

Effect of different pretreatment methods and materials on germination potential of *Faidherbia albida* seeds

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Abstract: The study was carried to find out how different pre-germination treatments can facilitate germination of *Faidherbia albida*. The experiment was conducted in Khartoum Forest Research Seed Centre (FRSC). The Seeds of *Faidherbia albida* were supplied by the FRSC, from Nuba Mountains collections (Longitude: 24° 21' E; Latitude: 12° 20' N); in March 2008. The experiments were laid out in completely randomized designs (CRD) with five main Pre germination treatments- untreated seeds (control), treatment with concentrated sulfuric acid (98%) for 30 minutes, nicking by electrical burner, emersion in boiling water for 5 minutes and soaking in hot water- each replicated four times. The germination tests were carried out in the nursery conditions and the germination media were sand, silt, mixture of sand and silt (50% by volume) and enrolled papers. Total of 25 seeds were sown in each soil medium and enrolled papers in March 2008. The total number of the experimental units was 20 with 4 times replications. The number of germinated seeds was counted daily till the end of the monitoring period (30 days). Then the germination percentage was calculated in each media. The result of the experiment shows that: In enrolled paper medium there were no significant differences in seed germination of *F. albida* by different pretreatments. The highest value of seed germination was recorded for seeds treated with sulfuric acid (26%) and the lowest value was recorded in untreated seeds (21%). In sand medium there were significant differences in seed germination of *F. albida* between seeds soaked in hot water and the other treatments. There were no significant differences in seed germination between the other four treatments. The highest value of seed germination was recorded for seeds treated with concentrated sulfuric acid (33%) and lowest value was recorded for seeds soaked in hot water (4%). In silt medium there were significant differences for seed germination of *F. albida* between untreated seeds and seeds treated with sulfuric acid. There were no significant differences in seed germination percentage between untreated seeds and those nicked by electric burner and boiled for five minutes. There were no significant differences in germination percentage between seed treated with sulfuric acid and those nicked by electric burner and boiled for five minutes. The highest value of seed germination was recorded for seeds treated with sulfuric acid (36%) and the lowest value for untreated seeds (10%) and in the mixture of sand-silt medium there were significant differences for seed germination of *F. albida* between seeds boiled for five minutes and seeds treated with sulfuric acid, but no significant differences for untreated seeds. Also there were no significant differences for seed germination of *F. albida* between seeds treated with sulfuric acid and control. The highest value of seed germination was recorded for seeds treated with sulfuric acid (45%) and the lowest value in seed germination was recorded for seeds boiled for five minutes (13%).

Keywords: *Faidherbia albida*, seed pretreatment, seed media

INTRODUCTION

Faidherbia albida (Del.) A. Chev belongs to the genus *Acacia* sub-family *Mimosoideae* of the family *Leguminosae* [3]. A tree, up to 30 m high. Its crown is usually rounded in mature trees with spreading branches [3, 32]. The trunk is usually single, with diameters often up to 2 m [3, 32]. Wood is light, sapwood streaky grey white, heartwood yellow. Bark is dark brown to dull grey, rough, and deeply fissured and scaly in mature trees. Stipules are spine scent in pairs. Leaves are bipinnate. Inflorescence is spicate. Flowers are yellowish white, Pods are orange to reddish-brown, and often coiled, twisted or falcate, thick and woody to thin

and flaky, indehiscent, Seeds are up to 29 per pod, light to very dark brown, elliptic-lenticular, 6-12 x 4-8 mm wide [3, 32].

Faidherbia albida occurs naturally from 270 m below sea level in Israel to 2700 m in Sudan [3] under a very wide range of meteorological conditions. In southwest Africa it can thrive under desert conditions where the mean annual rainfall is only 20 mm and the mean annual daily temperature 16.8 °C [10]. Whereas in west Africa it can also thrive in humid tropical conditions with mean annual rainfall of 1800 mm and a mean annual temperature of 28 °C [10] within an

absolute range of 0-42 °C [5]. Where rainfall is low, its occurrence is therefore generally limited to watercourses where groundwater is present. *Faidherbia albida* occurs on a remarkably wide range of soils. Most characteristically, it colonizes deep sandy clay soils, particularly alluvial deposits along the flood plains of rivers [27, 25]. It will, however, grow on sandy soils [1, 2, 7]. In Sudan, *F. albida* occurs in various habitats, ranging from alluvial soils of perennial or seasonal water courses, to open savanna woodland and cultivated land. The trees occur singly or gregariously, widespread along rivers and water depressions [11].

