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INFLUENCE OF WATERING REGIMES ON EARLY GROWTH OF Annona *muricata* SEEDLINGS

Yisau, J.A.,[1] Abass R.A.[1], Emilimor P.N.[2], Ojekunle, O.O.[1], Majomi A.A.[1]

[1] Federal University of Agriculture Abeokuta, Ogun State, Nigeria
[2] Delta State University, Delta State, Nigeria
***Corresponding Author:** *yisauja@funaab.edu.ng;*

ABSTRACT

Thestudy determined the response of Annona muricata seedlings to water regime and it effect on early growth. Levels of water required was determined by subjecting seedlings to four watering frequencies vis-à-vis Daily watering, watering every two days, watering every four days and once a week. The experiment was laid out in a Complete Randomized Design (CRD) and parameters such as stem height, collar diameter, leaf area, leaf number were collected fortnightly while, dry weight, fresh weight, root to shoot ratio, root length, root weight, shoot length, turgidity weight and relative water content were evaluated after Twelve (12) weeks of growth. Data collected was subjected to One Way Analysis of Variance on SAS software and significant means was separated using Duncan Multiple Range Test (DMRT). From the result, number of leaves (18.93) was significantly ($p<0.05$) increased in seedlings watered daily while seedling height (39.51 cm), collar diameter (8.05 mm) and leaf area (150.29 cm^2) were not significantly ($p>0.05$) different to watering regimes increased. Also, physiological variables such as dry weight (11.67 g), fresh weight (28.88 g), turgid weight (24.46 g), root weight (14.53 g) and shoot weight (14.36 g) increased significantly ($p<0.05$) in seedling water daily. Availability of water owing to daily watering of Annona muricata seedlings heightened its growth rate.

Key words: Watering regime, Growth, *Annona muricata*, Seedlings

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INTRODUCTION

*Annona muricata*is a native of Central America with the latin word origin annual harvest and, often referred to as guanabana, soursop, graviola, or Brazilian pawpaw (Wélé *et al.,* 2004). Southeast Asia, South America, and the African rainforests all have significant populations of this plant. Due to the fruit's sweet and sour flavor, *Annona muricata* is frequently referred to as soursop. Sopsop or shawa are the names used in Nigeria (Wélé *et al.,* 2004). According to Joseph-Adekunle (2014) *Annona muricata* is a versatile plant with

several uses, such as soursop can be used to produce food products with acceptable nutritional value, as well as goods for industry and medicine. It also helps small- and medium-scale farmers supplement their income and directly contribute to food security.

A fruit-bearing plant known as *Annona muricata*is a member of the kingdom Plantae, the division Angiospermae (Magnoliophyta), the class Magnolid, the order Magnoliales, the family Annonaceae family, and the genus Annona (Pinto *et al.,* 2005; Gavamukulya *et al.,* 2017). The Annonaceae family, which includes *Annona muricata*, has the largest fruits and is found in tropical climates. Pinto *et al.,* (2005) stated that a year-round bloomer and fruit producer, *Annona muricata* is an evergreen shrub. The upper surface of the obovate, oblate, and acuminate leaves is thick, glossy, and dark green.

According to Nugraha*et al.,* (2019), the herb *Annona muricata*is frequently used to treat a variety of illnesses, including parasite infections, inflammation, diabetes, and cancer. Individuals who stay in tropical areas employ *Annona muricata*in all forms of conventional medication; the leaves, stem bark, roots, and seeds are the most not unusual portions for use as lively elements (Badrie and Schauss, 2010). As it has anthelmintic, antihypertensive, anti-inflammatory, and anticancer properties, *Annona muricata*is used to deal with bacterial and fungal infections. In addition, it has been employed as an analgesic as a treatment for diabetes, internal and external parasites, fever, and skin and respiratory ailments. All parts of the plant are used to cure diabetes, cancer, parasite infections, stomachaches, and malaria in a number of tropical sub-Saharan nations, including Uganda. (Gavamukulya *et al.,* 2017, Ssenyange *et al.,* 2015). To treat internal and external parasites, Malaysian natives used the leaves of *Annona muricata* (Badrie and Schauss, 2010). The use of leaves to treat malaria is very important in tropical countries as Cameroon, Togo, and Vietnam (Boyom *et al.,* 2011,). In Ghana, some other plants are decocted with *Annona muricata* into a mixture and used in bath where females sit in (Asase *et al.,* 2012).

The fruit of the *Annona muricata* plant is used to deal with diarrhea and neuralgia, eliminate worms and parasites, boost milk supply in breastfeeding ladies, and decrease fever. The leaves are used to treat cancer, cystitis, cancer, headaches, and insomnia (Pieme *et al.,* 2014). The fruit is not only appreciated as food, but the juice is used as galactogogue to treat diarrhea, heart and liver diseases (Hajdu and Hohmann, 2012), and against intestinal parasites in South America (Badrie and Schauss, 2010). Additionally, the seeds are used as anthelmintic and antiparasitic treatments, and the leaves, bark, and roots of *Annona muricata* have been used for their anti-inflammatory, antihypertensive, sedative, antidiabetic, smooth muscle relaxant, and antispasmodic effects (Adewole and Ojewole 2009, Mishra *et al.,* 2013).

