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EFFECT OF SEED PRETREATMENTS ON GERMINATION AND WATERING REGIMES ON EARLY SEEDLING GROWTH OF *Afzelia africana* Sm & Pers

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ABSTRACT

Effect of pretreatments on germination of Afzelia africana seeds and watering regime on the seedlings growth was assessed. The pre-treatments used were; cold water treatment, hot water treatment, acid treatment, mechanical scarification and control. While watering regimes include; daily, thrice a week, and twice a week watering. The Pretreatments were completely randomized into three replications. The data collected were subjected to analysis of variance (ANOVA) at 5% level of significance. The result showed the highest germination percentage (58%) in cold water treatment while the least (5%) was recorded in hot water treatment. Seedling height was highest in thrice a week watering regime (18.24cm), seedling diameter was found highest in daily watering while the highest number of leaves (15) was obtained from seedlings under thrice a week watering regime. However, there was no significant difference (P>0.05) in the seedling collar diameter and number of leaves. Since seed pretreated with cold water gave the best germination and thrice-a-week watering regime proved to yield a better growth rate, pretreatment with cold water and thrice-a-week watering regime is therefore recommended for propagation of Afzelia africana.

Keywords: Agroforestry, germination, pre-treatments, multipurpose

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INTRODUCTION

In Sub-saharan Africa forests, many plant species have gone to extinction while some are presently threatened due to various disturbances (Hilton-Taylor, 2000). *Afzelia africana is* one of 280 plant species that have been classified as being vulnerable in various African nations. (Sinsin *et al.*, 2004; Lalaeye, 2015). The most widely dispersed of the seven species in the Afzelia genus is *Afzelia Africana,* found throughout tropical Africa (Salim *et al*., 2009). It belongs to the family Fabaceae (subfamily- Ceasalpinoidae) in the order Fabales. It is a large tree with a wide-spreading crown that ranges in height from 10 to 20 meters and a mean average diameter of 36 cm (Keay, 1989). The species has been under logging pressure in recent years as its use for lumber has increased dramatically. The plant is widely exploited as a fodder species and is frequently trimmed in an unsustainable manner to feed cattle during the dry season, when grass fodder is scarce (Ouedraogo-kone *et al*., 2006). The tree is also useful as a febrifuge, analgesic, anti-hemorrhagic, laxative, emetic, emmenagogue, and aphrodisiac, which has led to the tradomedicine practitioner debarking the stem regularly. (Kone *et al*., 2004; Delvaux *et al*., 2009).

As a result of multiple anthropogenic activities and unsustainable use of its products, the species' abundance is on decline. All of these threats have an impact on the long-term survival of the species populations. *Afzelia africana* was recently rated as vulnerable on the IUCN red list (Guerrero, *et al*., 2013) and on the nationally threatened

species red list. This is consistent with the findings of Sobola *et al*., (2021), who discovered that *Afzelia africana*, which was originally categorized as endangered, has now become extinct in some parts of Taraba State, Nigeria. This necessitates a deliberate effort to stimulate regeneration and protect existing stands of *Afzelia africana* on various land use types. The propagation of most tropical tree species is constrained by recalcitrant seed germination as a result of dormancy (Amusa, 2011). The degree of dormancy makes it difficult for seed to germinate evenly and adequately, which pose a challenge in plantation establishment. Moreso, natural regeneration is usually poor because seed predation by animals is generally high, making the rate of seed germination in the wild low and its seedlings rarely developed into saplings (Ogbimi and Sakpere, 2021). According to research, *Afzelia africana* seeds display a type of dormancy and become resistant when stored. Applying proper pre-germination treatments would increase the physiological activity of *Afzelia africana* seeds because pre-treatment encourages quick and even germination. Furthermore, plant seeds need to be tested in the nursery to determine their speed of germination under various pre-treatment methods to prepare for large-scale plantations establishment to meet society's demands for fruit, timber, and other products (Oyebamiji *et al*., 2021).

The physical foundation of life for all living things is water, it is necessary for the production of carbohydrates in plants and the transportation of food and mineral elements hence is an essential factor of seed germination and plant growth (Isah *et al*., 2012). There is a need to understand the amount of water that a plant needs as it depends on its botanical qualities, stage of development, and the local climate. Water availability is the most important environmental factor known to have a strong influence on tree species distribution and regeneration in the tropics (Goyne and Mclntyre 2003; Shaban, 2013). Therefore, a suitable silvicultural method for germination and seedling growth must be developed to establish its plantations and for supplementary seedling regeneration. This study seeks to investigate the best seed pre-treatment method and watering regime for *Afzelia africana* seedlings.

