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Growth and survivability of different mangrove species as influenced by rooting hormone

Froilan A Pacris Jr*, Gerlie U Bayani, Marvin V Baloloy, Mark Anthony R Macalingay

Implementing Agency/Station, Cagayan State University, Gonzaga Campus, Philippines

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Abstract

The study was conducted under protective environment of Barangay Amunitan, Gonzaga Cagayan from October, 2018 until March, 2019. Generally, the study was established to determine the growth and survival of different mangrove species as influenced by rooting hormones. Specifically, the study aimed to determine the average germination rate of the seeds (%), average seedling emergence (%), average number of leaves, average plant height (cm), average root length (cm) and the cost per piece of propagules (Php). The Mangrove species and rooting hormones were the two factors evaluated in this study. Moreover, mangrove species were of varying types: (*Xylocarpus granatum, Aegiceras corniculum and Brugueira pototan*) and rooting hormones (auxin) resulting to six (6) treatment combinations replicated thrice. This study was a 3 x 2 factorial experiment under Complete Randomized Design (CRD). The result show that most of the parameters studied were significantly affected by the nature and specie of the cultivars particularly on the average germination rate (%) which is favorable to *Brugueira pototan* while the average number of leaves was significantly affected by *Aegiceras spp*. On the other hand, *Xylocarpus granatum* affects significantly the average plant height (cm) of the mangroves. Furthermore, in terms using rooting hormones auxin significantly affected the average plant height (cm) of the cultivars as well as the combined reaction of auxin and *Aegiceras* specie with regards to the average number of leaves.

* **Corresponding Author:** Froilan A Pacris Jr ✉ froilanpacrisjr@yahoo.com

Introduction

The coastal areas of Cagayan Valley especially along the North Eastern Cagayan range are rich with a diversity of coastal marine resources including mangrove ecosystems. The coastal communities have been gathering and using these mangrove plants to sustain their aquaculture activities. Some of these mangrove species in their local names are: tagibi, dungon, and pototan. and many others. In Gonzaga, mangrove forest is one of the highly productive coastal ecosystems, which has multiple ecological functions especially for surrounding habitats and for the coastal communities providing an important role in the protection against coastal erosion, and environmental stabilization which also influence the socioeconomic aspects of the surrounding communities.

However, the population of mangroves along the coastal areas of Gonzaga is degrading due to the destruction cause by huge waves and illicit human activities like illegal fishing and deforesting the mangroves forest due to conversion of mangrove areas for aquaculture. Due to careless and improper treatment on mangroves population, the shoreline portion of the sea was slowly inhabited by the sea-water reaching residential houses as well as the population of sea creatures continues to lessen due to the destruction of their homes.

The conversion of mangrove swamps into fishponds simply means a substitution of a formerly highly diverse and naturally productive ecosystem into simplified and highly input-dependent ponds that are economically and ecologically unstable. Thus, mangrove depletion results in the diminishing abundance of propagules production, which is important in forest regeneration.

Moreover, the Cagayan State University is currently pursuing its efforts in rehabilitation and restoration of degraded mangrove areas in coastal municipalities of Cagayan thru its program Community Empowerment through Science, Technology, Education, Environment Protection and Health (CESTEEPH). Thus, a more effective approach must be innovated to restore and grow back naturally in the way it generally survives and function better. Mangrove reforestation using seed or propagule planting is a conventional method to regenerate new tree mangroves individuals such as *Bruguiera gymnorrhiza*, which belongs to *Rhizophoraceae* family but when mangrove planting does not coincide with the propagule peak season, the availability of seed sources and its range decreases, so the natural generative reproduction is limited.

Therefore, the use of rooting hormones in propagating mangrove seeds is a rare practice among the residents near the coastal areas nor even a simple propagation is disregarded. Hence, the importance of the study is centered on the propagation of mangrove seeds using different rooting hormones as treatments together with the selection of locally available mangrove species that possess complementarity on the use of rooting hormones in order to hasten propagation and restoration of the mangroves population in the area.

Materials and methods

Experimental Design and Treatments

Mangrove species and rooting hormone were the factors evaluated in this study. Moreover, these factors were of varying types: mangrove specie (tagibi, dungon, pototan) and rooting hormone (auxin) thus, resulting to six (6) treatment combinations. This study was a 3 x 2 factorial experiment under Complete Randomized Design (CRD) with three (3) replications.

The experimental treatments used in the study were the following;

T1 - *Xylocarpos granatum* soaked in auxin
T2- *Aegiceras curniculatum* soaked in auxin
T3 - *Brugueira pototan* soaked in auxin
T4 -*Xylocarpos granatum without auxin*
T5 - *Aegiceras curniculatum without auxin*
T6 - *Brugueira pototan without auxin*

The total experimental area was 50 sq. meter enclosed in a controlled atmosphere nursery made up of bamboo poles and nets. The nursery was situated near the brackish water of Barangay Amunitan, Gonzaga, Cagayan.

