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EFFECT OF PRE-TREATMENT ON GERMINATION OF *Azadirachta indica* AND *Acacia senegal* SEEDS IN AFFORESTATION

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ABSTRACT

The effect of pre-treatment on germination of Azadirachta indica A.JUSS and Acacia senegal (L) WILLD seeds in afforestation using was conducted at Yobe State University Botanical Garden to break the effect of dormancy using three different methods of seed treatments. The pre-treatments are hot water, cold water and acid treatment (1M H_{Cl}) at different time interval to enhance germination with an aim of relieving drought and enhance afforestation in arid zone environment. The results revealed that the highest germination rate of Acacia senegal were observed at acid treatment (85.6%) while moderate germination were recorded in hot water treatment (77.8%) and the lowest were observed at cold water treatment (74.4%) by using simple percentage. Similarly, the result for Azadirachta indica revealed highest germination rate (73.3%) using acid treatment; and moderate were observed at hot water treatment (66.7%) and the lowest were observed in cold water treatment (63.3%) using simple percentage as well. The study revealed that seed dormancy can be broken through pre-treatment and enhances seed germination. Thus, pre-treatment is important in agricultural and afforestation activities for maximum and faster seedling growth.

Key words: Pre-treatment, dormancy, afforestation, drought, germination

INTRODUCTION

Afforestation has proven to be a very important and sustaining way of improving dryland environments (Kamal and Sulaiman, 2015). Nigeria is a typical dryland where extensive deforestation and forest degradation due to rapid growth in population and increasing demand for forest and forest resources has resulted in the decrease in density of most forest tree species, forest productivity and sustainability (Okunomo, 2010). Falemara *et al.* (2014) noted that due to the arid, semi-arid, dry-sub humid, and savannah zones in Nigeria, sustained excessive exploitation can lead to the destruction and extinction of forest resource. To restore natural forest biota and the numerous benefits of afforestation which include allowing natural environmental regeneration, enhancement of biodiversity and addressing environmental degradation such as desertification, deforestation, erosion and flooding as well as reducing the effects of climate change (Lacombe *et al.,* 2015), there should be an increased intentional soil cultivation and planting of trees (FME, 2013).

The challenge of land degradation can be remedied by promoting the utilization, regeneration and planting of native under-utilized trees such as *Azadirachta indica* and *Acacia senegal*. *Azadirachta indica* (commonly called Neem) is an attractive broad-leaved, evergreen tree which can grow up to 30m tall and 2.5m in girth. The diameter of its trunk is usually 30-80 cm. Its spreading branches form a rounded crown of deep-green leaves and honey-scented flowers as much as 20m across (Orwa *et al.,* 2009). Environmentally, *A. indica* has a reputation as a natural air purifier, exhaling out oxygen and keeping the oxygen level in the atmosphere balanced. It also helps to improve fertility of the soil and to rehabilitate degraded wastelands (Childs *et al.,* 2001). This species can also play a vital role in controlling soil erosion, salination and preventing floods. The latter, *Acacia senegal* (L.) Willd, is a leguminous tree and the main species in the world producing the internationally traded Arabic gum (Jean-Michel *et al.,* 2012). Raddad *et al.* (2005) noted that *A. senegal* shows promise as a multipurpose species for its range of products and uses: gum arabic, fodder and wood production, and soil fertility improvement. *A. senegal* is essential in the improvement of land degradation and particularly in tree improved fallows to replenish soil fertility (Deans *et al*., 1999; Raddad *et al*., 2006; Isaac *et al*., 2011).

To achieve a successful soil cultivation and potential seed germination, factors that determine seed viability must be controlled. These factors include environmental conditions (e.g. moisture, light, air, soil fertility, etc.), seed dormancy, methods of seed handling after harvesting, conditions of seed storage and inherent genetic factors. Seed coat dormancy adversely affects the propagation and germination of many seeds which leads to poor growth potential (Falemara *et al.,* 2014). This is said to be a temporary failure of a mature viable seed to germinate under normal environmental conditions that favours germination (Ibiang *et al.,* 2012). Seeds of most arid and semi-arid tree species cannot germinate promptly when subjected to conditions favourable for germination due to impermeable seed coat to water. The adaptation to a unique prevailing environment has enabled seed dormancy to evolve differently across species (Botsheleng *et al.,* 2014). An understanding of the germination potential of the species involving pre-treatment will provide some information for its domestication and cultivation in Nigeria as studies have shown that pre-sowing treatment could significantly enhance seed germination of various tree species (Hossain *et al.,* 2005).

