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Seedling Growth Performance of EntandOphragmaangolense (Welw) C.Dc under Different Watering Regimes

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ABSTRACT

Water is a universal resource that sustains life and it's integral to maintain productivity of the land. Biomass harvested and utilization for energy can affect water quality and quantity. Water quantity is the timing and total yield of water from a watershed, and it's measured by total yield and peak flow over a specified period of time. This study assessed effect of different watering regimes (Immersion, daily watering, once in 3 days and once in 5 days) on the growth performance of Entandrophagmaangolense seedlings. The variables measured were; seedlings height, collar diameter, leaf production, biomass estimation, Relative Growth Rate (RGR) and Relative Turgidity (RT). The experiment was laid out in Completely Randomized Design with 4 treatments replicated 10 times. Watering daily to pot capacity gave the best performance in terms of collar diameter and leaf production with 3.14mm and 5 leaves respectively while the seedlings immersed in water had the best performance in terms of height with 9.57cm. Analysis of Variance (ANOVA) indicated that there was no significant effect ($p>0.05$) of watering regimes on the height of E. angolense seedlings.

Keywords: *Entandrophagmaangolense, seedlings height, collar diameter, biomass estimation, relative turgidity.*

INTRODUCTION

Forest plays vital roles in and influence on the water cycle and hence, have impact on water resources, both quantitatively and qualitatively. However, a key challenge faced by land, forest and water management is to maximize the entire diverse forest benefits without detriment to water resource and ecosystem function (FAO, 2013).

Entandrophragmaangolense has been a component of both forest and savanna parklands due to selective protection of mother trees. However, increasing anthropogenic and economic activities has reduced both mother trees and regeneration of stands to an unsustainable level. It has medicinal potentials for the treatment of ailments such as stomach-ache and peptic ulcers, earache, and kidney, rheumatic or arthritic pains (Arbonnier, 2004). It is also applied externally to treat ophthalmic, swellings and ulcers.

The tree is planted as roadside tree, and occasionally as a shade tree in banana, coffee and tea plantations. Pressure on existing timber resources brought about by an ever increasing world population has led to renewed efforts to find alternative raw materials for many of the traditional uses of wood.

The rapid and steady increase in worldwide demand for timber and forests products, coupled with the declining availability of wood supply is placing increasing emphasis on the potentials of indigenous hardwood species.

Despite these potentials, there is decreasing population of *E. angolense* mother trees as well as absence of both seedling and saplings in parklands (Gijsbers *et al.*, 2004).

Due to changing ecological situations (in term of distribution, regeneration and phytosociology relationships), *in-situ* conservation of germplasm of *E. angolense* requires monitoring programmers and provision for restorative intervention. Water stress is the major environmental stress that affects plant production worldwide, especially in arid and semi-arid region. The relationship between the growth of plants and the level of their water supplies is still uncertain. In order to investigate possible effect of soil moisture in the

rate of seedling growth performance have been subjected to four different water regimes. Successful use of different tools to mimic natural condition *ex-situ* in the planting of nurse crops and supporting future natural regeneration will be highly appreciated.

However, deliberate planting activities by farmers and at government levels are low. One of the reasons for this is limited silvi cultural knowledge of the species for rapid regeneration.

According to Hartmann *et al* (2007), seed germination depends on environmental factors such as availability of sufficient moisture, temperature, light, and oxygen.

Germination of some seeds, particularly those with dormancy problems, is inhibited by reduced moisture levels. Therefore, it is important to maintain a high moisture supply in the seed bed. Most seeds must absorb additional water beyond that present at maturity in order to start off the biochemical and physiological processes involved in germination (Hartmann *et al*., 2007).

Adequate knowledge of silvicultural requirements for the species can markedly improve its productivity. Therefore, the aim of this study was to determine the effect of different watering regimes on *E. angolense* seedlings.

MATERIALS AND METHOD

Experiment Site

The study was carried out at the Tree Improvement Nursery and Silviculture Nursery of the Department of Sustainable Forest management, Forestry Research Institute of Nigeria, Jericho Hill, Ibadan, Nigeria (FRIN).

FRIN is located within longitude $07^0$23'18"N to $07^0$23'43"N and latitude $03^0$51'20"E to $03^0$51'43"E. Mean annual rainfall is about 1548.9 mm, falling within approximately 90 days.

