

The influence of various pre-sowing treatments on germination of akle (*Albizia acle* (Blanco) Merr.) seeds

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Abstract



The objective of this study was to evaluate the most suitable pre-treatment method that will increase germination of *Albizia acle* seeds. The experiment was carried out in a Completely Randomized Design (CRD) and four hundred Akle seeds were used as an experimental material subjected to different pre-sowing treatments on germination such as Treatment 0 (T0) - control, Treatment 1 (T1) - hot soaking, Treatment 2 (T2) - cold soaking, Treatment 3 (T3) - sulfuric acid, and Treatment 4 (T4) - mechanical scarification, with four replications with twenty assessment units per replication. The effect of these treatments was evaluated through percentage germination, percentage germinative energy, and percentage germinative capacity after 30 days of observation. The seeds treated by sulfur acid (T-4) showed the highest percentage in terms of percentage germination and percentage germinative capacity (95% and 97.5%, respectively). Meanwhile, the seeds from Treatment 1 (hot soaking) had the highest percentage germinative energy with 58.75%. The overall results confirm that the most significant impact on germination and quality seedlings on Akle seeds had sulfur acid (T4 treatment).

Keywords: akle seeds, germination, pre-sowing treatments, germinative energy and capacity

Introduction

Akle (*Albizia acle* (Blanco) Merr.) is one of the several native trees being planted in reforestation initiatives in the Philippines (Schneider et al. 2014). It is a slow-growing deciduous tree that belongs to the family Fabaceae, native to the Philippines especially in Albay, Bataan, Bulacan and Camarines Norte, Camarines Sur, Capiz, Cebu, Davao, Ilocos Norte, Masbate, Occidental Mindoro, Negros Oriental, Nueva Ecija, Surigao, Tarlac, and Zambales (Sadie and Cornejo 2013). It has a dark-red, slightly porous, odorless, and flammable wood (The Philippine Star 2012) that is used to make furniture, musical instruments, sculptures, and houses. Because of its color, durability, and high-quality texture, Akle wood is actually regarded as the most beautiful wood in the Philippines. Unfortunately, it is declared as an endangered species due to rapid deforestation (Sadie and

Cornejo 2013). Surprisingly, Akle tree is propagated only by seeds. Due to its hard seed coat, planting untreated seed typically takes 120 days to germinate (Delizo, 1938). In order to shortened the germination duration and improve Akle seedling production, this study was carried out to identify the most suitable pre-sowing treatment that will increase of percentage germination, percentage germinative energy, and percentage germinative capacity to speed up the germination.

Methodology

Study site

This study was conducted in San Jose, Maria Aurora, Aurora, Philippines. The planting site were cleaned up properly.

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Collection of planting materials

Four hundred (400) homogenous Akle seeds were acquired from Barangay Ampayon, Butuan City, Agusan del Sur through Luzon Brokerage Corporation (LBC). The seeds were subjected to viability test, in order to remove seeds that were not viable. The test involved soaking in tap water wherein seeds floating were immediately removed as they were considered not viable. The viable seeds were then immediately dried for planting (Usman et al. 2010).

Soil preparation

Garden soil and decomposed rice hull from CENRO Dingalan Sub- Office in Barangay 01, Maria Aurora, Aurora were used as soil media. Soil media were pulverized and screened thoroughly to remove impurities. Heat sterilization for half hour was conducted to disinfect the soil and prevent it from pathogens (Shiffler 2019).

Preparation of treatments

For the preparation of Treatment 1, seeds were soaked in hot water (100°C) in aluminum container for 30 minutes until the water temperature dropped to 6°C using thermometer. For Treatment 2, seeds were soaked in cold water (10°C) in a jar for 24 hours until the water temperature dropped to 6°C using thermometer (Diamante and Vallesteros 2022). For Treatment 3, seeds were stirred in sulfuric acid with 98% concentration for 30 minutes (Yousif et al. 2020). After stirring, the seeds were rinsed immediately with tap water to wash out the acid (Olujobi et al. 2022). For Treatment 4, the seed coat of individual seed was mechanically scarified on one side with 100 grit sand paper (Diamante and Vallesteros 2022). Meanwhile, Treatment 0 seeds were not subjected to any treatments since it served as control. After subjecting the seeds in the different pre-sowing treatments, the seeds were directly sown in the specified black polyethylene bags.

