FUDMA Journal of Sciences (FJS)
ISSN online: 2616-1370
ISSN print: 2645 - 2944
Vol. 7 No. 6, December (Special Issue), 2023, pp 178 -181
DOI: https://doi.org/10.33003/fjs-2023-0706-2182

BIOMASS ASSESSMENT OF *Adansonia digitata* SEEDLINGS AS INFLUENCED BY VARYING DEGREES OF MOISTURE APPLICATION UNDER SCREENHOUSE CONDITION

***[1]Henry, C. A., [1]Ogunsola, O. S., [2]Akomolede, L. A., [1]Akinbayo, B. C. and [2]Ogundoyin, A. A.**

[1]Department of Forestry and Wildlife Management, Federal University of Agriculture, Abeokuta
[2]Forestry Research Institute of Nigeria, Jericho Hill Ibadan. Rainforest Research Station Ore, Ondo State, Nigeria.

*Corresponding authors' email: ask4henrysworld@gmail.com

ABSTRACT

Adansonia digitata L. (African baobab) is a tree species with significant socio-economic and ecological values. Evaluating the regeneration and moisture requirements of the plant for successful domestication is important. This study assessed the biomass accumulated by *A. digitata* seedlings as influenced by varying degrees of moisture application under screenhouse condition for 12 weeks. 100 mL of moisture application was carried out for three regimes, once in a week, W_1 (1/7), thrice in a week, W_2 (3/7) and every day, W_3 (7/7) in a Completely Randomized Design with four replicates each. Data collected on biomass were subjected to two-way analysis of variance using Statistical Analysis System (SAS vs 9.1.2) and where significant difference occurred among the means at $p \leq 0.05$, Fisher's Least Significant Difference was used for means separation. Results obtained revealed that moisture application had significant effect ($p \leq 0.05$) on the leaf dry weight (LDW), shoot dry weight (SDW), root dry weight (RDW) and total dry weight (TDW) of *A. digitata* seedlings across the three moisture regimes. Result of LDW ranged from 0.37g to 0.45g, SDW ranged from 0.34g to 0.43g, RDW ranged from 0.26g to 0.36g and TDW ranged from 0.97g to 1.24g. W_3 seedlings produced the highest biomass while W_1 seedlings produced the least. The study concluded that daily watering is required for optimum performance of seedlings as it produced seedlings with the highest biomass accumulation.

Keywords: Moisture, Biomass, *Adansonia digitata*, Regeneration

INTRODUCTION

Adansonia digitata (Linn) is a tree species with significant socioeconomic and ecological value. The tree is one of the nine species of baobab that make up the Malvaceae family, Bombaceae subfamily, and the genus *Adansonia* (Venter and Witkowski, 2010; Salami and Lawal, 2018). The species is primarily dominant in the dry and savanna parts of Africa, where it is abundant and show the existence of watercourse from a distance (Wickens and Lowe, 2008). Due to its shape, the baobab, a tree species that is frequently utilized for many purposes in Africa, is formally known as the "Africa upside-down tree". *Adansonia digitata*, among other things, makes significant contributions to human survival in the form of food, medicine, and fodder (Wickens and Lowe, 2008; Venter and Witkowski, 2010). Almost all of the tree's parts are utilized because of its versatility. Baobab frequently has cultural or spiritual value. Along with other ecological and environmental services like carbon sequestration, soil enrichment, improved air and water quality, and biodiversity preservation, it also provides habitat for a variety of wild species (Wickens and Lowe 2008; Gebauer and Luedeling 2013). This species mostly generate income when there is a dry spell or a drought (Sidibe and Williams, 2002; Duvall, 2007). It is a symbolic, culturally significant, and physically magnificent sub-tropical tree (Salami and Lawal, 2018).

