European Journal of Agriculture and Forestry Research
Vol.2, No.1, pp.31-41, March 2014
Published by European Centre for Research Training and Development UK (www.ea-journals.org)

Pre-Germination and Dormancy Response of *Adansonia Digitata* L Seeds To Pre-Treatment Techniques and Growth Media

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ABSTRACT: *The study investigated the effects of three pre-treatment techniques and growing media the dormancy and growth response of baobab seeds. The seeds were immersed in cold water (25-28^{o}C), hot water (100^{o}C), and sulphuric acid (10%, 50% and 98% conc. levels) at different time intervals. The seeds after pre-treatment were sown on three different growth media. Randomized Complete Block Design with 3 treatments and 3 germination media was adopted for this experiment. The result showed that earliest mean days of emergence (8days) was observed in seeds subjected to acid treatment at 98% conc. The highest (17 seeds) rate of germination was recorded in 98% acid conc. soaked for 1h and sowed in sandy soil growth medium with high significant variation. 98% acid conc. recorded the highest germination percentage ranging from 62% - 85%, while other treatments recorded a lower germination percentage (5% to 40%). Sandy soil growth medium showed significant effect in 98% acid treatment soaked for 1hr. The sawdust gave significant germination effect for hot water treatment. Thus, 98% acid concentration soaked for 1h and sowed in sandy soil growth medium was recommended for pretreatment of Adansonia digitata seeds prior to planting to improve germination performance.*

KEYWORDS: Germination, Dormancy, Pre-treatment, Growth Media and *Adansonia digitata* L

INTRODUCTION

In Nigeria, deforestation and forest degradation have been factors that threaten forest productivity and sustainability (Okunomo, 2010) coupled with impending and increasing demand for forest and forest resources as a result of increasing world population. Sustained overexploitation can lead to the destruction of forest resource which can consequently to resource destruction as well as extinctions. Tropical forests are overexploited at a rate faster than reforestation which competes with other land uses such as food production, livestock grazing, and living space for further economic growth. According to Mander (1998), popular indigenous plants with high economic value are coming under increasing exploitation pressure.

Many seeds have difficulty in germination such that their propagation is adversely affected by seed coat dormancy leading to poor growth potential. Dormancy is an adaptation that ensures seeds will germinate only when environmental conditions are favorable for survival. The conditions necessary to allow seeds to "break" dormancy and germinate can be highly variable among species, within a species, or among seed sources of the same species (Luna, *et al*., 2009). Seeds that have hard, thick seed coats that physically prevent water or oxygen movement into seeds have physical dormancy (Baskin, *et al*., 2000). One of such indigenous plants is *Adansonia digitata* which is being threatened of going into extinction because of its inability of not been able to regenerate under natural condition.

Natural regeneration and independent germination of *Adansonia digitata* is poor. The seeds are known to stay dormant in the soil for a long time before germination. The restricting factor in germination is due to the fact that the seed coat is impermeable to water. Cultivation of baobab necessitates that the seeds be pre-treated to enhance the accessibility of water and oxygen into the seeds before planting, in order to break dormancy and to obtain optimum germination and improved performance for plantation establishment. Baobab species is facing a high risk of extinction because of the lack of its natural regeneration, and hence practical ex situ conservation measures are urgently needed to preserve genetic diversity and maintain multiple specimens (Gebauer, *et al.*, 2002).

Adansonia digitata, (Baobab) a multipurpose tree species belong to the Bombacaceae family and occur throughout semi-arid and arid zones of Africa. Its survival is, however, threatened by bush fire, overexploitation, grazing and a lack of natural regeneration (Assogbadjo, *et al*., 2010). The tree sheds its leaves during the dry season, which can last most of the year depending on the climate zone. It is a massive, deciduous tree up to 25m in height and may live for hundreds of years. Several research findings show that a dried baobab leaves contains 13-15% protein, 60-70% carbohydrate, 4-10% fats, around 11% fibre, and 16 % ash. The energy value varies from 1180-1900kj/100g of which 80% are metabolisable energy (Gebauer, *et al.*, 2002). The multipurpose baobab is a key economic species used daily in the diet of rural communities in West Africa with various important medicinal and food uses (Sidibe and Williams 2002). *A. digitata* absorbs huge quantities of carbon dioxide from the atmosphere and is resistant to forest fires (Assogbadjo, *et al*., 2010).

