

Mangrove Seedling Development Under Different Salinity

Majd Alherbawi^{1*}, Ebrahim Al Jamali², Auhood Al Hammadi³ and Romina Nuqui³

¹Ministry of Climate Change and Environment, Biodiversity Expert, United Arab Emirates

²Ministry of Climate Change and Environment, Director of Marine Environment Research Centers Department, United Arab Emirates

³Ministry of Climate Change and Environment, Biologist, United Arab Emirates

*Corresponding author: Majd Alherbawi, Ministry of Climate Change and Environment, Biodiversity Expert, United Arab Emirates

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ABSTRACT

A mangrove is a shrub or tree that grows mainly in coastal saline or brackish water. Mangroves grow in an equatorial climate, typically along coastlines and tidal rivers. They have special adaptations to take in extra oxygen and to remove salt, which allow them to tolerate conditions that would kill most plants. Aquaculture in mangroves is a practice for decades in several parts of the world, mangrove serves as natural shelter and protection for aquaculture ponds and as breeding and nursery grounds for many marine animals. Also aquaculture effluents, can be a potential source of nutrients for mangrove trees, healthy grey mangrove standings, planted along fish farm drainage canal. Soilless system or hydroponics is growing plants using liquid as the media for cultivation, and aquaponics is a combination of hydroponics and aquaculture. Aquaponics has two separate systems; the first part is "aqua" which refers to aquaculture or rearing fish, and the second part is "ponics" which refers to the growing technique of plants. The nutrient-rich water feeds the soilless grown plants, were the primary source of nutrients is ammonia which is converted into nitrates thru nitrification process by nitrifying bacteria.

The Selected Species of Mangroves

There are Different families of mangrove can be found around the world, such as: grey mangrove, white mangrove, red mangrove, black mangrove, etc. Two mangrove species *Avicennia marina* (grey mangrove) and *Rhizophora mucronata* (red mangrove) were selected to study the development of the seedlings under different salinity and growing media. The *A. marina* seeds were collected from the mangrove forest in Umm Al Quwain, UAE on the months of August to September, while the seeds of *R. mucronata* brought from Indonesia.

The Conducted Activities

1) The study were done inside the Marine Environment Research Center Laboratory (MERD) of the Ministry of Climate Change and Environment (MOCCA) with the average room temperature of 26.59°C and average relative humidity of 43.71%.

2) The seeds were grown on soilless (water) and soil (sand) medium, with different water treatment, T1, T2, T3 and T4 (0ppt-freshwater, 15-17ppt, 25-27ppt and 38-40ppt-seawater).

3) The *R. mucronata* seeds were:

- The saplings were washed several times with freshwater and soaked on freshwater for 24 hours.
- After 24 hours, the saplings were directly cultivated on each tank.
- one sapling placed in each tank.

4) The *A. marina* seeds were:

- washed and rinsed with freshwater, and directly cultivated on the floating seedling tray.
- The seedling tray were placed on each tank with 49 grey mangrove seedlings each.
- After 24 hours the pericarp peeled off and removed from the tray to avoid fouling, seeds then placed back to the seedling tray.

5) Experimental/study setup:

- A 30 liter polycarbonate tank was used for the study.

- b. The 4 tanks were properly connected with aerator for oxygen supply.
 - c. Each tank was filled initially with Freshwater.
 - d. After 7 days, 20 pieces of Tilapia (mixed species) with weight ranging from 2.0grams to 30grams and length varying from 2cm to 15cm were added onto the 4 tanks.
 - e. After transferring the fish, the salinity on Tank 2, 3 and 4 were adjusted every 2 days to reached the salinity 15-17ppt (T2), 25-27ppt (T3) and 38-40ppt (T4).
 - f. To avoid ammonia building-up, daily water freshening at 40% was done.
 - g. The Tilapia were fed 3 times daily with 80% commercial fish feeds and 20% ground dried seaweed (*Ulva* spp).
- 6) Sandy soil is commonly used in the mangrove nursery established in MERD for growing *A. marina* seedlings. Before planting, 1 kilogram of the soil were set aside and sent to the MOCCA Central Laboratory for complete soil analysis. A plastic seedling pot was used and filled with sandy soil for the soil media application.
 - 7) The water parameters, temperature, dissolved oxygen, salinity and pH were monitored 3 times per week and Ammonia, Nitrate, Nitrite and Phosphate were analyzed every 14 days throughout the duration of the study.
 - 8) Data for roots length, seedling height and survival percentage were gathered.
 - 9) The roots development for *R. mucronata* were measured in terms of length (in cm) every 7 days after first root initiation was observed and for *A. marina*, daily observation was done after development of root hairs and after the appearance of the first root, length was measured every 7 days in centimeters (cm).
 - 10) For germination percentage, the seedling establishment

was used as an indicator, recording the appearance of the first leaf (de Silva, W. and Amarasinghe, M. 2021) of the two species.

- 11) Shoots height (in cm) were measured from the epigeal cotyledon to the base of the apical leaf (Pinzon et al. 2003).

Results and Findings of the Study

1. The average value of Temperature, pH, dissolved Oxygen, Ammonia, Nitrate, Nitrite and Phosphate have no significant difference except for the salinity.
2. Seedling development, root initiation and survival were observed to study the effect of different salinity (0ppt-freshwater, 15-17ppt, 25-27ppt and 38-40ppt-seawater) on mangrove saplings cultivated on two different media (soilless and sandy soil).
3. Moreover, water parameters on each treatment (T1, T2, T3, T4), salinity, temperature, dissolved oxygen, pH, TDS and nutrients (Ammonia, Nitrate, Nitrite and Phosphate) and soil samples were submitted in Central Laboratory for soil analysis of MOCCA.

Conclusion

Variation on water salinity shows the tolerance of the two mangrove species, *R. mucronata* and *A. marina*. The development of roots of both mangrove species grown in soilless media under 15-17ppt indicates that it is the preferable salinity level for establishing root system, and the roots length development is also better on water treatment with higher salinity (25-27ppt and 38-40ppt-natural seawater of the UAE). The low levels of the Ammonia, Nitrate and Phosphates indicates that the healthy root system of the saplings grown on 15ppt soilless water treatment has good nutrients absorption, and saplings on this treatment were the first to initiate leaves.

Which indicates that the cultivating mangrove seedlings at different salinity, ranging from 15-17ppt to 38-40ppt for soilless media or aquaponics system can be an alternative option on mangrove seedling management.

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Majd Alherbawi. Biomed J Sci & Tech Res



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