All living things need water to survive, and plants are no different. In times of drought and flooding, a shortage of water or an abundance of water causes plant stress. Emmanuel (2014) asserts that plants growing in water-stressed areas have a small number of tiny leaves. According to Bosco de Oliveira *et al*. (2013), a moisture deficiency is generally characterized by cellular dryness, stomata closure, decreased leaf water potential, and drought signaling in the roots. Reduced cell size and growth, reduced metabolic activity, suppressed photosynthetic activity, turgescence deficit, production of labile oxygen species, and remodeled carbon allotment are all alternate or long-lasting effects of soil moisture deficit (Bosco de Oliveira *et al.*, 2013; Osakabe *et al*., 2014). Lack of a steady water supply has been amongst the major challenges militating against the establishment and maintenance of tree nurseries, especially in the arid tropical and subtropical areas (Daba and Tadese, 2017). The availability of water poses a serious problem, particularly for dry land forestry and seedlings grown in nurseries (Oboho and Igharo, 2017). The proper water specification for tree seedlings must be determined so as to enable the conservation of water in nurseries (Simon *et al*., 2011). The aim of this study is to assess the biomass accumulated by *A. digitata* seedlings as influenced by varying degrees of moisture application under screenhouse condition.

MATERIALS AND METHODS

Study Site

The study was carried out at the Centre of Excellence in Agricultural Development and Sustainable Environment (CEADESE) Screenhouse at the Federal University of Agriculture Abeokuta, which is located northeast of Abeokuta in Odeda Local Government Area of Ogun State at latitude 7°13'57" N and longitude 3°26'17" E. The research location is a hot lowland with two seperate seasons, the longest of which is a rainy eight-month period and the shortest of which is a dry four-month period. The location is characterized by mean monthly temperatures ranging from 25.7 °C in July to 30.2 °C in February and a mean annual rainfall of 1250–2500 mm (Ogun Osun River Basin Development Authority).

Seed Collection and Seedling Establishment

Seeds of *A. digitata* were obtained from matured parent trees in the wild and in compound traditional agroforestry systems in South-West Nigeria based on the areas of the species abundance. Seed viability trial was conducted by putting the seeds in water and separating those that floated as not viable.

Fresh mature fruits of *A. digitata* were collected, dumped and dried under normal atmospheric conditions (Adelani *et al.*, 2016; Salami *et al*., 2019). The seeds were subjected to acid treatment according to the method of Salami *et al*. (2020). The seeds were soaked for 35 minutes in 20 ml of Sulphuric acid, before removal and rinsed thoroughly in running water before sowing. The top soil of 0-20 cm depth was used. The top soil was filled into bottom perforated poly pots of size 12 cm by 24 cm.

Procedure for Experimentation

Moisture application (100 mL) was applied at three levels; once in a week (1/7), three times in a week (3/7) and every day (7/7). Seedlings were set up in a completely randomized design (CRD) with four replicates. The seedlings received constant watering for two (2) weeks to allow adequate seedlings development before the drought stress treatment commenced.

After twelve (12) weeks of treatment application, a biomass assessment was carried out using the methods outlined by Nwoboshi *et al.* (1987) and Awodola (1991). The dry weight of individual plant parameters recorded was obtained. The mean height of the seedlings in each treatment was computed after the selection of two seedlings from each treatment, and the seedling whose height was closest to the mean height was chosen for destructive sampling. Each treatment's selected seedlings were carefully uprooted, and every soil particle was removed with care. The seedlings were divided into their component roots, stems, and leaves. An electronic meter balance was used to calculate the fresh weight of the various seedling components for each seedling. The different components were oven dried at 70 °C until a uniform weight was attained. Since each component was completely dried in the oven, the biomass was determined to be its dry weight. The sum of the biomasses of the various components was then used to calculate the total biomass of the seedlings.

Data Analysis

Data collected were subjected to Analysis of variance (ANOVA) using the statistical package Statistical Analysis System (SAS vs 9.1.2) and where significant difference occurs among the means at $p \leq 0.05$, Fisher's Least Significant Difference (LSD) was used for means separation.

