

Chapter

Improvement of *Leucaena* (*Leucaena leucocephala*) Benth. Seeds Emergence Using Hot Saline Water Treatment Durations

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Abstract

Leucaena leucocephala is a leguminous shrub that has the potential for increasing animal production with diverse environmental and ecological significance. An experiment was conducted to investigate the effect of hot saline water treatment durations on the emergence of *Leucaena* seeds. The experiment was arranged in a completely randomized design with six treatments and three replicates. The treatments are control, soaking of seeds in hot saline water (20 g NaCl/1 L of distilled water) at 80°C for 1, 2, 3, 4 and 5-min durations. The percentage emergence, emergence index, plant height and leave numbers were measured. Hot saline water treatment durations had positive effect of breaking *Leucaena* seed dormancy and enhance germination. The highest percentage emergence and emergence index (53.9% and 7.95) were obtained at 2 min treatment durations but plant height and number of leaves were highest (6.29 cm and 7.00 cm) respectively in 4 min of treatment durations. It could be concluded that percentage emergence and seedling growth of *Leucaena* can be enhanced using 2 min hot saline water treatment duration. It is recommended that saline soils that have being degraded due to oil spillage to enable production of *Leucaena* as animal feed and control environmental degradation.

Keywords: *L. leucocephala*, hot saline water, emergence, treatment durations, ecology

1. Introduction

Rangelands improvement is becoming a thing of the past, despite the fact that 80 to 90% of ruminants depend on the rangeland as their major source of the nutrient [1]. Grazing areas are undergoing extensive degradation due to overgrazing and adverse climatic conditions [2]. Overgrazing of rangelands has led to accelerated soil erosion, reducing productivity and biodiversity of important forages and contributes to the proliferation of non-palatable weeds. To overcome these problems [2], suggested the use

of stress-tolerant, soil improver, windbreaker, source of living stakes, high dry matter yielding and nutritive value browse plant as *Leucaena leucocephala*, is an evergreen shrub-like tree that spreads all over the world because of its adaptability to various ecological conditions as it grows in all type of soils from dry, semi-arid and arid areas and tolerate high temperatures for long periods. *Leucaena leucocephala*, to develop sustainable grazing, increase productivity and protect the biodiversity of rangelands. Despite all these advantages associated with *Leucaena*, the establishment and successful adoption of this multipurpose forage are limited to some extent by water impermeability of the seed coat or 'hardiness', caused by one or more water-impermeable layers of palisade cells in the seed coat [3]. More so, the seed coat can also exert germination restrictive action by its mechanical resistance to radicle protrusion as well as harboring inhibitors to suppress seed germination. Ecologically, this physical dormancy occurring in some plant families of Angiosperms is an important survival strategy as seeds time their germination to coincide with favorable natural conditions to maximize chances of successful establishment of seedlings [3, 4]. This is disadvantageous when a quick, uniform and high germination rate of *L. leucocephala* seed is required, thus discouraging most farmers and grazers from accepting it as a sown pasture species [5]. The presence of a hard seed coat needs to be broken to allow permeability of water and oxygen to reach the embryo and start the germination process. Therefore, numerous techniques to break seed dormancy have been investigated over the years including; soaking seeds in hot water or sulfuric acid or mechanical scarifying/nicking [3, 6–8], as well as varying levels of exposure to dry heat treatments [9]. According to [10], hot water treatment enhances seed germination by affecting various factors, viz., seed coat permeability for gases and water exchange and release of inhibitors. A previous report by [11] indicated that the hot water pretreatment duration to breaking seed dormancy in *L. leucocephala* was 5 min at 80°C. While [7] observed the highest seed germination in *Leucaena* when the seeds were exposed to hot water at 80°C for 10 min and that soaking in gibberellin 400 ppm is the most efficient in giving the best averages for roots and seedling length. Without scarification [2], reported that only 10% of *L. leucocephala* could germinate. Therefore, the objective of the present study is to investigate the effect of hot saline water treatment durations on the emergence of *L. leucocephala* seeds.

