Effects of Pretreatment Protocol and Watering Regime on the Germination and Early Growth of *Irvingia gabonensis* (Aubry-Lecomte ex. O'Rorke) Baill

Chukwu, O.[1], Ibe, A.E.[1], Nwadinobi, E. V.[1], Ezenwenyi, J.U.[1], Ajao, O. I.[2], Ezeano, C. I.[3], Ukpeli, G. A.[1], Ozomma, L. C.[1], Umeh, C. L.[1], Onyili, A. C.[1], Ndulue, N.B.[1], Adeyemi, M. A.[1], Okonkwo, C.C.[1], Maduabuchukwu, C. K.[1], Nzekwe, C.J.[1], Obiekwe, N.J.[3] and Udeh, M.U.[1]

[1]*Department of Forestry and Wildlife, Nnamdi Azikiwe University, Awka, Nigeria*
[2]*Department of Forest Resources Management, University of Ilorin, Ilorin, Nigeria*
[3]*Department of Forestry and Wildlife, Nnamdi Azikiwe University, Awka, Nigeria*

KEYWORDS

Early growth, Irvingia gabonensis, Pretreatments, Seedling growth, Watering regime

ABSTRACT

The early stage of plants is the major determinant of their growth and yield. This study evaluated the germination rate and growth response of Irvingia gabonensis to different Pretreatments and watering regimes. The experiment was laid in a 3×4 factorial experiment in a completely randomized design (CRD) and replicated 15 and 7 times for germination and early growth studies, respectively. Three watering regimes; Watering once; W1=daily (control), W2=watering twice daily, and W3=watering once 2 days with four pre-treatments; P1=No treatment (control), P2= Soaking in water (23°C) for 24 hours, P3= Soaking in warm water (43°C) for an hour, and P4= Scarification. Seedling height (cm), collar diameter (mm), and Number of leaves were assessed for 12 weeks. The data collected were subjected to analysis of variance and means were separated using Duncan multiple range test at α=0.05. The results showed that P2W2 had the best performance in germination with first emergence on the 13th day and 100% germination on the 28th day. A similar result was recorded for P2W2 in seedling height (24.39±2.068 and 26.82±1.705cm), collar diameter (4.712±0.995 and 4.313±0.922mm), and number of leaves with a mean value of 1.78±0.698. The study concluded that Irvingia gabonensis seeds germinate and seedlings thrive better when soaked in water (23°C) for 24 hours and watered twice daily, hence was recommended for mass seedling production.

*CORRESPONDING AUTHOR

onye20042000@yahoo.com

INTRODUCTION

Irvingia gabonensis (bush mango), the source of "Ogbono" (Irvingia kernel) is one of the most important Non-Timber Forest Products (NTFPs) in West and Central Africa especially in Southern Nigeria (Ladipo, 2000). The most important part of *I. gabonensis* to rural people is its nutritious seeds, which have also been found useful in the reduction of cholesterol and body weight in obese patients (Ngondi, 2005). It is an edible African indigenous fruit tree that produces edible fruits and seeds (Atangana *et al*., 2002).

Irvingia seeds constitute an important part of the rural diet in Nigeria. The sun-dried seeds are ground into flour and used as soup thickeners (Ekpe *et al*., 2007). The white cotyledons are roasted and eaten in the Bwemba community of Uganda; roasted seeds confer flavour and aroma on foods especially vegetables (Ousseynou and Nicodeme, 1994). It is the food gum component of the seeds that serve as a thickening agent in water (Ndjouenkeu *et al*., 1996).

Bush mango is a valuable source of income for farmers and traders in Nigeria, where the fruit is traded locally (Ladipo, 2000). The kernels, which fetch a higher price than the fruits are traded regionally and internationally, which has given it the potential for a true commercial crop, and this has led to a more intensive collection in the forests. Despite the nutritional importance of *I. gabonensis*,

there is a scarcity of large-scale plantations of the species for mass seed and fruit production. The existing stands of *Irvingia gabonensis* are mainly found in the traditional agro-forestry system and compound farms or homesteads. This creates the need for awareness in both yield potential and economic roles, to encourage more people to embark on large-scale plantation development and probably set up small-scale industries for seed export to many countries

Increased deforestation, urbanization, over-exploitation, and other industrial developments are major threats to forest species in Nigeria (Anozie and Oboho, 2019). Secondly, our knowledge of the optimal water requirements of most indigenous and exotic fruit tree seedlings that thrive in semi-arid and tropical environments is limited (Mng'omba *et al*., 2011). This knowledge gap constrains the ability of nursery operators to make informed management decisions about their operations (Mng'omba *et al*., 2011).