Herbivores are the main dispersal agents; the pods are highly palatable and nutritious and eaten in huge quantities [33]. The tree is best used in agroforestry; its nitrogen rich leaves which are shed at the beginning of the rainy season serve to significantly improve and fertilize the soil, and thus benefit crop growth [31].

Most *Faidherbia albida* trees growing in today are believed to have originated as natural regenerations [21]. The species is threatened by increasing rate of exploitation for various uses, wildfires [21]. Very little effort has been directed towards using these indigenous trees in afforestation programmes. The main problem encountered in propagating seedlings of most indigenous trees for afforestation programmes in arid and semi-arid areas is dormant seeds [6]. This dormancy must be broken before germination can occur because it blocks the completion of germination of an intact viable seed under favourable external conditions [6]. Seed germination starts with the uptake of water by the quiescent dry seed, ending up with the elongation of the embryonic axis [18]. Seeds of most arid and semi-arid tree species areas cannot germinate promptly when subjected to condition favourable for germination due to water impermeable seed coat. Seeds of such species need to be subjected to some chemical or physical treatment to break dormancy and obtain uniform germination [18, 19, 20, 22]. Mechanical or chemical (sulphuric acid) treatment and hot water are the method most commonly used to break water impermeable seed coat to obtain uniform and rapid germination Little is known about the germination requirements of indigenous trees species therefore the present study was carried to find out how different pre-germination treatments can facilitate germination of *Faidherbia albida*

MATERIAL AND METHODS

Materials

The experiment was conducted in Khartoum Forest Research Seed Centre (FRSC). The Seeds of *Faidherbia albida* (Plate 1) were supplied by the FRSC, from Nuba Mountains collections (Longitude: 24° 21' E; Latitude: 12° 20' N); in the year 2009 sulfuric acid (98%

concentration) was also supplied by FRSC together with the necessary equipments and laboratory facilities

Seed germination tests

The experiments were laid out in completely randomized designs (CRD) with five main (including the control) pregermination treatments each replicated four times. The five pre-germination treatments were as follows; untreated seeds (control); treatment with concentrated sulfuric acid (98%) for 30 minutes then washing thoroughly with distilled water and drying ; nicking by electrical burner; emersion in boiling water for 5 minutes and then leaving to cool; and soaking in hot water and leaving to cool. The germination tests were carried out in the nursery conditions and the germination media were sand, silt, mixture of sand and silt (50% by volume) and enrolled papers. The soil was filled in the plastic plates. Total of 25 seeds were sown in each soil medium and enrolled papers, on 20th March 2008. The total number of the experimental units was 20 with 4 times replications. The growth media were maintained moist throughout the experimental period. The number of germinated seeds was counted daily till the end of the monitoring period (30 days). Then the germination percentage was calculated in each media.



Plate 1: Seeds of *Faidherbia albida*

STATISTICAL ANALYSIS

The data from the experiment were subjected to ANOVA test by a SAS program (26) and the significant levels for the mean separations were assigned according to Duncan's Multiple Range Test ($P \leq 0.05$).

RESULTS

The effect of pretreatment and growing media on germination of *Faidherbia albida* seeds

There were significant differences in seed germination of *F. albida* between concentrated sulfuric acid and the other treatments. But there were no significant differences between the other treatments. The highest value of seed germination percentage was recorded in seeds treated with sulfuric acid (35%) and the lowest value was recorded for seeds soaked in hot water (13%) (Table 1).

Table 1: Percentage of *F. albida* seeds germination in different pretreatments

Pretreatment test	Germination (%)
Control	21b
Conc. sulfuric acid	35a
Electric burning	24b
Boiling water (5 minutes)	18b
Hot water soaking	13b

Means followed by the same letter (s) in the column are not significantly different at $p \geq 0.05$ (Duncan Multiple Range Test).

***Faidherbia albida* seed germination as affected by different pretreatments in enrolled paper medium:**

There were no significant differences in seed germination of *F. albida* between all the treatments. The highest value of seed germination was recorded for seeds treated with sulfuric acid (26%) and the lowest value for seed germination was recorded in untreated seeds (21%) in the control (Table 2).