2. Materials and methods

An experiment was conducted at Forage Laboratory of Feeds and Nutrition Research Programme, National Animal Production Research Institute Shika, Ahmadu Bello University, Zaria, Nigeria (latitude 11° 12' N, longitude 07° 33' E) and altitude 660 m above sea level in Northern Guinea Savannah of Nigeria [12]. The seeds of *Leucaena leucocephala* were collected from matured plants in the introduction plot. The seeds collected for the experiment were sorted, cleaned and separated from stones and broken pods. The experiment was arranged in a Completely Randomized Design with six treatments and three replicates. The treatment includes T1 (control), soaking of seeds in hot saline water (20 g of NaCl was dissolved in 1 liter of distilled water) at 80°C for 1, 2, 3, 4 and 5-min durations as (T2, T3, T4, T5 and T6 respectively). A total of 450 seeds were sorted, counted and divided into 6 treatments with 75 seeds per treatment and 25 seeds per replicate. The seeds to be treated were wrapped in white clean clothes and placed in 1 L of hot distilled water at 80°C containing 20 g of common salt. The placement was done at the same time and

withdrawn at the expiration of the treatment durations and seeds were cooled down under a running tap for 5 min according to [1]. Thereafter, seeds were spread thinly to allow air to dry and were used the next day for germination and emergence test. Twenty-five treated seeds were planted in polyethene bags (15 cm height × 10 cm top and bottom diameters), filled with sandy loam soil to a depth of 7 cm. The polyethene bags were watered daily and seedling emergence was recorded for 15 days. Thereafter, the experiment was terminated and parameters such as percentage emergence, plant height, the number of leaves and emergence index were determined. The emergence index was calculated using [13] formula $EI = (TiNi/S)$, where Ti is the number of days after sowing, Ni is the number of seeds germinated on day Ti and S is the number of seeds sown. Data collected were subjected to analysis of variance and significant means were compared using Duncan's Multiple Range Test of SAS package [14].

3. Results and discussion

Hot saline water treatment durations had a significantly ($P < 0.05$) positive effect of breaking *L. leucocephala* seed dormancy and enhance germination. The highest percentage seedling emergence in **Figure 1** (53.0%) and emergence index in **Figure 2** (7.95) were recorded when *L. leucocephala* seeds are placed in hot saline water at 80°C for 2 min and declined afterwards probably due to an increase in treatment durations. This study shows that *L. leucocephala* seeds are tolerant with regards to salinity and are able to germinate after soaking in hot water containing 20g l⁻¹ NaCl for up to 5 min. The study agrees with the report of [15] who listed *L. leucocephala* as a salt tolerant plant. According to [16], salt-tolerant plants are adapted to survive and complete their life cycle under saline levels of higher than 200 mM NaCl. Also, this work agrees with the reports of [17] that the behaviors of *Acacia albida* are tolerant to salinity and are able to germinate after treatment up to 12 g l⁻¹ and probably even higher. The Authors also added that the ability to germinate under saline conditions is an important feature for the rehabilitation and reforestation of the species, but is also interesting to use for enhanced soil marginalized and affected by salinization.

The higher percentage emergence reported in this study as compared to 49.0% reported by [2] may be as a result of the addition of salt which may have facilitated

