Journal of Forestry and Natural Resources
Jour.For.Nat.Reso (JFNR) (2026).5(1).27-35 | ISSN: 3005-4036
Web link: https://journals.hu.edu.et/hu-journals/index.php/jfnr

Research Article | OPEN ACCESS [1] | [2]

Influence of Watering Regimes and Irrigation Quantities on Seedling Growth and Biomass Accumulation in *Tetrapleura tetraptera* (Schumach and Thonn.) Taub

Gbadamosi A. E[1], Oginni M. M[1*]

[1]Department of Forestry and Wildlife Management, Adekunle Ajasin University, Akungba-Akoko, Ondo State, Nigeria

ARTICLE INFO

CORRESPONDING EMAIL
*Corresponding email:
muhammedoginni@gmail.com

ARTICLE HISTORY
Submitted: 26 jan 2026
Accepted: 30 June 2026
Published Online: 30 June 2026

CITATION
Gbadamosi A. E and Oginni M. M(2026). Influence of Watering Regimes and Irrigation Quantities on Seedling Growth and Biomass Accumulation in *Tetrapleura tetraptera* (Schumach and Thonn.) Taub. *Journal of Forestry and Natural Resources*5(1), 27-35.
https://doi.org/10.20372/sqjq6190

KEYWORDS
Beekeeping; Constraints; Households; Logit model; Ethiopia

Abstract

Effective water management is essential for producing high-quality tree seedlings, particularly under increasing climate variability. This study investigated the effects of watering regimes and water quantities on seedling growth and biomass accumulation of *Tetrapleura tetraptera* under controlled greenhouse conditions. Seeds were germinated, and 108 juvenile seedlings were transplanted in polythene bags in 12×14×16cm dimensions. A 3×4 factorial design was used, exposing seedlings to combinations of watering regimes (once daily, twice daily, once every 3days, once every 5days) and water quantities (30, 40, and 50ml). Growth parameters (height, collar diameter and number of leaves) and biomass (leaf, stem, root and total dry weight) were measured. Results revealed that both watering frequency and quantity significantly influenced all growth and biomass parameters ($P \leq 0.05$). Seedlings irrigated more frequently consistently outperformed those watered at longer interval. Interestingly, seedlings receiving 40ml twice a day achieved the highest values for height (26.51±3.96cm), collar diameter (5.57±0.37mm), and total biomass (61.16±29.72g). In contrast, seedlings watered once in every five days exhibited markedly reduced growth and biomass, underscoring the species' sensitivity to water stress. Increasing the quantity of water beyond the optimal level did not yield further growth, highlighting the importance of optimizing rather than maximizing irrigation. Overall, this study provides species-specific empirical evidence on the water requirements of T. tetraptera seedlings and demonstrates that frequent, moderate, irrigation promotes superior growth and biomass accumulation. The findings offer practical guidance for nursery management, and support optimized seedling production strategies in afforestation, agroforestry and conservation initiatives within water-limited tropical environments.

Keywords: biomass accumulation; growth parameters; *Tetrapleura tetraptera*; water quantity; watering regimes.

1 Introduction

Water availability is a critical determinant of plant growth, productivity and survival, particularly during the early stages of seedling development. Soil moisture directly regulates key physiological processes, including (cellular growth, photosynthesis and nutrient uptake), while prolonged water deficits often result in reduced biomass accumulation and stunted growth (Mo et al., 2025). The increasing unpredictability of precipitation whether from (natural rainfall or anthropogenic irrigation) can therefore exert significant influence on seedling developmental trajectories and biomass al-

location patterns in both natural ecosystems and nursery environments.

Watering frequency and magnitude are key determinants of seedling quality in forest nurseries, though the optimal combination of these factors often varies across species and environments. Regular watering maintains stable soil moisture, supporting continuous vegetative growth and development. In contrast, irregular watering regimes can impose recurrent water stress, thereby inhibiting growth (Ibeh & Akinyele, 2024). As climate variability intensifies, marked by prolonged dry seasons and increasingly unpredictable rainfall patterns in many tropical regions management strategies that optimize water supply have become increasingly critical for sustaining seedling performance and ensuring nursery success.

Recent empirical studies have underscored the critical role of water availability in enhancing seedling performance across diverse plant taxa. For instance, research in a Peruvian tropical forest demonstrated that regular watering regimes improved seedling growth and survival by increasing the stem density and total overall recruitment rates (Ezekiel et al., 2024). Similarly, an experimental study on Adansonia digitata showed that watering frequency significantly influenced key morphological and physiological traits, including seedling height and biomass accumulation (Ezekiel et al., 2024). Controlled irrigation experiments with Quercus acutissima further showed that reduced soil moisture led to declines in seedling height, basal diameter, and total biomass compared to the well-watered controls (Luo et al., 2025). Collectively, these findings highlight the strong link between water management practices and seedling developmental outcomes, emphasizing the need for species-specific irrigation strategies in both natural and nursery settings.