RESULTS AND DISCUSSION

Biomass Assessment of *A. digitata* Seedlings as influenced by varying degrees of Moisture Application

The result of leaf dry weight (LDW) presented in Table 1 revealed that there were significant differences ($p \leq 0.05$) in the means across the three treatments. The highest mean was observed in W_3 treatment (0.45 g) while the least was recorded in W_1 treatment (0.37 g). The result of shoot dry weight (SDW) also revealed significant differences ($p \leq 0.05$) in the mean values across the three treatments. W_3 recorded the highest mean value (0.43 g) while W_1 recorded the least mean value (0.34 g) (Table 1). The mean value for root dry weight (RDW) across the three treatments ranged from 0.26 – 0.36 g which were significantly different ($p \leq 0.05$) from each other. W_3 recorded the highest mean value while W_1 recorded the least (Table 1). The result of total dry weight (TDW) across the three treatments as shown in Table 1 revealed mean values ranging from 0.97 – 1.24 g which were significantly different ($p \leq 0.05$) from each other. W_3 recorded the highest mean value while W_1 recorded the least.

Table 1: Biomass Assessment of *A. digitata* Seedlings as influenced by varying degrees of Moisture Application

Treatment	LDW (g)	SDW (g)	RDW (g)	TDW (g)
W_1 (1/7)	0.37^c	0.34^c	0.26^c	0.97^c
W_2 (3/7)	0.40^b	0.36^b	0.28^b	1.04^b
W_3 (7/7)	0.45^a	0.43^a	0.36^a	1.24^a

Means with different superscript in columns are significantly different ($p \leq 0.05$)

LDW – Leaf Dry Weight; **SDW** – Shoot Dry Weight; **RDW** – Root Dry Weight; **TDW** – Total Dry Weight

Discussion

The biomass assessment of *A. digitata* Seedlings as influenced by varying degrees of moisture application revealed significant effects across all the treatments. Seedlings watered every day produced the highest value in LDW, SDW, RDW and TDW while seedlings watered once in a week produced the least value. This corroborates the findings of Kareem (2019) on *Mansonia altissima* seedlings. Similar result was also reported by Agbo-Adediran (2014) on *Entradrophragma angolense* seedlings. The seedlings of *A. digitata* were able to utilize the different moisture application for biomass accumulation. This is in line with the findings of Akinyele (2007), who found that seedlings of *Buchholzia coreacea* watered once in a day experienced the fastest growth. According to Mukhtar (2016), watering *A. digitata* once in a day and once in every three days results in the highest growth rates across all growth features evaluated. According to other researchers, seedlings exposed to routine watering showed the highest growth metrics including Gbadamosi (2014) on *Persea americana*, Oboho and Igharo (2017) on *Pycnanthus angolensis*, Ogunrotimi and Kayode (2018) on *Solanum macrocarpon* and Ogidan *et al*. (2018) on *Kigelia africana*. This shows that water is an essential constituent of all living organisms and is involved in crucial metabolic reactions (Oboh and Igharo, 2017). Water is crucial for plant growth, development, and productivity as it regulates transpiration rates, which in turn affect the flow of nutrient solutions (Gbadamosi, 2014; Aderounmu *et al.*, 2017; Ogidan *et al*., 2018). According to Isah *et al.* (2013) and Gbadamosi (2014), water is necessary for plants to produce carbohydrates and to transport nutrients, mineral elements and is therefore essential for the growth of seedlings, especially when significant amounts are needed for reforestation and afforestation projects (Oboh and Igharo, 2017). A significant fresh weight and dry weight were recorded in seedlings of *Citrus tangelo* subjected to daily watering (Adelani, 2019). Olajuyigbe *et al*. (2013) further reported that across all the watering regimes (once in a day, once in 7 days, and once in 14 days), there was no significant difference in terms of the height, number of leaves of biomass in *D. mespiliformes* seedlings.

CONCLUSION

The study revealed that varying degrees of moisture application significantly influenced the biomass accumulation of *A. digitata* seedlings. Seedlings that received everyday watering produced the highest total biomass while seedlings that received once in a week watering produced the least. This shows that regular moisture application is required in tree nurseries in order to produce seedlings with high standard.

