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HOT WATER ENHANCED GERMINATION OF *LEUCAENA LEUCOCEPHALA* SEEDS IN LIGHT AND DARK CONDITIONS

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ABSTRACT

Leucaena leucocephala has a great potential in crop and livestock production. However, the plant is difficult to propagate from both seeds and stem cuttings Scarification treatment has the prospective of enhancing seed germination. Chemicals and water have been used for seed scarification. This study evaluated the effectiveness of hot and boiling water in enhancing the germination of Leucaena leucocephala seed. Information on the condition (light or dark) at which Leucaeana seeds germinate better is also provided. The seeds were immersed in hot water and boiling water for 1, 2, 3, and 4 minutes respectively. At twenty-one days after the set-up of the experiment, untreated L. leucocephala seeds had 0 % and 13.3 % germinations under light and dark conditions respectively.; seeds immersed in boiling water for 1- 4 minutes did not germinate irrespective of the condition of germination while all the seeds immersed in hot water for one to three minutes had total (100%) germination; delaying the period of immersing the seeds in hot water to four minutes resulted in significantly less percentage germination than the aforementioned ones immersed in hot water for one to three minutes but had significantly greater germination than the untreated seeds. Dark and light conditions resulted in similar percentage seed germination outcome. Immersing Leucaena leucocephala seeds for one minute is recommended. Planting seeds in dark condition is recommended since continuous light provided no additional germination outcome, in spite of the additional cost of providing continuous light in the growth of seeds under light condition.

Keywords: *Leucaena leucocephala*, Seed scarification, Seed germination, Hot water, Boiling water.

1. INTRODUCTION

Leucaena *(Leucaena leucocephala)* has great potential in crop production as well as in livestock production. Kang [1] reported that in a long-term trial conducted on non-acid soil in southern Nigeria, high maize yield was obtained with or without nitrogen application when mulched with *L. leucocephala* pruning. Getahun and Njenga [2] also noted that in Kenya, farmers who grow yams have discovered the usefulness of *L. leucocephala* and have started growing it as a source of living stakes. Obiazi [3] observed that if yam stakes are produced on the farm, it will be a

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guaranteed source of cheap yam stakes and that pruning derived from yam stakes are sources of organic material in farm, leading to improved soil fertility, and reducing the need for fertilizer, thereby minimizing the cost of production. It should be noted that *L. leucocephala* being a fast growing tree legume could be used as a windbreak to protect crops like plantain and banana which suffer much damage from wind. In livestock production, Leucaena is a source of high quality nutrients for ruminants and suitable as year round feed because of its drought resistance, persistence, vigorous growth and re-growth and palatability [4]. It has high protein of high digestibility and is also high in minerals and vitamins [5, 6].

Despite the usefulness of *Leucaena leucocephala*, the plant is difficult to propagate; attempts at using the seeds result in poor and non-uniform germination, the stem cuttings also give poor sprouting. This study was carried out to evaluate the influence of hot and boiling water as well as photoperiod on seed scarification and germination in *Leucaena leucocephala*. .

2. MATERIALS AND METHODS

An experiment to investigate the germination response of *Leucaena leucocephala* seeds to hot water treatments was carried out in the rainforest ecological zone, Abraka (05º 47´ N, 06º 06´ E), Southern Nigeria. Dry pods of *L. leucaena* were collected from plants located in Abraka, Nigeria. Fifty randomly selected pods were opened and the seed distributions range 14 – 20 seeds per pod. The seeds were kept in a dry container after removing the dead and malformed ones. The seeds were divided into nine groups. Four groups of seeds were soaked in hot water for 1, 2, 3 and 4 minutes respectively and another set boiled at 100º C for 1, 2, 3 and 4 minutes respectively. Treated seeds were brought out of hot or boiling water at the expiration of the required time and allowed to cool at room temperature before being put out for germination. One group of seeds was untreated and served as control. The experiment was laid out in a randomized complete block design.