MATERIALS AND METHODS

Study site

The study was carried out at the Teaching and Research Farm of the Federal University Wukari, Taraba State, Nigeria. (Longitude 9°47' E and latitude 7°51' N) (Orunoye, 2011; Sobola *et al*., 2018). The vegetation of the area is predominantly characteristic of the savannah zone, with major climatic seasons (wet or rainy seasons), which start in March or April and end in October. The dry season starts in November and ends in March or April. The mean annual temperature is about 28ºC with a maximum temperature varying between 30ºC and 39.4ºC. The minimum temperature ranges between 15ºC to 23ºC (Taraba State Diary, 2008; Emeka and Abbas, 2011).

Experimentation and Data Analysis

Afzelia africana seeds were harvested from their natural habitat in the Ussa Local Government Area of Taraba State. A water floatation test was conducted on the seed of *A. africana* to authenticate the viability of the seed before sowing. A similar method for viability test was used by Sobola *et al*., (2018) and Onyekwelu (2012).

Experimental Procedure

Three hundred (300) seeds of *A. africana* were subjected to germination test to determine the appropriate pretreatment for optimum germination. Sixty (60) seeds per treatment were used and subjected to five pre-treatments, arranged in Completely Randomized design with three replicates. Germination parameters investigated include; date of emergence, speed of germination, period of germination, and Cumulative germination percentage

T1 – cold water treatment
T2 – Hot Water Treatment
T3 – 30mins acid scarification with 100% conc. H_2SO_4
T4 – Mechanical Scarification, by Nicking
T5 – Control (Untreated seeds)

Watering regimes on the growth rate of *Afzelia africana* seedlings

Afzelia africana seedlings pre-germinated through Cold water treatment were used for the watering regime experiment. The seedlings were subjected to three watering regimes and the growth response of the seedlings was monitored and recorded for twelve weeks. Healthy seedlings of similar height and vigor were transplanted from germination trays into experimental pots filled with topsoil and were subjected to three watering regimes; daily watering (A1), thrice a week (A2), and twice a week (A3). The experiment was laid out in a Complete Randomized Design (CRD) with three replicates. Initial growth data was obtained after which measurement was done fortnightly. Early seedling growth parameters such as; shoot height, stem collar girth, and leaf number were recorded. Plant height was measured from the collar to the tip of the apical bud using meter rule, stem girth was measured with the aid of a digital Vernier caliper, while the leaf number was obtained by physical counting.

Data Analysis

Data were analyzed using Analysis of Variance (ANOVA) with Statistical Package for Social Science (SPSS) at 5 % level of significance to determine differences in the treatments effect, while Duncan Multiple Range Test ($P \leq 0.05$) was used to separate the means of differences among the treatments.

RESULTS

The pretreatment effect on seed germination of *Afzelia africana* seeds in this study shows different germination speeds. The results showed that seed germination commenced on the 11th, 12th 13th 15th, and 21 days after sowing under mechanical, acid, cold water, control, and hot water scarification respectively. The germination of seeds of *Afzelia africana* was rapid with most of the seeds, germinating within the first two weeks in all the treatments except the hot water treatment as shown in Figure 1. Higher cumulative germination (58%) occurred under cold water treatment, followed by the control (47%), mechanical scarification (42%), and acid scarification (32%) while the least (5%) was obtained in hot water scarification. Seed pretreatment had a significant ($P < 0.05$) effect on the germination of *Afzelia africana* with seeds treated with cold water having the highest germination rate when compared with other treatments (Table 2).