This research was aimed at finding out the response of this *Irvingia gabonensis* to various seed pre-treatments and watering regimes for mass seedlings production. This study will provide data that would be used in the determination of the best seed treatment that improved the seeds' germination and growth.

MATERIALS AND METHODS

The Study Area

This study was carried out in the Prof. E.L.C Nnabuife screen house at the Department of Forestry and Wildlife, Nnamdi Azikiwe University (NAU), Awka in Anambra State, Nigeria. The University is located in the South-eastern geopolitical zone of Nigeria and lies between latitude 6.245° to 6.283° N and longitude 7.115° to 7.121° E (Chukwu *et al*., 2020). Awka has seasonal climatic conditions; the rainy and the dry seasons with a short spell of harmattan. It has a rainfall pattern ranging from 1828 mm – 2002 mm (Chukwu *et al*., 2020).

Seed Source and Experimental Design

Matured ripe fruits of *Irvingia gabonensis* were sourced from Onistha, Anambra state, Nigeria. Top Soil was collected from the Departmental Nursery. Two hundred seeds were extracted from the fruits. Seed viability was tested by soaking in water, where floating seeds were seen as not viable while those that sunk were viable, a total of one hundred and eighty (180) seeds were used for the germination study.

The experiment was carried out for fourteen (14) weeks between August-November 2021. Four (4) pre-treatments were used for the experiment which includes; P_1=No treatment (control), P_2= Soaking in water at room temperature for 24 hours, P_3= soaking in warm water for an hour, Warm water is between 110 and 90 ^{O}F (43.3-32.2 ^{O}C) and P_4= Scarification. Three (3) watering regimes were used namely: Watering once; daily (W1), watering twice daily (W2), and watering once in 2 days (W3).

The experiment was laid in a 3×4 factorial experiment laid out in a completely randomized design (CRD) with 2 factors (watering regime and Pre-treatment) where factor1(watering regime) consists of three (3) levels and factor 2 (pre-treatment) consists of four (4) levels. The experiment was replicated fifteen (15) times for germination and seven (7) times for early growth.

Data Collection and Analysis

The germination count was taken daily and ended after 50 days. The germination percentage was calculated using equation (1).

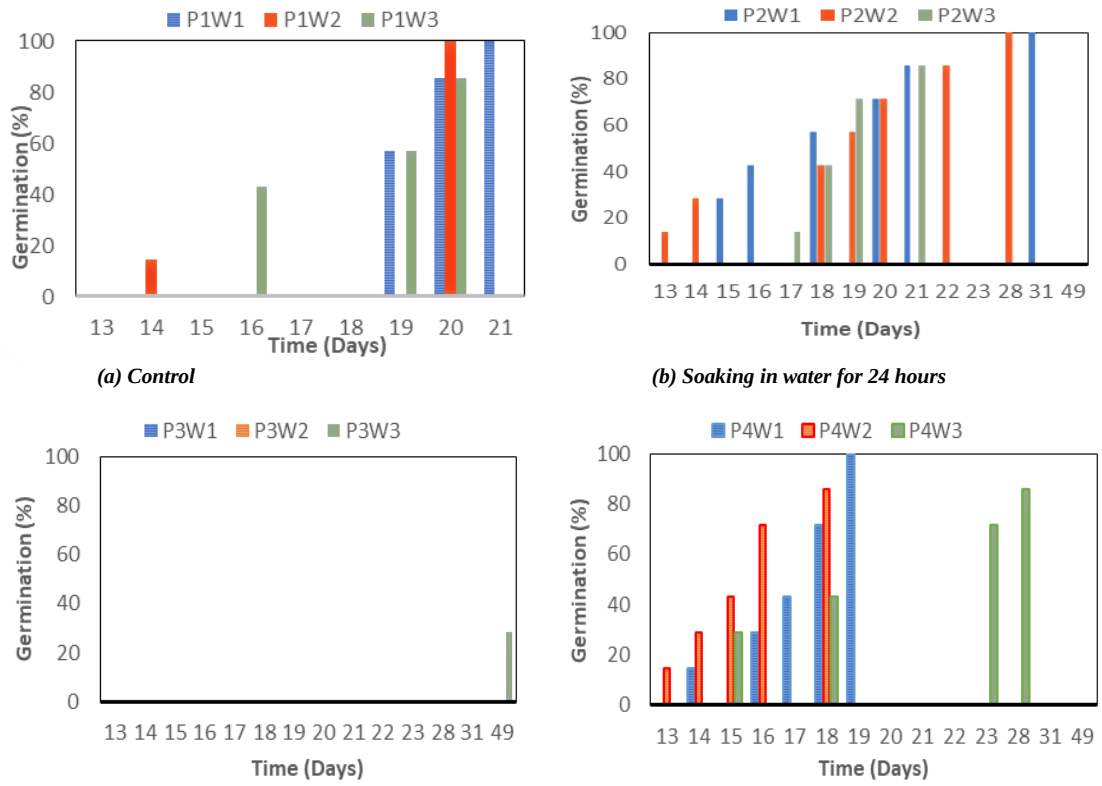
$$Germination\ (\%) = \frac{Number\ of\ seeds\ germinated}{Number\ of\ seeds\ sown} \times 100 \qquad (1)$$