Preliminary Activities

Nursery construction

The nursery was constructed using local materials like bamboo poles, coconut fronds and fishnets. It was established near the plantation site to minimize injury in handling and during transport of propagules. The site was accessible to transportation medium in order to facilitate ease on nursery and field operations as well as it was established near the stream with brackish water to have an adequate supply of water. The nursery was constructed with a dimension of 10m x 5m (50 sq. meters) and a height of 7 ft. It can cater 90-120 propagules of mangroves.

Preparation of soil media

The soil medium used in planting the seeds came from the nearby area where mangroves grow. In propagation process, black polyethylene bags with a dimension of 7 inches x 11 inches were used in potting bakawan species while polyethylene bags with a dimension of 6 inches x 10 inches were used in potting *Brugueira* species. The polyethylene bags were poured with soil media leaving 1.5 inches above the surface of the bag.

Securing of seeds

The three (3) different species of mangrove seeds (tagibi, dungon and pototan) used as planting materials in the study were gathered in the mangrove forest of Sta. Ana, Cagayan.

Seed preparation

The three different species of mangrove seeds were soaked in one type of rooting hormone (Auxin) for 24 hours using plastic basins. Then, the seeds were incubated for 6 days in a clean sack covered with rice straw and plastic bags in order to attain the desired temperature in germinating the seeds.

Sowing

The pre-germinated mangrove seeds were sowed in the prepared soil media.The seeds of *Brugueira* spp were sowed in plastic bags with 1 inch depth covered with potting medium. For bakauan species (*Xylocarpos granatum* and *Aegiceras curniculatum*), one-third of the seeds were burrowed in the potting bags. Then, the potting bags were watered with saline content water after sowing.

Care and Maintenance

The seedlings were watered early in the morning and late in the afternoon or as the need arises to prevent drying using fresh and brackish water alternately, or in combination since pure saltwater can cause stunting and wilting of seedlings.

Manual weeding was executed when the need arises by removing the unwanted plants that can compete with the main crops in terms of nutrients, water and sunlight.

Hardening

The seedlings were hardened after five months outside the nursery prior for dispersal or disposing the planting materials to buyers. Hardening was done to acclimatize the seedlings to the local weather conditions.

C. Data Analysis

The tabulated data were analyzed using the statistical procedure of Analysis of Variance (ANOVA) on Complete Randomized Design (CRD) in factorial method. Comparisons of means of different treatments were carried out using Duncan's Multiple Range Test (DMRT) at significant level of $p<0.05$.

Results

The growth of the different species of mangrove propagules varies from one another. The highest seed germination and emergence was the *Brugueira* species however, in terms of rapid growth and increase in height, *Xylocarpus granatum* attained the most rapid increase in height. On the otherhand, *Aegicera* species was very sensitive to changing weather temperature particularly the intensity of heat enabling the propagules into wilting and drying of leaves but it was remedied by frequent watering the shrub late in the afternoon. Since the study was in the confined atmosphere, the presence of pest and predators were prohibited. The growing behavior of the different species of mangroves was affected by the applied rooting hormones particularly on the seedling stage. Thus, variations on the number of leaves and plant height were monitored.

The occurrence of pests particularly insects were not observed within the area that leads the propagules to grow well and develop fastly even the survival of the plant was very low if it was not manage well and supplemented with optimum needs in order to survive. Thus, mangrove planting is not as easy as cultivating vegetables and cereals due to its rare survival that threatens the welfare of the coastal ecosystem if it was severely damage and it takes a lot of time to restore the mangrove forest.

Table 1. Parameters obtain on the growth and survival of different mangrove species as influenced of different rooting hormones, October 2018 - March 2019.

Treatment	Parameters				
	Average germination rate (%)	Average seedling emergence (%)	Average number of leaves	Average plant height (cm)	Average root length (cm)
T1-*Xylocarpos granatum* soaked in auxin	40.00	86.67	6.07	34.01	15.4
T2-*Aegiceras curniculatum* soaked in auxin	38.89	73.33	7.50	38.85	19.02
T3-*Brugueira pototan* soaked in auxin	95.55	88.89	3.42	14.4	10.66
T4-*Xylocarpos granatum*	40.00	80.00	7.02	23.18	15.61
T5-*Aegiceras curniculatum*	42.22	100.00	4.86	18.18	10.44
T6-*Brugueira pototan*	95.56	88.87	3.30	10.80	9.53
ANOVA RESULTS					
A. Species	*Brug***	ns	*Aegi***	Xylo	* ns
B. Rooting Hormone	ns	ns	ns	Aux	* ns
C.Species,Rooting Hormone	ns	ns	*Aegi,Aux**	ns	ns
C.V. (%)	19.30	15.77	18.24	45.36	31.18

Discussion

Average Germination Rate (%)

The table 1 shows the rate of germination of the different species of mangroves after soaking in rooting hormone (Auxin). The result portrays that the specie of *Brugueira pototan* achieved the highest average germination rate twice as higher as the other species having a value of 95.56% without rooting hormone and 95.55% when soaked in Auxin. The lowest value was attained by *Aegiceras spp.* (38.89%) soaked in Auxin.