Although there is increasing evidence on the effect of water supply on seedling growth, many indigenous tropical tree species of ecological, agronomic, and cultural importance still lack species-specific data. *Tetrapleura tetraptera* (Schumach & Thonn.) Taub., a valued leguminous species native to West and Central African forests, is widely recognized for its medicinal and nutritional qualities. However, the species faces regeneration challenges in degraded landscapes. Despite its significance, empirical studies examining the effects of varying watering regimes and water quantities on the growth and biomass accumulation of T. tetraptera seedlings remain limited, underscoring the need for targeted research to inform nursery management and conservation practices.

1.1 Objectives of the study

The general objective of this study is to evaluate the effects of watering regimes and water quantities on growth and biomass accumulation of T. tetraptera seedlings.

1.1.1 Specific Objectives

1. To determine the effect of watering frequency on seedling growth and biomass accumulation.
2. To assess the influence of water quantity on seedling growth and biomass accumulation.
3. To evaluate the interaction effects of watering regime and quantity.

1.1.2 Research Questions

1. How does watering frequency influence seedling growth and biomass accumulation?
2. What is the effect of water quantity on biomass accumulation and biomass accumulation?
3. Is there an interaction effect between watering regime and quantity?

1.1.3 Hypotheses

H0: Watering regime and water quantity have no significant individual or interaction effects on seedling growth and biomass accumulation.

H1: Watering regime and water quantity significantly influence seedling growth and biomass accumulation.

2 Materials and Method

2.1 Experimental Site

The experiment was conducted at a greenhouse in the Faculty of Agriculture, Adekunle Ajasin University, Akungba-Akoko, Ondo State, Nigeria between the months of December 2024 and May 2025. The location of Akungba-Akoko is approximately 7°28'11" N latitude and 5°44'10"E longitude, and its height is 357 meters above sea level (Omonijo et al., 2023). The climate of the region is tropical with the bimodal precipitation mode and the mean annual precipitation of about 1500 - 2000mm. The main rainy season lasts between April and July and is followed by another peak in late August to October, the dry season lasts between November and March.The mean daily temperatures are 23 to 35oC (Obateru et al., 2023).

