

1) The binger the diameters make the breaking load greater

2) The anchor model D with diameter 4-inch height 20 cm give the best performance

3) The Propagule can survive 100 % using the anchor model D, that make possible for direct propagules panting

4) When the propagules become the saplings that strong enough, the anchor can be removed and used for another propagules

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