Water is considered the primary germination regulator, as germination begins with seed imbibition. Sufficient moisture must be present for growth to take place (Luna *et al.,*2016). Water is one of the most crucial factors in plant productivity, development, and growth (Ogidan *et al*., 2018). Since water can impact plant germination parameters, it is known to be a determining factor for seedling germination (Shaban, 2013). Water is a vital component of all living things and is important in many metabolic processes, claim Oboh and Igharo (2017). According to Aderounmu *et al.*

(2017), water is essential for plant growth because it controls the rate of transpiration, which in turn impacts the uptake of mineral solutions. According to Bohnenert and Jensen (1996), moisture deficiency stress happens to be the most significant ecological element that impacts plant growth. Water stress causes plants to undergo a metabolic change that is accompanied by a decline in growth and photosynthesis. This impacts agriculture, forest species, and ecosystems, which disrupts human activities in the end (Tezara *et al.*, 1999; Massad *et al.,* 2012). Optimal water requirements for tree seedling growth must be established in nurseries in order to encourage sustainable water usage (Mukhtar *et al.,* 2016). This will lower the cost of producing planting stock in commercial nurseries (Mng'omba *et al.,* 2011).

MATERIALS AND METHODS

Study Site

The study was carried out at the forestry nursery unit of Forestry and Wildlife management in the Federal university of Agriculture, Abeokuta, Ogun state Nigeria. The site falls within longitude 3º20'E and 3º37'e and the latitude 7ºN and 7º58'N. The nursery has a gentle landscape and mild slope. The site is punctuated in parts by ridges, isolated, residual hills, valley and low lands. The soil is sand and clay with crystalline basement complex. The relative humidity of the area is 82.54% and an average monthly temperature should be 35.8ºC.

Seedling Collection and Preparation

Two weeks old *Annona muricata* seedlings were acquired from National Horticultural Research Institute (NIHORT). Forty (40) healthy seedlings were selected and transplanted in polythene pots of sizes 12cm by 24cm filled with the top soil. Seedlings were raised at one seedling per poly pot and watered until stability of seedlings was obtained. Stable seedlings were subjected to four (4) levels of watering regimes viz-a-viz, Daily watering (WED), Watering every other day (WET), watering every four days (WEF), Once a week (WES). These Four (4) treatments were replicated 5 times with a total of sample 20 samples. The experiment was laid out in a Completely Randomized Design (CRD).

Data Collection

Morphological parameters such as seedling height, number of leaves, leaf area and stem collar diameter were taken fortnightly (every two weeks) for 12 weeks. After twelve weeks of experimental treatment, the seedlings were harvested from the pots and separated into roots and shoots, to determine the shoot weight and length and the root weight and length. Biomass accumulation, Root to shoot ratio, Fresh weight, Turgidity weight and Relative water content were determined according to Pieczynski *et al. (*2013).

Mathematically,

Relative water content was determined by

$$\text{Relative water content} = \frac{Fwt-Dwt}{Twt-Dwt} * 100 \quad \ldots\ldots\ldots [1]$$

Fwt – Fresh weight, Dwt – Dry weight, Twt – Turgidity weight

Data Analysis

Data collected was subjected to statistical Analysis of variances (ANOVA) on SAS software and significant means were separated using DuncanMultiple Range Test (DMRT).

RESULTS

Effect of Watering Regime on the Morphological Parameters of *Annona muricata* seedlings

The study showed that watering regime had no significant effect ($p>0.05$) on stem height, stem collar diameter and leaf area of

Annona muricata seedling. With increased watering availability (WED), stem height had the highest mean value (39.51 cm) while seedlings watered once a week (WES) had the least mean value 23.60 cm. Stem collar diameter (8.05 mm) increased in seedling watered once a week (WES) and this effect was not significantly (P>0.05) different from seedlings watered every four days (6.01 mm), every other day (5.99 mm) and least effect (5.65 mm) recorded in seedlings watered daily (WED). Similarly, leaf area (150.29 cm^2) increased in seedlings watered once a week (WES) and was not significantly different (P>0.05) from seedlings watered daily (148.17 cm^2), every other day (93.16cm^2) and every four days (47.90 cm^2). However, result showed that number of leaf produced in *Annona muricata* increased with increased in the rate of water applied. Seedling subjected to daily (WED) watering regime had the highest significant mean (18.93). This effect was significantly different (P<0.05) from the mean value of seedlings watered once a week (7.03), every other day (6.83) and least effect (4.03) in seedlings watered every four days (Table 1).