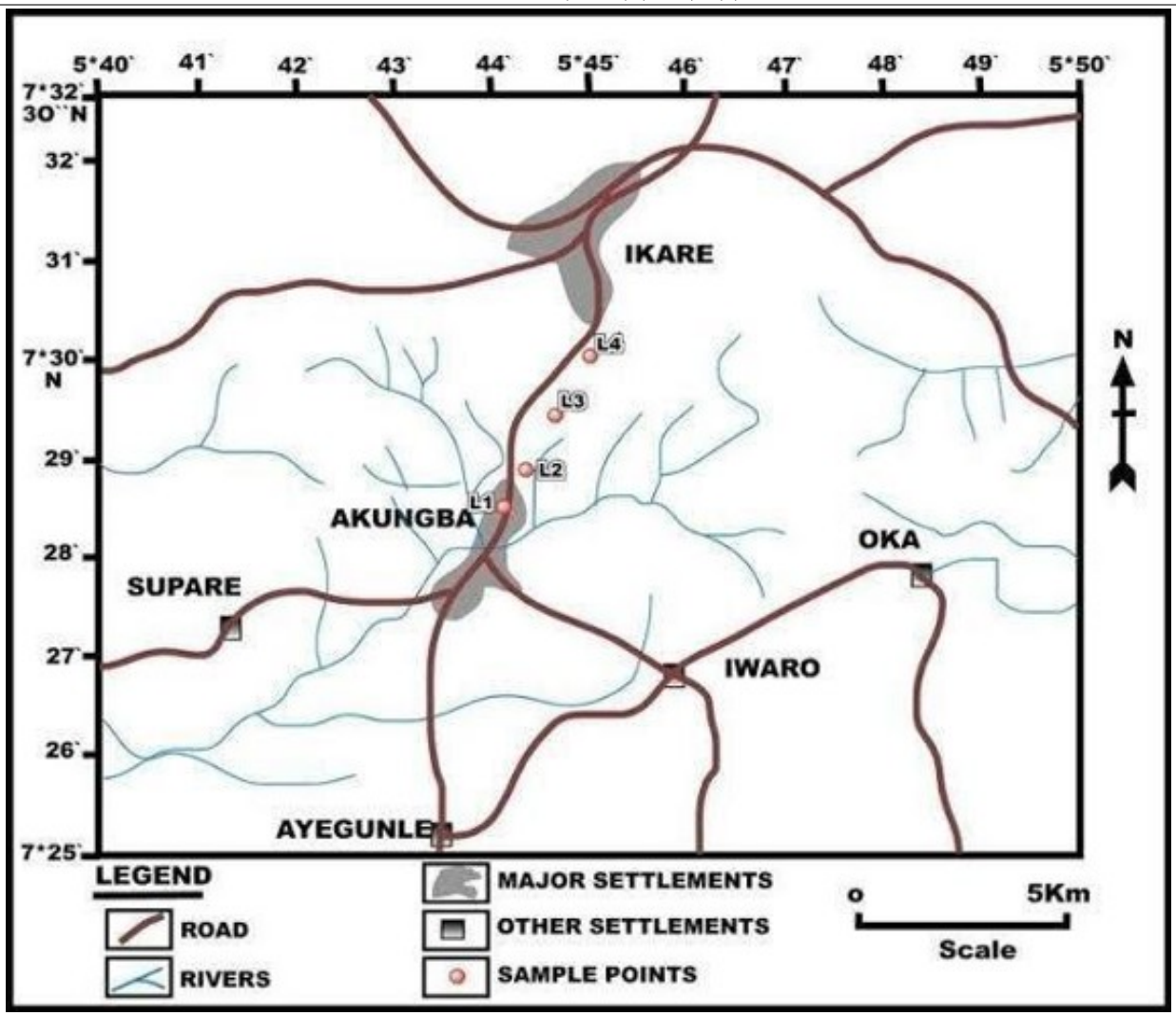

Figure 1: Map of the Study Area

2.2 Collection and Processing of Seed

Mature pods of *Tetrapleura tetraptera* were collected from healthy, naturally growing trees in Omuo-Ekiti, Ekiti State, Nigeria (7°43′N; 5°37′E). Fruits were manually depulped to extract seeds, which were subsequently air-dried under ambient laboratory conditions. Seed viability was assessed using the floatation method in which seeds were immersed in water for 30-minutes, with floating seeds considered non-viable and discarded, while submerged seeds were retained for further use in the experiment. The viable seeds were thoroughly mixed to form a homogenous seed lot prior to sowing.

2.3 Seed Germination

Viable seeds were sown in germination boxes filled with sterile, washed river sand to ensure uniform germination. The boxes were placed in a greenhouse and watered daily to maintain adequate moisture until sprouting occurred. Germination was monitored at regular intervals, and seedlings were allowed to develop to the two-leaf stage before being transplanted.

2.4 Experimental Design and Watering Treatments

Uniform seedlings at the two-leaf stage (108 seeds) were transplanted into medium-sized polyethylene bags (12×14×16cm) filled with topsoil collected from the forest nursery site and sieved to remove debris. The seedlings were transplanted and acclimatized under partial shade for three weeks and watered every day to reduce transplant shock.

Following acclimatization, the experiment was arranged in a Completely Randomized Design (CRD) with twelve watering treatments, combining frequency and volume, resulting in 108 experimental units.

2.5 Growth Measurements

Growth parameters were measured fortnightly over a five month period. Seedling height was measured between the collar region and the apical bud using a graduated ruler. The number of fully expanded leaves per seedling was counted and recorded, while collar diameter at the stem base was measured using a digital vernier cal-

liper. These parameters were chosen indicators of seedling vigour and establishment potential.

2.6 Biomass Assessment

Biomass accumulation was measured three months after transplant, which corresponds to the active vegetative growth phase of tropical tree seedlings (Maruyama et al., 2024). Destructive sampling was done on two seedlings randomly chosen at each fortnightly interval for every treatment. Seedlings were carefully uprooted and washed with water to remove adhering soil without damaging the roots. They were then separated into leaves, stems, and roots, and placed in labelled envelopes.

Fresh weights of each component were measured using a digital electronic balance. Samples were subsequently oven dried at 80o C for 24 hours until constant weight was achieved, after which dry weights were recorded. Total biomass was determined as a sum of leaf, stem, and root dry weights, serving as an indicator of biomass accumulation.

2.7 Statistical Analysis

Data on growth and biomass parameters were subjected to two-way Analysis of Variance (ANOVA) using Statistical Package of Social Sciences (SPSS). Duncan's Multiple Range Test (DMRT) was used to separate treatment means at 5% probability level whenever differences were detected. Results are presented as mean values with their corresponding standard error.

3 Results

3.1 Effects of Watering Regimes and Water Quantities on Seedling Growth

The two-way analysis of variance (ANOVA) indicated that watering frequency and water quantity significantly ($P \leq 0.05$) influenced the seedling height, collar diameter, and the number of leaves of the *Tetrapleura tetraptera* seedlings (Table 3.1). The interaction effect between watering frequency and water quantity was significant to collar diameter and number of leaves but not significant to seedling height.