The objective of this study is to investigate the effects of three pre-treatment techniques and growth media on breaking seed dormancy and germination response of seeds of *A. digitata*. Various research studies have been reported by various researchers on the breaking of dormancy and germination of seeds of baobab (Esenowo, 1991; Danthu, *et al*., 1995; Sidibe and Williams, 2002 and Chia, *et al*., 2008).

MATERIALS AND METHOD

The Study Site

The experiment was carried out in Federal College of Forestry Jos, Plateau State Nigeria located in Northern Guinea savanna situated at 9°55' latitude and 8°54' longitude. It has an average elevation of about 1,250m above sea level and stands at a height of about 600m above the surrounding plains. The average temperature ranges between 21°C to 25°C. The climate of the state is cool due to its high altitude. Rainy season is usually between April and September while the dry season is from October to March. The mean annual rainfall is 1,260mm (Olowolafe, 2002).

Experimental Procedure and Design

Seed Collection

The pods were harvested from the mother tree, broken down, the seeds decarped and the dry powdery coating was washed away. The extracted seeds were kept under ambient temperature (28^{o}C) for a period of 7 days. Viability test was carried out for the seeds through the floatation method.

Experiment 1 (Acid Treatment)

This trial was conducted to assess the effects of different soaking times and different concentration levels of sulphuric acid (H_2SO_4) on the seeds of *Adansonia digitata*. 180 seeds

were respectively soaked in three sulphuric acid concentrations (10%, 50% and 98%) at three times (1hr, 6hrs and 12hrs). After the soaking, the seeds were removed, washed and rinsed in running tap water to remove any remaining acid.

Experiment 2 (Cold Water Treatment)
This trail was conducted to assess the effects of different soaking times in cold water on the seeds of *Adansonia digitata*. 180 seeds were respectively soaked in distilled water at ambient temperature (28^{o}C) at three different times (6hrs, 12hrs and 24hrs).

Experiment 3 (Hot Water Treatment)
This trail was conducted to assess the effects of different boiling times in hot water on the seeds of *Adansonia digitata*. Water was allowed to boil for 15mins. Thereafter, 180 seeds were respectively added to the boiled water and allowed to boil for three different times (5mins, 7mins and 10mins). After boiling for the specified times, the seeds were removed and allowed to cool down.

Control Treatment
This trail was conducted to have a comparable effect of no pre-treatments of *Adansonia digitata* seeds in the three growth media. 20 seeds of *Adansonia digitata* seeds were planted in each growth media.

Growth Media
The growing media were loamy soil, river sand and sawdust. The river sand were sieved using 2mm sieve to remove stones, roots and other materials that may hinder the emergence of the plumule upon seed germination. All unwanted materials that may hinder seed germination were also removed from the sawdust and loamy soils. After the pretreatments were carried out and the seeds air-dried after 24hrs, the seeds were then planted in the germination boxes and replicated per treatment, per growing media, and per time.

Experimental Design
The experiment was a 3 x 3 x 3 factorial experiment involving three treatments (sulphuric acid (10%, 50% and 98% concentrations), cold water and hot water), three growing media (loamy soil, river sand and sawdust), and three time intervals ((1hr, 6hrs and 12hrs – acid treatment); (5mins, 7mins and 10mins – hot water treatment); and (6hrs, 12hrs, and 24hrs – cold water treatment)) which were all replicated three times. Twenty (20) seeds were allotted to each of the time intervals and concentrations (in the case of acid treatment) in each growing medium and replicated three times. The parameters assessed in the course of the experiment include: Days of Emergence (Numbers of days taken for first emergence); Rate of Germination (Numbers of seeds germinated); and Germination percentage

Statistical Analysis
The cumulative data collected were computed and subjected to Analysis of Variance (ANOVA) by adopting the Randomized Completely Block Design (RCBD). Mean Separation was carried out for significantly different parameters by using the Duncan's Multiple Range Test (DMRT), to determine the more suitable pre-treatment technique and growing media for the germination potential of the seeds of *Adansonia digitata* (Akindele, 2004).