Ten seeds of each treatment and the control were placed in two Petri dishes at five seeds per dish. Three blotting papers were placed in the floor of each Petri dish and were kept wet throughout the experiment. One set of each treatment was placed under continuous fluorescent light; the other set was placed under complete darkness in boxes. This process was repeated three times.. Emergence of 1.00 mm of ridicule was used as criterion for germination as was used by Gill, et al. [7]. Radicule emergence is widely accepted as an indication that germination has begun [8]. Count for germination was made after three days until 21 days after set up. Data obtained with respect to germination performance of the treatments were subjected to analysis of variance and treatment means separated using Duncan's multiple range tests.

3. RESULTS AND DISCUSSION

3.1. Effect of Boiling Water on Seed Germination

The contents in the Table 1 has clearly shown that exposure of Leucaena seed to boiling water

from 1 – 4 minutes did not aid germination. Immersing *Leucaena leucocephala* seeds in boiling water did not result in germination irrespective of the time duration of one to four minutes and the condition of germination (continuous light or continuous darkness) (Table 1). Gill, et al. [7] observed that *Mimosa pigra* boiled for 4 and 5 minutes did not germinate while those boiled for 1 and 2 minutes resulted in 40% and 35% germination respectively after 21 days. They added that boiling for one minute resulted in 46% germination in dark condition. The 0% germination of *L. leucocephala* seeds subjected to 1-4 minutes boiling water in this study could be attributed to high level of heat transmission from the boiling water through the seed testa to the cotyledon and the embryo. The embryo may have been destroyed and enzymes in the seed denatured. When hot water-treating vegetable seeds it is critical to follow the instructions exactly, as seeds may be damaged by the treatment [9]. Research has equally shown that hot-water treatment can penetrate the seed sufficiently to eradicate bacterial infections inside the seed. There are only a few seed companies that routinely do hot-water treatment of some seeds, peppers for instance are considered fragile since there is risk that germination will be reduced if the water gets too hot. Thus, some varieties or seed lots are more vulnerable to heat treatment than others [10].

Table-1. Effect of boiling water exposure on seed germination in *Leucaena leucocephala*

Treatment	Cond.* of	Germination % (Days After Treatment)						
duration	Germ. **	3	6	9	12	15	18	21
Control	Light	0	0	0	0	0	0	0
Control	Dark	0	6.7	6.7	13.3	13.3	13.3	13.3
1M	Light	0	0	0	0	0	0	0
1 M	Dark	0	0	0	0	0	0	0
2 M	Light	0	0	0	0	0	0	0
2 M	Dark	0	0	0	0	0	0	0
3 M	Light	0	0	0	0	0	0	0
3 M	Dark	0	0	0	0	0	0	0
4 M	Light	0	0	0	0	0	0	0
4 M	Dark	0	0	0	0	0	0	0

Cond.* = Condition, Germ. ** = Germination, M = Minute (s).

3.2. Effect of Hot Water on Seed Germination

Seeds immersed in hot water for one minute irrespective of light condition attained 100.0 % germination significantly earlier than that observed in any of the other treatments; seeds immersed in hot water for one minute germinated six days earlier than seeds immersed in hot water for two or three minutes which were germinated under dark condition (Table 2). At twenty-one days after treatment all the seeds which were immersed in hot water for one to three minutes had total germination. Seeds immersed in hot water for four minutes at twenty-one days after treatment had significantly less germination than the other treated seed but had significantly greater germination than the untreated seeds.

Table-2. Effect of immersing *Leucaena leucocephala* seeds in hot water for different time durations on seed germination

