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Original Article

Effect of frequencies of watering and water volumes on the growth performance of *Adansonia digitata* (Linn) Seedlings

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ABSTRACT

Water is a universal resource that sustains life and maintains seedling productivity. 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 is measured by total yield and peak flow over a specified period of time. This study was carried out to investigate the effect of watering frequencies and water volume on the seedlings growth and performance of *Adansonia digitata.* The experiment was laid out in a 3 × 3 factorial in completely randomized design (CRD) with nine treatments combination replicated 3 times. Factor A was 3 watering regimes (once daily, 3 days and 5 days interval) and factor B was three water quantities (50 ml, 100 ml, and 150 ml). The variables measured were as follows; shoot height, stem diameter, leaf production, and leaf area. Data collected were subjected to analysis of variance (ANOVA). The results revealed from the study that 150 ml at 5 days interval (T9) had the highest performance followed by 50 ml at once in a day (T1). There was a significant difference for volume, frequency, and interaction at ($P < 0.05$) of watering of the relative turgidity in all the morphological attributes of *A. digitata* seedlings. 150 ml at 5 days interval of watering is therefore recommended for the early growth performance of this species. The species requires little amount of water and man-day activities for growth and establishment of fencing and wire netting during production the species for protection against rodents are required.

Keywords: *Adansonia digitata*, early stage, growth performance, seedlings, water volume, watering frequencies

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INTRODUCTION

Variations in environmental and weather conditions necessitated by the global climatic change in recent times have created diverse reactions from plants, animals, and among other microorganism. This situation has greatly influence the rainfall pattern with its attendant unpredictable flooding and drought conditions around the globe that have create a new approach to doing research on regeneration of useful forest species.[1] Water sourced naturally or artificially is an important component for plants growth, survival, and productivity. Adequate quantity of water is critical to the successful growth of any forest seedlings in the nursery.[1,2] Seedlings water requirements are dependent on the growth parameters of specific forest seedlings, its stage of growth and the prevailing atmospheric conditions.[3] According,[4] water is a considerable factor in forest land ecosystems both in arid, semi-arid, and rainforest ecosystem and it is important for tree growth and development.

Adansonia digitata is one of the rising agricultural demands, different strategies have been innovated on increasing production of Boabab and one of the strategies has been watering of plants. The problem remains what frequency of watering is proper to the seedlings of baobab growth and performance. The required volume of water for tree growth and development is dependent on tree species, growth stage, and time of the year. Plants required water for the manufacture of carbohydrates and as a means for transportation of foods and mineral element; however, depletion in food and water reserves cause seedlings to depend on photosynthesis for their steady survival and available sufficient water in plants aids vital processes such as cell division, cell elongation, stem enlargement, leaf enlargement, and chlorophyll formation[5,6]

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which reported that a change in all structures leading to the death of the plants is due to insufficient water in the plants below critical level. In dry climates, for a successful vegetative growth, hundreds of tons of water are consumed by the particular growing plant,[7] which observed that a reduction in the contents of relative water affects plant growth and its physiological processes. Similarly, water present above its required volume in plants may cause retardation in their physiological processes. It was stated that soil water balance influences the stomata and the xylem pressure.[8] There has been a rising conflict regarding the type of growth medium most suitable for the growth and development of most forest seedlings as it played a positive and negative role on the growth and development of seedlings. An important natural resource that supports life and growth of plants is water; however, in recent times, there has been an alarm as regards water availability.[9]

The availability of permanent water supply has been one of the major challenges in forest nursery establishment and management especially in the drier regions of the tropics and sub-tropics and determination of the exact volume of water required for the survival and development of nursery seedlings.[10] Arid and semi-arid regions are blessed with many forest tree and shrubs species like Acacias, palm and others which provide shade, an esthetic sight, or fruits, tannins resins, oils, extracts, and medicinal pharmaceutical products.[11] In recent times, *A. digitata* has been widely distributed for many human purposes such as food, beverages, health, and fibers and as such have a high demand which resulted in many chemical, economical, physical, and material researches. Watery of *A. digitata* seedlings is one of the ways to resolve the high demand, preserve for next generations, and make research study easy.

