Original Research Article

Growth Performance of *Crescentia cujete* (Robx) Seedlings as Influenced by Different Watering Regimes

ABSTRACT

This study investigated the effects of different watering regimes on the growth of *Crescentia cujete*. The seedlings were subjected to six different watering regimes which include: W_1 – control (watering everyday), W_2 – watering once every two days, W_3 – watering once every three days, W_4 – watering once every four days, W_5 – watering once every five days and W_6 – watering once every six days; each treatment replicated six times. The experiment was arranged in a Completely Randomized Design (CRD). The study was carried out at the Central Nursery of Forestry Research Institute of Nigeria, Ibadan. Growth parameters assessed include: plant height (cm), collar diameter (mm), leaf production and the biomass accumulation which was sectioned into leaf, stem and the root. The data collected were subjected to one-way Analysis of Variance (ANOVA) and means separation was done using Duncan Multiple Range Test (DMRT) at 5% level of probability. The results showed that there were significant differences among the treatments in plant height and number of leaves produced while there was no significant difference in the collar diameter. However, seedlings watered once every 5 days (W_5) performed best in height (20.48 cm) and leaf production (18.42). It was revealed that there were significant differences in the leaf and stem dry weights among the treatments with W_5 having the highest weight while there were no significant differences in the root dry weight. *Crescentia cujete* optimized water shortage for its growth.

Keywords: Crescentia cujete, watering regime, growth, dry weight

1. INTRODUCTION

Crescentia cujete commonly referred to as Calabash tree is a forest tree that belongs to the family of Bignoniaceae which originated from tropical America and later introduced to Africa (Michael, 2004). According to Gilman and Watson (1993), it grows to about 6 to 9 m in height with a wide crown and long branches covered with clusters of tripinnate leaves and gourd-like fruit. The large fruit has a thin hard shell and whitish pulp with dark-brown seeds that are thin and flat. The spoon-shaped leaves are 5 to 18 cm long and 2 to 5 cm broad and they are arranged in clusters along the stout twigs. It is frequently cultivated as ornamental tree.

Nearly all parts of the tree are utilized for diverse articles and equipment, the wood is used as tools handles, ribs in boat building and gourds for containers and musical instruments (Ejelonu *et al.*, 2011). They are valued in the manufacture of handicrafts and musical instruments. The wood has specific gravity of 0.6 to 0.8; it is strong, flexible, moderately hard and heavy. Hence, it can be used for firewood and construction in rural areas and in the manufacture of handles for agricultural implements. The fruit pulp is laxative, emollient, expectorant and fever medicine. Fresh seeds are ground and mixed with water to make a refreshing drink which has sweet and pleasant taste (UNCTAD, 2005).

Phenols and tannins are present in the fruit sample of *C. cujete*. Phenol and phenolic compounds have been extensively used in disinfections and remain the standard with which other bactericides are compared in official test (Carter, 1979; Ejelonu, 2011). This underscores why *C. cujete* is used as disinfectants and bactericides in emollient healing and in the treatment of burns (Michael, 2004). Flavonoids found in *C. cujete* can act as anti-oxidants and protects the cells of the body form radical damage; free radicals are believed to damage cell and inflict various health-related problems (Phaniendra *et al*., 2015).

Water, which is in a continual state of flux, is a very essential factor in the growth and development of plants (Ordog, 2011). Various vital processes in plants such as cell division, cell elongation, stem as well as leaf enlargement and chlorophyll formation depends on plant water availability (Price *et al*., 1986; Oyun, 2010). There is usually structural deformity in plants frequently leading to death when there is insufficient water below critical level (Levy and Krikum, 1983). The reduction in relative water contents affects physiological processes and hence plant growth (Awodola, 1984 unpublished MSc dissertation); Sale, 2015).

Water is required by plants for the manufacture of carbohydrates and as a means for transportation of essential nutrients and minerals and cooling of plant leaves. About ninety-five percent of water in plants is used up in cooling via evapotranspiration while the remainder is utilised in physiological processes such as photosynthesis and respiration (Pallardy, 2008) and evapotranspiration rates increases with higher temperature (Chaouche *et al.*, 2010; Synder *et al*., 2010). However, water availability is seasonal coupled with climate change effects which manifests in longer dry spell or inundation giving way to waterlogging.

The water requirements of tree species differ due to their varying morphological and/or genetic makeup; this explains the disparate adaptive tendencies of different plants to water availability extremes such as water deficit and waterlogging (Chavarria and Pessoa dos Santos, 2012). Season-dependent water availability in nurseries spawns the need to study the responses of different tree seedlings in the nursery to different watering regimes in order to achieve optimum growth and engender effective water management.

