

## Improvement of leucaena (*Leucaena leucocephala*) Benth. seeds emergence using hot saline water treatment durations

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### Abstract

*Leucaena leucocephala* (*Leucaena*) is a leguminous shrub that has the potential for increasing animal production with diverse environmental and ecological significance. But the major problem is poor seed germination and seedling emergence. 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 treatment includes T1 (control), soaking of seeds in hot saline water (20g of NaCl was dissolved in 1 litre of distilled water) at 80°C for 1, 2, 3, 4 and 5-minute durations designated as (T2, T3, T4, T5 and T6 respectively). The percentage emergence, emergence index, plant height and leave numbers were measured. Hot saline water treatment durations had a significantly ( $P < 0.05$ ) 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 two minutes treatment durations but plant height and number of leaves were significantly ( $P < 0.05$ ) highest (6.29cm and 7.00cm) respectively in 4 minutes of treatment durations. The control recorded no germination within the 15 days of the emergence study. It could be concluded that percentage emergence and seedling growth of *Leucaena* can be enhanced using two minutes hot saline water treatment duration. It is recommended that a trial study should be conducted on environments with saline soils and on soils that have being degraded due to oil spillage to enable production of *Leucaena* as animal feed and control environmental degradation.

**Keywords:** *Leucaena*, hot saline water, emergence, treatment durations

## Amélioration de la leucaena (*Leucaena leucocephala*) Benth. émergence des graines à l'aide de durées de traitement à l'eau chaude salée



### Résumé

*Leucaena leucocephala* (*Leucaena*) est un arbuste légumineux qui a le potentiel d'augmenter la production animale avec diverses significations environnementales et écologiques. Mais le problème majeur est la mauvaise germination des graines et l'émergence des semis. Une expérience a été menée pour étudier l'effet des durées de traitement à l'eau chaude salée sur l'émergence des graines de *Leucaena*. L'expérience a été organisée dans une conception complètement randomisée avec six traitements et trois répétitions. Le traitement comprend T1 (témoin), le trempage des graines dans de l'eau salée chaude (20 g de NaCl ont été dissous dans 1 litre d'eau distillée) à 80 °C pendant des durées de 1, 2, 3, 4 et 5 minutes désignées par (T2, T3, T4, T5 et T6 respectivement). Le pourcentage d'émergence, l'indice d'émergence, la hauteur des plantes et le nombre de feuilles ont été mesurés. Les durées de traitement à l'eau salée chaude ont eu un effet positif significatif ( $P < 0,05$ ) sur la rupture de la dormance des graines de *Leucaena* et sur l'amélioration de la

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germination. Le pourcentage d'émergence et l'indice d'émergence les plus élevés (53,9 % et 7,95) ont été obtenus à des durées de traitement de deux minutes, mais la hauteur de la plante et le nombre de feuilles étaient significativement ( $P < 0,05$ ) les plus élevés (6,29 cm et 7,00 cm) respectivement en 4 minutes de durée de traitement. Le témoin n'a enregistré aucune germination dans les 15 jours de l'étude d'émergence. On pourrait conclure que le pourcentage d'émergence et la croissance des semis de *Leucaena* peuvent être améliorés en utilisant une durée de traitement à l'eau salée chaude de deux minutes. Il est recommandé qu'une étude d'essai soit menée sur des environnements avec des sols salins et sur des sols qui se sont dégradés en raison de déversements d'hydrocarbures pour permettre la production de *Leucaena* comme aliment pour animaux et contrôler la dégradation de l'environnement.