Treatment duration	Cond* of Germination	Germination % (Days After Treatment)						
		3	6	9	12	15	18	21
Control	light	0.0 ^{c}	0.0 ^{d}	0.0 ^{d}	0.0 ^{e}	0.0 ^{e}	0.0 ^{e}	0.0 ^{c}
Control	Dark	6.7 ^{b}	6.7 ^{d}	13.3 ^{d}	13.3 ^{d}	13.3 ^{e}	13.3 ^{d}	13.3 ^{d}
1M	Light	20.0 $^{a\,b}$	40.0 ^{b}	73.3 ^{bc}	100.0 ^{a}	100.0 ^{a}	100.0 ^{a}	100.0 ^{a}
1M	Dark	33.3 ^{a}	66.7 ^{a}	93.3 ^{a}	100.0 ^{a}	100.0 ^{a}	100.0 ^{a}	100.0 ^{a}
2M	Light	6.7 ^{b}	20.0 ^{c}	66.7 ^{bc}	66.7 ^{c}	66.7 ^{c}	80.0 ^{b}	100.0 ^{a}
2M	Dark	33.3 ^{a}	40.0 ^{a}	73.3 ^{bc}	80.0 ^{b}	80.0 ^{b}	100.0 ^{a}	100.0 ^{a}
3M	Light	0.0 ^{c}	6.7 ^{d}	20.0 ^{c}	33.3 ^{d}	66.7 ^{c}	80.0 ^{b}	100.0 ^{a}
3M	Dark	33.3 ^{a}	40.0 ^{b}	66.7 $^{b\,c}$	66.7 ^{c}	80.0 ^{b}	100.0 ^{a}	100.0 ^{a}
4M	Light	20.0 $^{a\,b}$	26.7 ^{c}	66.7 $^{b\,c}$	66.7 ^{c}	66.7 ^{c}	66.7 ^{c}	66.7 ^{c}
4M	Dark	20.0 $^{a\,b}$	40.0 ^{b}	80.0 ^{ab}	80.0 ^{b}	80.0 ^{b}	80.0 ^{b}	80.0 ^{b}
Means		15.3	28.7	55.3	60.7	65.3	72.0	76.0

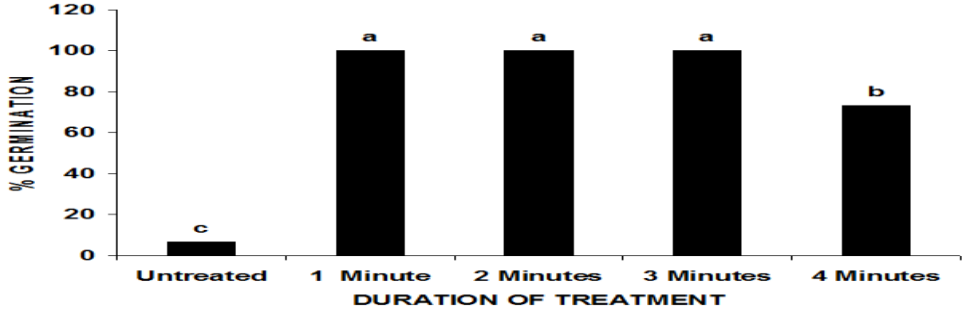
Means within a column followed by the same letter(s) do not differ significantly at 5% level of probability.

Cond.* = Condition, Germ. ** = Germination, M^{+} = Minute (s).

3.3. Effect of Duration in Hot Water on Seed Germination

Placement of seeds in hot water for one minute under dark condition was consistently among treatments that gave significantly (P>0.05) best percentage germination. Only one minute seed immersions in hot water under dark or light condition were observed to have attained 100% germination at 12 days after planting (DAP). Six days later (18 DAP) two and three minutes treatments under dark condition attained 100% seed germination. Four minutes treatment only attained 66.7% and 80% germination at 21 DAP under dark and light conditions respectively.

At 6 DAP, dark condition treatments recorded their significantly greater germination % than their respective light conditions (Table 2); this same trend was repeated at 9 DAP for 1, 3 and 4 minutes treatments. This was the general trend in this study. Larger difference was observed between light and dark conditions in the germination of *Mimosa pigra*, using 70% HNO_3 for 20 minutes, it resulted in 58% and 38% germination in light and dark respectively [7]. Some seeds either require light for germination or germinate better in light, while others are insensitive to light. For instance, seeds of *Rottboelia cochinchinensis* germinate better in light than in darkness [8].



Bars with similar letters are not significantly different at 5 % level of probability.

Fig-1. Percentage germination of *Leucaena leuccocehala* seeds as influenced by the duration of treatment in hot water twenty-one days after treatment set up.

