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THE EFFECT OF DIFFERENT PRE-SOWING TREATMENTS ON BREAKING SEED DORMANCY IN BAOBAB (*Adansonia digitata* L.) PLANT

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ABSTRACT

Seed germination of baobab has necessitated with quiescence and hard seed coat impermeable to water and gases. It faces a high risk of extinction due to lack of regeneration. An experiment was carried out to investigate the effect of pre-sowing treatment techniques on seed germination of Baobab. Pot trials were conducted during 2021 dry season at Biological garden, Department of Plant Science and Biotechnology, Faculty of Life Science, Federal University Dutsin-Ma, Katsina State using completely randomized design (CRD). Seeds were subjected to four different concentrations of sulphuric acid, hot water, cold water, physical treatment and untreated seed as control and were analyzed independently to obtain the best treatment periods. Total of nine hundred and sixty (960) viable seeds were surface sterilized in 1.0% Sodium-hypochlorite (NaOCl) for 1 minute and rinsed three (3) times in sterile distilled water. 20 viable seeds were sown for each polypot. Physical pre-sowing treatment with full-sided scarification and treatment with hot water for 10 minutes produces the highest germination percentage (95.00%) and early seedling emergence (7th day after sowing). Seeds soaked in cold water for 8.00 hours gave the least mean days of seedling emergence (6th day after sowing) when compared to other treatments. These results suggested that full side scarification, soaking seed in hot water for 10 minutes and cold water for 8.00 hours were optimum in breaking seed dormancy in Baobab and the techniques could be apply prior to planting to improve germination performance.

Keywords: *Adansonia digitata*, Emergence, Pre-sowing treatment, Scarification

INTRODUCTION

Baobab (*Adansonia digitata* L.) is a medium to large deciduous tree that belongs to the family malvaceae, sub-family bombocoideae and genus *Adansonia digitata* (Shama *et. al*., 2017). It is among the long-lived vascular economic multipurpose tree of West Africa that has the capacity to withstand drought because of its deep tap root system and ability to restrict transpiration **(**Kornei, 2021)**.** The tree stores water in the trunk up to 1200 litres to endure harsh drought condition (Musa *et. al.*, 2021). Baobab is resistant to forest fires and absorbed large amount of carbon (IV) oxide from atmosphere (*Vermaak, 2021*). More attentions have been given to economic important species of tree plants for a sustainable use and integrated management due to an increasing recognition of its contribution to fulfill basic needs of people, household economics, food security and conservation of natural resources **(***Baum and David, 2020).* The genus *Adansonia* consists of about eight different species which are usually medium-to-large deciduous tree, occupying different habitats in Sub-Saharan Africa and several species introduced throughout the world (*Pettigrew, 2012*). The tree is multipurpose indigenous to Nigeria, Niger, Gambia, Ghana, Guinea, Mali, Benin, Burkina Faso, Cameroon and Central African Republic (*Cvetković, et. al*., 2021). Many species of Baobab have been recorded in bushy grassland, woody savannah, forest edges and rocky environment (Joshi and Joshi, 2009). In West African local communities, the tree is widely used as a source of fibers, food, medicines, fuel, dyes and other commodities as well as restoration of fertility (Kunz, 2009). The fruit is resinous, slightly acidic with pleasant taste in which both fresh and dried fruits are eaten raw or made into juicy, jamy, or puddy substances while the leaves are cooked and eaten as a leaf vegetable (Ubaidillah *et. al*., 2020*)*. Baobab seed possesses an exogenous dormancy and quiescence structure that prevents the seed from fast and uniform germination at vegetative stage (Falemara *et. al.*, 2014). Variation in breaking seed dormancy using different pre-sowing treatments in improving *Adansonia digitata* seedling production is determined (Amosa., 2011). Many research works were carried out on seed dormancy but only few have tackled the mechanism of softening the seed coat (Okunlola *et. al*., 2011). This problem can be tackled by establishing plantation of this indigenous tree there by successful production of vigorous and healthy emergence seedling by ensuring viability at nursery stage.