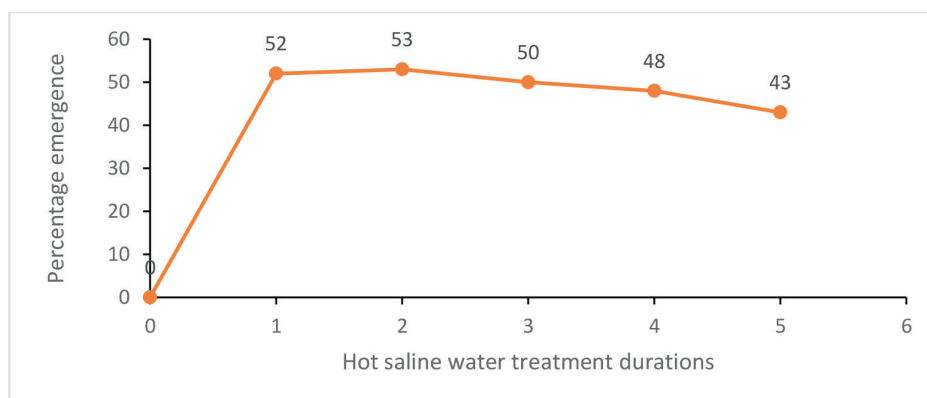


Figure 1.
Percentage emergence of *L. leucocephala* seeds as affected by hot saline water treatment durations.

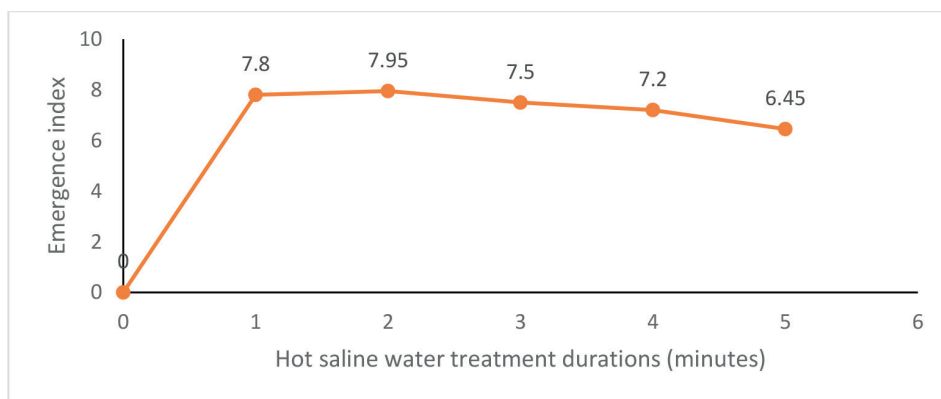


Figure 2.

*Emergence index of *L. leucocephala* seeds as affected by hot saline water treatment durations.*

the breakdown of hard seed coat and thereby facilitating water permeability and gas exchange which promotes faster germination and seedling emergence. The plant height and number of leaves were significantly ($P < 0.05$) affected by treatment durations. The highest plant height (6.29 cm) in **Figure 3** and the highest number of leaves (7.00 per plant) in **Figure 4** are recorded in 4 min treatment durations. The plant height and the number of leaves reported in this study were within the values 5.30–6.51 cm and higher than 3.63–4.0 leaves per plant earlier reported by [2] for hot water scarifications on seedling emergence and early growth of *L. leucocephala* seeds. The plant height recorded in this study was higher than the ones (2.2 cm) obtained by [7]. Rusdy [2] also observed significant improvement of seed emergence, emergence index and seedling growth of *L. leucocephala* by acid scarification which stimulated prompt and uniform germination compared to hot water treatment durations. Obiazi [5] reported that research has equally shown that hot water treatment can penetrate the seed sufficiently to eradicate bacterial infections inside the seed to promote germination. Also, [10] reported that the treatment of seeds with hot water to improve germination is a better, safe and cost-effective alternative to sulfuric acid and sandpaper methods. Soaking *L. leucocephala* seeds in hot saline water recorded the highest germination rate and the lowest mean germination