RESULTS AND DISCUSSION

Results

Table 1: Mean Days of Emergence of *A. digitata* seeds (53 days after planting)

Growth Media	Acid Treatment									Hot Water Treatment			Cold Water Treatment			Control
	10%			50%			98%									
	1H	6H	1H	1H	6H	12H	1H	6H	12H	5M	7M	10M	6H	12H	24H	
Loamy	14	25	14	10	14	11	9	10	8	31	0	0	14	15	12	39
Sandy	11	27	15	13	15	18	8	10	9	10	0	11	18	9	9	39
Sawdust	23	23	24	15	15	18	10	8	13	20	30	12	16	10	9	44

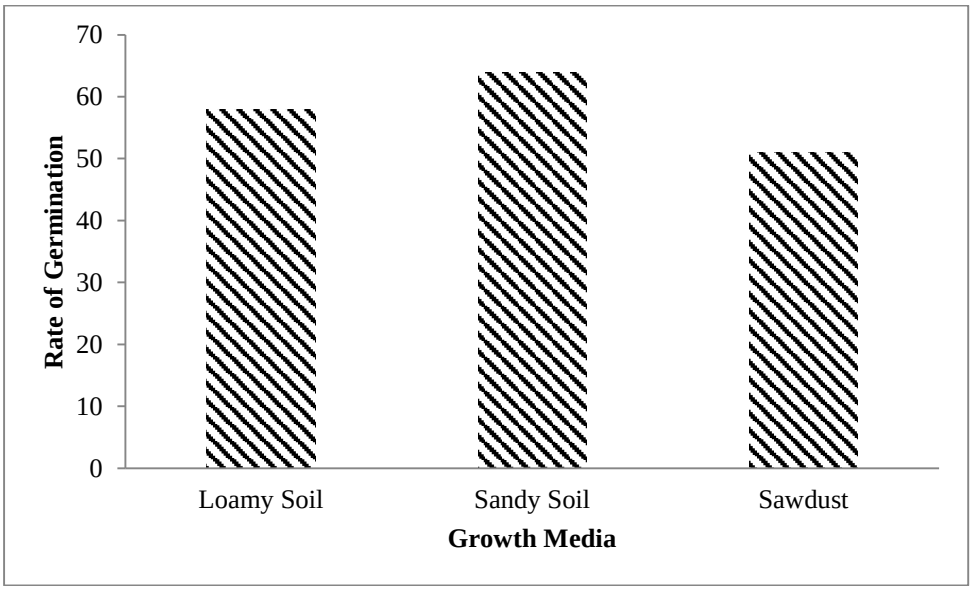

Figure 1: Rate of Germination of *A. digitata* seeds in the three growth media

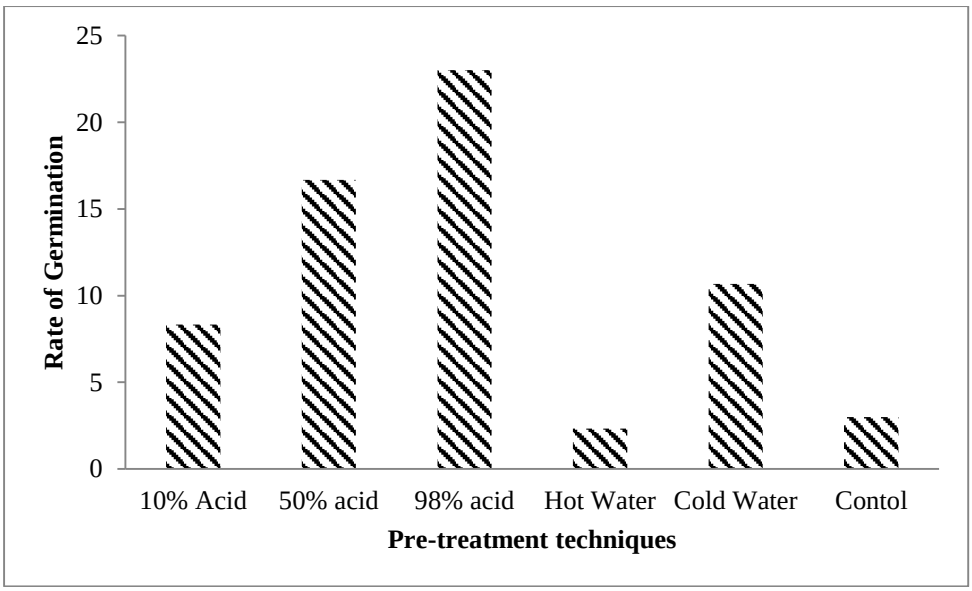

Figure 2: Rate of Germination of *A. digitata* seeds in the three pretreatment techniques