3.1.1 Effects of Watering Regimes and Water Quantities on Seedling Height

Seedling height of T. tetraptera was significantly influenced ($P \leq 0.05$) by both watering frequency and water volume. The highest mean height was recorded in seedlings watered twice a day with 40ml (26.51±3.96cm), followed by those watered twice a day with 50ml (23.84±2.45cm). In contrast, seedlings subjected to prolonged watering intervals exhibited markedly reduced growth. The lowest mean height (9.22±0.47cm) was observed in seedlings watered with 30◉ml once every five days (Table 1).

Table 1: Analysis of Variance for Growth Variables of *Tetrapleura tetraptera* Seedlings under Different Watering Regimes and Water Quantities

Parameter	Source of Variation	SS	df	MS	F	Sig.
Height	Water Quantity	1820.45	2	910.23	4.55	0.013*
	Watering Frequency	2890.67	3	963.56	4.82	0.004*
	Quantity × Frequency	1519.63	6	253.27	1.27	0.276ns
	Error	21579.03	108	199.81		
	Total	27809.78	119			
Collar Diameter	Water Quantity	38.20	2	19.10	10.22	0.000*
	Watering Frequency	47.60	3	15.87	8.49	0.000*
	Quantity × Frequency	26.17	6	4.36	2.33	0.038*
	Error	201.91	108	1.87		
	Total	313.88	119			
Number of Leaves	Water Quantity	320.10	2	160.05	23.56	0.000*
	Watering Frequency	510.50	3	170.17	25.05	0.000*
	Quantity × Frequency	227.68	6	37.95	5.59	0.000*
	Error	733.83	108	6.79		
	Total	1792.11	119			

Significant at $p \leq 0.05$; ns = not significant

SS = Sum of Squares; df = Degrees of Freedom; MS = Mean Square; F = F-value

Table 2: Means values of growth variables of *Tetrapleura tetraptera* under different watering regimes and water quantities

Treatments	Height(cm)	Collar Diameter(mm)	Number of Leaves
50ml once/day	20.91±2.57ab	4.53±0.36ab	15.10±1.20ab
40ml once/day	22.47±1.85ab	5.01± 0.25a	15.96±1.09ab
30ml once/day	13.98±1.14c	3.91± 0.25b	13.30±1.09bc
50ml twice/day	23.84±2.45ab	5.15±0.37a	17.86±1.13a
40 ml twice/day	26.51±3.96a	5.57±0.39a	17.77±1.13a
30ml twice/day	19.55±1.48b	4.49±0.31ab	14.8±0.83ab
50ml once/3 days	14.428±1.34c	3.54±0.23b	12.27±1.09bc
40ml once/3 days	12.42±0.74cd	3.49±0.18b	12.31±0.84bc
30ml once/3 days	10.57±0.75cd	3.11±0.14bc	12.33±0.73bc
50ml once/5 days	9.35±0.55d	2.85±0.13bc	9.20±0.67c
40 ml once/5 days	9.38±0.48d	2.75±0.17c	9.58±0.95c
30ml once/5 days	9.22±0.47d	2.66±0.11c	8.95±0.55c

Mean values with the same superscript alphabets in the columns are not significantly different from each other at (P>0.05)

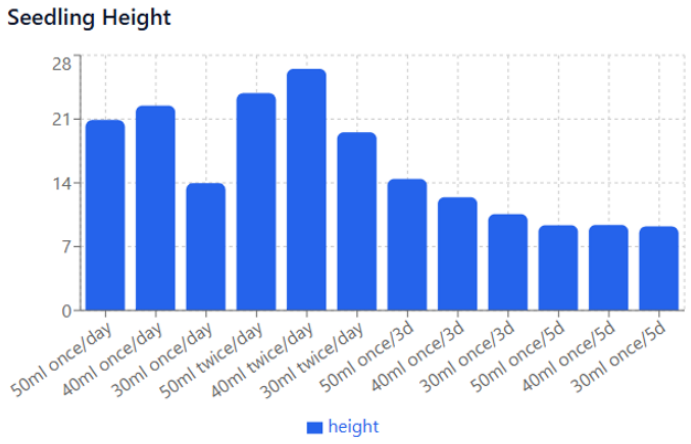

Figure 2: Effect of watering regimes and water quantities on seedling height (cm) of *Tetrapleura tetraptera*

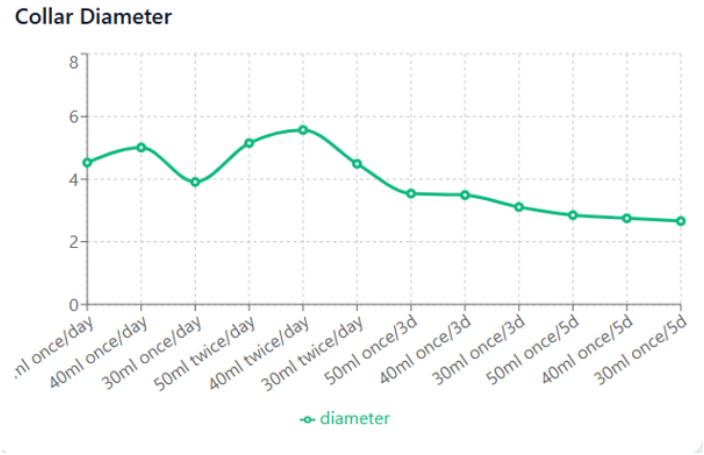

Figure 3: Effect of watering regimes and water quantities on collar diameter (mm) of *Tetrapleura tetraptera* seedlings