Duration of hot water treatment had significant effect on the germination of *Leucaena* seeds (Figure 1). The treated seeds had significantly greater seed germination than the untreated seeds; untreated seeds had mean germination of 6.65 %, while the seeds that were immersed in hot water for one, two and three minutes respectively had 100 % seed germination at 21 days after set up; seeds treated for four minutes had significantly less average germination of 73.3 %, but were significantly greater than what was observed with the untreated seeds.

Hot water treatments for 2 and 3 minutes must have destroyed more of the seed testa with insignificant injury to the seed embryo; these particular treatments had 100% germination (Table 2). The heat transmitted through the testa to the cotyledon and the embryo when the seeds were immersed in hot water for four minutes must have caused injury to the embryo of some of the seeds resulting in 33.3% and 20% loss in germination under light and dark conditions respectively, relative to seeds which received hot water treatment for one to three minutes which had 100% germination.

3. 4. Effect of Light Condition on Seed Germination

Untreated seeds (control) under continuous light did not germinate (Table 1). Untreated seeds (control) placed under dark condition had 6.7% germination six days after set up; 12 days after set up the percentage germination double (13.3%) thereafter there was no additional germination in the untreated seeds under dark condition. Dark and light environment did not affect the percentage germination of treated Leucaena seeds differently (Fig. 2). Equally comparable are the percentage germination in dark and light conditions for the untreated seeds. However the treated seeds had significantly greater germination than the untreated seeds right from three days after treatment up till 21 days after set up. Treated seeds had an average of 95 % seed germination at 21 days after set up in dark and light conditions.

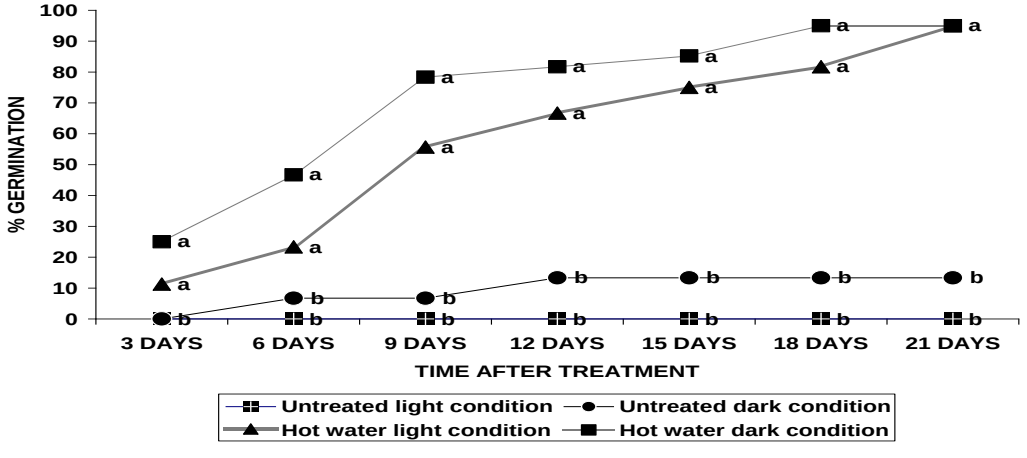


Fig-2. Germination of *Leucaena leuccocehala* seeds as influenced by light condition and hot water treatments.

4. CONCLUSION

Dark and light environments did not affect the percentage germination of treated Leaucaena seeds in different ways. Planting seeds in dark condition is recommended since it is cost effective relative to a situation where continuous light is provided with no additional germination outcome. The results obtained from this study show that dipping *L. leucocephala* seeds in boiling water for one or more minutes did not result in any germination. Further studies should be carried out on Leucaena seed immersion in boiling water for different time durations of less than one minute. Immersing *leucaena* seeds in hot water for 1-3 minutes had similar (100 %) germination at 21days after planting. One to three minutes *Leucaena leucocephala* seeds exposure to hot water treatment is recommended for enhanced germination. Use of water in the scarification of seeds is both safe and sustainable; farmers can easily afford and adopt the technology. This method of seed scarification is also handy in organic agriculture.

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