The specifications for moisture application depend on tree species, phase of growth, period of year, and the present climatic situation of the propagation locality; consequently, it is pertinent to establish this for each tree species as there are variations in rates of growth. At the seedling stage of *A. digitata*, every day watering should be employed as it produced seedlings with the highest total biomass.

REFERENCES

Adelani, D. O. 2019. Effect of watering regimes on the growth and nutrient uptake of *Citrus tangelo* J. W. seedlings grown in a mixture of sand and pulverized *Jacaranda mimosifolia* D. Don leaves. *Journal of Research in Forestry, Wildlife and Environment*. 11(3): 172-179.

Adelani, D. O., Maisamari, I. J and Oloyede, I. 2016. Effect of hydro-priming and sodium chloride concentration on the germination of *Zizyphus mauritiana* seeds. *Proceeding of the 8th Annual Conference of the Forestry Association of Nigeria held in Port Harcourt, Rivers State* 7th-11th March, 2016. Pp. 60-65.

Aderounmu, A. F., Adenuga, D. A., Ogidan, O. A. and Alonge, O. O. 2017. Effect of different watering regimes on the early growth of *Terminalia superba* ENGL and DIELS. In: Adekunle, V. A. J., Ogunsanwo, O. Y. and Akinwole, A. O. (Eds) 2017. Harnessing the Uniqueness of Forest for Sustainable Development in a Diversifying Economy. *Proceedings of the 39th Annual Conference of the Forestry Association of Nigeria*. Pp. 183-189.

Agbo-Adediran, A.O. 2014. Effect of light intensity and watering regimes on the seedlings growth of *Entradrophragma angolense.* M.Sc. Thesis submitted to the Department of Forest Resources Management, University of Ibadan, Nigeria. Pp 12-49

Akinyele, A. O. 2007. Silvicultural requirement of seedlings of *Buchholzia coriacea* Engler. Unpublished PhD theses, submitted to the Dept. of Forest Resources Management, University of Ibadan Pp. 20-34.

Awodola, A. M. 1991. The effect of soil moisture regime on growth of *Acacia albida* and *Acacia seyal* seedlings. *Nigeria Journal of Forestry*. 21 (1+ 2) 35- 37.

Bosco de Oliveira, A., Alencar, N. L. M. and Gomes-Filho, E. 2013. Comparison between the water and salt stress effects on plant growth and development. In: Akıncı S, editor. *Responses of organisms to water stress: Agricultural and Biological Sciences*. IntechOpen Publisher. Pp. 46.

Daba, M. H and Tadese, A. E. 2017. Estimation of optimum water requirement and frequency of watering for different tree seedlings at Bako Agricultural Research Center nursery site. *Journal of Health and Environmental Research*. 3 (6): 90-97.

Duvall, D. B. K (2007). Rural economy and livelihoods from the non-timber forest products trade. Compromising sustainability in southern Africa. *International Journal of Sustainable Development and World Ecology*. 10: 247–262.

Emmanuel, G. A. 2014. Effect of watering regimes and water quantity on the early seedling growth of *Picralima nitida* (Stapf). *Sustainable Agriculture Research*. 3: 35-43.

Gbadamosi, A. E. 2014. Effect of watering regimes and water quantity on the early seedling growth of *Picralima nitida* (Stapf). *Sustainable Agriculture Research*. 3 (2): 35- 42.

Gebauer, J. and Luedeling, E. 2013 A note on baobab (*Adansonia digitata* L.) in Kordofan, Sudan. *Genetic Resources and Crop Evolution.* 60(4): 1587–1596.

Isah, A. D., Bello A. G., Maishanu H. M. and Abdullahi, S. 2013. Effect of watering regime on the early growth of *Acacia senegal* (Linn) wild provenances. *International Journal of Plant, Animal and Environmental Sciences*. 3(1): 52-56.

