International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391

A Comparative Evaluation of Coconut Water as Root Setting Medium for *Rhizopora Stylosa* Hypocotyl Propagation

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Abstract: ***The study evaluated if coconut water can be utilized as root setting medium in mangrove propagation. The study also determined if there is a major difference between coconut water and commercial rooting hormone on the growth of Rhizopora stylosa in terms of number of roots and average length of roots generated. Rhizopora stylosa hypocotyls were obtained from their natural habitat located at Baluarte, Tagoloan Misamis Oriental, Philippines. The hypocotyls were washed, disinfected and treated with coconut water and with commercial rooting hormone. The cultivars were hydroponically grown and were kept in a laboratory conditions with artificial lightning. After six weeks the number of roots was counted and the length of roots was measured. The t-test analysis set at 0.05 level of significance showed that coconut water can be utilized as root setting hormone since the results showed enough evidence that there is no significant difference between the coconut water and the commercial rooting hormone on the number of roots and lengths of roots generated by Rhizopora stylosa. This means that root generation and root growth capability of coconut water was as good as commercial rooting hormone. Therefore coconut water can be used as alternative root setting medium in Rhizopora stylosa propagation.***

Keywords: Rosuvastatain, Rabbits, Hypercholestermic, Lipid profiles, β-Sitosterol, chitosan, Passiflora incarnata L.

1. Introduction

Mangroves live in a unique environment between land and sea where the effects of sea level rise is visible (Nitto et al, 2014). There are approximately 70 species of mangroves worldwide. Mangrove forest has substantial role to mitigate sea level rise brought by climate change and melting of polar ice cups. Mangrove roots hold sediments and prevent erosion. Mangroves also serve as habitat for a lot of marine species. Mangroves are known to provide shelter, act as nursery grounds and are also habitats for economically important fishes, prawns, crabs and mollusks. Like other plants mangroves also suffer from natural diseases. Mangrove juveniles are prone to natural predators which include snails, fish, monkeys, goats and others. Since seedling predators hinder natural growth of seedlings, raring mangrove seedlings up to sapling stage in nurseries is a best way to minimize this predator damage. Mangroves are mainly propagated through stem cuttings and seeds. According to de Silva & Amarasinghe (2013) propagation of Rhizophora apiculata, by propagule cuttings, treated with root promoting hormones is feasible. But air layering with Avicennia marina and R. apiculata was not able to generate roots and therefore these vegetative propagation methods cannot be used for mass propagation of these mangrove species.

Many authors cited coconut water has growth- promoting activities because it contains phytohormones (Prades et al., 2012). Coconut water is traditionally used as a growth supplement in plant tissue culture. The wide applications of coconut water can be justified by its unique chemical composition of sugars, vitamins, minerals, amino acids and phytohormones (Yong et al, 2009). Phytohormones can directly or indirectly promote plant growth which includes gibberellins, auxins and cytokinins (Kurepin et al, 2014). Since coconut water is rich in phytohormones and nutrients there is a possibility it can be used as root promoting medium in mangrove propagation. Mangrove forest are degraded and threatened worldwide. There is a need for massive production of mangrove planting materials to rehabilitate mangrove forest. There is also a need to discover a simple but efficient way to propagate mangrove.

In the Philippines mangrove forest is an important ecosystem of the marine environment. It protects human settlement from storm and typhoon. Philippines is also coconut producing country, coconut farmers usually produce a lot of coconut water which is normally thrown away. This study was carried out to utilized coconut water as root setting medium to propagate *Rhizopora stylosa* through hypocotyls. A summary of findings as well as the proposed methodology was presented.

2. Objectives

The study aims to evaluate if coconut water can be utilized as root setting medium in *Rhizopora stylosa* hypocotyl propagation. The study also aims to compare if there a is significant difference on the growth of *Rhizopora stylosa* using coconut water as root setting medium and using commercial rooting hormone in terms of number of roots and average length of roots.

3. Materials and Method

Rhizopora stylosa (Local name: bakhaw bato) hypocotyls were obtained from their natural habitat located at Baluarte, Tagoloan Misamis Oriental, Philippines (8° 32' 20" North, 124° 45' 25" East). The culture medium used was a commercial hydroponics nutrient blended with 240 mMNaCl solution. According to Kanai et al, (2014) the best growth of *Rhizopora stylosa* was accomplished under moderate salinity (240 mMNaCl). The hypocotyls were washed and cleaned with water and were disinfected using commercial bleach. The hypocotyls were dipped in a solution of 25% bleach and 75% distilled water for about 5 minutes. After 5 minutes it was rinsed with distilled water three times. The first treatment was immersed to coconut water for 4-6 hour. Coconut water was taken from matured

coconut fruit. The second treatment was dipped in the commercial rooting hormone. The commercial rooting hormone has 0.1% Indole-3-butyric Acid as active component. Three hypocotyls in three trials were used in each treatment. The hypocotyls were grown hydroponically using rock wool as growing medium. The culture was kept in a laboratory condition with artificial lightning 9-13 hours. After six weeks the number of roots was counted while the length of roots was measured.

4. Results and Analysis

After six week, the number of adventitious roots was counted. In first treatment which used coconut water as root setting medium, the average number of roots was 18. On the other hand, commercial rooting hormone has an average of 17 as shown in Table 1.