In Sudan, *A. digitata* tree is called Tebaldi (Plate 1) and people make juice by soaking and dissolving the dry powder pulp in the fruit and make a refreshing drink, locally known as Gonguleis, which is rich in Vitamin C and B2.[12] Recently, the European Commission authorized the import of baobab fruit pulp as a novel food[13] and it was approved in 2009 by the Food and Drug Administration as food ingredient in United States of America.[14] Nevertheless, almost all parts of *A. digitata*; leaves; bark; and fruits are traditionally employed as food stuffs that possess high nutritional values and for medicinal purposes, and hence, baobab is named: the small pharmacy or chemist.[15] There are normally 2000–3000 seeds/kg.[11] Baobab seeds have very hard seed coats and germination is usually <20%.[16]

However, several methods were used to get rid of dormancy negative effects such as; wet heat, total or partial seed de-coating, and scarification of seeds with concentrated acids.[17] Moreover, herbicides, fungicides, and growth regulators were tested and seeds treated with herbicides and fungicides did not germinate.[18] Seeds are probably orthodox; no loss in viability during 1 year of hermetic storage at 4°C; and viability can be maintained for several years in hermetic storage at 3°C with 8–11% mc. Hence, the research investigates the effects of growth medium and water quantity on the seedling growth and survival of *A. digitata* with a view to enhancing and promoting its conservation.

Objective of the Study

The main objective of the study is to determine watering frequencies and water volume on seedlings growth and performance of *A. digitata* seedlings.

The specific objectives are to:

i. Determine the effect of water frequencies and volume on the seedlings,
ii. Determine the interactive effect among the treatments.

MATERIALS AND METHODS

Description of the Area

The study was carried out at Federal University Dutse Jigawa State. Dutse is a city located in northern Nigeria. Study area has coordinate of latitude $11^0$42' 04"N, $9^0$20'31' 'E and Longitude $11^0$70'11"N, 9·$3^0$41'94"E, and elevation of 435 m above the sea level. The rainy season lasts from May to September with an averages annual rainfall of between 600 mm 100 mm and high temperature are normally recorded between the month of April and September 2009,[19] which revealed that it covered by Sudan savanna, also characterized by hot wet summer and cool dry winter with average raining season of 3–5 months (644 mm) as it reported by Salami and Lawal.[20] The inhabitants are predominantly farmer engage in farming and rearing of livestock.[21] Dutse is predominantly occupied by Hausa and Fulani with the estimate population of 153000.[22] The topography is characterized by high land area which is almost 750 m. Soil tends to be fertile ranging from sandy -loamy.[23]

Data Collection

Seed

The baobab seeds were collected from the nursery at Forestry Department, Federal University Dutse. The outer seeds coat were slightly cracked then soak in warm water for 6 h after which the brown outer shell was carefully peel, soak in a paper tissue for a day before planting.[25] All seeds sown were evaluated through self-watering in different water regime and the growth and performance of the seedlings were monitored from the time of the planting until the seedling before transplanting. The water use in watering the seedlings and the pots use in planting was monitored and well treated from all pollutions.

Soil

The soil sample was collected from the upper level of the earth's crust (topsoil) 0–20 cm depth. Soil collections were made from the Forestry Nursery Unit of the Federal University Dutse, Jigawa State.[20] Two germination baskets were used in raising the seeds.

Experimental Procedure (Design) and Layout

This study was employed a 3 × 3 factorial experiment in completely randomized design (CRD). Factor A is 3 watering regimes (once daily, 3 days and 5 days' interval) and factor B was 3 water quantities (50 ml, 100 ml, and 150 ml). A total of nine treatments were replicated 3 times. A total of 27 seedlings with good vigor and relatively uniform growth were randomly selected from germinated seeds raised with forest top soil. They were transplanted into poly pots filled with forest top soil at 4 weeks after germination. Three watering regimes (once daily, 3 days and 5 days' interval) were applied to the seedlings and differing volume of water (50 ml, 100 ml, and 150 ml) using measuring cylinder modifications of Iroko *et al*.[25] The experiment was monitored for a period of 16 weeks.

Data Analysis

Data collected was subjected to inferential and descriptive statistics (Table 1) based on the data obtained from morphological characteristics. Data collection was subjected to two-ways analysis of variance (ANOVA) in factorial experiment with the aid of the Statistical Package for the Social Sciences (SPSS) version 19.