MATERIALS AND METHODS

Study Area

The experiment was carried out during 2021dry season at biological garden, Department of Plant Science and Biotechnology, Faculty of Life Science, Federal University Dutsin-Ma, Katsina State. The area is typically Sudan savanna ecological zone located in the north-western region of Nigeria which lies between latitude 12 27' 14.11" N and longitude of 07 29'50.03" with an average elevation of *1,744 feet* above sea level. The climate of the area is tropical sub-humid with high temperatures and high humidity. Wet season is oppressive and mostly cloudy, the dry season is partly hot and cloud. The mean annual rainfall value is between May and September with a peak in August. The average annual rainfall is about 700 mm. The pattern of rainfall in the area is highly variable. This can result in severe and widespread droughts that can impose serious socio-economic constraints (Abaje *et. al.*, 2014). The mean annual temperature ranges from 29 °C – 31 °C. The highest air temperature normally occurs in April/May and the lowest in December through February. Evapo-transpiration is generally high throughout the year. The highest amount of evaporation occurs during the dry season. The vegetation of the area is the Sudan Savanna type which combines the characteristics and species of both the Guinea and Sahel Savanna (Abaje *et. al*., 2014). Dutsin-Ma has boundaries to Kurfi and Charanchi LGAs to the north, Kankia LGA to the east, Safana and Dan-Musa LGAs to the west, and Matazu LGA to the southeast.

Seed Collection and Polypot Preparation

Baobab fruits used in the experiment were collected from Dutsin-Ma community of Katsina State. The fruits were sorted and cracked to remove the seeds for pre-treatment prior to the germination experiment. Polythene bags were filled with top soil. Seeds were sown in polypots (30 x 30 x 40cm) containing 7kg of the mixture of top soil and compost manure (ratio 3:1). All standard cultural practices were maintained based on the procedure described by Chude *et. al.*, (2012).

Viability Test

The seeds collected for the experiment were subjected to the viability test and those not viable were liberated. This involved immersion of seeds into water in a container, the seeds that were observed to float were immediately removed and considered not viable. The seeds that observed viable were dried for further used in the experiment.

Seeds Preparation, Seed Sowing and Weed Control

Pot trials were carried out during 2021 dry seasons at the biological garden, Department of Plant Science and Biotechnology, Faculty of Life Science, Federal University Dutsin-Ma, Katsina State. Sowing of seeds was carried out on 15th April, 2021 at 4:30 to 5:30 pm. To remove the fungal spores and exudate, total of nine hundred and sixty (960) viable seeds were selected and surface sterilized in 1.0% Sodium-hypochlorite (NaOCl) for 1 minute and rinsed three (3) times in sterile distilled water. 20 viable seeds were sown for each polypot. The depth of the sowing was 1 cm and few weed germinated with seeds were removed by hand picking.

Irrigation

For better emergence and performance of the baobab seed germination, moisture supply was very essential. Constant watering of the polypots was crucial throughout the period of the experiment because the experiment was carried out during dry season. Polypots were watered twice, morning and evening every day.

Experimental Design and Analysis

The experimental layout was Completely Randomized Design (CRD) with equal replications. The seeds were subjected to three (3) pre-treatment methods at three (3) pre-treatment durations with untreated seeds as control and were analyzed independently to get the best treatment time for the four pretreatment periods. Data on days to early emergence of seeds were collected at vegetative stage and subjected to Analysis of Variance (ANOVA) using SPSS soft were version 23 (www.ibm.com) and significant means were separated using Turkey's Honestly significant diffrence (HSD).

Chemical Pre-Treatment

50% dilute Sulphuric acid was poured in a beaker containing viable baobab seeds. The seeds were fully immersed and left in an acid for 0.0, 1.0, 2.0 and 3.0 hours after which they were removed and rinsed thoroughly in a cold water for 3 to 5 times to remove the excess chemicals.

Physical Pre-Treatment

For physical treatment, one side, two sides and full sides of the seeds were scrapped so that some parts of the seed coats were removed and healthy radicals were left and used for the evaluation.

Hot Water Pre-Treatment

Water was boiled at 100 ^{0}C and the seeds were soaked in boiled water (100 ^{0} C). Subsequently, the source of heat was removed to allow the immersion of the seeds. The seeds were then immersed in the hot water for a period of 0.0, 10.0, 15.0 and 20 minutes in a 100 ML beaker. The seeds were then dried upon removal from hot water.

Cold Water Pre-Treatment

The seeds were soaked in cold water at room temperature for 8, 16, 24 hours. As in hot water, the seeds were then dried upon removal from cold water.

RESULTS AND DISCUSSIONS

The result on the effects of acid treatment (50% dilute H_2SO_4) on seed germination of Baobab is presented in Table 1. The finding shows significance differences ($P \leq 0.05$) in seeds treated with 50% dilute H_2SO_4 at different time interval. On the percentage of seed germinated, the result shows statistically significant increase when compared to untreated seeds. Maximum germination percentage (80.00%) and early seedling emergence (9th day after sowing) were recorded in seed treated with 50% Sulphuric acid for 1 hour when compared to control and other time intervals. Maximum days to late emergence were recorded in untreated seeds (22nd day after sowing). This result observes that, *Adansonia digitata* seeds dormancy might have been associated with hardness of the seed coat. The lower the time taken for seeds soaked in an acid concentration, the higher the percentage germination. Seed pre-sowing treatment in 50% dilute H_2SO_4 induced germination with effective breakage of seed coat. This was in line with work of Amonum *et. al*., (2016) in *Parkia biglobosa* seeds, who reported that early emergence of germination, might have occurred as a result of exposure of the seed to acid. This permits hydrolysis in the seed by increasing the activities of hormone such as Auxin and Ethylene gas which contribute in the synthesis of proteins and releasing nucleic acid metabolisms in the cells. The result was also in conformity with work of Ariana *et. al*., (2011), in *Tamarindus indica* who reported that, exposure of seed to a very high acid concentration will have an adverse effect on germination due to high concentration of gibberellic acid.