Kareem, A. A. 2019. Biomass Accumulated by *Mansonia altissima* A. Chev. Seedlings under the effect of Arbuscular Mycorrhiza, Fertilizer Application and Moisture Supply. *Journal of Research in Forestry, Wildlife and Environment.* 11 (2): 114-121.

Mukhtar, R. B. 2016. Effect of Drought stress on early growth of *Adansonia digitata* (L.) in semi-arid region of Nigeria. *Journal of Research in Forestry, wildlife and Environment*. 8(4):23-27.

Nwoboshi, L. C., Onocha, V. and Ehiabor, R. 1987. Indices of macronutrient deficiencies in Terminalia superba. *Nigerian Journal of Forestry*. 17(12):23-27.

Oboho, E. G. and Igharo, B. 2017. Effect of pre-germination treatments on germination and watering regimes on the early growth of *Pycnanthus angolensis* (Welw) Warb. *Journal of Agriculture and Veterinary Science.* 10 (3): 62-68.

Ogidan, O. A., Olajire-Ajayi, B. L and Adenuga, D. A. 2018. Assessment of watering regimes on seedling growth performance of *Kigelia africana* (Lam) Benth. Biodiversity Conservation and National Development Potentials and Challenges. In: Gabriel, S.U., Folaranmi, D.B and Edem, A.E (eds). *Proceedings of 6th Nigeria Chapter of Society for Conservation Biology (NSCB) Biodiversity Conference*. Pp. 341-345.

Ogunrotimi, D. G. and Kayode, J. 2018. Effect of watering regimes on early seedling growth of *Solanum macrocarpon* L. (Solanaceae). *Journal of Applied Sciences*. 18:79-84.

Olajuyigbe, S. O., Jimoh, S. O., Adegeye, A. O and Mukhtar, R. B. 2013. Drought stress on early growth of *Diospyros mespiliformis* Hochst ex A. Rich in Jega, Northern Nigeria. *Nigerian Journal of Ecology.* 12(1):71-76.

Osakabe, Y., Osakabe, K., Shinozaki, K., Tran, L. S. P. 2014. Response of plants to water stress. *Frontiers in Plant Science*. 5: 86.

Salami, K. D. and Lawal, A. A. 2018. Description of Economical Trees and Shrubs species in Northern part of Nigeria and their potentials. *A proceeding of the 6th Biennial National Conference of the Forests and Forest Products Society.* April 23th-27th, 2016, 136-144.

Salami, K. D., Akinyele, A. O. and Folorunso, W. O. 2020. Effect of Pre-Treatments, Inorganic Fertilizer and varying Soil Volumes on the Early Growth Performance of *Adansonia digitata* (Linn) Baobab. *Nigeria Journal of Horticultural Science, Horticultural Society of Nigeria*. *25*: 1-10.

Salami, K. D., Odewale, M. A., Gidado, A. H and Adam, Z. 2019. Pre-germination Treatments on Seeds of *Balanites aegyptiaca* (L) Delile and Influence of Potting Mixtures on the Early Growth. *Journal of Forestry Research and Management.* 16(1):107-117.

Sidibe, M. and Williams, J. T. 2002. *Baobab - Adansonia digitata* (PDF). Southampton, UK: International Centre for Underutilised Crops. pp. 43, 48. ISBN 978-0854327768.

Simon, A. M., Festus, K. A., Gudeta, S., Oluyede, C. A., Betserai, I. N. and Ranmi, J. 2011. Water Application Rate and Frequency affect Seedling Growth of *Vangueria infusta* and *Persea americana*. *African Journal of Biotechnology*. 10(9): 1593-1599.

Venter, S. M., and Witkowski, E. T. F. 2010. Baobab (*Adansonia digitata* L.) density, size class distribution and population trends between four land-use types in Northern Venda, South Africa. *Forest Ecology and Management.* 25:(9)294-300.

Wickens, G. E. and Lowe, P. 2008. *The baobabs pachycauls of Africa, Madagascar and Australia*. New York: Springer Science + Business Media, B.V. pp. 31–. ISBN 9781402064319.