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Effect of acid pre-treatment and potting media on seed germination and early seedling growth of *Albizia Lebbek*

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Abstract

The study was conducted to assess the effect of acid pre-treatment and potting media on seed germination and early seedling growth of *Albizia Lebbek.* One hundred (100) seeds of *Albizia lebbeck* were respectively soaked in tetra-oxo-sulphate (vi) acid at 98% concentration for 2mins, 80% concentration for 5mins and 60% concentration for 8mins. After soaking, the seeds were removed, washed and rinsed in running tap water to remove the acid. The treated and the untreated seeds (control) were sown in a bowl previously filled with top soil and watered for germination to take place. Number of seeds germinated per day was monitored and recorded for each treatment. For early growth experiment, seedlings with relatively uniform height were selected from all the treatments and were transplanted into polythene pots filled with different soil media (top soil, river sand and sawdust). Growth parameters viz; (heights, stem diameter, number of leaves, and length of leaves,) were measured over a period of 12 weeks. The results on germination showed that 97, 91, 81 seeds germinated for 98%, 80%, 60% acid concentration respectively on the 5th day of sowing while 27 seeds germinated for control on the 6th day of sowing. Effect of the different sowing media on seedling growth parameters showed that seedlings grown in topsoil has the highest mean values of growth performance, while the least values were obtained for the seedlings grown in sawdust. It was recommended that top soil should be used by tree growers for production of quality seedlings of *Albizia lebbeck*.

Keywords: Seedlings, Growth; Potting media; Seed germination; *Albizia Lebbek*

1. Introduction

Forest resources are essential due to the wide variety of goods and services they provide [1]. In Sub-Saharan Africa, indigenous fruits offer vital insurance against famine and malnutrition during times of seasonal food shortage or emergencies such as drought and flood [2]. Moreover, in the rural Africa communities, most rural households also rely on forest products as source of cash and subsistence [3]. The reliance of millions of the world's populations on natural forest products, particularly edible wild plants for their sustenance has been established [4]. This is evidenced by the fact that such plants which may be trees, palms or shrub species have been known to provide shade, aesthetic sight, edible fruits, seeds, leaves, resins, tannins, gums, oils and pharmaceutical products [5].

Despite the importance of these product for man's sustenance, most of these forest resources are under threat from anthropogenic activities. These activities have resulted in the loss of some plant species and a decline in environmental quality as well as in the biodiversity conservation status of the forest. *Albizia lebbeck* (L.) Benth, a multipurpose, medium-sized deciduous tree species is one of the most suitable tree species for reforestation of degraded sites due to its ability to fix nitrogen and improve soil structure [6]. *Albizia lebbeck* is widely spread in the world, and its tree has large leaves and fragrant cluster of green-yellow flowers and long seed pods.

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Albizia lebbeck is grown for shelter belts, and as a shading tree in coffee and tea plantations [7]. Due to its coppicing ability, site adaptability and nitrogen fixing property it is a preference species in agroforestry systems. *Albizia lebbeck* is an excellent fuelwood and charcoal species and the wood is suitable for construction, furniture, and veneer. The shallow root system makes it a good soil binder and recommended for soil conservation and erosion control [8]. Due to high level of exploitation and deep seed dormancy, the species is becoming scarcer, thus exposing the species to dangers of extinction [9].

Seed dormancy is a condition in which seed is unable to germinate in a specified period of time under a combination of environmental factors that are normally suitable for the germination of the non-dormant seed [10]. Seed dormancy could be caused by numbers of factors such as hard seed coat and presence of growth inhibitor in the embryo. Breaking of seed dormancy required some treatments to ensure quick and uniform seed germination. Seed germination is affected by many factors, which include; type of substrate used, environmental factors such as oxygen, water, temperature and for some plant species, light [11]. It involves absorption of water by the seed and splitting of seed coat giving rise to plumule (which grows upward and develops into stem and branches) and ridicule (that grows downward and develops into root system) [12].

Growth media or substrates is essential for the production of quality seedlings, it directly affects the development and maintenance of extensive functional rooting system [13]. A good growing medium would provide sufficient anchorage or support to the plant, serves as reservoir for nutrient and water, allow oxygen diffusion to the roots and permit gaseous exchange between the roots and atmosphere outside the root substance [14].

Poor growth performance of the *Albizia lebbeck* on the field is a major constraint to the production and cultivation of the species. Identifying efficient nursery management practice through breaking of seed dormancy and the use of suitable growth media is crucial. Low seedling propagation rates of a tree can be attributed to inadequate knowledge of their requirements such as appropriate potting media that can be adopted to enhance their growth at the nursery [15]. Growth medium has been reported to be the most critical factor determining seedling quality and their subsequent survival in the nursery [16], [17].