Based on the analysis performed in the appendix table 1a, significant differences among the treatments came from the nature of the specie itself not on the application of rooting hormone and the combined intervention of the study. It was observed that *Brugueira* species germinates faster than other species tested for this specie is a robust mangrove with the ability to adapt to different growing conditions and easier to cultivate in a common environment (www.mangrove.at) thus having the highest average germination rate among the group.

Average Seedling Emergence (%)

Table 1 presents the average seedling emergence (%) after 60 DAS, T5 (*Aegiceras curniculatum*, without auxin) marked a 100% seedling emergence among others followed by T3 (*Brugueira pototan*, Auxin) at 88.89%, T6 (*Brugueira pototan*, without auxin) with 88.87%, T1 (*Xylocarpos*, Auxin) with 86.67%, T4 (*Xylocarpos*, without auxin) (80%) and lastly, T2 (*Aegiceras*, Auxin) got the lowest mean on average seedling emergence. However, all the interventions used didn't yield any significant differences with respect on the seedling emergence.

The reason behind why the treatments failed to satisfy any significant differences is that maybe the mangrove planting does not coincide with the propagule peak season (Kusmana *et al.*, 2008). Thus, the natural generative reproduction was limited.

Average Number of Leaves

Table 1 shows the average number of leaves, based on the gathered result of the study, T2 (*Aegiceras*, Auxin) got the maximum mean on the average number of leaves with 7.50 seconded by T4 (*Xylocarpos*, without auxin) at 7.02 followed by T1 (*Xylocarpos*, Auxin). The lowest value was garnered by T6 (*Brugueira*, without auxin) having a 3.30 on the average number of leaves. After subjecting into analysis, it was found out that the nature of the specie

brought a huge significant differences among others for *Aegiceras species* has a trait of having an oval thick leaves, leathery dark green glossy above and paler below compared to the thinly leaf species (www.wildsingapore.com).

Furthermore, appendix table 3a shows that there was also significant differences among the treatments studied brought by the reaction of the species on the applied rooting hormone. It was found out that T2 (*Aegiceras* soaked in Auxin) has a beneficial response on the average number of leaves having the highest value (7.50) on the parameter's studied for Auxin inhibits growth of the lateral buds and maintains apical dominance of a plant (www2.estrellamountain.edu).

Average Plant Height (cm)

Table 1 shows that the average plant height of the mangrove plants was significantly affected by the nature of the tested species as well as the function of the applied rooting hormone. *Xylocarpos* specie posed a significant effect on the parameter due to the natural traits of the shrub having a taller height among others. *Xylocarpos granatum* grow from 5 to 15 metres tall (www.tropical.theferns.info) while *Aegiceras spp* grows only 6 metres tall (www.wildsingapore.com). Meanwhile, Brugueira specie was the shortest among the species studied. On the other hand, the applied rooting hormone possessed also a significant effect on the average plant height of the plant specifically, Auxin which promotes growth and development of plant tissues during the vegetative stage (www.biologydictionary.net).

Average Root Length (cm)

Table 1 shows the mean values of the average root length (cm) as intervened by the different treatments used. It portrays that T2 (Aegeceras, Auxin) Achieved the highest increment (19.02 cm) with respect on the average root length (cm) of the plant followed by T4 (*Xylocarpos*, without auxin) at 15.61cm, T1 (Xylocarpos, Auxin) with a value of 15.4 cm. The lowest mean root length was marked by T6 (*Brugueira pototan*, without auxin) having a 9.53 cm. Based on the analysis performed (Appendix Table 5A), all the treatments did not possessed any significant differences with respect on the average root length even the propagules were treated with rooting hormone.

Conclusion

Based on the result of the conducted research study, *Brugueira pototan* has a huge significant effect on the average seed germination rate (%) while *Aegiceras corniculatum* posed a significant effect also on the average number of leaves. On the other hand, *Xylocarpus granatum* marked a significant effect with respect on the average plant height of the plant. Furthermore, Auxin as a rooting hormone has a significant effect on the average plant height of the plant. Moreover, the combination of the beneficial reaction of *Aegiceras corniculatum* and Auxin brought a significant response on the average number of leaves among the treatments studied. On the Cost and Return Analysis, T4 (*Xylocarpos*, without auxin) got the lowest cost per piece of propagules and the highest cost per piece was achieved by T5 (*Aegiceras*, without auxin). with respect on the operating cost, all the treatments without rooting hormone marked the highest operating cost and high net income with 28.98% return of investment.

Recommendation

In order to expand more the capacity of a rooting hormone and attain more significant effects on the basic parameters, it is still recommended to verify the study nor select other cultivars of mangroves to achieved the desired interaction of both species and rooting hormone that were used in the experiment. However, application of auxin as rooting hormone is better than none since it has a significant effect on the specific parameters studied. Thus, every species has significant effects on the basic parameters studied but decisions may rely on the producer depending on the purpose and goals of the production.

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