The information about the response of *C. cujete* to different watering regime is sparse despite its diverse medicinal and domestic potentials. Hence, the objective of this study is to investigate the effects of different watering regimes on the early growth of *C. cujete* with a view to contributing to its conservation and efficient water management in the nursery.

2. MATERIALS AND METHODS

The experiment was carried out at the central nursery of Forestry Research Institute of Nigeria, Ibadan located on latitude 7^{o}23`N and longitude 3$^{o}$58`E. The climate is characterized by wet (April to October) and dry seasons (November to March). The annual rainfall ranging between 1300 - 1500 mm and annual mean relative humidity of 80-85% (Forestry Research Institute of Nigeria Annual Meteorological Report, 2015).

The experiment was carried out between January and March, 2017. The seeds of *C. cujete* were obtained from a mother tree at the herbal garden of Forestry Research Institute of Nigeria, Ibadan, Oyo State, Nigeria. The top soil (0-20 cm) was collected from the floor of a *Gmelina arborea* plantation. The seedlings were raised in a germination tray for two weeks, with sterilized river sand used as the growing media. The two weeks old seedlings were transplanted into polythene pots filled with 2 kg of top soil and watered to pot capacity with respect to the treatments. The growth parameters such as plant height (cm), collar diameter (mm) and leaf production were assessed weekly while the biomass estimation was carried out at the end of the growth assessment.

The height of the seedlings was measured with the aid of a measuring tape graduated in centimeters (cm) from the soil surface while the collar diameter was determined with the aid of a Vernier caliper.

Biomass estimation was carried out by selecting three (3) seedlings from each treatment. The seedlings were sectioned into leaves, stem and root and oven-dried at 70^oC for 24 hours. The dry weight of the leaves, stem and root of the seedlings were weighed and recorded. The mean of the dry weights of the three seedlings selected in each treatment were calculated.

There were six treatments and each treatment was replicated six times making a total of thirty-six experimental units in all.

The treatments are:

W_1 – control (watering everyday)

W_2 – watering once every two days

W_3 – watering once every three days

W_4 – watering once every four days

W_5 – watering once every five days

W_6 – watering once every six days

The experimental design used was Completely Randomized Design (CRD). The data collected were subjected to a one-way Analysis of Variance (ANOVA) at 5% level of probability while the means found to be significant were separated using Duncan Multiple Range Test (DMRT) at 5% level of probability (Steel and Torrie, 1988).

3. RESULTS AND DISCUSSION

Table 1: Particle size distribution and chemical properties (0-20 cm)

Soil Properties	**Values**
pH (H_2O)	5.71
Organic carbon (g/kg)	9.6

Total Nitrogen (g/kg)	0.72
P (mg/kg)	7
K (cmol/kg)	0.6
Ca (cmol/kg)	7.0
Mg (cmol/kg)	5.79
Mn (mg/kg)	23.6
Fe (mg/kg)	6.0
Cu (mg/kg)	12
Zn (mg/kg)	3.08
Sand (%)	84.5
Clay (%)	9.9
Silt (%)	5.6
Textural Class	Loamy sand

According to Federal Fertilizer Department of the Federal Ministry of Agriculture and Rural Development (2011), the soil was moderately acidic; the nitrogen and organic carbon contents were low while there was moderate amount of phosphorus and potassium (Table 1).

Table 2: Analysis of Variance of the Growth Parameters

Parameters	Source of variation	df	Sum of squares	Mean square	F	Significance
Height	Watering regime	5	25.327	5.065	4.871	0.002*
	Error	30	31.194	1.040		
	Total	35	56.522			
Collar Diameter	Watering regime	5	0.341	0.068	0.622	0.684^{ns}
	Error	30	3.292	0.110		
	Total	35	3.633			
Leaf Production	Watering regime	5	59.206	11.841	3.142	0.021*
	Error	30	113.065	3.769		

Total	35	172.271	

ns – not significant; * - significant (p≤0.05)

Table 3: Mean Values of the Growth Parameters of *C. cujete* Subjected to Selected Watering Regimes

Treatments	Height (cm)	Leaves	Collar diameter (mm)
W_1	18.01^{a}	15.76^{a}	4.82
W_2	18.86^{ab}	14.56^{a}	4.79
W_3	19.99^{bc}	16.82^{ab}	4.65
W_4	20.01^{bc}	14.96^{a}	4.97
W_5	20.48^{c}	18.42^{b}	4.88
W_6	19.85^{bc}	16.57^{ab}	4.81

Means followed by the same superscripts in the same column are not significantly different (p= .05)

