



Influence of Pre-sowing Treatments on the Germination of *Prosopis africana* (Guill. and Perr.) Taub. Seeds

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Authors' contributions

This work was carried out in collaboration among all authors. Authors OC and MAU designed the study, data collection and writing of the manuscript. Author AEE managed the literature searches and writing of the manuscript. Authors JUE and OC performed the statistical analysis, interpret data and reviewed manuscript. All Authors read and approved the final manuscript.

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ABSTRACT

Aims: The application of pre-sowing treatment has greatly improved the germination of seeds of tree species used in afforestation programmes all over the world. This study aimed to determine the effect of different pre-sowing treatments on the germination of *Prosopis africana* seeds.

Study Design: The experiment was laid in a completely randomized design.

Place and Duration of Study: This study was carried out from 11th November to 30th December 2019 at the Department of Forestry and Wildlife, Faculty of Agriculture, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria.

Methodology: Ten seeds each were soaked in ten treatments: tetraoxosulphate (VI) acid (H₂SO₄) for 10, 20 and 30 minutes; hot water for 6, 12 and 24 hours; and cold water for 3, 5 and 7 days. Ten seeds from each of the treatments were sown in a germination box containing sterilized river bank sand and each replicated five (5) times. Percentage germinations for each treatment were arcsine transformed, subjected to analysis of variance and significant means were separated using Duncan multiple range test at 5% probability level.

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Results: The results revealed significant differences ($p < 0.05$) in germination. The seeds treated with acid for 30 minutes had the highest mean (51.405) and standard deviation (8.983), seeds soaked in cold water for 3 days and 7 days had no germination.

Conclusion: The study concluded that soaking *Prosopis africana* seeds for 30 minutes in H_2SO_4 breaks its dormancy, hence, was recommended for improved seed germination.

Keywords: Acid; dormancy; germination; pre-sowing treatments; *Prosopis africana*; seeds; silviculture.

1. INTRODUCTION

Prosopis africana is a tree species in the Fabaceae family, found in subtropical and tropical regions of the Africa, Americas and Asia. They often thrive in arid soil and are resistant to drought, on occasion, developing extremely deep root systems. Their wood is usually hard, dense and durable. In West Africa, *Prosopis africana* is highly exploited as all its parts (leaves, bark, roots) are used by the rural population. Its wood is used for building materials (sheds, attics) and in the manufacture of household utensils (mortar, pestle) and charcoal, judged good by blacksmiths [1]. The leaves and pods are used by farmers for animal feed, and the bark and roots are used to treat diseases. The wood is dense and resistant to termites and fungi [2,3]. It is also very tough, rich red-brown, with grey sapwood. Its timber has been noted to have good physical properties in terms of dimensional stability and strength even more than *Tectona grandis* [4] and used for construction, poles, planks, mortars and handles for farm implements. The application of pre-sowing treatments has greatly improved the germination of the seeds of trees species used in afforestation programmes all over the world.

One of the major problems associated with afforestation programmes in the tropics is the fact that most tropical forest tree seeds exhibit one form of dormancy or another [5]. The conditions necessary to allow seeds to break dormancy and germinate can be highly variable among species, within a species, or among seed sources of the same species [6]. Hard seed coat, type and sizes have been identified by Agboola [7] as some attributes which affect germination and growth of *Prosopis africana*. The pre-treatment of *Prosopis africana* seeds are necessary to enhance accessibility of water and oxygen into the seeds and to obtain optimum germination and improved performance for plantation establishment.

Ffolliot and Thames [8] revealed that, repeated attempt to germinate *Prosopis africana* seed with

intact endocarps has yielded less than five percent germination. To overcome this dormancy, the seed must be scarified, by scratching of the seed coat to aid germination, or otherwise treated to make the seed permeable to water and hasten germination. Once dormancy has been broken, the period of active germination is usually less than 30 days. A possible exception to the above is a fresh collection of *Prosopis africana* seeds that has not been dried; it has been observed that such seed may germinate promptly without pre-treatment [9]. According to Ffolliot and Thames [8], pre-sowing treatments of *Prosopis africana* seeds can be classified based on; mechanical treatments, water treatment, dry heat treatment, chemical treatment, and electrical treatment.