On the effect of physical treatments on seed germination of Baobab the result is presented in Table 2. The result obtained shows significant increase ($P \leq 0.05$) in number of seeds with full-sided scarification. Highest germination percentage was also recorded in seeds with full-sided scarification (95.00%), when compared to other scarifications and non-sided (40.00%). On the days to early emergence of the seedling, the result shows significant variation ($P \leq 0.05$) among the different scarification methods. Days to early emergence of the seed were recorded in seed with full scarification (7th day after sowing) when compared to non-sided scarification (16th day after sowing), while the maximum days to late emergence recorded in non-sided scarification (23rd day after sowing). This might have observed that, the palisade layers in the seed coat were lignified with malpighian cells tightly packed together and impregnated with water repellant in the seed. The full-sided scarification might have functioned as a water-gap associated with the impermeable layers of the seed that prevent the uptake of water. This was in conformity with work of Ubaidillah *et. al*., (2020), on physical scarification technique of *Moringa oleifera* seed. Bhardwaj, (2014) reported that, breaking physical dormancy involves disruption of a specialized structures of the seed.

The result on the effect of hot water as pre-sowing treatment is presented in Table 3. Hot water significantly ($P \leq 0.05$) affects the seed germination, germination percentages and early seedling emergence. Highest germination percentage (95.00 %) and days to early seedling emergence (7th day after sowing) were recorded in seeds soaked in hot water for 10 minutes when compared to untreated seed emerged (12th day after sowing) while maximum days to late emergence also recorded in untreated seed (22nd day after sowing). This might have been attributed to physiological potential from the seed micropyle which speed the germination. This result agrees with the work of Amonun *et. al*., (2016), who stated that germination performance increases with decrease in hot water concentration. Soaking seeds in hot water for a long period of time resulted to the rupture and damage of seed embryo. Amosa, (2011) also reported that, subjecting the seed to hot water for long period led to the killing of the cotyledon. This agrees with report of Saikou *et. al*., (2008) in *Acacia senegalensis*, who offered that, treatment with hot water for a short period of 10 minutes, result to the early seedling emergence.

On the effect of cold water on germination percentage and days to early seedling emergence, the result is presented in table 4. The result did not produce significance differences ($P > 0.05$) among the treatments except for seeds soaked in cold water for 8 hours which produces highest germination percentage (75.00%) and days to early seedling emergence (7th day after sowing) when compared to seed treated for 24 hours (12th day after sowing) and the untreated control (14th day after sowing). Days to late emergence were recorded at (22th day after sowing). This might be as a result of impermeability of the seeds, palisade cell with hard pectinaceous outer layer and higher lignin content in the seed coat. This work was in line with work of Kimura and Islam, (2012) in Long bean (*Vigna sinensis*), who reported that germination of seeds treated with hot water for long time could be decreased by developing macro-cracks on the seed coat. Novita *et. al*., (2021) also reported that, treatment with cold water might have removed the thick palisade layer of seed coat. This is contrary to work of Falemara *et. al*., (2014), who reported that soaking in cold water usually is ineffective. Effectiveness of the seed dormancy may vary within the cultivars of same species, depending on their seed coat structures. Each type of seed from various plants has a different level of seed coat hardness, and then this affects the sensitivity of the seed coat to start an imbibition in the germination process.

Table 1: Effect of Chemical Treatments on Germination Percentage and Days to Early Emergence in Seeds of Baobab

Treatments 50%Sulphuric acid in (Hours)	No. of Seed Germinated Mean+SE	% of Seed Germinated Mean+SE	Days to Early Emergence Mean+SE	Days to late emergence Mean+SE
T_0	$8.00^d \pm 1.10$	$40.00^d \pm 1.20$	$16.00^a \pm 1.70$	$22.00^a \pm 1.23$
T_1	$16.00^a \pm 1.13$	$80.00^a \pm 1.11$	$9.00^d \pm 1.11$	$15.00^d \pm 1.10$
T_2	$10.00^c \pm 1.11$	$50.00^c \pm 1.12$	$11.00^c \pm 1.41$	$18.00^c \pm 1.21$
T_3	$13.00^b \pm 1.12$	$65.00^b \pm 1.11$	$14.00^b \pm 1.51$	$20.00^b \pm 1.22$

Means followed by the same letter (superscripts) are not significantly different using Turkey's honestly significant difference (HSD) $P \leq 0.05$. T_0 = Untreated Seeds (Control), T_1 = Treatment with 50% Dilute **H_2SO4** for 1 Hour, T2 = Treatment with 50% dilute **H_2SO4** for 2 hours, T_3 = Treatment with 50% Dilute **H_2SO4** for 3 Hours, % = Percentage, SE± ═ Standard error.

