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CLIMATE CHANGE PARTNERSHIP ACTIONS FOR SUSTAINABLE FUTURE AND RESTORING LIFE ON EARTH

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PREFACE

There is a growing concern on the adverse impacts of climate on biodiversity. This phenomenon is greatly manifested in form of shifting weather patterns threatening global food security, health and species existence. Humanity is at the receiving end of the consequences of climate change hence there is a need to step up actions on all fronts- overtime, everywhere all at once.

This calls for collaboration, partnership and networking to strengthening synergy among relevant stakeholders in a bid to tackling climate change menace. This forms the basis for the theme of this year world Environmental conservation conference: **CLIMATE CHANGE PARTNERSHIP ACTIONS FOR SUSTAINABLE FUTURE AND RESTORING LIFE ON EARTH.** The theme is conceived with a view to create an interface for information sharing and offer opportunities for participants to refine their commitments and pledges in the quest to achieving Sustainability in the face of climate change.

This year World Environmental Conservation Conference is memorable in the sense that it received overwhelming funding from the host - West African Science Service on Climate Change and Adapted Land use). WASCAL is posed to provide information and knowledge at the local, national and regional level to cope with the adverse impacts of climate change. Thus, this conference will offer opportunities for participants to learn from good practices demonstrated and showcase by WASCAL during the course of the conference. It will also strengthen staff-student exchange and provide prospect for Doctorate Research Doctoral Research in West Africa Climate System Programme (DRP WACS) – WASCAL among others.

Special appreciation goes to the management of The Federal University of Technology, Akure the host institution, National Park Service and African Regional Center for Space Science and Technology Education-English (ARCSSTE-E) that co-host this conference. We equally acknowledge other private, individual and corporate organizations that have contributed towards the success recorded in this event.

All the submitted articles were subjected to strict double blind peer-review process by the reviewers that are experts in the area of the particular submitted manuscript. The accepted manuscripts are published in WECC 2023 proceedings and also available for download on the organization website (www.necorng.org).

The accepted manuscripts fall within the underlisted subthemes:

- Climate change adaptation strategies in Agriculture, Forestry and Other Land Use (AFOLU)
- Climate smart city and architectural landscape design
- Retrofitting and decarbonization in tourism and hospitality industry
- Indigenous knowledge and local innovation in climate change adaptation
- Climate risk management, health, safety and hygiene
- Carbon credit-offset marketing/circular economy
- ICT development in environmental conservation (image processing and acquisition, computer vision, graphics, speed, interface technology, HMD devices, GIS: Body Tracking, AI and IOT, VRT, IVE).

We commend our keynote speaker Prof. Douda Kone Director Capacity Building Department, WASCAL Headquarter, Ghana and other guest speakers Prof. Babatunde Rabiu, Director General, Chief Executive Office, African Regional Centre for Space Science and Technology Education-English (ARCSSTE-E) and Dr. Goni I. M., Conservator General National Park Service.

It is hoped that researchers, students and policy makers will find the papers in this book very useful. Even though all the papers were reviewed and edited, the content and option expressed remain essentially that of the authors and not necessarily that of Netlink Environmental Conservation Organization.

Dr. Oladeji S. O.

President Netlink Environmental Conservation Organization

Convener World Environmental Conservation Conference

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ECOLOGICAL VARIATION AND VARYING WATERING REGIMES ON SEEDLING GROWTH PERFORMANCES OF *Annona muricata* L.

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ABSTRACT

This study was conducted to investigate the effect of provenances and watering Regimes on the growth of potted seedlings of Annona muricata L. The experiment was set up using 4 x 4 Factorial experiments in Completely Randomized Design (CRD) with five replicates. Four different ecological zones were selected for the seed source: Port Harcourt, Umuahia, Benin city and Ibadan and four watering regimes (watering every day, watering every three days, watering once a week and watering once in two weeks) were considered. Data collected on growth parameters and biomass accumulation were subjected to Analysis of Variance (ANOVA) while means were separated using Duncan's Multiple Range Test at 5% probability level. The results showed that Port Harcourt with watering once in three days had the significant mean leaf production (20.75), seedling height (46.93cm), collar diameter (4.96mm) while Ibadan with watering once in three days had the highest number of branches. Similarly, biomass accumulation results showed that seedlings from Port Harcourt watered once in three days was significantly different from all the studied areas with the dry leaf weight (2.66g), dry stem weight (1.24g), dry root weight (2.10g) and leaf area estimate (101.11g/cm-2). Collection of seeds from Port Harcourt and watering of seedlings once in three days are recommended as the best strategic way of raising healthy seedlings of A. muricata for sustainable production in the nursery.

