



## Seed Germination of *Faidherbia albida* (Delile) A. Chev as Influenced by Different Pretreatments

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**ABSTRACT:** *Faidherbia albida* is an agroforestry tree that has the potential of promoting agroforestry establishment in Nigeria. The seeds are glossy due to the presence of wax in the seed coat which prevents easy penetration of water. Thus, this study assessed the effect of different pretreatments (biological, mechanical and chemical) on the germination of *F. albida* seeds. The treatments include; seeds scarified at the helium, soaked in cold water for 24 hours, soaked in hot water for 3 minutes, 5 minutes, 10 minutes, & 15 minutes and soaked in Conc. H<sub>2</sub>SO<sub>4</sub> for 3 minutes, 5 minutes, 10 minutes, and 15 minutes. The result showed that all treatment had uniform germination percentage of 100% but seeds soaked in H<sub>2</sub>SO<sub>4</sub> for 15 min and 10 min had the highest germination value of (65.25) and (65.00) respectively, followed by 15mins soaking in hot water (47.14) while the least germination value was recorded in seeds scarified mechanically (33.31). Analysis of variance revealed that there was no significant difference in the treatments. However, seeds treated with H<sub>2</sub>SO<sub>4</sub> at 15 mins and 10 mins had the best performance in terms of germination value compared with other treatments. Therefore, for optimum and uniform germination, the seed of *F. albida* seeds should be soak in concentrated H<sub>2</sub>SO<sub>4</sub> for 15 min.

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*Faidherbia* is a genus of leguminous plants containing one species, *Faidherbia albida*, which was formerly widely included in the genus *Acacia* as *Acacia albida*. The species is native to Africa and it's commonly called apple-ring acacia because their circular seed pods resemble apple rings. (Ismail *et al.*, 2016; Maab Osman *et al.*, 2019). For a long time, this species was formerly called *Acacia albida*. It is a thorny tree growing up 6 – 30m (20–98 ft) tall and 2m (6.6 ft) in trunk diameter. It's highly resistant to drought due to deep-penetrating tap root. The bark is grey and fissured when old. According to Armstrong (2015), *F. albida* is found along flood plains of some areas in South Africa. *F.albida* flowers provide bee forage at the close of the rainy season showing it's important for raising bees, the seed pods are used for feeding livestock in Nigeria, and eaten by stock and game in Southern Africa (Bramm, 1997). The leaves are eaten by elephant, antelope, buffalo, baboons and various browsers and grazers, though strangely ignored by warthog and zebra (Kevin, 1990). The wood is used for canoes, mortars and pestles, and the bark is pounded in Nigeria and used as a packing material. Ashes of the wood are used as tanning agent for hides and as a depilatory and used in making soap. The wood is used for carving, the thorny branches is useful for a

natural barbed fence. Some 90 % of Senegalese farmers interviewed by Felker (1981) collected stored and rationed *Acacia albida* pods to livestock. It is valued in agroforestry as it fixes nitrogen, and a high yield has been achieved in at least one test plot of maize crops grown amongst the trees at a density of 100 to 25 tree per hectare (Bayala *et al.*, 2010). According to a 2018 article by the Guardian, monocultures of this species are popular in parts of Niger, where it is known as gao in Hausa, to use for intercropping (MacLean, 2018). It is also used for erosion control. Its value as an agroforestry tree cannot be overlooked as this species drops leaves during raining season which helps to add nutrient to the soil which invariably improves the growth and productivity of crops (Burrow *et al.*, 2018; Becking, 2020). Extract from the bark of *F. albida* is used in traditional medicine in Southern Africa, and Niger (MacLean, 2018).

*F. albida* is hard seeded which produces seeds with tough and hard seed coat (Connor, 2009). This condition does not encourage even germination but rather results in erratic germination of seeds (Alderete-Chavez *et al.*, 2011). In other to achieve rapid and synchronous germination the seeds of *F. albida* need

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to be subjected to some physical or chemical treatment enhancing early germination (Butola and Bedola, 2004; Islam *et al.*, 2009). Studies by Connor (2008) and Asiedu *et al.* (2011) suggested the treatment of seeds with hot water and scarification with 97% sulphuric acid increases germination percentage of hard coated seeds. Several other pre-sowing treatments have been suggested to enhance germination in seeds with hard seed coats. These include gibberellic acid, potassium nitrate, succinic acid, HCl, nitric acid, boric acid, acetic acid, ethanol, methanol, benzene, xylene, urea, benzyl adenine, among others (Alves *et al.*, 2000; Ghadiri and Torshiz, 2000; Idu *et al.*, 2007; Schmidt, 2000). It has been noted by Orwa *et al.* (2009) and Asiedu *et al.* (2011) that very little work has been done on the plant thus the need to conduct further study to determine the best pre-treatment method that will help to break dormancy and give higher germination. Hence, this experiment investigated the effects of some pre-sowing treatments on the germination of *Faidherbia albida* seeds.