3.1.2 *Effects of Watering Regimes and Water Quantities on Collar Diameter*

Significant differences (P≤0.05) in collar diameter were observed among seedlings subjected to different watering regimes and volumes, as well as their interaction. The largest mean collar diameter was recorded in seedlings watered twice daily with 40◉mL (5.57±0.39 mm), followed closely by watered twice daily with 50ml (5.15 ±0.37 mm). In contrast, seedlings receiving less frequent watering and lower volumes exhibited markedly smaller collar diameters, with the minimum value (2.66±0.11 mm) observed in seedlings watered with 30ml once every five days (Table 1).

3.1.3 *Effects of Watering Regimes and Water Quantities on Leaf Production*

Watering treatments had a significant effect (P≤0.05) on the number of leaves produced by T. tetraptera seedlings. The highest mean leaf number (17.86 ±1.13) was achieved in the seedlings watered twice daily with 50ml, closely followed by those watered twice daily with 40ml (17.77 ± 1.13). In contrast, seedlings subjected to prolong watering intervals produced markedly fewer leaves. The lowest mean value (8.95±0.55) was observed in seedlings watered with 30ml once every five days (1).

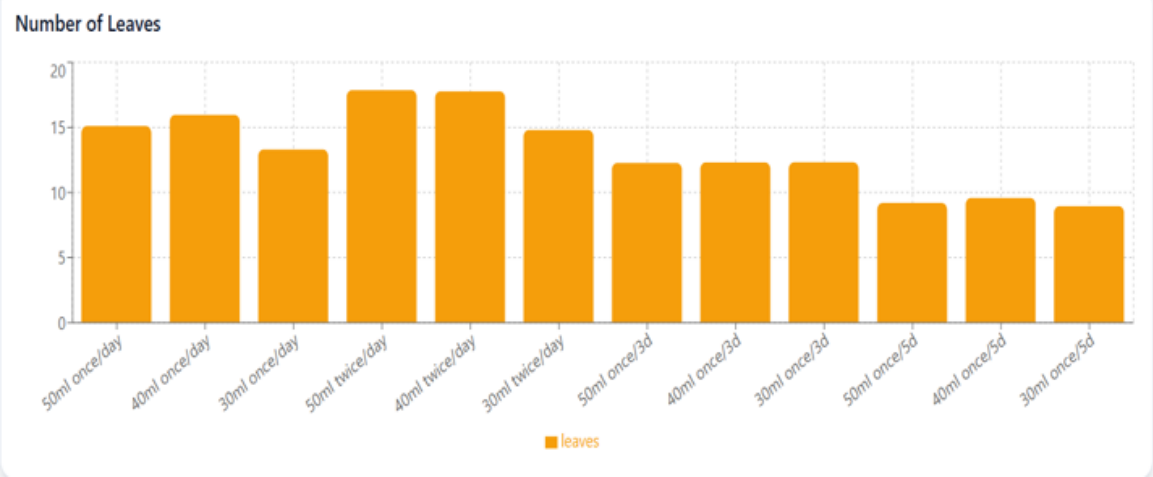

Figure 4: Effect of watering regimes and water quantities on leaf production of *Tetrapleura tetraptera* seedlings

3.2 Effects of Watering Regimes and Water Quantities on Seedling Biomass Accumulation

The two-way ANOVA (Table 3.3) results revealed that the watering frequency and water quantity had significant ($p \leq 0.05$) impact on the leaf dry weight (LDW), stem dry weight (SDW), root dry weight (RDW), and total dry weight (TDW). The interaction effects of the two factors, however, were not found to be significant to biomass parameters.

3.2.1 Leaf Dry Weight

The watering regimes and volumes had a significant effect ($P \leq 0.05$) on the leaf dry weight of T. Tetraptera. The highest mean leaf dry weight (23.99±0.117 g) was observed in seedlings watered twice daily with 50ml and 40ml. In contrast, seedlings subjected to low water volumes at prolonged intervals accumulated substantially less leaf biomass. The lowest mean value (0.94±0.26g) was recorded in seedlings watered with 50ml once every five days (Table 3).

