

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

36 of 0.6 to 0.8; it is strong, flexible, moderately hard and heavy. Hence, it can be used for firewood and
37 construction in rural areas and in the manufacture of handles for agricultural implements. The fruit pulp is
38 laxative, emollient, expectorant and fever medicine. Fresh seeds are ground and mixed with water to
39 make a refreshing drink which has sweet and pleasant taste (UNCTAD, 2005).

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

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52 affects physiological processes and hence plant growth (Awodola, 1984 unpublished MSc dissertation);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

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

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

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

70 **2. MATERIALS AND METHODS**

71 The experiment was carried out at the central nursery of Forestry Research Institute of Nigeria, Ibadan
72 located on latitude 7°23'N and longitude 3°58' E. The climate is characterized by wet (April to October)

73 and dry seasons (November to March). The annual rainfall ranging between 1300 - 1500 mm and annual
74 mean relative humidity of 80-85% (Forestry Research Institute of Nigeria Annual Meteorological Report,
75 2015).

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

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

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

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

92 The treatments are:

93 W_1 – control (watering everyday)

94 W_2 – watering once every two days

95 W_3 – watering once every three days

96 W_4 – watering once every four days

97 W_5 – watering once every five days

98 W_6 – watering once every six days

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

103 3. RESULTS AND DISCUSSION

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

Soil Properties	Values
pH (H ₂ O)	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

105

106 According to Federal Fertilizer Department of the Federal Ministry of Agriculture and Rural Development
 107 (2011), the soil was moderately acidic; the nitrogen and organic carbon contents were low while there
 108 was moderate amount of phosphorus and potassium (Table 1).

109

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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

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

112

113 **Table 3: Mean Values of the Growth Parameters of *C. cujete* Subjected to Selected Watering**
 114 **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

115 *Means followed by the same superscripts in the same column are not significantly different (p=*
 116 *.05)*

117 **3.1 Mean Height, Collar Diameter and leaf production**

118 The effect of watering regime was significant on height of seedlings of *C. cujete* at 5% level of probability
 119 (Table 2). The seedlings watered once in five days (W₅) significantly recorded the highest mean value of
 120 20.48 cm, which was not significantly different from the seedlings watered once in four days (W₄) with
 121 mean value 20.01 cm, W₆ (19.85 cm) and W₃ (19.99 cm) while seedlings watered once **every day** (W₁)
 122 had the least mean value of 18.01 cm which was not significantly different from W₂ (18.86 cm) (Table 3).

123 There was no significant difference in the collar diameter of the seedlings of *C. cujete* at 5% level of
 124 probability. However, seedlings watered once in four days (W₄) had the highest mean value of 4.97 mm
 125 closely followed by seedlings watered once in five days (W₅) with mean value of 4.88 mm while the
 126 seedlings watered once in three days (W₃) had the least mean value of 4.65 mm (Table 3).

127 In terms of leaf production, there was significant difference among the treatments used at 5% level of
 128 probability. The seedlings watered once in five days (W₅) produced the highest number of leaves with
 129 mean value of 18.42 followed by seedlings watered once in three days (W₃) with mean value of 16.82 and
 130 the seedlings watered once in two days (W₂) produced the least number of leaves with mean value of
 131 14.56 (Table 3).

132 **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)
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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

133 **Means followed by the same superscripts in the same column are not significantly different (p**
 134 **$=.05$)**

135 **3.2 Biomass accumulation**

136 **3.2.1 Leaf Biomass Accumulation**

137 The result showed that the selected watering regimes had significant effect on the leaf biomass
 138 accumulation of *C. cujete* with W₅ recording the highest mean value of 2.29 g and W₄ recording the least
 139 mean value which was not significantly different from mean value recorded by W₂ (1.93 g) (Table 4).

140 **3.2.2 Stem biomass accumulation**

141 The result showed that the stem biomass accumulation of *C. cujete* was significantly affected by the
 142 selected watering regimes. W₅ had the highest mean value of 1.80 g which is not significantly different
 143 from W₁ and W₆ with mean values of 1.75 g and 1.30 g respectively while W₂ and W₄ recorded the least
 144 mean value of 1.18 g (Table 4).

145 **3.2.3 Root biomass accumulation**

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

149 **4. DISCUSSION**

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

155 The seedlings watered once in five days (W₅) produced the highest number of leaves which was not
 156 significantly different from the seedlings watered once in three days (W₃) and the seedlings watered once
 157 in six days (W₆). Sale (2015) observed similar results in studies of different watering regimes on the
 158 growth of *P. biglobosa* seedlings where seedlings watered once in three days or once in five days yielded
 159 the highest number of leaves. Lisar *et al.* (2012) reported that plants optimize the morphology, physiology

Comment [j1]: First time written full name then short name use. Not use full name again except first time.

160 and metabolism of their organs and cells in order to maximize productivity under the moisture stress
161 conditions.
162 Sale (2015) also observed that *P. biglobosa* seedlings watered once in three days gave the highest dry
163 plant weight. Arndt *et al.* (2001) reported that reduced soil moisture may cause a reduction in root growth
164 and limit nutrient uptake by roots; this is contrary to the result from this study. It has been widely reported
165 that extensive root growth is an adaptive feature under drought stressed conditions (Guoxiong *et al.*,
166 2002). Shoot dry weight increases with increase in soil moisture but under water stress conditions, root
167 growth exhibits better growth than the shoot. This causes the increase in root to shoot ratio (Chiatante *et*
168 *al.*, 2006).

169

170 5. CONCLUSION

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

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