Experimental design

The experiment was laid out in a Completely Randomized Design (CRD). The pre-germination study consisted of control and 4 treatments and were set up in four replications with twenty (20) assessment units

per replication with a total of four hundred (400) seeds. The following treatment combinations and layout were as follows in Table 1.

Data collection

Termination of the study was done after one month of observation. Weekly observations were done to determine the effects of pre-sowing treatments on the germination on Akle seeds. The seedlings were watered twice a day (early in the morning and late in the afternoon) using hand sprayer. As required, manual weeding was done. The effects of the treatments were evaluated by percentage germination, percentage germinative energy, and percentage germinative capacity.

a. Percentage germination

To determine the percentage germination, the total number of seeds germinated were divided by the total number of seeds planted then multiplied by 100 (Pabalan and Aquino 2020).

$$\% \text{ Germination} = \frac{\text{Number of seeds germinated}}{\text{Number of Total seeds planted}} \times 100$$

b. Percentage germinative energy

To determine the percentage germinative energy, the total number of germinated seeds up to the peak period were divided by the total number of seeds planted then multiplied by 100 (Pabalan and Aquino 2020). Peak period was the day with highest number of germinants.

$$\% \text{ Germinative Energy} = \frac{\text{Number of seeds germinated up to the peak period}}{\text{Total seeds planted}} \times 100$$

c. Percentage germinative capacity

To determine the percentage germinative capacity, the number of seeds germinated plus the number of ungerminated sound seeds were divided by the total number of seeds planted (Azad et al. 2012). Viability test through floatation method was performed to determine the sound seeds. Seeds that floated are considered not

Table 1. The different treatment combinations applied in this study

Number	Treatments	Duration
T0	Control	No treatment
T1	Hot water treatment	Soaking for 30 minutes
T2	Cold water treatment	Soaking for 24 hours
T3	Acid treatment with 98% concentration level	Stirring for 30 minutes
T4	Mechanical Scarification	Scarified on one side of the seed

viable while the seeds that sank were used in the study (Olujobi et al. 2022).

$$\% \text{ Germinative Capacity} = \frac{\text{Total number of seeds germinated} + \text{number of ungerminated sound seeds}}{\text{Total seeds of planted}} \times 100$$

Data analysis

Analysis of Variance (ANOVA) was utilized to assess the difference among treatments and the significance between treatment means with $p < 0.05$ level of significance.

Result and discussion

Percentage germination

Based on the result of the percentage germination of Akle seeds after being subjected to five pre-sowing treatments using LSD test, it was found that seeds treated with sulfuric acid (T3) obtained the highest percentage germination with a mean of 95%. The acid has a scarification effect, breaking seed coats and promoting germination. The germination suggests the potential of using sulfuric acid as seed treatment in improving the germination rate of Akle. In addition, mechanical treatment also stands out with a mean germination rate of 88.75% (Table 2). This treatment involves a mechanical process that appears to positively impact seed germination. Further investigation is warranted to identify the specific mechanical processes contributing to this effect. Moreover, the seeds treated by hot soaking show a mean germination rate of 82.50%, indicating that subjecting seeds to elevated temperatures during soaking enhances germination. This aligns with known practices where heat can stimulate seed dormancy breakage and promote germination.

Sulfuric acid and mechanical scarification were highly significant because it softens the outer covering of the seed, exposing the seed and allows the seed to absorb water more easily to promote germination. This is in support with the study of Nourmohammadi et al. (2019), reported that the best treatment was sulfuric acid in increasing the germination rate of other *Gleditsia* species, like *G. caspica*. Sulfuric acid and mechanical scarification were the most effective treatments for breaking the dormancy of *Vachellia karroo* which showed the highest significant cumulative germination percentages (Nosrati et al. 2008). Several studies showed that seed of *Azelia africana* are described by hard seed coats that function mainly as physical barrier that prevents water and entrance of oxygen (Amusa 2010). Applying sulfuric acid and mechanical scarification treatment intends to break or soften the endocarp (Grisez et al. 2008). While the control treatment had the lowest cumulative germination percentage (Pego et al. 2016). Additionally, this is in support with the

study of Kim (2019), that untreated seeds did not germinate despite of the length stratification period or temperature.