2. Material and methods

2.1. Study Area

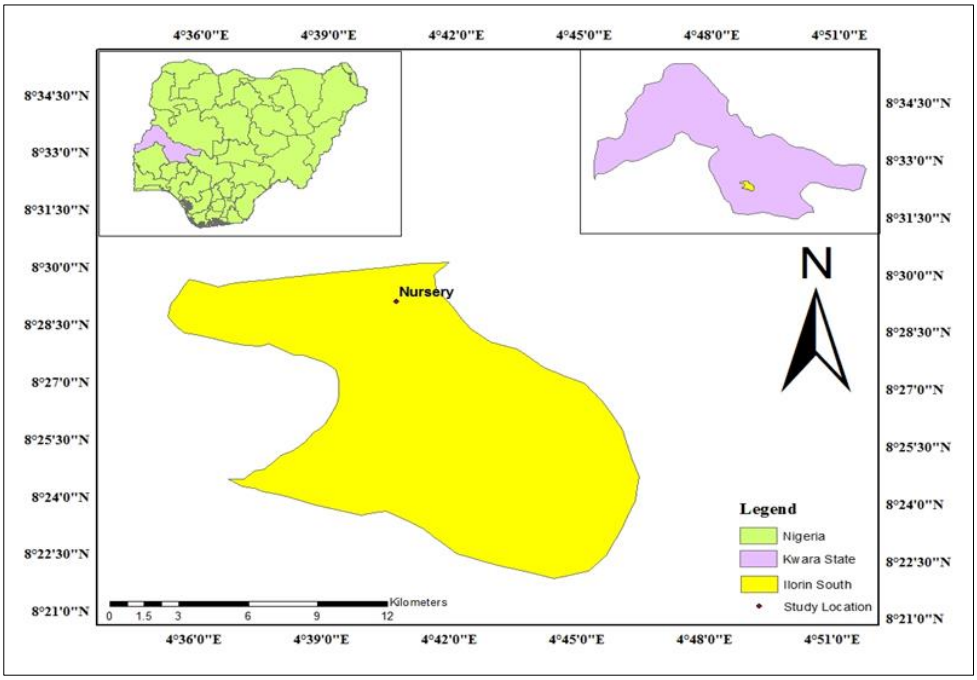

Figure 1 Map of the study area

The study was carried out at the Faculty of Agriculture, University of Ilorin nursery site. The nursery is geographically located on latitude N8°29'10" and longitude E4°40'39". in the Guinea Savanna vegetation of Nigeria. The annual rainfall

is between 600 mm and 1500 mm with distinct wet and dry seasons of almost six months each. The average relative humidity is 78% and daily sunshine of 7.1 hours. The mean monthly temperatures are very high, varying from 25 ℃ to 38 ℃ [18]. The soil is loamy sand and the vegetation of the area is savanna with occasional scattered trees [19].

2.2. Seed Collection and Processing

The seeds of *A. lebbeck* were collected from mother trees within the University of Ilorin premises. The pods were opened manually to extract the seeds. Viability test was carried out through the floatation method, the ones that float was regarded as not viable while the ones that sink was used for the study. The viable seeds were dried at a normal room temperature. Afterwards, the seeds were stored in a paper envelope.

2.3. Experimental Procedure

One hundred and twenty (120) seeds of *Albizia lebbeck* were respectively soaked in tetra-oxo-sulphate (vi) acid at 98% concentration for 2mins, 80% concentration for 5mins and 60% concentration for 8mins. After soaking, the seeds were removed, washed and rinsed in running tap water to remove the acid. The treated seeds and the untreated seeds (control) were sown in a bowl previously filled with top soil and watered for germination to take place. Number of seeds germinated per day was monitored and recorded for each treatment. till no further germination is observed. For the early growth experiment, seedlings with relatively uniform height were selected from all the treatments and were transplanted into polythene pots filled with different soil media (top soil, river sand and sawdust). Growth parameters viz; (heights, stem diameter, number of leaves, and length of leaves,) were measured over a period of 12 weeks. The treatments were replicated three (3) times and arranged in Completely Randomized Design.

2.4. Calculations

$$\text{Germination Percentage} = \frac{Number\ of\ seeds\ germinated}{Total\ number\ of\ seeds\ planted} \times 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$\text{Emergence Index (EI)} = \frac{\sum(\text{Seedlings emerged})(Days after sowing)}{\text{Total number of seedlings germinated}} \quad \ldots\ldots\ldots\ldots\ldots (2)$$

$$\text{Emergence rate index (ERI)} = \frac{Emergence Index}{Germination\ percentage} \quad \ldots\ldots\ldots\ldots\ldots (3)$$

2.5. Data Analysis

Data collected were computed and subjected to analysis of variance {ANOVA} using Ms. Excel. at p = 0.05, to determine differences in mean, while the means were separated using Duncan Multiple Range Test (DMRT).

