زانکۆی سەلاحەدین - هەولێر
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Effect of seed pre-treatment methods on germination ratio and early seedling growth of *Leucaena leucocephala*

Research Project

Submitted to the department of (Forestry) in partial fulfillment of the requirements for the degree of BSc. in (Agriculture)

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1. Introduction

Leucaena is a genus of flowering plants that belongs to the pea family (Fabaceae). One species of particular interest is *Leucaena leucocephala*, commonly known as lead tree, white lead tree, or simply Leucaena. It is a fast-growing and versatile tree native to southern Mexico and northern Central America. Still, it has been widely introduced and cultivated in various tropical and subtropical regions worldwide (Yousif et al.,2020).

Leucaena leucocephala (Lam) de wit a small tree, typically growing to a height of 3–15 m and a bole diameter of 10–35 cm; older trees can grow to a height of 20 m and a diameter of 50 cm. Subsp. leucocephala has a shrubby, ramose (highly branched) form, whereas subsp. glabrata is arborescent with an open, rounded crown, upright, angular branching, and a short, clear bole up to 5 m. (Bakewell-Stone, P., 2023)

Deep-rooted evergreen plant (Orwa et al., 2009). Bark mid-grey-brown with shallow rusty orange-brown vertical fissures; slash reddish.

leaves have 4–9 pinnae and 13–21 leaflets per pinna, respectively. With a concave, cup-shaped, elliptic petiole gland, the leaflets are small, measuring 9–21 mm in length and 2-4.5 mm in width. They are linear-oblong or weakly elliptic, sharp at the tip, rounded to obtuse at the base, and glabrous except on the margins. (Bakewell-Stone, P., 2023).

Compact globose heads with compacted, arranged flowers; flower heads in groups of two to six in leaf axils arising on actively growing young shoots; leaves developing concurrently with flowers; heads measure 12 to 21 mm in diameter, containing 100–180 flowers per head; flowers white. Leucaena is distinguished from all other mimosoid legume genera by its hairy anthers, which can be seen through a hand lens.

Subspecies glabrata have glabrous, slightly lustrous pods that are 9-19 cm long and 13-21 mm wide, with papery pod walls. Subspecies leucocephala has densely packed, white, velvety hairs that are arranged in clusters of 3–20, and sometimes up to 45, per flower head. (Gonzalez et al., 1967; Pan, 1988)

Leucaena leucocephala has several uses and benefits, including Forage and Fodder: Leucaena leaves and young shoots are an important source of protein for cattle, especially in areas with limited access to other forage resources. It's crucial to remember that some animals may be poisoned by certain of the substances found in Leucaena, such as mimosine. Appropriate management techniques, such as incorporating the plant gradually into the diet, can lessen these dangers. (Nakamanee et al., 2019)

Leucaena is well-known for fixing nitrogen from the atmosphere, which increases the fertility of the soil (Chouhan et al., 2022). The nitrogen-fixing bacteria found in the nodules formed by the tree's

roots transform atmospheric nitrogen into a form that plants can utilize. Because of this, Leucaena is a useful element in agroforestry systems, where it may be used in systems for pasture and crops to enhance the general health of the soil. (Fernández et al., 2020)

Wood and Timber: Leucaena wood is lightweight and useful for building, furniture manufacture, and fuelwood, among other things. It is a desirable alternative for the production of sustainable wood due to its quick growth. (Panigrahi et al., 2021)

Erosion Control: Leucaena has a deep root system and dense growth, which help to effectively control soil erosion. Stabilizing the soil is aided by planting Leucaena in erosion-prone areas.

Benefits to the environment: By fixing nitrogen, Leucaena enriches the soil and lessens the need for artificial fertilizers. Furthermore, the tree's ability to store carbon can help to slow down global warming. (Bomfim et al., 2023)

However, it's important to note that Leucaena can become invasive in some regions, outcompeting native vegetation. It must be managed carefully to stop it from spreading to non-native areas. (Yousif et al.,2020).

In summary, *Leucaena* spp. is a multipurpose tree that has a number of advantages for agriculture, the environment, and the economy. However, its introduction and cultivation should be done carefully to avoid any potential negative effects.

The aim of this study is to determine the role of different treatments in stimulating the germination of seeds of *Leucaena Leucocephala* and to select the most appropriate ones as a treatment that will increase their speed of germination in order to restore degraded ecosystems in Erbil.

Classification:

Kingdom: Plantae

Order: Fabales

Family: Fabaceae

Sub family: Mimosoideae

Tribe: Mimoseae

Genus: Leucaena

Species: *L. leucocephala*

Hindi name: Subabool

Figure 1: Leucaena leucocephala Plant with pod

2. Materials & Methods

2.1. Seed Collection

The seeds of *L. leucacephala* were collected from the mature pods of growing trees on the college Campus. Then seeds were extracted from the pods manually after that the seeds were transferred onto a filter paper for elimination of cracked, unhealthy ones, and then stored in a container at room temperature until used.

2.2. Seed Germination in the Laboratory

The laboratory study was conducted in the Department of Forestry/College of Agricultural Engineering Sciences, Salaheddin University-Erbil to improve the germination of *Leucaena leucocephala* seeds using several treatments.

2.2.1. Laboratory seed treatments

Control: untreated seeds.

Seed coat removal:

Soaking treatments:

- Soaking in normal water overnight: soak seeds in normal water for 24 hours then seeds were placed in sterile Petri dishes with filter paper.

- Soaking in boiling water: soak seeds in boiling water at 60 ° C for 12, and 24 hours allowed to cool.