Keywords: *Ecological zones, Provenance, Collar diameter, watering regimes.*

INTRODUCTION

Climate change adaptation strategy is a combine effort of individual through application of environmental friendly plans in agricultural development that will allow deliberate inclusion of forest trees in soil and land sustainability. Agroforestry is an ecologically sustainable land use management (Pratap and Abhishek, 2018). It is a designed strategies to address poverty, land depredation and improve agricultural productivities for food sufficiency (Raj *et al.*, 2014).

Soursop is an agroforestry and home garden plant commonly planted among the elite; it is also called guyabano (Thompson, 2003). It is a shrub or small tree of three to ten metre in height. It is adapted to humid tropical climate and can tolerate partial shade. This fruit crop grows in any kind of soil but does well in loose, fairly rich, deep loam and well drained soil with PH between 6.0-6.5. The young green fruits with soft seeds can be cooked as vegetable; the ripe fruits can be eaten off hand or as dessert, or processed into candies, jams and jelly or processed drinks. The leaves are used as herbal medicine (Majolagbe and Ogunwande, 2019). Because of the moderate size, the tree can be intercropped as agroforestry species with tree and agricultural crops. It is a good source of vitamins B and C, calcium and phosphorus. *Annona muricata* is a promising tropical tree, a good species for agroforestry practices and wealth of phytochemical analysis. *A muricata* is proven to possess a wide spectrum of biological activities for body improvement processes (Christoph *et al*., 2013).

Conformity between an organism and its environment constitutes adaptation of the living organisms (Pianka, 2000). According to Umar 2012, despite numerous socio-economical potential of edible Annonaceae, the species in the family remained underused due to non-availability of the plant to meet the need of the people. Also, the limiting factor which is good seed source has lessened the renewal of stand in the wild. With these impending problems there is a need to develop seedling with good physiological attributes and optimum silvicultural treatments to guarantee large scale seedling production so as to meet the global environmental challenges and sustainable production in different ecological zones of Nigeria. This research work aimed at assessing the influence of provenances on seed germination and to determine the best watering system for optimum growth of *A. muricata* seedlings.

MATERIALS AND METHODS

Four (4) sources of *A. muricata* seeds were considered for the experiment. These include: Port Harcourt (P1), Umuiahia (P2), Benin (P3) and Ibadan (P4). Twenty-five (25) fruits were carefully harvested from all the five locations per provenance and kept separately in an open chamber to get fermented naturally. The viable seeds were carefully extracted according to sources and air dried for a period of forty-eight (48) hours in an open chamber. One hundred (100) seeds were randomly picked for sowing in germination tray filled with river sand. After germination, relatively uniform seedlings were pricked out and potted into 2kg top soil filled polythene pots and allowed to stable for two weeks. Then different watering regimes vis; watering every day (W1), watering every three days (W2), watering once a week (W3) and

watering once in two weeks (W4) were considered using equal volume of water (150ml). The experiment was laid in 4 x 4 Factorial in Completely Randomized Design (CRD) with five replicates per treatment. Seedlings growth parameters; number of leaves (NL), number of primary branches (NB), plant height (HT) and collar diameter (CD) were observed fortnightly for 16 weeks starting from two Weeks After Transplanting (WAT). At 16 WAT, four plants were sampled from each treatment; the plant parts were separated into roots shoots and leaves for biomass assessment. Data collected were subjected to analysis of variance (ANOVA). While significant difference existed among the mean were separated using Duncan multiple range test (DMRT).

RESULTS AND DISCUSSION

Table 1: Seedling growth parameters in response to watering regimes and provenances

Provenance	Number of Leaves	Height (Cm)	Collar Diameter (mm)	Number of Branches
Benin	3.08c	13.20c	21.07b	1.45a
Umuahia	3.20c	14.95bc	23.28b	1.50a
Ibadan	4.15b	17.60ab	31.72a	1.75a
Port Harcourt	4.85a	19.50a	34.30a	1.20a
Watering regime				
Two weeks interval	3.35c	13.85c	27.11ab	0.20c
One-week interval	3.50bc	15.15bc	24.11b	0.25c
Three days interval	4.03ab	17.60ab	28.48ab	1.55b
Daily	4.43a	18.65a	50.68a	3.90a

Note: within column means with the same alphabet are not significantly different.