Table 3: Analysis of Variance for Biomass Parameters of Seedlings of *Tetrapleura tetraptera* under Different Watering Regimes and Water Quantities

Parameter	Source of Variation	SS	df	MS	F	Sig.
LDW	Water Quantity	1245.382	2	622.691	7.29	0.002*
	Watering Frequency	1398.614	3	466.205	5.46	0.004*
	Quantity × Frequency	485.800	6	80.967	0.95	0.470ns
	Error	3076.124	36	85.448		
	Total	6205.921	47			
SDW	Water Quantity	745.120	2	372.560	5.86	0.006*
	Watering Frequency	702.400	3	234.133	3.69	0.021*
	Quantity × Frequency	391.667	6	65.278	1.03	0.420ns
	Error	2287.187	36	63.533		
	Total	4126.374	47			
RDW	Water Quantity	812.500	2	406.250	7.96	0.001*
	Watering Frequency	730.833	3	243.611	4.78	0.007*
	Quantity × Frequency	394.880	6	65.813	1.29	0.280ns
	Error	1836.101	36	51.003		
	Total	3774.314	47			
TDW	Water Quantity	1035.600	2	517.800	9.36	0.000*
	Watering Frequency	980.120	3	326.707	5.90	0.002*
	Quantity × Frequency	447.360	6	74.560	1.35	0.260ns
	Error	1992.236	36	55.340		
	Total	4455.316	47			

Significant at $p \leq 0.05$; ns = not significant

SS = Sum of Squares; df = Degrees of Freedom; MS = Mean Square; F = F-value

LDW = Leaf Dry Weight; SDW = Stem Dry Weight; RDW = Root Dry Weight; TDW = Total Dry Weight

Table 4: Mean values of biomass parameters of seedlings of *Tetrapleura tetraptera* under different watering regimes and water quantities

Treatments	LDW(g)	RDW(g)	SDW(g)	TDW(g)
50ml once/day	15.34±11.81b	14.32±11.72ab	11.33±10.17b	40.99±33.7b
40ml once/day	6.72±3.30c	9.59±5.15c	9.66±4.51bc	25.97±12.96c
30ml once/day	5.18±2.53cd	5.95±2.46cd	3.5±1.81a	14.63±6.8d
50ml twice/day	23.99±11.18a	18.46±3.52a	17.84±2.02a	59.85±8.71a
40 ml twice/day	23.99±11.18a	17.39±8.59a	19.78±9.96a	61.16±29.72a
30ml twice/day	7.81±3.42c	8.39±4.70c	6.30±3.96c	22.50±12.08c
50ml once/3 days	4.49±0.69d	5.36±0.52cd	4.24±0.65cd	14.09±1.86d
40ml once/3 days	2.74±0.57de	2.44±0.4d	2.47±0.58d	7.65±1.55e
30ml once/3 days	2.01±0.51de	2.14±0.24d	1.83±0.41d	5.98±1.16ef
50ml once/5 days	0.94±0.26e	0.93±0.03e	0.88±0.06e	2.75±0.35f
40 ml once/5 days	1.11±0.28de	0.90±0.38e	0.78±0.18e	2.79±0.84f
30ml once/5 days	1.06±0.08de	0.95±0.10e	0.70±0.24e	2.71±0.47f

Mean values with the same superscript alphabets in the columns are not significantly different from each other at (P>0.05)

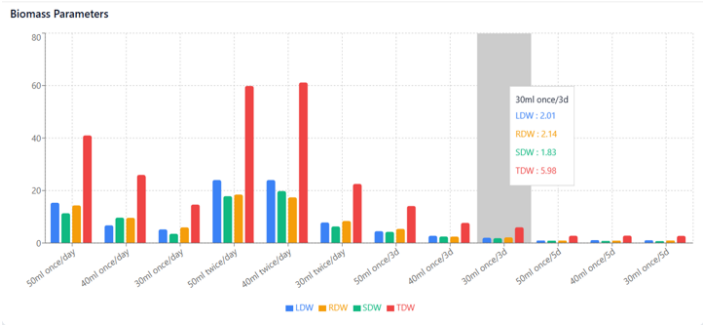

Figure 5: Effects of watering regimes and water quantities on biomass accumulation (g) of *Tetrapleura tetraptera* seedlings

3.2.2 *Root Dry Weight*

Significant differences (P≤0.05) in root dry weight were observed among treatments. The highest mean root dry weight (18.46 ±3.52 g) was observed in seedlings watered twice daily with 50ml, followed by those watered twice daily with 40ml (17.39±8.59 g). In contrast, seedlings watered with 40ml once every five days exhibited the lowest root biomass (0.90 ± 0.38 g) (Table◉3.2).

3.2.3 *Stem Dry Weight*

Significant differences (P ≤ 0.05) in stem dry weight were observed across watering regimes and volumes. The highest mean stem dry weight (19.78 ±9.96g) was recorded in seedlings irrigated twice daily with 40ml. In contrast, the lowest value (0.70 ± 0.24 g) was recorded in seedlings irrigated with 30ml once every five days; highlighting the negative impact of infrequent and low volume watering on stem biomass accumulation (Table 3.2).