Table1. Average Number of Roots after Six Weeks

Treatment	Number of Roots			Average
	Trial 1	Trial 2	Trial 3	
Coconut water	19	19	15	18
Commercial	18	20	13	17

To test if there is a significant difference between the two treatments on the number of roots generated, t-test was employed and set at 0.05 level of significance. The result showed that calculated t value was smaller than critical value (0.270<3.182, α=0.05), so the means are not significantly different (Table 2). The t-test verified that there is no significant difference on the number of roots generated between two treatments. This signified that coconut water was comparable to commercial rooting hormone in terms of root induction capability. This also means that coconut water can be utilized as rooting medium in hypocotyl propagation of *Rhizopora stylosa.*

Table 2: Summary of t-test on the Average Number of Roots

	Treatment 1 (Coconut water)	Treatment 2 (Commercial)
Mean	17.67	17
Variance	5.33	13
Stand. Dev.	2.31	3.61
n	3	3
t	0.270*	
degrees of freedom	3	
critical value	3.182	

* not significantly different at $p < 0.05$

The length of roots was measured after six weeks. The average length of roots in coconut water as root setting medium was 46 mm. While using commercial rooting hormone, the average length was 46.33 mm as shown in Table 3.

Table 3: Average Lengths of Roots after Six Weeks

Treatment	Lengths of Roots (mm)			Average (mm)
	Trial 1	Trial 2	Trial 3	
Coconut water	43	45	50	46
Commercial	53	40	46	46.33

The t test analysis on the average length of roots generated between the two treatments showed that the absolute value of the calculated t is smaller than critical value (0.07765<3.182) at α=0.05, so the means are not significantly different. This means that the lengths of roots generated between the two treatments has no significant difference. Coconut water has comparable ability to enhance root length to commercial rooting hormone. The summary of t- test was shown in Table 4.

Table 4: Summary of t-test on the Average Lengths of Roots

	Treatment 1 (Coconut water)	Treatment 2 (Commercial)
Mean	46	46.333
Variance	13	42.333
Stand. Dev.	3.6056	6.5064
n	3	3
t	-0.0776*	
degrees of freedom	3	
critical value	3.182	

* not significantly different at $p < 0.05$

5. Discussion

The evaluation of coconut water as root setting medium for propagation of *Rhizopora stylosa* hypocotyls was carried out. The evaluation and analysis of the study showed that coconut water can be utilized as root setting hormone since the t- test showed enough evidence that there is no significant difference between the coconut water and the commercial rooting hormone on the number of roots and length of roots generated by *Rhizopora stylosa*. This means that root generation and root growth capability of coconut water was as good as commercial rooting hormone.

Coconut water contains phytohormones such as auxins, gibberellins, cytokinins, ethylene, and abscisic acid, as well as the plant growth regulators polyamines and nitric oxide (Cassan et al., 2014). These phytohormones were responsible for the induction of roots in *Rhizopora stylosa.* According to the study of Kurepin et al (2014), naturally occurring 'biostimulators' for enhancing the growth of agricultural and horticultural crops such as bacteria, fungi and protozoa, as well as seaweed extracts, can produce or promote plant growth and development. Since coconut water enhanced the root growth of *Rhizopora stylosa*, coconut water may also be considered to contain biostimulator that may enhance the growth of agricultural crops and ornamental plants. Mamaril et al (1988) found out that bioassays of treated centrosema, rice, corn and several legumes showed increases in root and stem elongation and root branching using coconut water extract.

Coconut water contains indole-3-acetic acid (IAA), the primary auxin in plants (Yong et al., 2009). Indole-3-acetic acid is responsible in many regulatory processes in plants particularly to plant growth and development. The synthetic equivalent of indole-3-acetic acid was indole-3-butyric acid (IBA) in which most commercial rooting hormone is made of. In this study it was apparent that indole-3-acetic acid in coconut water was responsible in generation and growth of roots of *Rhizopora stylosa* which was very similar with the

study of Ibironke (2016) that also found out that the Indole - 3-butric acid and the coconut water had significant effect on the root emergence and root growth of Bougainvillea. Hassanein (2013) also found out that treatment of cuttings of Ficus hawaii a woody tree and Chrysanthemum morifolium a herbaceous plant by indole acetic acid (IAA) was more effective than treatment by either indole butyric acid (IBA) or naphthyl acetic acid (NAA). This verified that coconut water can stimulate root emergence to plant cuttings. The study of Agampodi & Jayawardena (2009) found out that adventitious root development, shoot development, and leaf emergence of Dracaena purplecompacta L. an ornamental plant is promoted by indole acetic acid extracted from coconut water.

6. Conclusions

After a thorough evaluation, the results of the study showed that coconut water can be utilized as root setting medium in *Rhizopora stylosa* propagation. The results also showed that coconut water has comparable properties to commercial rooting hormones. Rooting characteristics of *Rhizopora stylosa* hypocotyls was enhanced when soaked in coconut water within 4-6 hours before planting. The use of coconut water as root setting medium can be advantageous since it is less expensive than commercial rooting hormones but is equally effective. In coconut producing country like the Philippines, coconut farmers generate a lot of coconut water which is normally thrown away. This study presents how wastes products can be utilized to another high- value byproduct. Aside from enhancing plant growth and development, coconut water can be utilized as alternative to synthetic plant growth hormones which is environmentally friendly and economically viable.

It is very much recommended that gardeners and plant growers should utilized coconut water as root setting medium in growing ornamental and horticultural plants. Instead of throwing it away, coconut farmers should also utilize coconut water in growing other crops. There should also be further study about the effect of coconut water on other plant species since this study focused only on *Rhizopora stylosa*.

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