Table 2: Mean biomass assessment (wet and dry matters) and Leaf area estimate in response to watering regimes and provenances

Watering Regimes	WLW(g)	WSW(g)	WRW(g)	DLW(g)	DSW(g)	DRW(g)	LAE(mm^2
Once two weeks	8.05b	4.6b	5.43b	2.32b	1.41a	2.02b	82.10c
Once a week	7.42c	3.27c	4.13c	2.17bc	0.89b	1.60c	95.09b
Every three days	8.20b	2.94c	2.71e	1.95d	0.65c	0.58d	98.63a
Every day	7.40c	3.18c	3.34d	2.02cd	0.81b	1.53c	97.74a
Provenance							
Benin	6.97b	3.22c	4.15c	2.01c	0.88c	1.43b	89.97b
Umuahia	7.15b	3.29c	3.35d	1.91c	0.80c	1.19b	85.94b
Ibadan	9.03a	4.06b	4.94b	2.31b	1.14b	2.33a	98.77a
Port Harcourt	9.40a	4.72a	5.34a	2.66a	1.24a	2.10a	101.11a

Note: Within column means with the same alphabet are not significantly different

From table 1, the combined effects of watering regimes and provenances was observed on leaf production as Port Harcourt seedlings watered at 3 days interval (P1W2) produced highest mean number of leaves (38.42) while Umuahia seedlings watered at 2 weeks interval (P2W4) recorded the least mean value of 22.08 leaves. However, the leaf production is significantly influenced by provenances. From Table 1, it was observed that Port Harcourt and Ibadan were not significantly different from one another with mean value of 4.85 and 4.15leaves respectively but significantly different from Umuahia and Benin. Benin had the least mean value for leaf production (3.08) and was not significantly different from Umuahia provenance (3.20). Considering watering regimes, significant variation was observed as daily watering recorded highest mean values of 4.43 leaves while watering done 2 weeks interval has the least mean value of 3.35 leaves

The combined effects of watering regime and provenance were also observed on seedling height (Figure 1) as Port Harcourt seedlings watered at 3 days interval (P1W2) recorded highest mean values (38.42cm) while Umuahia seedlings subjected to 2 weeks interval watering

had the least mean value of 22.08cm. Significant variation in seedling height as influenced by different provenances was observed (Table 1) as Port Harcourt had the overall mean value of 19.50cm which was significantly different from all the remaining provenances. Also, there was a significant effect of watering on the seedling height as daily watering of Port Harcourt sourced seedlings had the highest mean value of 18.65 cm while watering once in two weeks had least seedling height. Interaction effects of watering regime and provenance was also observed in collar diameter of *A. muricata* seedlings. From Figure 1, it was observed that seedlings from port Harcourt watered at 3 days interval (P1W2) had biggest collar diameter with 50.67mm followed by same provenance watered daily (P1W1) while least mean value was recorded in seedlings from Umuahia watered at 2 weeks interval (21.12mm). According to Table 1, significant effect of watering regimes on collar diameter was observed as daily watering produced seedlings with highest mean value (50.67mm) followed by watering once in three days interval (28.47mm) which is not significantly different from watering at 1week interval. The least value was observed in watering at 1-week interval with 24.11mm. Variation was observed in collar diameter of the seedlings from different provenances in Nigeria.
Highest mean collar diameter with 34.3mm which is significantly different from other sources except Ibadan (31.7mm). The least was observed in Umuahia (21.1mm) but not significantly different from Benin (21.3mm).

Tables

The effects of interaction of watering regime and provenance on seedling growth parameters considered are shown in Figure 1. Seedlings from Ibadan sourced seeds watered at 1-week interval produced highest mean number of branches (P4W3) with 4.69 followed Ibadan sourced seeds watered at 2 weeks interval (P4W4). Least branch production was observed in Benin subjected to daily watering (P3W1). However, there is no significant variation noticed in all provenances studied but watering regime showed observable variation as daily watering is significantly different from other regimes with production of highest number of branches (3.9). The least is observed in watering done at 2 weeks interval (2.0) which is not significantly different from watering once a week. The wet leaf weight of the daily watering of Port Harcourt and Ibadan were significantly different from seedlings from other treatments. Port Harcourt had the highest overall mean of 9.40g and followed by the Ibadan provenance. Umuahia and Benin were not significantly different from each other but significantly different from Ibadan and Port Harcourt. Reduced wet weights were recorded from all the provenances watered once in two weeks while the least was observed in Benin seed sourced seedlings (6.32g).

The wet stem weight from Port Harcourt daily watering had the highest mean value of 4.72g and was significantly different from the other provenances, followed by Ibadan provenance daily watering with a mean value of 4.06g and it was significantly different from Port Harcourt and Ibadan (Table 2). Benin provenance watering once in two weeks had the least mean value (2.28g) and it was not significantly different from Umuahia provenance watering once in two weeks as both have almost the same mean value (2.31g). The wet root weight from Port Harcourt daily watering was significantly different from every other provenance with the highest mean value of 5.39g irrespective of the number of days of watering or watering regimes. Followed by this was the Ibadan daily watering (4.94g), Benin watering once in three days (4.15g) and Umuahia watering once in two weeks intervals had the least value of 3.35g.