## MATERIALS AND METHODS

**Experiment Site:** The study was carried out at the Seed Section of the Department of Sustainable Forest Management (SFM), Forestry Research Institute of Nigeria (FRIN), Jericho Hill, Ibadan, Nigeria. FRIN is located on the longitude 07°23'18"N to 07°23'43"N and latitude 03°51'20"E to 03°51'43"E (Bolanle-Ojo *et al.*, 2018). The climate of the study area is the West African monsoon with dry and wet seasons. The dry

season is usually from November through March and is characterized by dry cold wind of harmattan. The wet season usually starts from April to October with occasional strong winds and thunderstorms. Mean annual rainfall is about 1548.9 mm, falling within approximately 90 days. The mean maximum temperature is 31.9°C, minimum 24.2°C while the mean daily relative humidity is about 71.9% (FRIN, 2017).

**Seed Collection and Extraction:** Matured fruits of *F. albida* were collected from Ogbomoso area of Oyo State and seeds were extracted from the pods. Washed and sterilized river sand was filled into germination trays (30cm x 12cm) for germination investigation under mist propagator.

**Experimental Design:** This experiment was laid in a Completely Randomized Design (CRD). Ten (10) treatments were used for this experiment as shown in Table 1. Ten (10) seeds were used for each experimental units and replicated 5 times. A total of 500 seeds were used for this experiment.

**Seed Pre-germination treatments and Methods:** The experiment was subjected to 10 pre-germination treatments which comprises of mechanical scarification, cold and hot water (soaked for 3, 5, 10 and 15 minutes) and acid (soaked for 3, 5, 10 and 15 minutes). Mechanical scarification involved scarified at the helium (Table 1). All the treated seeds were sown in germination trays under a mist propagator.

**Table 1:** Pre-germination treatments and methods

S/N	Treatment	Methodology
T1	Mechanical Scarification	Scarified at the helium
T2	Cold Water (24 hours)	Seeds soaked in cold water for 24 hours
T3	Hot water (60°C)	Seeds soaked in hot water for 3 minutes
T4	Hot water (60°C)	Seeds soaked in hot water for 5 minutes
T5	Hot water (60°C)	Seeds soaked in hot water for 10 minutes
T6	Hot water (60°C)	Seeds soaked in hot water for 15 minutes
T7	Concentrated Acid	Seeds soaked in concentrated H <sub>2</sub> SO <sub>4</sub> for 3 minutes
T8	Concentrated Acid	Seeds soaked in concentrated H <sub>2</sub> SO <sub>4</sub> for 5 minutes
T9	Concentrated Acid	Seeds soaked in concentrated H <sub>2</sub> SO <sub>4</sub> for 10 minutes
T10	Concentrated Acid	Seeds soaked in concentrated H <sub>2</sub> SO <sub>4</sub> for 15 minutes

**Data Collection:** The germinated seeds were monitored and data were collected on Germination assessment: The effects of pre-sowing treatment were assessed by daily counting of number of germinated seeds. A seed was considered to have germinated when the tip of the radicle emerged free of the seed coat (Auld *et al.*, 1988). Daily germination percentage was summed up to obtain cumulative germination on each assessment. Germination period was determined as the number of days from first observed germination to when there was no more germination but energy period was arbitrarily defined in 12 days (Willan,

1993). Germination pattern was also determined by number of seeds that germinate at the different days after sowing (Viswanath *et al.*, 2002). Germination energy is defined as the percentage by number of seeds in a given sample which germinate within a definite period such as 7-14 days under optimum or stated condition (Willan, 1987). Germination energy is also a measure of the speed of germination and hence, a measure of the vigour of seedlings (Willan, 1993). In addition, germination value which is a composite value that combines both germination speed and total germination was also determined. Germination value

is an objective means of evaluating results of a germination test and is calculated using the formula proposed by Hartmann *et al.* (1997) as follows:

$$GV = MDG \times PV \dots\dots\dots(1)$$

Where: GV= Germination value; MDG = (Final) Mean daily germination; PV = Peak value mean daily germination

Germination Percentage (GP), Germination Energy (GE), Mean Daily Germination (MDG), Peak Value (PV) and Germination value (GV) were determined with the use of the following equations according to Schelin *et al.*, (2003):

$$GP (\%) = \frac{\text{total seeds germinated}}{\text{Total seeds sown}} \dots\dots\dots (2.)$$