MATERIALS AND METHODS

Study Site

The experimental site was the Botanical Garden of Biological Science Department, Yobe State University, Damaturu. Damaturu is located at semi-arid zone of agro ecological zone (latitudes 11°44′ 45″N and 11°58′ 31″S). Annual rainfall ranges from 500mm to 1000mm, the rainy season started from June to September with mean annual temperature ranging from 39°C to 40°C.

Seed Collection and Preparation

Azadirachta indica and *Acacia senegal* seeds were collected from standing trees within the boundary of North-East Arid Zone Development Programmes (NEAZDP) via Garin Alkali 5km away from Gashua, the capital city of Bade Local Government. Polythene bags were filled with top soil by the used of soil scooper up to 2cm to its normal capacity allowing only 1cm above for watering. The polythene bags were arranged in form of beds (also known as polypots) as described by Odo and Oleghe, (1988). The polypots were arranged in the order: treatment, species and control.

Viability Test

The seeds collected for the experiment were subjected to viability test as described by Usman *et al.* (2010), to rid them of seeds that were not viable. The test involved immersing the seeds into plastic container filled with water; the seeds that were observed to float were immediately removed and considered non-viable. The viable seeds were then immediately dried for further tests.

Experimental Design and Treatments

The seeds were subjected to four treatments (including the control) in three replications in a Completely Randomized Design (CRD) for each species. The four pre-germination treatments of *Azadirachta indica* and *Acacia senegal* seeds were as follows; untreated seeds (control), acid treatment, hot water and cool water treatments.

Experiment 1: Acid Treatment (AT): In this treatment, 30 viable seeds each of *Azadirachta indica* and *Acacia senegal* were immersed in three different beakers containing 1 Molar (1M) Hydrochloric acid (Hcl) and left for three different time intervals of 5 (AT_5), 10 (AT_{10}) and 15 (AT_{15}) minutes respectively. After each time interval the treated seeds were removed and rinsed thoroughly with tap water to remove all the acid and finally air dried before sowing for germination (Asinwa *et al.,* 2012).

Experiment 2: Hot Water Treatment (HWT): Water was boiled to 100°C in three different beakers and 30 viable seeds each of *Azadirachta indica* and *Acacia senegal* were immersed in the respective beakers and left for three different times 5, 10, and 15 minutes. The seeds which were labeled (HWT_5, HWT_{10} and HWT_{15} respectively) were thereafter removed from the closed beakers and allowed to cool. The seeds were finally air dried before sowing for germination in the polypots.

Experiment 3: Cold Water Treatment (CWT): In this method of pre-treatment, 30 viable seeds each of *Azadirachta indica* and *Acacia senegal* were soaked in three different beakers containing cold water (at room temperature) and kept for 6, 12 and 24 hours respectively. As in the previous treatments, the seeds which were labeled (CWT_6, CWT_{12} and CWT_{24} respectively) were air dried before sowing for germination in the polypots.

Experiment 4: Control (C): Viable seeds of *Azadirachta indica* and *Acacia senegal* were directly sown into polypots without any pre-treatment.

Seed Sowing and Observation of Germination Rate

As described by Baumer (1983), three viable seeds were sown for each polypot; the sowing depth was 1cm. Seeds Germination was monitored for four weeks and data were collected on rate of germination (number of seeds germinated) and germination percentage.