Prosopis africana faces regeneration problem mainly due to a low germination rate [10] and hardness of its seed [11]. Faye et al. [12] pointed that *P. africana* is a particularly vulnerable species facing the danger of going into extinction. It is therefore necessary to identify the best pre-sowing treatment used in the germination of *Prosopis africana*. The main objective of this study is to determine the effect of different pre-sowing treatment on the germination of *Prosopis africana* seeds for increased seedling production.

2. MATERIALS AND METHODS

2.1 Study Area

This study was carried out within duration of about 7 weeks, precisely between November 11th and December 30th 2019 in the Prof. E.L.C Nnabuife screen house of the Department of Forestry and Wildlife, Faculty of Agriculture, Nnamdi Azikiwe University, Awka, Anambra State. 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. The temperature in Awka is generally 27-30°C between June and December but rises to 32-34°C between January and April with the last few months of the dry season marked by the intense heat. It has an

average annual temperature of 26.3°C. It has a rainfall pattern ranging from 1828 mm -2002 mm. The climate of Awka falls within the tropic wet and dry type based on Koppen’s classification [13].

2.2 Seed Collection

Mature seeds were collected from three mother trees at Tse–Anuba village along University of Agriculture Gbajimba road, Markurdi Local Government Area of Benue State, Nigeria. The seeds were subjected to viability test through floatation method as described by Amusa [14].

2.3 Experimental Design

The experiment was laid in a completely randomized design (CRD) involving ten treatments (T): soaking in 98% concentration of tetraoxosulphate (VI) acid (H₂SO₄) for 10 minutes (T1), 20 minutes (T2) and 30 minutes (T3); soaking in hot water for 6 hours (T4), 12 hours (T5) and 24 hours (T6) and soaking in cold water for 3 days (T7), 5 days (T8) and 7 days (T9) and no treatment (T10). Ten seeds from each of the treatments were sown in a germination box containing sterilized river bank sand and each replicated five (5) times.

2.4 Data Collection and Analysis

Germination count was based on the emergence of the radicle on a daily basis. Seed germination counts under different pre-sowing treatments were analyzed using descriptive statistics and analysis of variance (ANOVA). For the purpose

of analysis of variance, the percentage values were transformed into arcsine values [15,16,17]. The means with significant difference were separated using Duncan multiple range test at 5% probability level.

3. RESULTS AND DISCUSSION

3.1 Results

The result of mean germination for *Prosopis africana* seeds under different pre-sowing treatments was shown in Fig. 1. The result showed that seeds treated with tetraoxosulphate (VI) acid for 30 min (T3) had the highest germination percentage (83.3%), followed by the seeds treated with hot water for 6 hours (T4) and 12 hours (T5) (33.3% and 13.3%, respectively). However, no germination was recorded in seeds with no treatment (T10) and seeds treated with cold water for 3 days (T7) and 7 days (T9) (0%). The details of germination percentages for other treatments are shown in Fig. 1.

The result of the One-way Analysis of Variance (ANOVA) showed that there was significant difference (p<0.05) in the germination of *Prosopis africana* seeds subjected to different pre-sowing treatments.

The DMRT result for the pre-sowing treatments revealed that the seeds treated with acid for 30 minutes (T3) had the highest mean of 51.405± standard deviation (SD) of 8.983, followed by the seeds treated with hot water for 6 hours (T4) with 30.626±7.999. The seeds treated with acid for