- Soaking in cool water:

The seeds were put in sterile plastic Petri dishes with one Whatman No. 1 filter paper lined up, with 20 seeds per plate, and incubated at room temperature. Each treatment was done three times, and the dishes were observed every day for seven days, with distilled water added to each dish as needed to ensure proper germination. The number of seeds that germinated in each treatment, beginning on the second day when germination initially started, was used to calculate germination. The exit of the radicle outside the seed cover (F. Kruger et al.,2016) is the germination criterion.

2.2. Studied Parameter

Germination Percentage (%)

After the experiment, the following final results were obtained qualities: -

Germination percentage (PG %) = number of germinated seeds / total number of seeds × 100 (Y. Alomia et al.,2017).

Growth Performance

Length of root and shoot: The length of root and shoot was taken using a ruler after 14 days of germination examination, and calculation of averages by taking 5 seedlings from each plate of most of the transactions and some transactions did not reach the required number, so averages were taken based on growing seedlings.

2.3. Field seedling treatments:

Growth performance:

Growth performance, which included shoot length, main root length, and, basal stem diameter of the seedlings, was recorded as an index of the seedling growth. The shoot length was taken by a centimetre ruler from the soil surface to the top of the shoot and the tap root length was also measured by a centimetre ruler. Basal stem diameter was measured by using a digital vernier calliper in millimetre units.

2.4. Statistical analysis

The full randomized design (CRD) was followed in creating the study's experiment. The ANOVA variance analysis tables were compared using the least significant difference (Duncan 0.05) and the statistical analysis was carried out using the () program.

3. Results & Discussion

The results showed that all treatments increased germination rates of seeds of *Leucaena leucocephala* trees compared with untreated seeds (control) after 7 days from the start of germination.

3.1. Laboratory germination

The results are shown in Table 1 that Pre-treatments have significant effects on the germination percentage, shoot length, and stem length of *L. leucocephala*. Depending on ANOVA variance analysis tables.

Table 1: Analysis of variance for the effect of different seed pre-treatments, sowing depths, and their interactions on germination percentage, shoot length, and root length, of L. leucocephala.

		df	F	Sig.
Germination rate	Between Groups	6	33.300	.000
Shoot length	Between Groups	6	29.501	.000
Root length	Between Groups	6	32.017	.000

3.2. Germination and growth parameters

Table 2 are shown the Effect of seed pre-treatments on the means of germination percentage, shoot length, and root length, of L. leucocephala, the highest significant means of the germination percentage (95.55%) and root length(6.08cm) were recorded in the seeds that soaked in cold water for 12 hours (T4) and the largest shoot length showed in Boiling Water 12h (6.26).

Table 2: Effect of seed pre-treatments on the means of germination percentage, shoot length, and root length, of *L. leucocephala*.

Treatment	Germination percentage (%)	Root length (cm)	Shoot length(cm)
Control	0.0000^{c}	0.0000^{d}	0.0000^{c}
Removed Seed Coat	84.4433^{a}	3.8133^{c}	4.4933^{b}
Normal Water	91.1067^{a}	5.2400^{ab}	5.2733^{ab}
Cold Water 12h	95.5533^{a}	6.0867^{a}	5.2600^{ab}
Cold Water 24h	84.4433^{a}	5.8267^{a}	5.6600^{ab}
Boiling Water 12h	91.1067^{a}	4.9133^{abc}	6.2600^{a}
Boiling Water 24h	93.3300^{a}	4.2667^{ab}	5.8267^{a}

3.3 Field growth parameters

Table 3 show the effect of different seed pre-treatments of *L. leucocephala*. based on ANOVA variance analysis tables results. The impact of plant part (leaf, stem), solvent type (hot water, ethanol, methanol), and the interaction of these two factors on the extract yield results of all *pre-treatments* were significant.

Table 3. Analysis of variance for the effect of different seed pre-treatments, on stem Diameter, stem length, root length, stem diameter, plant fresh weight and plant dry weight of L. leucocephala.

		df	F	Sig.
Diameter	Between Groups	6	43.056	.000
Stem length	Between Groups	6	37.664	.000
Root length	Between Groups	6	7.591	.001

As can be seen from the table 4, the highest stem diameter, root length and stem length results were determined in Cold Water 24h (1.96 mm and 8.43 and 8.43 cm respectively)

Table 4. Effect of seed pre-treatments on the means of Stem Diameter, shoot length, and root length, of *L. leucocephala.*

Treatment	Stem Diameter	Root length (cm)	Stem length(cm)
Control	0.0000^{c}	0.0000^{d}	0.0000^{c}
Removed Seed Coat	1.6040^{b}	21.5333^{a}	6.6667^{b}
Normal Water	1.7707^{ab}	22.0000^{a}	7.8333 ^{ab}
Cold Water 12h	1.8877^{ab}	21.8333 ^{a}	8.3000^{a}
Cold Water 24h	1.9620^{a}	23.7333 ^{a}	8.4333^{a}
Boiling Water 12h	1.6203^{ab}	22.9667^{a}	7.2000 ^{ab}
Boiling Water 24h	1.6337^{ab}	23.423^{a}	6.3333^{b}

4. Conclusion

This study conclusively demonstrates the value of seed pre-treatment for enhancing germination and early seedling growth in Leucaena leucocephala. Compared to the control group, all pre-treatment methods significantly boosted germination rates within just seven days. Delving deeper, the research revealed a specific treatment for each growth aspect: soaking in cold water for 12 hours yielded the highest germination rate (nearly 96%) and the most extensive root development (over 6 cm), while boiling water for 12 hours produced seedlings with the longest shoots (exceeding 6 cm). These findings underscore the importance of pre-treatment in optimizing Leucaena leucocephala cultivation. While cold water soaking appears to be the most effective method for promoting overall germination and root strength based on laboratory results, further investigation is necessary. Future research should focus on refining pre-treatment techniques for successful field application and evaluating their long-term impact on Leucaena leucocephala growth and establishment.

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