RESULTS

Table 1 shown the mean of leaf production of *A. digitata,* where T9 (150 ml × 5 days) at (25) had the highest value of productions followed by T1 (once day at 50 ml) which also have value of (22) and the least production of leaf in the species is T7 (5 days at 150 ml) which had (13) value. Result showed that the mean of stem diameter in *A. digitata* seedlings were (0.06 mm) at T5 (3 days watering at 100 ml) had the highest value of the species and the least production of *A. digitata* seedlings is (0.01) at T9 (5 days watering at 150 ml). Findings from Figure 4 showed that treatment 1 (once daily at 50 ml) and 9 (5 days at 150 ml) had the highest performance of shoot height of 30 cm, respectively. The least shoot height (23cm) observed from T4 (3 days watering at 50 ml). The leaf area of seedlings watered 5 days at 150 ml (T9) had the highest valve of relative turgidity of 20 cm^2, while the least performance observed from treatment T3 (Once day watering at 150 ml), T4 (3 days watering at 50 ml, and T5 (3 days at 100 ml) with value 10 cm^2 (Tables 2 and 3).

Table 1: Showing the sample layout

	Frequency	Everyday	Once in three days	Once in 5 days
Volume		A1	A2	A3
50 ml	B1	A1B1	A2B1	A3B1
100 ml	B2	A1B2	A2B2	A3B2
150 ml	B3	A1B3	A2B3	A3B3

There are nine treatments and three replicates

DISCUSSION

According to Awodola and Nwoboshi,[4] water is a considerable factor in forest land ecosystems both in ecosystem and it is important for seedling growth and development. Water requirements are dependent on the growth parameters of specific forest seedlings, its stage of growth.[3] Therefore, the study was conducted on the influence of water on the species. Influences of the water frequency and volume on *A. digitata* were determined. Seedlings watered with 150 ml at interval of five days (T9) in a week had the highest relative turgidity as its positively affect the morphological attributes such as leaf production, leaf area, and shoot height (Figures 1 and 2). Furthermore, TI was also proved better and moderately impacted on the growth performance of the species. There was a significant difference for volume, frequency, and interaction at ($P < 0.05$) of watering of the relative turgidity in all the morphological attributes of *A. digitata* seedlings. Awodola[7] observed that a reduction in the contents of relative water affects plant growth and its physiological processes. Water sourced naturally or artificially is an important component for plants growth, survival, and productivity. Adequate quantity of water is critical to the successful growth of any forest seedlings in the nursery.[1,2] However, Iroko *et al*.[25] had a close observation from its discovery that watered 3 days had

Figure 1: Showing the map of Dutse. Adapted: Garba et al.[24]

Table 2: Showing the mean values of growth parameters of the seedlings

Treatment	Symbol	Leave production	Stem diameter (cm)	Shoot height (cm)	Leave area (cm^2)
T1	A1B1	22	0.04	30	15
T2	A2B1	20	0.03	25	12
T3	A3B1	16	0.05	25	10
T4	A1B2	15	0.03	23	10
T5	A2B2	14	0.06	26	10
T6	A3B2	15	0.04	28	11
T7	A1B3	13	0.05	25	13
T8	A2B3	17	0.03	27	11.5
T9	A3B3	25	0.01	30	20

Table 3: The analysis of variance for leave production, stem diameter, shoot height, and leave area

Source of variation	Degree of freedom	Leave production	Stem diameter (cm)	Shoot height (cm)	Leave area (cm^2)
Frequency	2	3.520*	3.520*	3.520*	3.520*
Volume	2	3.520*	3.520*	3.520*	3.520*
Interaction	4	2.900*	2.900^{ns}	2.900*	2.900*
Error	19				
Total	27				

*Significance different at 5% while ns show non-significant differences

Figure 2: Showing a baobab tree

the highest relative of turgidity 67.49% for *E. angolensis* seedlings.

CONCLUSION AND RECOMMENDATIONS

Conclusion

Water serves as essential tools of a plant growth and development in the nursery. It can be deduced from the study that the species required little amount water. This implies that the species can adapt to the dry terrain and season for its survival.

Recommendations

150 ml at 5 days interval of watering is therefore recommended for the early growth performance of this species. The species requires little amount of water and man-day activities for growth and establishment of fencing and wire netting during production the species for protection against rodents required.

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