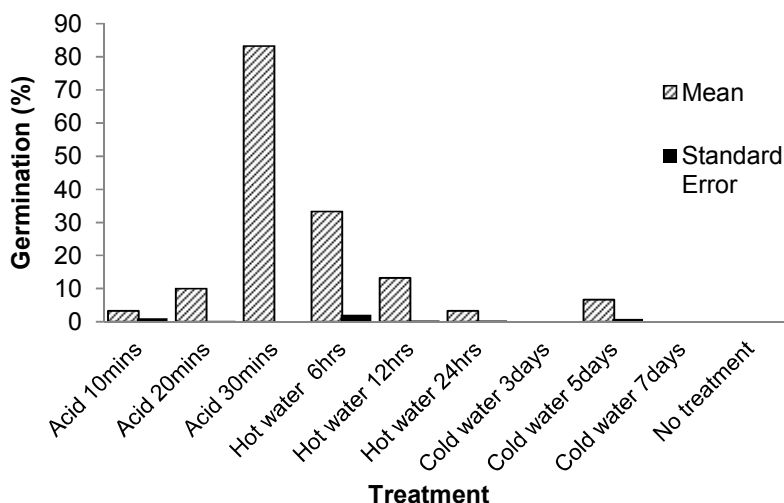


Fig. 1. The germination of *Prosopis africana* seeds under different pre-sowing treatment

Table 1. Results of seed germination for different treatments

Treatment No.	Treatment	Mean \pm Std. dev.
T1	Acid 10 minutes	10.466 \pm 0.003 ^c
T2	Acid 20 minutes	15.584 \pm 3.776 ^{bc}
T3	Acid 30 minutes	51.405 \pm 8.983 ^a
T4	Hot water 6 hours	30.626 \pm 7.999 ^b
T5	Hot water 12 hours	17.748 \pm 6.306 ^{bc}
T6	Hot water 24 hours	10.466 \pm 0.002 ^c
T8	Cold water 5 days	15.002 \pm 0.001 ^{bc}

*means with the same alphabet show not significant at 0.05 level of significant

10 minutes and those treated with hot water for 24 hours had the lowest mean, both having 10.466 \pm 0.003. However, the seeds treated with cold water for 3 days and 7 days had no mean (Table 1).

3.2 Discussion

From the result of this study, of all the different pre-sowing treatments, the highest germination percentage was recorded in seeds soaked in tetraoxosulphate (VI) acid (H₂SO₄) for 30 minutes which stimulated prompt and uniform germination. This is in tandem with the report of Uleh and Fagbemi [18] who recorded highest germination percentage of *Prosopis africana* seeds soaked in H₂SO₄ for 30 min and Ajiboye et al. [19] who reported that *Prosopis africana* seeds soaked in H₂SO₄ yielded higher (80-100%) germination than those soaked in water. Agbogidi et al. [20] reported that acid treatment can improve seed viability and enhance seedling emergence. Similarly, [21] stated that acid treatment of seed removes the waxy layer of the seed coat by chemical decomposition of seed coat component as similar to breakdown processes occurring during microbial attack.

The result of this study was in disagreement with the findings of Kumar et al. [22] on *Albizia lebbbeck* who reported that the immersion of the seeds in hot water and subsequent cooling at room temperature gave the highest germination percentage. Reason was that soaking of seeds in hot water softens the hard seed-coat and hydrates the seed tissues. It was also observed from this study that cold water treatment did not support the germination of *Prosopis africana* seeds. This is in agreement with the findings of Amoakoh et al. [23] on *Pouteria campachiana* who reported that cold water treatment had a negative influence on the germination of *Pouteria campachiana* seeds. This study, furthermore, disagrees with the findings of Azad et al. [24] who reported that hot water treatment had the

highest germination on *Acacia auriculiformis* seeds.

4. CONCLUSION

In this study, soaking seeds of *Prosopis africana* in 98% concentration of tetraoxosulphate (VI) acid (H₂SO₄) for 30 minutes was superior in breaking the seeds dormancy as it also gave the highest germination percentage.

5. RECOMMENDATION

To ensure maximum germination of *Prosopis africana* seeds for plantation establishment and nursery program, the study recommended pre-sowing treatment of seeds soaked in tetraoxosulphate (VI) acid for 30 minutes. Further research should be carried out on vegetative propagation of *Prosopis africana*.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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