Table 3: Germination Percentage of *A. digitata* seeds (53 DAP)

Growth Media	Acid Treatment									Hot Water Treatment			Cold Water Treatment			Control
	10%			50%			98%									
	1 Hr	6 Hrs	12 Hrs	1 Hr	6 Hrs	12 Hrs	1 Hr	6 Hrs	12 Hrs	5 Mins	7 Mins	10 Mins	6 Hrs	12 Hrs	24 Hrs	
Loamy	22	18	13	23	40	37	62	10	12	5	0	0	15	10	23	5
Sandy	10	8	10	28	32	33	85	25	15	0	0	5	22	30	15	20
Sawdust	15	10	20	10	32	15	62	13	7	5	10	10	12	25	8	5

Table 4: Effects of Pre-treatments on germination of seeds of baobab

% Acid Concentration				Cold Water Treatment		Hot Water Treatment	
Time (Hrs)	10%	50%	98%	Time (Hrs)	Mean GS	Time (Mins)	Mean GS
1	2.89^{a}	5.30^{a}	13.7^{a}	**6**	2.89^{a}	**5**	0.33^{a}
6	2.00^{a}	6.89^{a}	3.22^{b}	**12**	4.33^{a}	**7**	0.22^{a}
12	1.67^{a}	5.67^{a}	2.22^{b}	**24**	2.89^{a}	**10**	0.56^{a}

Means along each column bearing the same superscripts are not significantly different at 5% probability level (DMRT)
GS – Germinated Seeds

Table 5: Effect of Growth Media on germination of seeds of baobab

Growth Media	Acid Concentration			Cold Water Treatment	Hot Water Treatment	Control
	10%	50%	98%			
Loamy Soil	3.22^{a}	7.60^{a}	5.56^{b}	2.89^{a}	0.11^{b}	1.00^{b}
Sandy Soil	1.00^{b}	6.22^{ab}	8.22^{a}	4.44^{a}	0.11^{b}	3.67^{a}
Sawdust	2.33^{ab}	3.78^{b}	5.44^{b}	2.78^{a}	0.89^{a}	0.33^{b}

Means along each column bearing the same superscripts are not significantly different at 5% probability level (DMRT)

DISCUSSION

Pre-treatment Techniques

The findings revealed that acid pre-treatment reduced the period of dormancy as seeds pretreated with sulphuric acid emerged earlier (8th day after sowing) than others pretreatment techniques (Table 1), closely followed by cold water pretreatment. Acid treatment also gave the highest rate of germination and very high percentage germination which was significantly different at 1 hour period of soaking (Tables 1, 3, 4 and fig. 1). This can be attributed to the findings of Amusa, (2011) on *Afzelia Africana* who asserted the fact 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. Sulphuric acid is thought to disrupt the seed coat and exposes the lumens of the macrosclereids cells, permitting imbibition of water, which triggers germination (Nikoleave, 1977 cited in Amusa, 2011). The high germination percentage and significant effect of acid treatment at 1h of seed soaking recorded in this study agrees with earlier studies which established that acid concentrations are significant factor that stimulates germination of seeds (Amusa, 2011 (*Afzelia Africana*); Awodola, 1994 (*Parkia biglobosa*); Emerhi and Nwiisuator, 2010 (*Baillonella toxisoerma*)). According to Esenowo, (1991), the most effective method of pretreatment was scarification with HNO_3 or H_2SO_4, which gave 86 and 98% germination, while Danthu, *et al*., (1995), affirmed that treatment with concentrated

sulphuric acid for six to twelve hours led to germination of more than 90% of the seeds within twenty days of sowing. This study also revealed that the higher the time of soaking or exposure of the seeds to higher acid concentrations, the lower the percentage germination. Seeds subjected to 98% acid concentration at 6h and 12h gave a low germination percentage compared to average percentage germination on exposure to 10% and 50% acid concentrations at varying time intervals (Table 4). The implication of this is that exposure to seeds to very high acid concentration for a long period of time will have an adverse effect on germination as confirmed by Ariana, *et al*., (2011) who reported that high concentrations of gibberellic acid on germination of seeds of five species of cactifrom restricted germination. In the same vein, Ajiboye (2010), reported that seeds of *Tamarindus indica* subjected into Nitric acid scarification showed as low as 20-25% percentage germination under 10mins treatments, while 5 min treatments of Hydrochloric acids showed 70% percentage of germination, while Isah (2012), also collaborate the finding that suphuric acid concentration of 90% used at 1hr and also 98% concentration for *Tamarinda indica* at 10 and 30mins gave the highest seed germination percentage.