Table 1. Effect of Watering Regime on the Morphological Parameters of *Annona muricata* seedlings

Watering regime	Stem height(cm)	Collar diameter (mm)	Leaf number	Leaf area(cm^2)
WED	39.51^a	5.65^a	18.93^a	148.17^a
WET	32.36^a	5.99^a	6.83^b	93.16^a
WEF	26.15^a	6.01^a	4.03^b	47.90^a
WES	23.60^a	8.05^a	7.03^b	150.29^a

Mean values with the same subscript in each column are not significantly different (P> 0.05)
***Key:- WED**: Daily watering, **WET**: Watering every other day, **WEF**: Watering every four days, **WES**: Watering once a week*

Effect of Watering Regime on the Physiological Parameters *Annona muricata* seedlings

It was recorded that watering regime has significant effect (P<0.05) on some physiological variables of *Annona muricata* seedlings. Mean values in variables such as Dry weight (11.67 g), fresh weight (28.88 g), dry root weight (14.53 g), dry shoot weight (14.36 g) and turgid weight (24.46 g) were significantly (P<0.05) higher in seedlings watered daily (WED). This effect was not significantly different (p>0.05) from seedling watered every other day (WET) (7.06 g, 14.20 g, 9.90g, 15.79 g respectively). However, there was significant difference (p<0.05) in the dry weight of the shoot between seedlings watered daily (WED) 14.36 g and seedlings watered every other day (WET) 3.80 g. Seedlings watered every four days (WEF) had the least mean effect on dry weight (2.81 g), fresh weight (6.90 g), dry root weight (3.28 g), dry shoot weight (3.40 g) and turgid weight (6.78 g) Table 2.

Effect of Watering regime on the Physiological Parameters *Annona muricata* seedlings.

Watering frequency	Dry weight	Fresh weight	Root to Shoot ratio	Root length	Root weight	Shoot length	Shoot Weight	Turgidity Weight	Relative water content
WED	11.67[a]	28.88[a]	25.80[a]	3.18[a]	14.53[a]	37.58[a]	14.36[a]	24.46[a]	117.26[a]
WET	7.06[ab]	14.20[ab]	14.80[a]	2.08[a]	9.90[ab]	23.20[a]	3.80[b]	15.79[ab]	84.75[a]
WEF	2.81[b]	6.90[b]	14.80[a]	2.16[a]	3.28[b]	25.90[a]	3.40[b]	6.78[b]	58.41[a]
WES	4.26[b]	10.97[b]	27.30[a]	1.31[a]	5.02[b]	33.60[a]	4.75[b]	13.37[ab]	59.67[a]

Mean value with the same subscript in each column are not significantly different (P>0.05)
***Key: WED**:Daily watering, **WET**: Watering every other day, **WEF**: Watering every four days, **WES**: Wateringonce a week*

DISCUSSION

It was observed from the study that water availability is important for early seedlings growth in *Annona muricata* seedlings. According to the study, rate of watering application influenced that morphological changes in *A. muricata.* Increase in the rate of water applied (Daily watering) significantly increased the leaf production however, stem collar diameter, stem height and leaf area were not influenced by the rate of watering applied. In contract to this observation, daily watering significantly influenced the stem collar diameter *Synsepalum dulcificum* seedlings (Yisau and Aduradola, 2019). According to Mohammed *et al.* (2013), watering regime significantly influenced seedlings height and number of leaf produced in five tropical species. In another study, watering regime increased collar diameter in *Dialium guineense* (Olajide*et al.,* 2014) and seedling height in *Pica nitida* (Gbadamosi, 2014). Water constraints affect the uptake and transfer of nutrients from roots to the shoot of a plant (Jalota, 2006). According to McDonald (1984), Jensen *et al*, (1998) and Araya (2007) water deficit imposes an unwanted moisture stress in plants causing a reduction in leaf expansion, leaf water potential of plant resulting in cell turgor loss and stomata conductance. This process often leads to loss of transpiration and eventual decrease in photosynthetic rate thereby reducing the overall growth and in severe cases, it causes wilting of plant.

The physiological response of *Annona muricata* seedlings increased with water availability. The study observed an increase in dry weight, fresh weight, dry root weight, dry shoot weight and turgid weight in response to soil water availability accrued in daily watering. Yisau and Aduradola (2019) observed significant increase in fresh weight and stem dry weight of *Synsepalum dulcificum* seedlings. With increase in rate of water application, water was made available for physiological process that enhanced the growth rate in *Annona muricata* seedlings. Growth and biomass production is directly proportional to the supply and use of water in plant (Cao, 2000; Olajuyigbe *et al.,* 2013; Fahad*et al,* (2017) stated that, water deficit in plants affects physiological process and reduction in overall plant growth. Water stress in form of under watering or over watering causes reduction in physiological processes in plant hence, retards growth and plant development (Isah *et al*., 2012; Gbadamosi 2014). It also reduces the rate of photosynthesis due to absence of translocation, reduction of leaf area, chlorophyll content and photosynthetic rate per leaf area (Blum, 2017). Furthermore, Dry weight is a better measure of growth and it indicates that this specie will have better growth rate with increase in levels of water in the soil (Yisau and

Aduradola, 2019). Although, root length, shoot length, root to shoot ratio and Relative water content were not significantly influenced by watering regime, growth increased in seedlings watered daily. Allahverdiyev*et al.* (2015) opined that increase in growth rate is directly related to higher water content and as relative water content affect plant physiological process.

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