**Mots-clés :** *Leucaena*, eau chaude salée, émergence, durées de traitement

### **Introduction**

Rangelands improvement in Nigeria 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. The rangelands are undergoing extensive degradation due to overgrazing and adverse climatic conditions (Rusdy, 2017). 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, Rusdy (2017) has suggested the use of stress-tolerant, soil improver, windbreaker, source of living stakes, high dry matter yielding and nutritive value browse plant or shrub-like *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 (Koobonye *et al.*, 2018). More, the seed coat can also exert germination-restrictive action by its mechanical resistance to radicle protrusion as well as harbouring 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 favourable natural conditions to maximize chances of successful establishment of seedlings (Baskin *et al.*, 2000; Koobonye *et al.*, 2018). 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 (Obiazi, 2015). 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 sulphuric acid or mechanical scarifying/nicking (Tadros *et al.*, 2011; Koobonye *et al.*, 2018; Salih and Abdulraziq, 2020; Yousif *et al.*, 2020), as well as varying levels of exposure to dry heat treatments (Mott *et al.* 1982). According to Sharma *et al.* (2008), hot water treatment enhances seed germination by affecting various factors, viz., seed coat permeability for gases and water exchange and release of inhibitor. A previous report by Teles *et al.* (2000) indicated that the hot water pretreatment duration to breaking seed dormancy in *L. leucocephala* was 5 min at 80°C. While Salih *et al.* (2020) observed the highest seed germination in *Leucaena* when the seeds were exposed to hot water at 80°C for 10 min. Without scarification, Rusdy (2016) 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.

### Materials and methods

The two trial experiments were conducted in 2017 at the 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 660m above sea level in Northern Guinea Savannah of Nigeria (Ovimaps, 2017). 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 (20g of NaCl was dissolved in 1 litre of distilled water) at 80°C for 1, 2, 3, 4 and 5-minute 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 litre of hot distilled water at 80°C containing 20g 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 minutes according to Ishiaku *et al.* (2015). 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 (15cm height x 10cm top and bottom diameters), filled with sandy loam soil to a depth of 7cm. 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 Scott *et al.* (1984) 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 (2005).

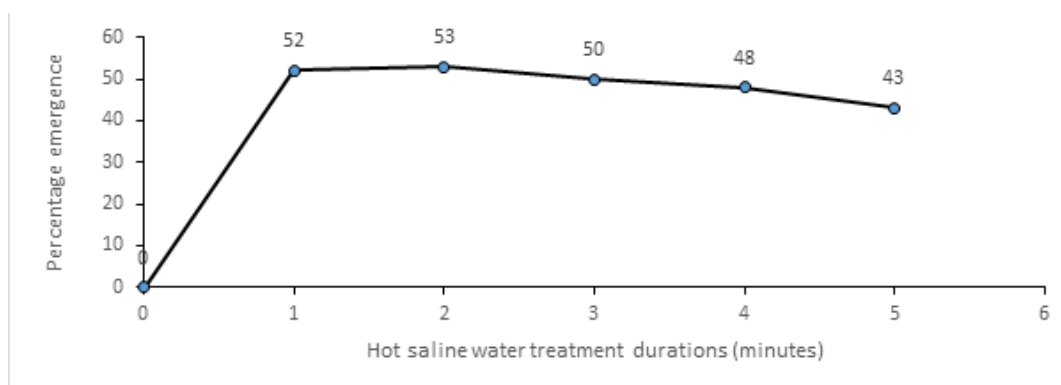
### Results and discussion

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 minutes 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 NaCl for up to five minutes. The study agrees with the report of Rashid *et al.* (2004) who listed *L. leucocephala* as a salt-tolerant plant. According to Flowers and Colmer (2008), salt-tolerant plants are adapted to survive and complete their life cycle under saline levels of higher than 200 mMNaCl. Also, this work agrees with the reports of Karoune *et al.* (2013) that the behaviours of *Acacia albida* are tolerant to salinity and are able to germinate after treatment up to 12g/l 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

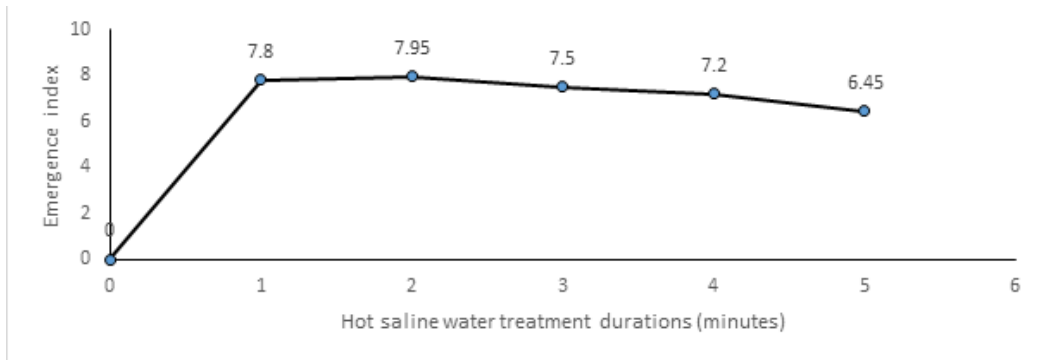
### Improvement of *leucaena* (*Leucaena leucocephala*) Benth. seeds