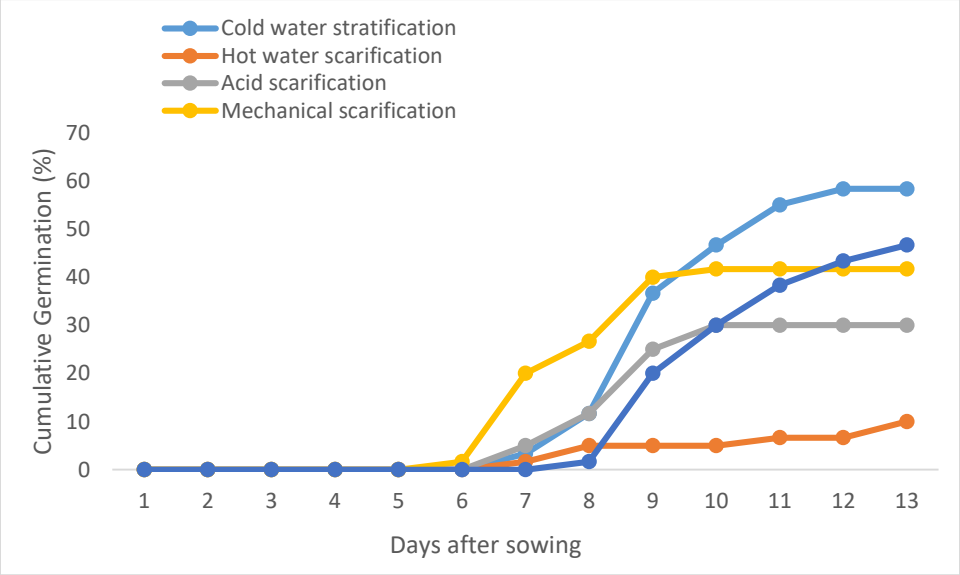

Figure 1: Pretreatment effect on germination of *Afzelia africana*

The result presented in Figures 2, 3, and 4 showed the effect of the watering regime on the growth rate of *Afzelia africana*. The result showed variation in the height of the seedlings under the various regimes. The height varied between 18.24cm and 14.13cm. The highest total height (18.24cm) was obtained in seedlings, watered twice a week, followed by thrice a week (17.85cm) while the least plant height (14.13cm) was recorded under a daily watering regime as shown in **(**Figure 2). The result of the statistical analysis showed a significant difference ($P < 0.05$) in the seedling height under the three watering regimes (Table 1).

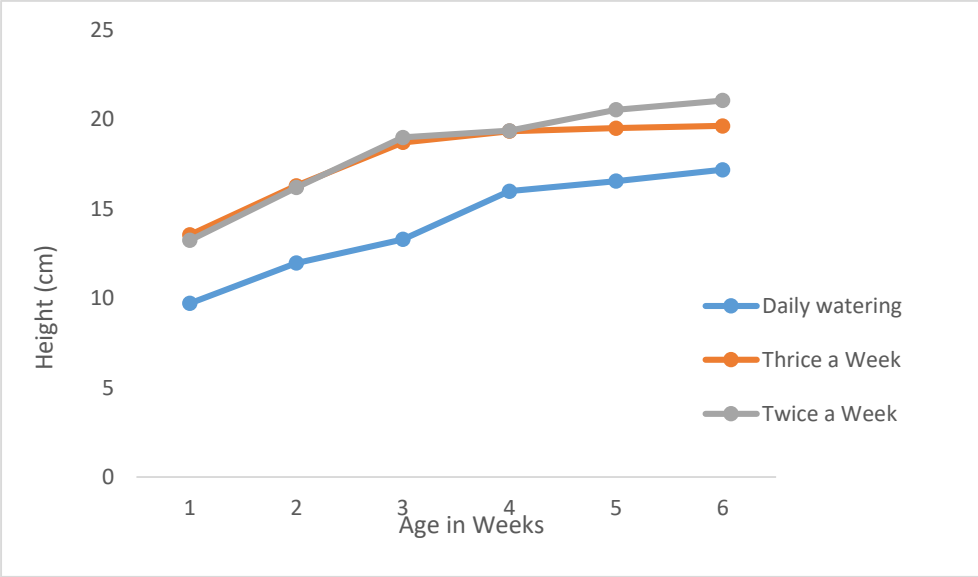

Figure 2: Effect of watering regime on the height of *Afzelia africana* seedlings.

The girth of *Afzelia africana* varied with the different watering regimes in this study. Daily watering had the plants with the highest collar diameter of 1.97cm, followed by thrice watering with a collar diameter of 1.89cm while twice watering had the least collar diameter of 1.82cmas shown in **(**Figure 3). However, there was no significant difference ($P > 0.05$) in the effect of watering regimes on the total collar diameter of seedlings within the group as presented in (Table 1).