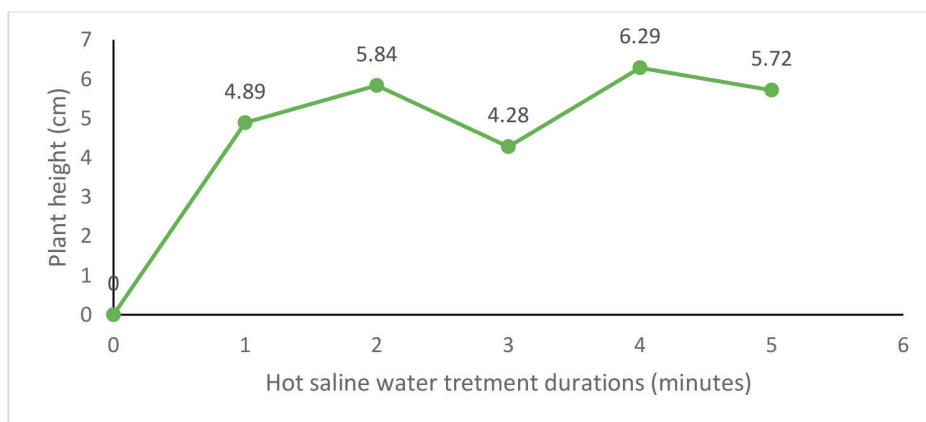


Figure 3.

*Plant height of *L. leucocephala* seedlings as affected by hot saline water treatment durations.*

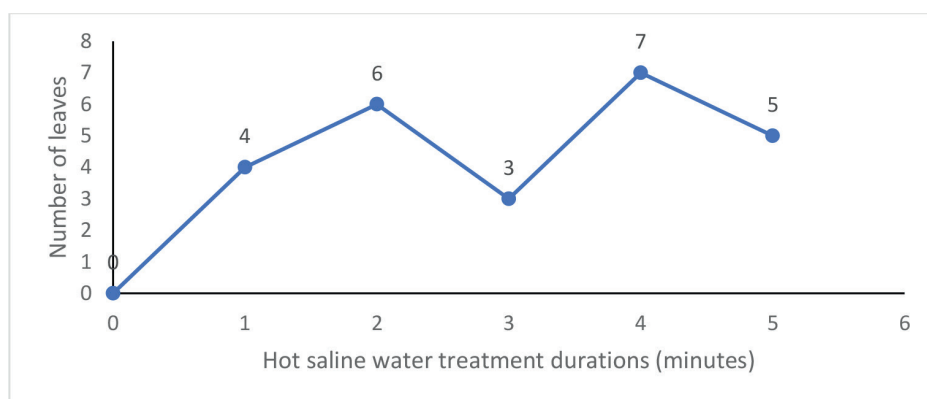


Figure 4.
Leaves number of *L. leucocephala* seedlings as affected by hot saline water treatment durations.

time because it helps in providing the largest area for water absorption and gas exchange for germination. This finding was similar to a study by [11] that soaking of seeds in hot water 80°C for 5, 10 and 15 min gave 94%, 83%, 63% respectively. The variation in germination percentage might be a result of the hardness of the seed casing based on its chemical composition or the environment in which the seeds grow. No germination record was obtained for the control during the 15-day experimental trials. Generally, conversion of agricultural soils into human settlement and industrial use has led to the decreased territory of arable lands. Upcoming climate change with consequences on the raise of sea level, sea water intrusion, and high evaporation was regarded as a major environmental issue which also posed some challenges in the cultivation of economic crops [18] reported that salt stress is one of the serious abiotic factor which limit the growth and development of important crops in agricultural lands. Delvian and Hartanto [19] reported that positive impact of application of Arbuscular mycorrhizal fungi (AMF) towards salt tolerant by *L. leucocephala* with potential application and in salt stressed ecosystem.

4. Conclusion

The concentration of NaCl shows an effect on the germination of *L. leucocephala* seeds. The study indicated that germination and emergence of *Leucaena leucocephala* seeds can be improved by 53.0% when soaked in hot saline water at 80°C for 2 min. Therefore, *L. leucocephala* seeds can be easily propagated in salt stress environments especially in Arid, semi-arid and coastal regions. It is recommended that farmers around these areas are encouraged to adopt this technique but with caution for mass production of this plant for range lands improvement and as dry season feed for livestock.

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Conflict of interest

The authors declare no conflict of interest from this work.

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