Percentage germinative energy

The seeds treated by hot soaking (T1) got the highest mean percentage germinative energy of 58.75%, suggesting it as the most effective treatment among those listed (Table 2). This treatment in seeds results with a higher percentage of strong and vigorous germination. Meanwhile, the seeds from T3 (sulfuric acid) demonstrate a mean percentage germinative energy of 57.5%, indicating a positive impact on the vigor of germination. This finding is similar to the works of Tiwari et al. (2020) in *A. lebbeck* where seeds soaked in hot water and 75% sulfuric acid for 12 hours standout among other treatments. The findings have practical implications for seed treatment strategies, especially when considering the vigor and strength of germination. Hot soaking and sulfuric acid appear to be promising for enhancing the vigor of germination. This is in support with the article of Higgins (2018) wherein hot water primes seeds, resulting them to germinate quickly than untreated seed.

Percentage germinative capacity

The Akle seeds evaluated for their ability to germinate by counting the germinated seeds and sound seeds that remained ungerminated. It is believed that sound seeds require sufficient time to germinate since they are free from pests. Thus, all of the ungerminated seeds perish due to rot and decay. As reflected in Table 2, T3 (sulfuric acid) stands out with the highest mean germinative capacity of 97.5%. The seeds treated by mechanical scarification (T4 treatment) also demonstrate high percentage germination capacity with a mean of 91.25%, indicating a positive impact on germination. T1 treatment (hot soaking) has an average of 88.75% germination capacity and T0 (control) has a mean of 87.5%. Both are effective, but the statistical analysis does not distinguish them significantly.

The results of this study is in agreement with the findings of Azad et al. (2012) who reported that subjecting seeds in different pre-sowing treatments facilitates germination. Additionally, this result is consistent with the study on pre-treated seeds of *Albizia* species which showed that all scarification treatments improved the germination capacity, the highest being after mechanical scarification followed by sulfuric acid and 80°C hot water treatment (Tigabu & Oden 2001). Scarification by sulfuric acid break the barrier of the seed in absorbing water and oxygen and permits radicle emergence by weakening the seed coat structure as well as the reason for increased imbibition and subsequent germination through micropylar plug (Baskin and Baskin 2014).

Table 2. Average values for percentage germination (%), percentage germinative energy (%) and percentage germinative capacity (%) of tested Akle seeds

Treatment	Percentage Germination	Percentage Germination Energy	Percentage Germination Capacity
T0 – Control	50 ^c	35 ^b	87.5 ^a
T1 - Hot Soaking	82.50 ^{ab}	58.75 ^a	88.75 ^a
T2 - Cold Soaking	66.25 ^{bc}	48.75 ^{ab}	76.25 ^b
T3 - Sulfuric acid	95 ^a	57.5 ^a	97.5 ^a
T4 - Mechanical scarification	88.75 ^a	40 ^b	91.25 ^a
Fc	7.39	3.85	5.08

*Fc= cumulative frequency

Meanwhile, the seeds from Treatment 2 (cold soaking) had the lowest average percentage for germination capacity (76.25%), indicating comparatively lower germinative capacity among the treatments listed. This study is in contrary with the findings in *Maesopsis eminii* seeds soaked in cold water for 12 hours wherein it attained higher germination capacity 10 weeks earlier compared to the untreated seeds which delayed up to 13 weeks likely because of seed dormancy (Odoi et al. 2019). Additionally, cold water is effective to lift the dormancy and improve germination of many species (Baskin and Baskin 2004).

The result of this study aligned with the study of Kumar et al. (2018) when they subjected seeds of *A. lebbeck* in seven pre-sowing treatment to observe germinative capacity and found out that immersion of seeds in hot water (100°C) and subsequent cooling at room temperature for 12 hours gave the highest germination (96%) compared to other treatments. Therefore, different pre-sowing treatments provides varied germinative capacity to the seeds.

Conclusion

Based on the findings, sulfuric acid treatment appears to be the most effective, consistently performing well in terms of percentage germination, germinative energy, and germinative capacity. Hot soaking also showed a promising result, particularly in enhancing germinative energy and capacity. Mechanical treatment was effective in terms of percentage germination and germination capacity. However, it is not as successful in terms of germinative energy compared to sulfuric acid and hot soaking. Therefore, sulfuric acid treatment could be considered the best treatment option for improving germination rates in this study.

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