3.2.4 *Total Dry Weight*

Watering regimes and volumes had significant impact (P≤0.05) on the total dry weight of T. tetraptera. The highest mean total dry weight (61.16±29.72g) was recorded in seedlings watered twice daily with 40ml, followed closely by those watered twice daily with 50ml (59.85±8.71g). In contrast, seedlings subjected to the lowest watering frequency and volume exhibited minimal biomass accumulation. The lowest mean total dry weight (2.71±0.47g) was observed in seedlings watered with 30ml once in five days (Table 3.2).

Overall, frequent watering with moderate to high volumes consistently promoted greater growth and biomass development in T. tetraptera seedlings, whereas infrequent watering with low volumes severely constrained seedling performance.

4 Discussion

This study demonstrates that both watering frequency and water quantity exert profound effects on the growth and biomass accumulation in *Tetrapleura tetraptera* seedlings. Across all measured traits, seedlings subjected to higher watering frequencies, particularly twice daily with moderate volumes, consistently outperformed those exposed to prolonged intervals. These findings highlight the pivotal role of soil moisture dynamics in determining seedling performance under controlled nursery environments.

The strongest responses to repeated watering at moderate quantities (40ml) were observed in seedling height and collar diameter, suggesting that consistent moisture availability stimulates cell division and stem thickening. Continuous irrigation likely alleviated transient water stress, thereby facilitating sustained vegetative development. Comparable influences of irrigation regimes on seedling growth have been reported in other tropical taxa. For instance, Yisau et al. (2023) found that Khaya senegalensis seedlings irrigated daily exhibited significantly greater collar diameters, leaf numbers, and biomass compared to those watered less frequently, underscoring the causal role of regular water supply in promoting growth.

Similarly, Djaha et al. (2022) reported that irrigation frequency strongly influenced morphological traits in Anacardium occidentale with seedlings watered 2-4days outperforming those subjected to longer intervals. In Albizia lebbeck Ibeh and Akinyele (2024) observed enhanced height and leaf production under irrigation schedules of 1–3 days, supporting the hypothesis that moderate irrigation maintains soil moisture conducive to growth. Evidence

from non woody taxa, such as Festuca kryloviana, also indicates that sufficient water supply facilitates both structural and metabolic activities during early ontogenesis (Shi et al., 2024).

Leaf production exhibited a slightly different response pattern, with the highest number of leaves recorded under twice-daily watering at higher volumes (50ml). Leaf initiation and expansion are closely linked to water availability and turgor maintenance, which, in turn, promote leaf surface development. Under extreme or low watering conditions, reduced leaf production may represent an adaptive response to minimize transpirational losses, consistent with patterns observed in species exposed to water-stress gradients (Lu & Yeh, 2024).

Biomass accumulation (leaf, stem and root dry weight) was significantly constrained under infrequent watering and reduced volumes. Seedlings watered once every five days showed drastic reductions in biomass, reflecting limited carbon assimilation and altered dry-matter partitioning. Conversely, seedlings irrigated twice daily displayed statistically significant increases in biomass, underscoring the cumulative benefits of uninterrupted water supply. These findings align with reports that reduced soil moisture inhibits growth and overall biomass accumulation in tree seedlings subjected to experimental watering stress (Lim et al., 2017).

Interestingly, seedlings irrigated twice daily with 40ml achieved slightly higher total biomass than those irrigated with 50ml twice daily. This suggests that excessive watering may not enhance growth beyond a certain threshold. Excessive moisture in container nurseries can inhibit soil aeration, reduce oxygen availability to root tissues, potentially offsetting the benefits of high soil moisture. Recent nursery studies emphasize the importance of optimizing rather than maximizing irrigation inputs, particularly in the context of increasing water scarcity and climate unpredictability (Zhang et al., 2024).

Overall, the results indicate that T. tetraptera seedlings perform best under moderate, frequent watering conditions. While general evidence exists on the effects of water stress on plant growth, this study provides species-specific insights into an indigenous tropical tree of considerable medicinal and socio-economic importance. The findings offer practical guidance for nursery managers and contribute to the limited empirical evidence on water-management requirements of T. tetraptera, demonstrating that moderate irrigation frequencies and volumes are optimal for growth and biomass accumulation.

5 Conclusion

This study evaluated the effects of watering regimes and water quantities on the growth and biomass accumulation of *Tetrapleura tetraptera* seedlings under controlled nursery conditions. The findings reveal that both variables exert statistically significant effect on the seedling performance where growth responses strongly dependent on the interaction effect between watering frequency and volume.

Key growth parameters, such as seedling height, collar diameter, leaf production, and other biomass components, consistently showed superior performance under frequent watering schedules. In particular, bi daily irrigation with moderate volumes (40 ml) proved most effective, resulting in enhanced structural development and total biomass. Conversely, extended watering intervals, especially once every five days, significantly inhibited growth and biomass accumulation, underscoring the sensitivity of young T. tetraptera seedlings to water stress during early development.