The mean maximum temperature is 31.9^0C, minimum 24.2^0C while the mean daily relative humidity is about 71.9% (FRIN, 2014).

Experimental Procedure

A total of Forty (40) seedlings with good vigour and relatively uniform growth were randomly selected from germinated seeds raised on top soil. They were transplanted into 4kg capacity polypots filled with forest topsoil at four weeks after germination.

These were exposed to different regimes (immersion, 50ml, 100ml, and 150ml) using measuring cylinder (modifications of Mneneet al., Akinyele, 2007).

Immersion was achieved by putting the poly pots in a bowl containing water to drench the medium. This experiment was monitored for the period of 16 weeks

RESULTS AND DISCUSSION

Effect of Different Watering Regimes on the Height, Collar Diameter and Leaf Production of E. Angolense Seedlings

Analysis of Variance (ANOVA) indicated that there was no significant effect ($p>0.05$) of watering regimes on the height, collar diameter and number of leaves of E.

Angolense seedlings however, mean values showed that the mean seedlings height ranged from 7.87 to 9.57 cm with the highest mean height from the seedlings immersed in water and the lowest mean height from the seedlings watered once in 3 days.

The mean seedling collar diameter ranged from 2.52 to 3.14 mm with the highest mean collar diameter from the seedlings watered everyday while the least mean collar diameter from the seedlings watered everyday while the least mean collar diameter was obtained from seedlings watered once in 3 days.

The mean seedlings leaf production ranged from 4 to 5 leaves. Seedlings watered every day, once in 3 days and once in 5 days produced the highest number of leaves while seedlings immersed in water produced the least number of leaves (Table 1).

Table1. *Mean Values for the Effect of Watering Regimes on the Growth of E. angolense Seedlings*

Watering Regimes	Plant Height (cm)	Collar Diameter (mm)	Leaf Production
Watering Once Everyday	9.15 ±0.61	0.64 ±0.29	4.78 ±0.27
Watering Once in 3days	7.87 ±0.81	0.38 ±0.17	4.60 ±0.44
Watering Once in 5days	8.13 ±0.82	0.58 ±0.26	4.60 ±0.42
Immersion in Water	9.57 ±0.53	0.54 ±0.24	4.45 ±0.39

Mean ± SE followed by the same superscripts in column are not significantly different ($p>0.05$)

ANOVA for the Effect of Watering Regimes on the Growth of E. Angolense Seedlings

Variables	SV	df	SS	MS	F	Sig.
Height (cm)	Watering Regimes	3	9.84	3.28	1.33	0.30^{ns}
	Error	16	39.43	2.46		
	Total	19	49.27			
Collar Diameter (mm)	Watering Regimes	3	0.98	0.33	1.11	0.38^{ns}
	Error	16	4.73	0.30		
	Total	19	5.71			
Leaves Production	Watering Regimes	3	0.27	0.09	0.12	0.95^{ns}
	Error	16	11.87	0.74		
	Total	19	12.13			

ns- Not significant (p>0.05)

Effect of Different Watering Regimes on the Biomass Accumulation of E.Angolenseseedlings

Analysis of Variance (ANOVA) indicated that there was no significant effect (p>0.05) of watering regimes on the Leaf Dry Weight (LDW), Stem Dry Weight (SDW), Root Dry Weight (RDW) and Total Dry Weight (TDW) of E. angolense seedlings.

However, mean seedlings' LDW ranged from 0.56 to 1.78 g. Seedlings immersed in water had the highest LDW while seedlings watered once in 5 days had the lowest LDW (Table 2). The mean seedlings SDW ranged from 0.40 to 0.64 g. Seedlings immersed in water had the highest SDW while seedlings watered once in 3 days had the lowest SDW. Mean seedlings RDW ranged from 0.35 to 1.29 g. Seedlings watered every day had the highest SDW while seedlings watered once in 5 days had the lowest RDW. Mean seedlings TDW ranged from 1.38 to 3.11 g. Seedlings immersed in water had the highest TDW while seedlings watered once in 5 days had the lowest TDW (Table 2).