3.1 Mean Height, Collar Diameter and leaf production

The effect of watering regime was significant on height of seedlings of *C. cujete* at 5% level of probability (Table 2). The seedlings watered once in five days (W_5) significantly recorded the highest mean value of 20.48 cm, which was not significantly different from the seedlings watered once in four days (W_4) with mean value 20.01 cm, W_6 (19.85 cm) and W_3 (19.99 cm) while seedlings watered once everyday (W_1) had the least mean value of 18.01 cm which was not significantly different from W_2 (18.86 cm) (Table 3).
There was no significant difference in the collar diameter of the seedlings of *C. cujete* at 5% level of probability. However, seedlings watered once in four days (W_4) had the highest mean value of 4.97 mm closely followed by seedlings watered once in five days (W_5) with mean value of 4.88 mm while the seedlings watered once in three days (W_3) had the least mean value of 4.65 mm (Table 3).
In terms of leaf production, there was significant difference among the treatments used at 5% level of probability. The seedlings watered once in five days (W_5) produced the highest number of leaves with mean value of 18.42 followed by seedlings watered once in three days (W_3) with mean value of 16.82 and the seedlings watered once in two days (W_2) produced the least number of leaves with mean value of 14.56 (Table 3).

Table 4: Mean Values of the Biomass of Sectioned Parts of *C. cujete*

Treatments	Leaf Dry Weight (g)	Stem Dry weight (g)	Root Dry weight (g)

W_1	2.52[ab]	1.75[b]	2.87
W_2	1.93[a]	1.18[a]	2.30
W_3	2.25[ab]	1.20[a]	2.37
W_4	1.82[a]	1.18[a]	2.32
W_5	2.92[b]	1.80[b]	3.08
W_6	2.29[ab]	1.30[ab]	2.18

Means followed by the same superscripts in the same column are not significantly different (p =.05)

3.2 Biomass accumulation

3.2.1 Leaf Biomass Accumulation

The result showed that the selected watering regimes had significant effect on the leaf biomass accumulation of *Crescentia cujete* with W_5 recording the highest mean value of 2.29 g and W_4 recording the least mean value which was not significantly different from mean value recorded by W_2 (1.93 g) (Table 4).

3.2.2 Stem biomass accumulation

The result showed that the stem biomass accumulation of *Crescentia cujete* was significantly affected by the selected watering regimes. W_5 had the highest mean value of 1.80 g which is not significantly different from W_1 and W_6 with mean values of 1.75 g and 1.30 g respectively while W_2 and W_4 recorded the least mean value of 1.18 g (Table 4).

3.2.3 Root biomass accumulation

The effect of watering regime on root biomass accumulation of *Crescentia cujete* is not significantly different among the treatments. This implies that irrespective of the selected watering regimes, the root dry weight of *Crescentia cujete* may not differ (Table 4).

4. DISCUSSION

The resultant effect of different watering regimes on the height of *C. cujete* agrees with the findings of Sale (2015) who reported that *Parkia biglobosa* subjected to watering once in five days had the best performance in growth. Isah *et al*. (2013) recommended watering once in two to three days for the optimum growth for *Acacia senegal.* Oyun *et al.* (2003) reported that watering twice a week is suitable to achieve the optimum growth of *A. senegal* in the nursery.

The seedlings watered once in five days (W_5) produced the highest number of leaves which was not significantly different from the seedlings watered once in three days (W_3) and the seedlings watered once in six days (W_6). Sale (2015) observed similar results in studies of different watering regimes on the growth of *Parkia biglobosa* seedlings where seedlings watered once in three days or once in five days yielded the highest number of leaves. Lisar *et al.* (2012) reported that plants optimize the morphology, physiology and metabolism of their organs and cells in order to maximize productivity under the moisture stress conditions.

Sale (2015) also observed that *Parkia biglobosa* seedlings watered once in three days gave the highest dry plant weight. Arndt *et al.* (2001) reported that reduced soil moisture may cause a reduction in root growth and limit nutrient uptake by roots; this is contrary to the result from this study. It has been widely reported that extensive root growth is an adaptive feature under drought stressed conditions (Guoxiong *et al*., 2002). Shoot dry weight increases with increase in soil moisture but under water stress conditions, root growth exhibits better growth than the shoot. This causes the increase in root to shoot ratio (Chiatante *et al*., 2006).

5. CONCLUSION

In this study, the effect of selected watering regimes on *C. cujete* was examined. It is evident that *C. cujete* can optimize water deficit for its growth. For effective water management coupled with optimum growth during the early growth of *C. cujete* seedlings, water can be applied once in four to five days.

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