From the result all the provenances are significantly different from one another likewise all the watering regimes. According to Figure 2, the dry leaf weight of seedlings from Port Harcourt and Ibadan provenance were similar to one another but significantly different from other provenances with mean value of 2.66g and 2.62g respectively.

Umuahia with watering once in two weeks had the least dry leaf weight of 1.91g and was not significantly different from all other provenances watering once in two weeks. The highest mean value of dry stem weight was recorded in Port Harcourt watered once in three days 1.89g and was significantly different from all other provenances and watering regimes as shown in Figure 2.

However, Ibadan seed sourced with daily watering had the mean value of 1.14g and was significantly different from all other treatments. Seedlings of seeds sourced from Benin and Umuahia provenances watering once in two weeks had the least value of 0.98g and 0.94g respectively and were not significantly different from one another.

Figure 2 reveals that dry root weight of the seedlings from Ibadan watering once in three days had the highest mean value (1.62g) and was not significantly different from the Port Harcourt watering daily (1.59) and Port Harcourt watering once in two days (1.57g). The Umuahia seed sourced seedlings had the least mean value and not significant different from the Benin provenance irrespective of the watering patterns but was significantly different from Ibadan and Port Harcourt provenances in all the watering regime patterns. From Figure 3, the results showed that watering regimes and provenance significantly influenced leaf area estimate of the seedlings. There was no significant difference between daily and two days water application. Watering every two days of Port Harcourt seed sourced seedlings had the highest mean value of 98.63mm^2, watering everyday 97.7 mm2, watering once a week 95.09mm2 and. However, watering once in two weeks of seedlings with

seeds sourced from Umuahia had the least mean value of 62.10mm2 and it was significantly different from all provenances and different days of water watering.

The results from the variation study showed that Port Harcourt had outstanding performance in seedling growth and biomass acumination assessment and it implies that provenance has significant impact on seedlings growth. This was in agreement with the findings of Oyun (2003) who observed a significant growth performance in seedling height, number of leaves and biomass at early growth of *Parkia biglobosa* collected from Ilorin and Afaka over Badeji and Kabba seed sources. The higher vigour of seedlings from Port Harcourt may be attributed to environmental adaptation and some genetic components from the mother plants as deduced by Oyun (2003). Similarly, Akinyele and Salami (2014) observed that the difference in height growth of *Jatropha curcas* seedlings in south Western Nigeria was significant among other five provenances studied. Also, the same varieties of species planted and grown under the same climatic and edaphic condition showed significant differences in their growth parameters measured over time. Watering is essential for good growth performance of any seedling in the nursery Water is required by plants for the manufacture of carbohydrates and transportation mean of foods and mineral elements. As observed by Awodola (1984), the reduction in relative water contents affects physiological processes and hence plant growth. Similarly, too much water in excess of plant need may retard physiological processes in plants (Sale 2015).

According to Table 3, *Annona muricata* seedlings prefer daily to 3 days watering interval and can manage water effectively when subjected to water stress for 2 weeks. This implies that watering regime has significant influence on *Annona* seedling growth. Oyun *et al,* (2010) observed the effect of watering regimes on *Afzelia senegal* seedlings as the seedlings that were watered twice per week had higher stem growth and leaf number than those that were watered daily and once per week which is contrary to the findings from this study. Gbadamosi, (2014) when studying effects of watering regimes and water quantity on early seedling growth of *Picralima nitida* (Stapt) found that seedlings watered with 10cl at 3 days interval had highest mean values of 13.17cm while 20cl at 3 days interval supported leaf production. Port Harcourt seedlings had the highest values for all the silvicultural parameters except the number of branches produced when compared with other seedlings sourced from other provenances. The study has shown that the choice of an appropriate seed source is an integral step in restoration and establishment of plant species on a sustainable production (Aigbe *et al.,* 2016).

CONCLUSION AND RECOMMENDATIONS

This findings from the study revealed that seeds sourced from Port Harcourt and Ibadan provenances had best growth performances as expressed through the assessed growth parameters. Furthermore, the results indicated that adequate watering either on a daily basis or once in two days had great contributions on the height, leaves production and increased collar diameter. For production of seedlings with outstanding growth performance and good vigour in the nursery for plantation establishment, it is therefore recommended that Port Harcourt be considered as best seed source. But if not accessible, Ibadan can be given consideration. More so, watering once in three days should be applied to the seedlings at nursery stage to promote good performance due to its outstanding results.

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