Table2. *Effect of Watering Regimes on the Biomass Accumulation of E. angolense Seedlings*

Watering Regimes	LDW	SDW	RDW	TDW
Watering Once Everyday	1.05 ±0.59	0.61 ±0.22	1.29 ±0.84	2.95 ±1.00
Watering Once in 3days	0.10 ±0.22	0.40 ±0.11	0.39 ±0.08	0.89±0.42
Watering Once in 5days	0.56 ±0.11	0.46 ±0.10	0.35 ±0.15	1.37±0.27
Immersion	1.78 ±0.72	0.64 ±0.19	0.69 ±0.16	3.11 ±0.89

Mean ±SE followed by the same superscripts in column are not significantly different (p>0.05)

ANOVA for the Effect of Watering Regimes on the Biomass Accumulated by E.Angolense Seedlings

Variables	SV	df	SS	MS	F	Sig.
Leaf Dry Weight (g)	Watering Regimes	3	2.31	0.77	1.11	0.40^{ns}
	Error	8	5.57	0.70		
	Total	11	7.88			
Stem Dry Weight (g)	Watering Regimes	3	0.12	0.04	0.47	0.71^{ns}
	Error	8	0.66	0.08		
	Total	11	0.78			
Root Dry Weight (g)	Watering Regimes	3	1.71	0.57	0.99	0.44^{ns}
	Error	8	4.59	0.57		
	Total	11	6.29			
Total Dry Weight (g)	Watering Regimes	3	6.59	2.20	1.44	0.30^{ns}
	Error	8	12.20	1.53		
	Total	11	18.79			

ns- Not significant (p>0.05)

Effect of Watering Regimes on the Relative Growth Rate of E. Angolense Seedlings

The best performance was recorded for seedlings watered daily to pot capacity (WR1) (0.49 g g-1 month) while seedlings watered once in 5 days (WR3) performed least with 0.09 g g-1 month-1 for the first assessment from 1st month to 2nd month. At the second assessment, seedlings watered once in 5 days (WR3) performed best (0.19g g-1 month-1) while seedlings immersed

in water (WR4) performed least with 0.01 g g-1 month-1. At the final assessment from the 3rd month to the 4th month, seedlings watered daily (WR1)performed best and seedlings watered once in 3 days (WR2) performed least with 0.31 and 0.14 g g-1 month-1 respectively (Table 3).

Table3. *Effect of Watering Regimes on the Relative Growth Rate (RGR) of E. angolense Seedlings*

	RGR (gg^{-1})		
Watering Regime (WR)	**Month 1**	**Month 2**	**Month 3**
WR1	0.49	0.03	0.31
WR2	0.1	0.02	0.14
WR3	0.09	0.19	0.17
WR4	0.23	0.01	0.21

Summary Discussion, Conclusion and Recommendation

According to Awodola and Nwoboshi (1993), water is a significant factor in tree growth and development in the tropics. The knowledge of the responses of the seedlings under conditions of restricted moisture may provide an indication of its responses to increased water stress. Also the evaluation of the morphological and physiological growth of plants at periods of restricted moisture is useful for the isolation of plants with seedlings characteristics acceptable for afforestation in drought prone environments (Akinyele, 2007). This implies that the seedlings of E. angolense were able to utilize the different watering regime and quantity for their growth in terms of height and leaf production. The significant effect of watering regimes on the collar diameter of E. angolense seedlings might be due to the fact that water is required by plants for the manufacture of carbohydrates and as a means for transportation of foods and mineral elements and also for various vital processes in plants such as cell division, cell elongation and stem enlargement (Price et al., 1986). Watering regimes and quantity had no significant effect on the biomass accumulated by E. angolense seedlings which is in correlation with the work of Elhadiet al. (2013), who reported that there was no significant difference in the shoot dry weight of five tropical species subjected to different irrigation frequencies.

The highest value for seedling height was observed in seedlings immersed in water while the highest mean for collar diameter was observed in seedlings watered daily. E. angolense is found in the Tropical rainforest and the South coastal part of Nigeria and hence, the immersion of the seedlings in water was not detrimental to the seedlings.

This is because the excess water was not more than the need of the seedlings. Seedlings immersed in water gave the best growth in terms of total dry weight which shows that this species might do well in water logged areas of Nigeria. This study showed that seedlings of E. angolense will be better raised with daily watering as this help to enhance the growth of this species in the nursery. This study also revealed that seedlings of E. angolense were able to survive in immersion in water. This shows that the roots of the seedlings were able to respire without any constraints. The seedlings immersed in water performed better than seedlings watered once in 3 and 5 days. This shows that this species requires constant soil moisture for good growth. This species shows the possibility of surviving in water logged areas.

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