The results further indicate that increasing water quantity beyond an optimum threshold does not yield proportional gains in growth, highlighting the importance of optimizing rather than maximizing irrigation. This insight is practically relevant to water-efficient seedling production, in regions facing rainfall variability and water scarcity.

Overall, the study provides species-specific empirical evidence on the water requirements of T. tetraptera, a tropical tree of considerable ecological, medicinal, and socio-economic importance. The findings offer practical guidance for nursery managers, afforestation initiatives, agroforestry systems, conservation programs, presenting a viable model for improving seedling quality while ensuring efficient water utilization under changing climatic conditions.

6 Recommendations

1. Nursery managers should adopt twice-daily irrigation with moderate water volumes (≈40ml).
2. Further studies should investigate physiological responses under varying irrigation.
3. Field validation trials are recommended.

Acknowledgements
The authors acknowledge the Department of Forestry and Wildlife Management, Adekunle Ajasin University, for providing facilities.

Conflict of interest
The authors declare that they have no conflict of interest.

Funding
The study received no specific funding.

Data availability Statement
Data can be made available on the behave of the request

References

Djaha, J. B. A., Adiko, O. Y., Kouakou, C. K., Letto, A. K. Y. C., & Fondio, L. (2022). Morphometric parameters, cashew (Anacardium occidentale L.) nuts germination and graft plant production time in Côte d'Ivoire. *International Journal of Biological and Chemical Sciences*, *16*(6), 2602–2610.

Ezekiel, O., Yisau, J. A., & Aduraola, A. M. (2024). Effect of watering regime and mycorrhizal inoculation on the growth of Baobab (Adansonia digitata). *Journal of Agriculture and Environment for International Development (JAEID)*, *118*(1), 5–18.

Ibeh, K. G., & Akinyele, A. O. (2024). Investigating Light and Water Optimization for Early Seedling Establishment in Albizia lebbeck (L.) Benth. *South-east European forestry: SEEFOR*, *15*(2), 151–159.

Lim, H., Kang, J. W., Lee, S., Lee, H., & Lee, W. Y. (2017). Growth and physiological responses of Quercus acutissima seedling under drought stress. *Plant breeding and biotechnology*, *5*(4), 363–370.

Lu, P., & Yeh, F. C. (2024). Seedling Growth Responses to Nutrient and Water Treatments Among Jack Pine Open-Pollinated Families. *Forests*, *15*(12), 2062.

Luo, Y., Dong, J., Mao, A., & Yuan, Y. (2025). The Effect of Soil Moisture Content on The Growth and Photosynthetic Rate of Quercus Acutissima Seedlings. *American Journal of Agriculture and Forestry: Science Publishing Group*, *13*(1), 1–6.

Maruyama, T. E., Tsuruta, M., & Mori, T. (2024). Effect of Culture Temperatures on the Initial Growth Performance of Seedlings Germinated from Cryostored Seeds of a Tropical Tree Parkia nitida Miq. (Fabaceae, Mimosoideae). *Seeds*, *3*(3), 381–392.

Mo, Q., He, Z., Gu, X., Peng, Z., Tao, Y., & Zhou, Q. (2025). Divergent adaptation of different functional tree seedlings to precipitation changes in a secondary tropical forest. *Journal of Plant Ecology*, rtaf064.

Obateru, O. C., Ishaya, S., Lucky, E., & Adakayi, P. E. (2023). Spatio-Temporal Occurrence of Climate Change: Evidence from Rainfall and Temperature Records in the Agro-Ecological Zones of Ondo State, Nigeria. *World Scientific News*, *182*, 237–249.

Omonijo, A. G., Olutumise, A. I., & Olabimpe, O. T. (2023). Agro-climatic zonation based on rainfall distribution over. *Journal of Meteorology and Climate Science*, *22*(1), 195–224.

Shi, Z., Liang, G., Li, S., & Liu, W. (2024). Adequate water supply enhances seedling growth and metabolism in Festuca kryloviana: insights from physiological and transcriptomic analysis. *BMC Plant Biology*, *24*(1), 714.

Yisau, J. A., Adesewa, A. R., Ndidi, E. P., & Agnes, M. A. (2023). Early Growth Response of Khaya senegalensis Seedlings to Water Requirement. *European Journal of Agriculture and Food Sciences*, *5*(4), 28–31.

Zhang, M., Liu, S., An, Y., Zhang, D., Qi, Q., Jiang, M., & Tong, S. (2024). Re-watering solution facilitates seed germination and seedling growth of Carex schmidtii: Implication for species re-introduction in degraded semi-arid wetlands. *Journal of Environmental Management*, *362*, 121286.