3. Results

3.1. Effects of acid pre-treatments on germination of *Albizia lebbeck* seed

Table 1 Germination parameters of *Albizia lebbeck* seeds under different acid concentration

Acid Conc. %)	Variables				
	Days of Emergence	No of Emerged Seeds	Germination %	Emergence Index	Emergence Rate Index
98%	5	97	80.83%	16.38	20.26
80%	5	91	75.83%	15.33	20.21
60%	5	81	67.5%	16.28	24.12
Control	6	27	22.5%	16.37	72.76

Table 1 presents result of the effects of acid pre-treatment on germination of *Albizia lebbeck* seed. The result showed that out of 120 seeds socked for each acid pre-treatment, 97 seeds germinated for 98% acid concentration, 91 and 81 seeds germinated for 80% and 60% acid concentrations respectively, while 27 seeds germinated for control. The result also showed that the first germination for all the acid pre-treatments occurred on the 5th day after sowing, while

germination for control occurred on the 6th day of sowing. The result on germination percentage, emergence index and emergence rate index were as shown in Table 1.

3.2. Effect of growth media on early growth of *Albizia lebbeck*

Table 2 presents the effect of the different sowing media on seedling growth parameters. The result showed that highest mean values for all the growth parameters was obtained for seedlings grown on topsoil while the least value was obtained for the seedlings grown on sawdust. The result futher revealed that leaf number was significantly differ on top soil ($p \leq 0.05$). While stem diameter was not statistically different ($p \leq 0.05$) in all the sowing media.

Table 2 Seedling performance of *Albizia lebbeck* as influenced by different growth media

Treatments	Growth parameters			
	Leaf Number	Height (cm)	Stem Diameter (cm)	Leaf Area(cm^2)
Topsoil	20.960 ± 1.2^a	25.928 ± 1.4^a	0.031 ± 0.006^a	19.156 ± 1.6^a
Sawdust	9.240 ± 1.2^b	13.160±2.4b	0.024 ± 0.007^a	3.511 ± 1.2^b
River sand	10.400 ± 1.9^b	14.504 ± 3.9^{ab}	0.026 ± 0.005^a	7.852 ± 4.8^{ab}
Topsoil + sawdust	10.520 ± 2.9^b	17.580 ± 9.1^{ab}	0.025 ± 0.005^a	7.493 ± 6.6^{ab}

Note: means with the same alphabets in the same column are not significantly different ($p \leq 0.05$)

4. Discussion

It is evident from this study that acid pre-treatment is very effective in hastening germination of *Albizia lebbeck*. Acid treatment of seed removes the waxy layer of the seed coat through chemical reaction thereby enhances absorption of water by the embryo. This assertion is in agreement with [20] who explained that the more rapidly the seed coat is ruptured, the faster the rate of germination. The high percentage germination obtained for acid treated seed within 5 days in this study is similar to the findings of [21] and [22], who respectively reported early germination commencement day for *Afzelia africana* and *Albizia lebbeck* seeds soaked in concentrated H_2SO_4. Similarly, [23] obtained 90% germination for *Albizia lebbeck* seeds soaked in sulphuric acid.

The growth response of seedlings in the topsoil with regards to growth parameters viz; height, leaf number and leaf area was significantly higher ($p<0.05$) when compared with the rest of the treatments. This observation conforms with the assertions of Ehiagbonare, and Onyibe [24] who reported better seedlings growth of *Albizia lebbeck* and other tree like *Alstonia boonei* and *Afzelia Africana* on topsoil. Also, the observed maximum value recorded in leaf number, height, stem diameter and leaf area for seedlings grown on topsoil media shows that topsoil had the best effect on the seedlings growth parameters and this could be attributed to its high-water retention and high organic matter content compared to other media. This assertion is in consonance with the findings of Okunomo *et al*.,[25] who related the positive effect of topsoil on seedlings growth parameter to the high-water retention ability of the topsoil. Similarly, authors like Ngwuta *et al*., [26] and Agbogidi *et al*., [27] has attributed significant effect of topsoil on growth parameters of seedlings to its high organic matter, better aeration and high-water retention capacity.

5. Conclusion

The present investigation showed that acid pre-treatments can be used for breaking seed dormancy in *Albizia lebbeck* for improved and faster rate of germination. The result also revealed that no significant effect was observed on germination for seed pre-treated with different acid concentration level. The study further revealed that topsoil gave the best result with respect to all measured growth parameters of the species.

Recommendations

Based on the result obtained in this study, topsoil is recommended to tree growers for the production of quality seedlings of *A. lebbeck.*

Compliance with ethical standards

Disclosure of conflict of interest

We the authors of this article hereby declare that there was no conflict of interest, and that we are responsible for the content and writing of the article.

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