Table 2: Effect of Physical Treatments on Germination Percentage and Days to Early Emergence in Seeds of Baobab

Physical Scarification	No. of Seed Germinated Mean+SE	% of Seed Germinated Mean+SE	Days to Early Emergence Mean+SE	Days to late emergence Mean+SE
Non-sided	$8.00^d \pm 1.60$	$40.00^d 1.60$	$16.00^a \pm 1.20$	$23.00^a \pm 1.20$
One side	$12.00^c \pm 1.70$	$60.00^c \pm 1.43$	$13.00^b \pm 1.20$	$22.00^a \pm 1.20$
Two sides	$17.00^b \pm 1.60$	$85.00^b \pm 1.70$	$9.00^c \pm 1.21$	$15.00^b \pm 1.11$
Full sides	$19.00^a \pm 1.50$	$95.00^a \pm 1.71$	$7.00^c \pm 1.10$	$15.00^b \pm 1.16$

Means followed by the same letter (superscripts) are not significantly different using Turkey's honestly significant difference (HSD) $P \leq 0.05$, % = Percentage, SE± ═ Standard error.

Table 3: Effect of Hot Water Treatments on Germination Percentage and Days to Early Emergence in Seeds of Baobab

Hot Water Treatment (100^0C) in min	No. of Seed Germinated Mean+SE	% of Seed Germinated Mean+SE	Days to early Emergence Mean+SE	Days to late emergence Mean+SE
0.00	$9.00^c \pm 2.13$	$45.00^c \pm 2.16$	$12.00^a \pm 1.33$	$22.00^a \pm 1.42$
10.00	$19.00^a \pm 2.51$	$95.00^a \pm 2.25$	$7.00^c \pm 1.23$	$15.00^b \pm 1.22$
15.00	$14.00^b \pm 2.41$	$70.00^b \pm 2..22$	$9.00^b \pm 1.12$	$15.00^b \pm 1.22$
20.00	$14.00^b \pm 2.51$	$70.00^b \pm 2.16$	$10.00^b \pm 1.23$	$16.00^b \pm 1.23$

Means followed by the same letter (superscripts) are not significantly different using Turkey's honestly significant difference (HSD) $P \leq 0.05$, % = Percentage, SE± ═ Standard error.

Table 4: Effect of Cold-Water Treatments on Germination Percentage and Days to Early Emergence in Seeds of Baobab

Treatments Cold Water in (Hours)	No. of Seed Germinated Mean+SE	% of Seed Germinated Mean+SE	Days to Early Emergence Mean+SE	Days to late emergence Mean+SE
0.00	6.00^{b}±2.50	30.00^{c}±2.50	14.00^{a}±0.22	22.00^{a}±0.25
8.00	15.00^{a}±2.71	75.00^{a}±2.71	6.00^{b}±0.21	13.00^{b}±0.18
16.00	8.00^{b}±2.60	40.00^{b}±2.52	9.00^{a}±0.21	14.00^{b}±0.21
24.00	10.00^{b}±2.80	50.00^{b}±2.60	12.00^{a}±0.23	22.00^{a}±0.22

Means followed by the same letter (superscripts) are not significantly different using Turkey's honestly significant difference (HSD) P≤ 0.05, % = Percentage, SE± ═ Standard error.

CONCLUSION

The study investigated the effect of different pre-sowing treatment techniques on breaking seed dormancy and early germination of Baobab (*Adansonia digitata* L.) seeds. It was revealed that, physical pre-sowing treatment with full-sided scarification and hot water treatment for 10 minutes break the seed coat and lead to highest germination percentage (95.00%) with early seedling emergence (7^{th} day after sowing). Seeds soaking in cold water for 8.00 hours gave the least mean days of seedling emergence (6^{th} day after sowing) when compared to other treatments. Base on the finding of this research work, it is recommended that, in improving the breaking of seed dormancy and early seedling emergence of **baobab** seeds, physical pre-sowing treatment with full-sided scarification, soaking of seeds in hot water for 10 minutes and cold water for 8.00 hours should be adopted.

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