The insignificantly low percentage germination of hot water treatment gave a contrary result as against that which would have been naturally expected when compared with the control which yielded a fair germination percentage (Table 3 and fig 1). The implication of this is that hot water pretreatment is not a suitable technique in seeds of *Adansonia digitata* as well as *Afzelia africana* as stated by Amusa, (2011). He opined that, subjecting the seeds to hot water could lead to the seed embryo been killed because of prolonged contact with boiled water. This is contrary to the view of Saikou, *et al.*, (2008), who offered that pre-treatment of *Acacia Senegal* seeds in hot water for 10min, increased its growth potential.

Seeds soaked in cold water emerged earlier, thus also reducing dormancy period and giving a considerable germination percentage (Table 4 and fig 3) contrary to the report of Danthu, *et al*, (1995), who acclaimed that soaking in cold water was generally ineffective. Earlier studies (Ibrahim and Otegbeye (2004), Agboola and Adebire, 1998; and Aduradola and Shinkafi, 1999 cited in Emerhi and Nwiisuator, 2010) have shown that soaking in water is a feature that enhances germination in seeds of tropical trees.

Growth Media

This study revealed that sandy soil growth medium showed the lowest days of emergence, highest rate of germination and highest percentage germination (Table 1, 2, 3 and fig 1). The treatments showed significant effect on seeds germination in sandy soil growth medium at 98% acid concentration for seeds soaked for 1h and the control likewise showed a significant effect in sandy soil medium with 20% germination percentage. The 98% acid concentration at 1h period of soaking gave the highest (85%) percentage germination (Table 3 & fig.2). While hot water pretreatment showed a significant effect in sawdust growth medium but with a lower percentage germination. On the other hand, seeds subjected to 98% acid treatment for 1h in sawdust growth medium yielded 62% percentage germination in the same manner with loamy soil.

The findings affirmed with the investigation of Chia, *et al*., (2008), who revealed that, the highest percentage germination was recorded in sandy soil (75%), followed by humus soil (32.7%). However, the highest number of days before emergence was recorded in humus soil. In general sandy soil supported germination of seeds than the other soil media which can be related to early emergence (Table 1), high rate of germination (fig. 2), and high germination

percentage (Table 3). According to Chia, *et al*., (2008), when seeds are subjected to excess water as in the case of soils or growth medium with high water retention capacity, it is prune to decay, therefore not likely to germinate and establish itself. This could explain why sawdust had the lowest germination performance as a result of its high water retention.

Conclusion and Recommendation

This study investigated the effect of three pre-treatment techniques and growing media on breaking seed dormancy and germination response of seeds of *Adansonia digitata*. It was revealed that acid treatment at 98% concentration for 1h period of soaking and cold water treatment gave the least mean days of seeds emergence. The rate of germination recorded the highest number of seeds in sandy soil followed by loamy soil and then in sawdust. The highest significant percentage germination was also recorded in 98% acid treatment at 1h period of soaking. Sandy soil had better germination performance compared with the two other growth media. This was confirmed by the significant effect exhibited in sandy soil growth medium at 98% acid treatment for seeds soaked for 1h, as well as in the control, while sawdust growth medium gave the lowest germination performance.

Based on the findings of the research work, it is therefore recommended that to improve the period of breaking seed dormancy and enhance germination of *Adansonia digitata* seeds, 98% suphuric acid pretreatment at 1 hour soaking period and sandy soil growth medium should be adopted. In situations where the use acid pretreatment might be limited by availability and risk factors, cold water treatment for 6 hours period of soaking should be adopted.

Acknowledgement

We acknowledged the wonderful assistance of Ashe Bitrus and Dike Mercy of Federal College of Forestry, Jos, Plateau State, Nigeria during the execution of the project.

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Experimental Pictures

Plate 2: Seed soaked in sulpuric acid

Plate 3: Seeds soaked in cold water

Plate 4: Growth Media

Plate 5: Germinated seeds in sandy soil

Plate 6: Germinated seeds in sawdust

Plate 7: Germinated seeds in loamy soil

Plate 8: Emerging Baobab *seedling*

Plate 9: Germinated Baobab seedling after 53 days