STATISTICAL ANALYSIS

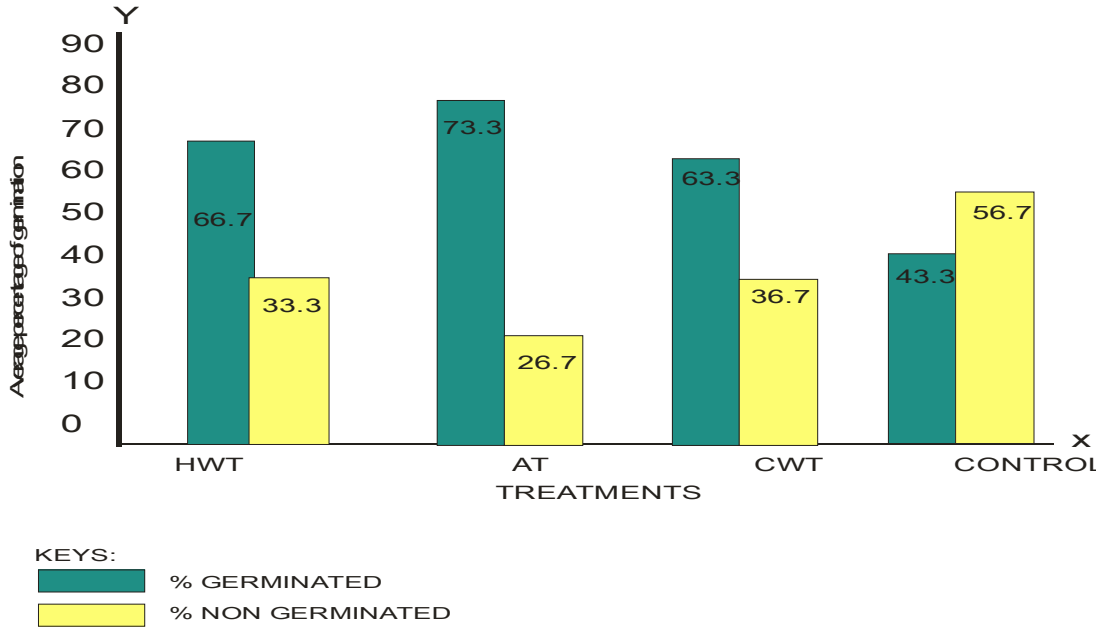
The cumulative data collected were computed and subjected to analysis using SPSS statistical software (SPSS version 16.0). Analysis of Variance (ANOVA) was carried out on the collected data by adopting the Randomized Completely Design (RCD) and Duncan's Multiple Range Test (DMRT) was used for mean separation (Charity *et al.,* 2016).

RESULTS AND DISCUSSION

Rate of Germination of *Azadirachta indica* Seeds

The mean germination percentage rate of *A. indica* seeds under various treatments varied from 43.3% to 73.3%. Germination percentage was highest in AT (73.3%), followed by HWT (66.7%) and lowest in C (43.3%) followed by CWT (63.3%) as shown in figure 1.

Figure 1: Shows Mean Percentage of Germination success of *Azadirachta indica* seeds under Different Treatments



Rate of Germination of *Acacia senegal* Seeds

The mean germination percentage rate of *Acacia senegal* seeds under various treatments varied from 56.7% to 85.6%. Germination percentage was highest in AT (85.6%), followed by HWT (77.8%) and lowest in C (56.7%) followed by CWT (74.4%) as shown in table 2.

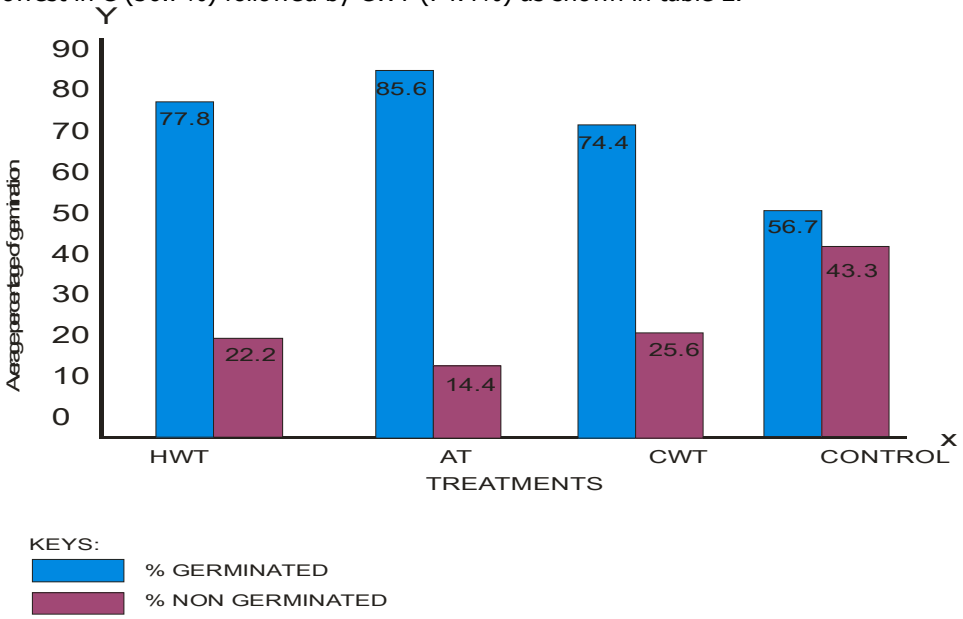


Figure 2: Shows Mean Percentage of success of *Acacia Senegal seeds* under Different Treatments