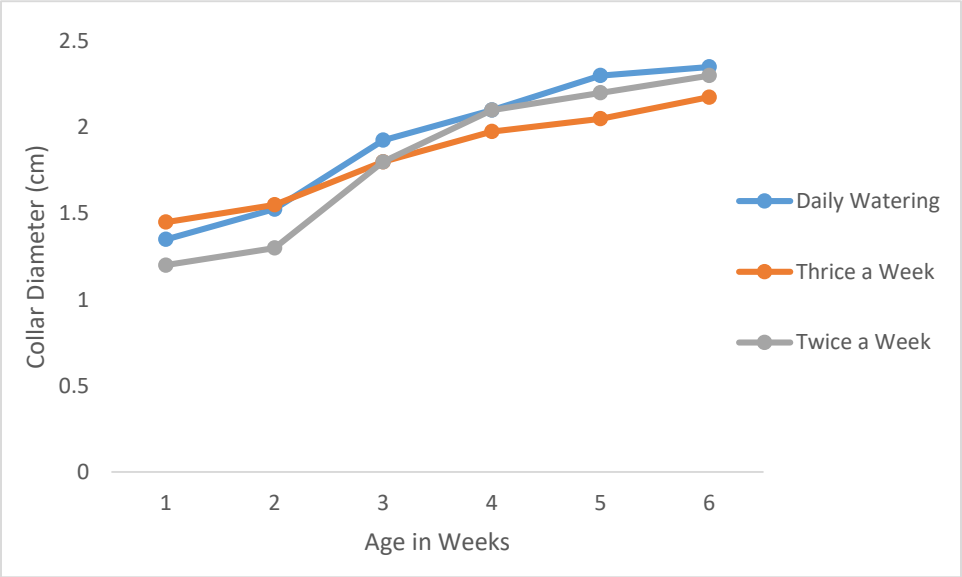

Figure 3: Effect of watering regime on collar diameter of *Afzelia africana* seedlings

There was also a slight variation in seedling leaf production under the various watering regimes. The number of leaves produced ranged from 13 to 15 leaves. The highest number of leaves, sixteen (16) was recorded in thrice a week watering regime, fifteen (15) leaves in twice a week watering regime while daily watering had fourteen (14) leaves as shown in Figure 4. However, the result showed no significant difference ($p < 0.05$) in the number of leaves under the various watering regime (Table 1).

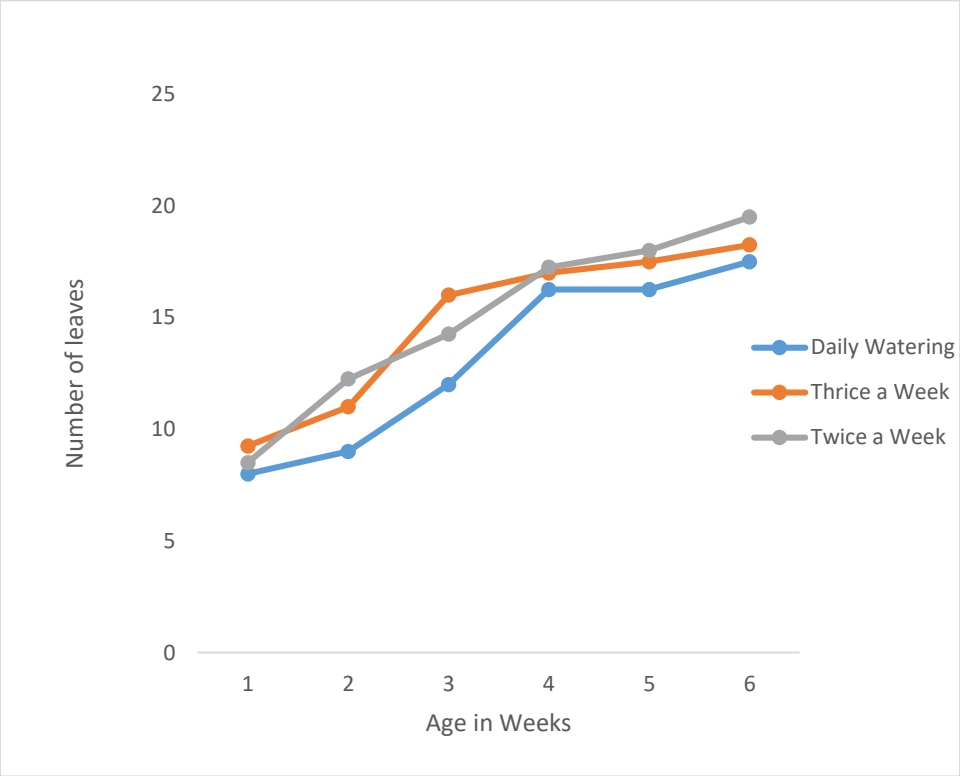

Figure 4: Effect of watering regime on the number of leaves of *Afzelia africana seedlings*.