***Faidherbia albida* seed germination as affected by different pretreatments in sand medium**

There were significant differences in seed germination of *F. albida* between seeds soaked in hot water and the other treatments. There were no significant differences in seed germination between the other four treatments. The highest value of seed germination was recorded for seeds treated with concentrated sulfuric acid (33%) and lowest value was recorded for seeds soaked in hot water (4%) (Table 2).

***Faidherbia albida* seed germination as affected by different pretreatments in silt medium**

There were significant differences for seed germination of *F. albida* between untreated seeds and

seeds treated with sulfuric acid. There were no significant differences in seed germination percentage between untreated seeds and those nicked by electric burner and boiled for five minutes. There were no significant differences in germination percentage between seed treated with sulfuric acid and those nicked by electric burner and boiled for five minutes. The highest value of seed germination was recorded for seeds treated with sulfuric acid (36%) and the lowest value for untreated seeds (10%) (Table 2).

***Faidherbia albida* seed germination as affected by different pretreatments in the mixture of sand-silt medium**

There were significant differences for seed germination of *F. albida* between seeds boiled for five minutes and seeds treated with sulfuric acid, but no significant differences for untreated seeds. Also there were no significant differences for seed germination of *F. albida* between seeds treated with sulfuric acid and control. The highest value of seed germination was recorded for seeds treated with sulfuric acid (45%) and the lowest value in seed germination was recorded for seeds boiled for five minutes (13%) (Table 2)

Table 2: Percentage of *F. albida* seed germination in different pretreatment and media

Media	Pretreatments	Germination (%)
Paper	Control	21bcde
	H ₂ SO ₄	26abcd
	Hot water	22bcde
Sand	Control	20bcde
	H ₂ SO ₄	33abc
	Electric burn	29abcd
	Boiling water	26abcd
Silt	Control	10de
	H ₂ SO ₄	36ab
	Electric burn	18bcde
	Boiling water	16bcde
Sand-Silt	Control	10de
	H ₂ SO ₄	45a
	Boiling water	13cde

Means followed by the same letter (s) in the column are not significantly different at $p \geq 0.05$ (Duncan Multiple Range Test).

DISCUSSION

The performance of seed germination of *F. albida* in the different pretreatments was highest for seeds treated with concentrated sulfuric acid (35%) and

lowest for soaking in hot water (13%), with significance differences (Table 2). From this study, it is quite obvious that pretreatment of seeds in hot water did not induce good germination. Mieke (21) reported that most

seeds will develop impermeability as they mature on trees. FAO (13) also reported that the majority of rainforest species are known to have seeds which lose their viability within a short period under conditions of high temperature. Gill *et al.*; [16] attributed the major cause of viability loss to the scarcity of oxygen, since water at high temperature has less gaseous content. However, 40% germination of seed of *Delonix regia* was found when immersed in warm water for three minutes.

In this study, acid treated seeds of *F. albida* have significantly high germination than the untreated seeds (control); similar results were obtained for seeds of *Acacia Senegal* treated with acid for 15 minutes and gave 90% germination, which was significantly higher than that of the untreated seed [23]. Fish wick [15] obtained similar results for *Acacia nilotica* and *Acacia albida*. Cavanagh [8] stated that pretreatment with sulfuric acid is frequently more effective for African acacias. Generally acid treatment stimulates prompt and uniform germination. Dutta [10] reported that pre-soaking seeds in water increases their germination percentage in many plant species. The mechanism by which seed hydration treatment improves seed germination is probably due to increase in hydrophilic enzyme activity.

The hard seed coat of many arid and semi-arid woody species has evolved to survive under unfavourable conditions such as heat caused by sunlight, severe drought, mechanical and animal damage. Seeds of these species present difficulties to tree growers if sown untreated due to dormancy. Dormancy has evolved differently across species through adaptation to the prevailing environment, to allow seeds to germinate only when conditions are likely to favour the establishment of a new plant [4, 6, 14, 17, 28] Mechanical scarification is known to break physical dormancy of hard coated seeds which inhibit water uptake and gases such as in *Acacia* species [9, 19, 28]. Mechanical scarification allows water and air to enter into the seed and stimulate germination. The enhanced germination observed in the mechanical treatment could be attributed to water uptake by the quiescent dry seed, which ended up with the elongation of the embryonic axis [18]. The results of the current study are in agreement with Nainar *et al.*; [22] who used different pre-treatments in *Terminalia chebula* seeds and found that mechanical scarification gave the highest germination percentage of 60%.

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