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 Rusdy (2017) may be as a result of the addition of salt which may have facilitated 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 (6.29cm) in Figure 3 and the highest number of leaves (7.00 per plant) in Figure 4 are recorded in four minutes 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 Rusdy, (2017) 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 (2.2cm) obtained by Salih *et al.* (2020). Rusdy, (2017) also observed significant improvement of seed emergence, emergence index and seedling growth of *L. leucocephala* by acid

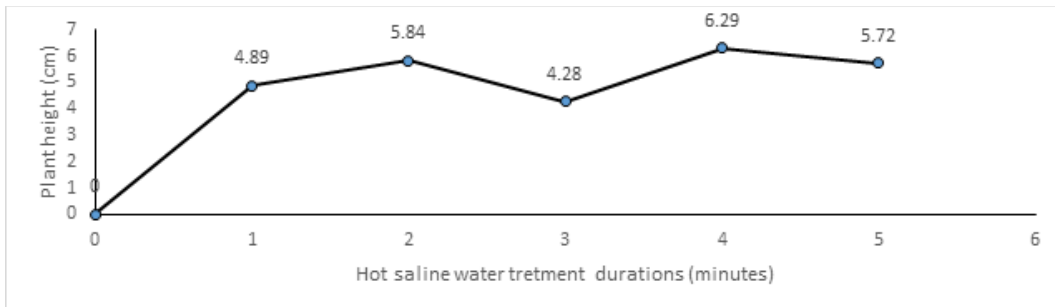
scarification which stimulated prompt and uniform germination compared to hot water treatment durations. Obiasi (2015) reported that research has equally shown that hot-water treatment can penetrate the seed sufficiently to eradicate bacterial infections inside the seed to promote germination. Also, Sao Jose *et al.* (2019) 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 time because it helps in providing the largest area for water absorption and gas exchange for germination (Salih *et al.*, 2020). This finding was similar to a study by Teles *et al.* (2000) that soaking of seeds in hot water 80°C for 5, 10 and 15 minutes 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 (Salih *et al.*, 2020). No germination record was obtained for the control during the 15 day experimental trials.



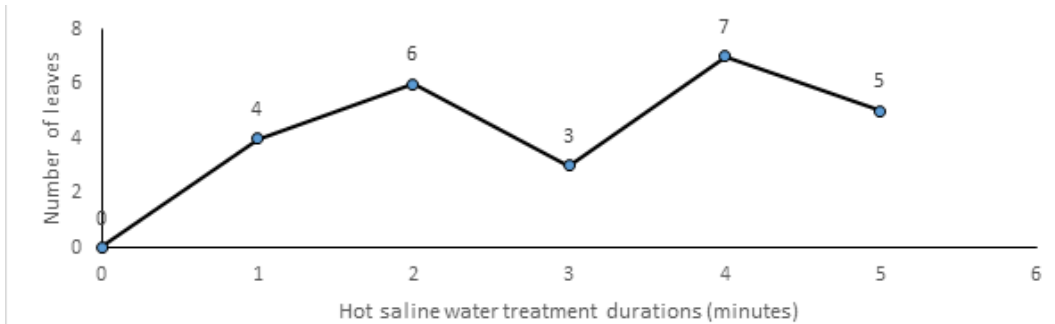
**Figure 1: Percentage emergence of *Leucaena* seeds as affected by hot saline water treatment durations**



**Figure 2: Emergence index of *Leucaena* seeds as affected by hot saline water treatment durations**



**Figure 3: Plant height of *Leucaena* seedlings as affected by hot saline water treatment durations**



**Figure 4: Leaves number of *Leucaena* seedlings as affected by hot saline water treatment durations**

### Conclusion

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 two minutes. Therefore, *L. leucocephala* seeds can be easily propagated in salt stress

environments especially in Arid, semi-arid and coastal regions of Nigeria. It is recommended that farmers around these areas are encouraged to adopt this technique for mass production of this plant for our rangelands improvement and for dry season feed.

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