Eighty-four (84) seedlings of similar heights were selected for early growth assessment. Growth variables assessed are; height, number of leaves, and collar diameter on weekly basis. The Number of leaves was transformed using square root transformation. The growth variable data were then subjected to Analysis of Variance (ANOVA) and significant means were separated using Duncan multiple range test (DMRT) at 0.05 level of significance.

RESULTS AND DISCUSSION

The result showed that P1W2 (control and watering twice a day) had the first seed emergence on the 14th day with a 100% germination rate on the 20th day, P1W1 (control and watering once a day) also had a 100% germination rate 21st day, While P1W3 (control and watering once in 2 days) had the least germination rate of 80% (Figure 1). This implied that viable seeds of *Irvingia gabonensis* can germinate without pretreatment once there is regular watering. Also, P2W2 (soaking in water for 24 hours and watering twice daily) had the first seed emergence on the 13th day with a 100% germination rate on the 28th day, P2W1 also had a 100% germination rate on the 31st day, While P2W3 had the least germination rate of 80%. This result was in agreement with Udosen and Sam (2015) who assessed the effects of pretreatment protocols on seed germination of *Irvingia gabonensis* (Aubry-lecomte exo'Rorke) Baill and found that the seed steeped in water for 24 hours before sowing gave 100% germination. According to Udosen and Sam (2015), the

enhancing effects of the rehydration of seeds on germination may be due to the stimulating effect of rehydration on germination, which may be related to enzyme activities.



(a) Control ***(b) Soaking in water for 24 hours***

(c) Soaking in warm water for 1 hour ***(d) Scarification***

Figure 1: Seed Emergence and Germination and *Irvingia gabonensis* under different treatments

The post hoc result for seedling early growth under different pre-treatments showed that soaking in water for 24 hours had the highest means for stem diameter = 4.712±0.995 mm, Number of leaves = 2 ±0.698 and stem height of 24.39±2.068 cm, respectively (Table 1). This result is in agreement with Fredrick *et al*. (2016), that soaking the seed in water at room temperature enhances the germination of seeds and early growth of seedlings of tropical trees. However, the number of leaves and height (cm) of the seedlings showed no significant difference ($p>0.05$) in all the treatments (Table 1). Similarly, for the watering regime, watering twice daily gave the highest means for seedling growth variables: stem diameter (4.630±0.907 mm), Number of leaves (1.833±0.657), and height (26.820±1.705 cm). This is in agreement with Hsiao and Xu (2000) that regular watering allows the nutrient to dissolve and transport to the appropriate area for leaf expansion for photosynthesis which is necessary for plant growth.

Table 1. Summary of different pretreatment effects on height, stem diameter, and number of leaves of *Irvingia gabonensis* Seedlings

	Treatment	N	Mean ± Std. Dev.		
			collar diameter (mm)	Number of leaves	height (cm)
Pre-Treatment	Stratification (P4)	59	4.313±0.922^{b}	1.755±0.644^{a}	24.117±2.13^{a}
	Control(P1)	69	4.423±0.848^{b}	1.732±0.590^{a}	22.699±1.860^{a}
	soaking 24hrs(P2)	50	4.712±0.995^{a}	1.780±0.698^{a}	24.39±2.068^{a}
Watering Regime	Once daily(W1)	58	4.487±0.922^{a}	1.699±0.657^{a}	18.654±1.778^{b}
	Once 2 days(W3)	69	4.332±0.922^{b}	1.735±0.631^{a}	25.731±1.860^{a}
	twice daily(W2)	61	4.630±0.907^{a}	1.833±0.657^{a}	26.820±1.705^{a}

The means in a column with similar letters are not significantly different at 5% level of probability according to Duncan Multiple Range Test.