Germination Energy (GE) is the percentage total of highest germination counts from the day it begins till when it starts diminishing divided by total seed sown.

$$GE = \frac{\dots\dots x+y+z}{\text{Total sseds sown}} \times 100 \dots\dots\dots (\text{Eqn. 3})$$

Where: x = the first highest germination count, y = higher germination count, z = high germination count

Mean Daily Germination percentage (MDG): This is cumulative total percentage of germinated seeds divided by exact germination day.

$$MDG (\%) = \frac{\text{Cumulative Total Percentage of seed sown}}{x} \dots\dots\dots (\text{Eqn. 4.})$$

Where: x = Exact germination day

Peak Value (PV) is the highest value calculated as MDG

Germination Value (GV) is the product of the last day MDG and PV

$$GV = \text{Last day MDG} \times PV \dots\dots\dots (\text{Eqn. 5})$$

Total germination is expressed as Mean Daily Germination (MDG), calculated as the cumulative percentage of full seed germination at the end of the test divided by the number of days from sowing to the end of test period. Speed of germination was determined and expressed as peak Value, which is the maximum mean germination reached at any time during the period of the test (Willan, 1993).

*Data Analysis* Data collected were analyzed using descriptive statistics and Analysis of Variance (ANOVA) and results were presented in tables.

**RESULTS AND DISCUSSION**

The result revealed that the treatments had uniform 100% germination percentage. Seeds soaked in Conc. H<sub>2</sub>SO<sub>4</sub> in 10 and 15 minutes had the highest peak value 17.33 and 17.40 respectively as well as germination value of 65.00 and 65.25 respectively followed by hot water treatment with peak value 12.57 and germination value (47.14) while the least value was recorded in mechanical scarification with peak value (9.33) and germination value (33.31) (Table 2). However, the ANOVA result revealed that there were no significant difference in all the treatments applied (Table 3).

**Table 2:** Comparison of Various Pre-treatment and germination value of *F. albida* seeds

Treatment	Germination percentage (%)	Peak Value (PV)	Mean Daily Germination (MDG)	Germination Value (GV) = PV X MDG
T1	100	9.33	3.57	33.31
T2	100	12.01	3.75	45.04
T3	100	10.88	3.75	40.80
T4	100	10.63	3.75	39.86
T5	100	9.39	3.57	33.52
T6	100	12.57	3.75	47.14
T7	100	10.90	3.75	40.88
T8	100	11.13	3.33	37.06
T9	100	17.33	3.75	65.00
T10	100	17.40	3.75	65.25

Where: **Peak Value (PV)** = Cumulative percentage of total seed germination divided by number of days; **Mean Daily Germination (MDG)** = Cumulative percentage of total seed germination divided by peak value; **Germination Value (GV)** = Mean Daily Germination multiplied by Peak Value

**Table 3:** Analysis of Variance (ANOVA) for the germination of *Faidherbia albida* under different pre-treatment

SV	DF	SS	MS	Fcal	Ftab
Treatment	9	0.59	0.058	1.72	1.83 <sup>ns</sup>
Error	154	5.19	0.034		
Total	163	5.78			

ns- Not significant ( $p>0.05$ )

Seed morphology, anatomy and environmental factors affect effective and sustainable germination of seeds which invariably helps to ensure successful plant propagation (Orwa *et al.*, 2009). This study revealed that all the pre-sowing treatments gave 100 % germination which is in contrast to the findings of Chuyong and Acidri (2015) who reported germination percentage in all the pre-sowing treatments applied on *F. albidawere* lower than 100 %. In this study, there was no significant difference in the treatments applied on the *F. albida* seeds. This is not in correlation to the findings of Chuyong and Acidri (2015) who reported significant difference in the treatments applied to treatments applied to the seeds of *F. albida*. The 100 % germination in all the treatments shows that the seeds of *F. albida* have high germination potential. The result obtained for this study on the germination value shows that the seeds soaked in Conc. H<sub>2</sub>SO<sub>4</sub> for 15 minutes gave the best in terms of germination value. This might be due to the fast wearing off of the seed coat which allowed quick penetration of water into the seeds. Aliero (2004) stated the importance of sulphuric acid pre-treatment in the germination of *Parkia biglobosa* seeds. The seeds of *F. albida* used for this study were freshly harvested and immediately subjected to the different pre-treatments.

**Conclusion:** This study revealed that mechanical scarification can help to increase the germination value of *F. albida* seeds. Therefore, in order to enhance optimum and uniform germination as well as, seedling production, soaking of *F. albida* seeds in concentrated H<sub>2</sub>SO<sub>4</sub> for 15 min is recommended. Germination of this species definitely facilitates the availability of seedlings for reforestation and agroforestry programs on sustainable basis in Nigeria.

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