DICUSSION

The results of this study showed that all treatments significantly ($p \leq 0.05$) affected various germination parameters of *Azadirachta indica* and *Acacia senegal* seeds. The result shows that AT_{15} minutes acid treatment of *A. indica* seeds as the best in enhancing germination rate (table 1). However, there is no significant difference ($p \leq 0.05$) between AT_{15} and AT_{10} of the various species. This result agrees with the findings of Musa (2010) and Igboanugo (2010) who noted that acid treatment of seeds with hard seed coat give best result in 15 minutes soaking. Similarly, Nikoleave (1977) and Amusa (2011) also reported that highest percentage germination accorded to acid pretreatment is an indication that the more rapidly the seed coat is ruptured, the faster the rate of germination. 1M Hydrochloric acid (Hcl) is thought to disrupt the seed coat and exposes the lumens of the macrosclereids cells, allowing rapid penetration of water which triggers germination. At HWT_{15}, hot water treatment of *A. indica* seeds yielded a moderate result as compared to the acid treatment. This result agrees with the findings of Usman *et al.* (2010) and Missanjo *et al.* (2014) who reported that seeds soaked in hot water treatment at 100°C did better than the control while Soliman and Mohamed (2013) noted that soaking seeds in hot water at 100°C for few minutes was the best method for breaking dormancy which resulted in an increased germination percentage of 96% and gave high quality of golden shower seedlings. Contrarily, Amusa (2011) asserts that hot water treatment for few minutes can destroy seed embryo and prevent germination. This therefore appears that different species have varying ability to withstand level of temperature which is one of the primary conditions suitable for germination. While cold water yielded a fair germination percentage and a reduced mean germination time when compared to hot water treatment and acid treatment. This also implies that soaking in cold water could also reduce dormancy period in seeds of *A. indica* when compared to the control. This result concurs with earlier report of Emerhi and Nwiisuator (2010) and Falemara *et al.* (2013) which shows that soaking in cold water is a feature that enhances germination in seeds of tropical trees. The control treatment exhibited a lower germination percentage when compared with other treatments.

The result of *A. senegal* also shows that acid pre-treatment gave best result at AT_5. This agrees with the findings of Likoswe *et al.* (1997) which revealed that soaking of *A. senegal* in concentrated hydrochloric acid at five (5) minutes yield best result. Furthermore, Nwoboshi (1982) asserts that shorter treatment of seeds with less hard seed coat yield efficient result in terms of germination. Similarly, hot water treatment (HWT) yield a moderate result in terms of pre-treatment of *A. senegal* seeds which is in line with the work of Aminu (2012) who posited that hot water and acid treatment gave best results in terms of *A. senegal* treatment. However, he recommended the use of hot water treatment because it is not expensive and risk free for chemical contamination (Essam, 2005). Cold water seems to be the least in terms of rate of germination of *Acacia Senegal* in the various treatments. However, CWT_{24} hour's water treatment seems to be the best among other CWT_6, CWT_{12} cold water treatment. Musa (2010) asserted that seeds treated with cold water yield fair germination rate. Cavanagh (1980) says the higher the observation of water by hard seed, the higher the germination percentage and not forgotten the control also seems to be good because the viability and the freshness of the seeds plays a certain role in the germination.

CONCLUSION

Conclusively, this study revealed that seeds of *Azadirachta indica* and *Acacia senegal* are highly successful with pre-treatment, Acid treatment yielded very significant result in *Azadirachta indica* with time increase because of the hardness of the seed-coats while less significant to *Acacia Senegal* because of the less hardness of the seeds coats as it damages the embro. The samething applicable to hot water, but very successful in cold water treatment than *Azadirachta indica.* Hence pre-treatment is very significant to arid and semi-arid plant related species of the same ecological zones that cannot germinate promptly when subjected favourable conditions for germination due to their seeds dormancy. An understanding of the germination potential of these species involving pre-treatment will pave way for its domestication and cultivation in Nigeria. Thus this studies have shown that pre-sowing treatment significantly enhance seed germination of various tree species which was used to be the instrument to tackling the challenge of soil infertility, land degradation, desertification, deforestation, erosion and flooding as well as reducing the effects of climate change.

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