CONCLUSION AND RECOMMENDATION

The findings from the present study showed that *Irvingia gabonensis* seedlings responded to different pretreatment and watering regime on the germination and early seedling growth performance. That was explained by the increase in plant height, number of leaves, and collar diameter growth variables. This study concluded that the control (no pretreatment) and watering twice daily yielded the best seeds germination. For early growth of *I. gabonensis* seedlings, soaking in water at room temperature for 24 hours and

watered twice daily gave the best performance. Therefore, soaking seeds of *Irvingia gabonensis* in the water at room temperature for 24 hours and watering twice daily is recommended for improving seed germination and seedling growth performance respectively for optimum seedlings production.

REFERENCE

Anozie, E. L. and Oboho, E.G. (2019). The effect of seed source and different presowing treatments on the germination of Canarium schweinfurthii (Engl) *seeds. Asian journal Research in Agriculture. and Forestry* 4(4): 1-11.

Atangana, A. R., Ukafor, V., Anegbeh, P., Asaah, E., Tchoundjeu, Z., Fondoun, J. M., Ndoumbe M and Leakey, R. R. B. (2002). Domestication of Irvingia gabonensis: 2. the selection of multiple traits for potential cultivars from Cameroon and Nigeria. *Agroforestry Systems* 55: 221-229.

Chukwu, O., Ezenwenyi, J. U. and Kenechukwu. T. V. (2020). Checklist and abundance of open grown medico-ethnoforest tree species in Nnamdi Azikiwe University, Awka, Nigeria. *Asian Journal of Biological Sciences*, 13(1):105-112.

Ekpe, O. O., Umoh, I. B. and Eka, O. U. (2007). Effect of a typical rural processing method on the proximate composition and amino acid profile of bush mango seeds Iirvingia gabonensis). *African Journal of Food, Agriculture, Nutrition and Development* 7 (1):1-12.

Fredrick, C., Muthuri, C., Ngamau, K. and Sinclair, F. (2016). Provenance and pretreatment effect on seed germination of six provenances of Faidherbia albida (Delile) A. *Chev. Agroforestry System*, Pp 1-11.

Hsiao, T. C., and Xu, L. (2000). Sensitivity of growth of roots versus leaves to water stress: biophysical analysis and relation to water transport. *Journal of Experimental Botany*, 51(350), 1595-1616.

Ladipo, D.O. (2000). *Harvesting of Irvingia gabonensis and Irvingia wombulu in Nigerian forests; potentials for the development of sustainable systems.* Paper presented at the Seminar Harvesting of Non-Wood Forest Products, held at Menemen-Izmir, Turkey on 2–8 October 2000. http://www.fao.org/ documents/show_cdr.asp?url_file=/ DOCREP/005/Y4496E/ Y4496E32.htm.

Mng'omba, S. A., Akinnifesi, F. K., Sileshi, G., Ajayi, O. C., Nyoka, B. I. and Jamnadass, R. (2011). Water application rate and frequency affect seedling survival and growth of Vangueria infausta and Persea americana. *African Journal of Biotechnology*, 10(9): 1593-1599.

Ndjouenkeu, R., Goycoolea, F. M., Morris, E. R., and Akingbala, J. O. (1996). Okra (hibiscus esculentus) dika nut (*Irvingia gabonensis*) polysaccharides. *Car. Polym.* 29:263-269.

Ngondi, J. L., Oben, J. E. and Minka, S.R. (2005). The effect of *Irvingia gabonensis* seeds on body weight and blood lipids of obese subjects in Cameroon. *Lipids in Health and Disease*, 4(12)1-4.

Ousseynou, N, and Nicodeme, T. (1994). *International Institute of Tropical Agriculture and the Rockefeller Foundation*. A paper on Utilization and marketing of *Irvingia gabonensis* produce in the humid forest of Cameroon.

Udosen, I. R. and Sam, S. M. (2015). Effects of Pretreatment Protocols on Seed Germination of Irvingia gabonensis (Aubry-lecomte exo'Rorke) Baill. *Asian Journal of Agriculture and Food Sciences*, 3(3): 289-291.