Table 1: Analysis of variance for the effect of Watering Regime on *Afzelia africana* germination and early growth rate

Treatments	Total height (cm)	Collar diameter (cm)	Number of leaves
Daily (A1)	15.43[b]	1.97[a]	13.833[a]
Thrice a week(A2)	18.91[a]	1.89[a]	15.67[a]
Twice a week(A3)	17.71[a]	1.82[a]	14.96[a]
P.Value	0.0009	0.3935	0.3144

DISCUSSION

The earliest germination of *Afzelia africana* in this study was on the 11th day under mechanical scarification while germination in hot water scarification was delayed till the 22nd day after sowing. This shows that the seeds of *Afzelia africana* exhibit a form of exogenous dormancy which could be overcome by mechanical scarification and cold water treatment. The delayed emergence in hot water is a pointer to the negative effect of high temperature on the seed's embryo which resulted in a delayed germination process. The result of this study is in line with the findings of Adeniji *et al*. (2019) which shows that mechanical scarification had an early emergence out of the four pre-treatment methods used on Afzelia africana in their study. Other studies (Jayasuriya, 2013; Ogbimi and Sakpere, 2021) also suggested that seed dormancy in leguminous plants is mostly caused by the impermeability of hard seed coats to water. However, the result of these findings showed that cold water pre-treatment gave the highest germination percentage of 58% while the least (10%) was recorded under hot water treatment. This indicates that *Afzelia africana* seeds respond negatively to high temperatures while cold treatment poses to be the best for maximum germination of the seeds. Previous research on the germination response of *Afzelia africana* to pre-treatments suggests that exposure of the seeds to a higher concentration of Acid could be

damaging to the seed's embryo (Amusa, 2011 and Schmidt, 2000). This explains why higher percentages were recorded under control and mechanical scarification as against hot water scarification and acid treatment. The result obtained in this study corroborates the work of Ogbbimi and Sakpere (2021) who observed that further subjection of the seed of *Afzelia africana* to a higher concentration of acid leads to distortion of the embryo and a harsh burning effect on the seed coat.

The growth characteristics of *Afzelia africana* were also influenced by the watering regime. The result showed that the watering regime has a significant effect ($P<0.005$) on the growth of *Afzelia africana seedlings.* Thrice a week watering regime gave the best growth performance for *Afzelia africana* seedlings on total height and number of leaves. These findings are in agreement with the report of Oboho and Ahanon (2017), who reported significant differences in the growth rate of *Afzelia africana* seedlings under the varying watering regime used in their study. They further revealed that thrice a week watering regime of *Afzelia africana* has a higher plant height and number of leaves. However, the daily watering regime improved the growth rate through an increase in tree height and folia development. Sala *et al.* (2012) opined that height development at the expense of diameter in trees may be related to the role of non – structural carbohydrates within a tree body. The growth parameters for twice-a-week watering and daily watering regimes were lower than the values of thrice-a-week watering regime, However, statistical analysis revealed no significant difference in the number of leaves and the seedling diameter. Vandoome *et al*., (2012) indicated that water stress drastically decreases fresh and dry weight, leaf number, and total leaf area of *Afzelia africana.* Similarly, Sadeghian and Yavari (2004) believed that seedling growth severely diminished with increased drought stress irrespective of genetic differences. Sharma and Prasad (1984) indicated that inadequate soil moisture can reduce germination, slow down seedling growth and decrease yield in rain-fed crops. Hence water is indispensable for seed germination and plant growth. It initiates germination, supports metabolic processes, aids nutrient uptake, participates in photosynthesis, maintains cell turgor, facilitates nutrient transport, and regulates temperature. Adequate water availability is crucial for the overall health and productivity of plants.

CONCLUSION AND RECOMMENDATION

The research outcomes demonstrate that the seeds of *Afzelia africana* exhibit exogenous dormancy, which can be effectively alleviated through various pretreatment methods examined in this study. Among these methods, cold water treatment emerges as the most favorable for achieving maximum and uniform germination rates. Furthermore, the investigation highlights the notable water requirement attribute of *Afzelia africana* during crucial stages of its life cycle, as evidenced by the superior growth response observed under the thrice-weekly watering regime. These findings provide valuable insights into the adaptive mechanisms of *Afzelia africana*, enabling its successful adaptation and thriving in arid and water-scarce environments.

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