Effect of Seed Priming Methods on Germination of Sweet dattock (*Detarium microcarpum*) andIndian jujube (*Ziziphus mauritiana*) in Sudan savanna Ecological Zone of Nigeria

Abstract

This study was conducted to evaluate the effect of different methods of seed pre-treatment on germination of two indigenous tree speciesSweet dattock and Indian jujube (*Detarium microcarpum* and *Ziziphus mauritiana*). The experiment is carried out at the Tree SeedlingsNursery of Faculty of Agriculture, Kebbi State University of Science and Technology, Aleiro. Treatments consisted of Boiled water (100^0C) for 10 minutes, 20 minutes and 30 minutes;three levels of diluted sulphuric acid (H_2S0_4) soaking time for 10minutes, 20 minutes and 30 minutes; Seed scarification and control. The treatments were arranged in Completely Randomized Design (CRD) with three replications per treatment. Results revealed that the seed ofSweet dattock(*Detarium microcarpum*) soaked in hot water at 100^0C for 30 minutes exhibited the best germination percentage (100.00±0.00) within four (96 hours) days. This is followed by hot water treatment for 10 minutes and sulphuric acid treatment for 20 minutes which gave the same germination percentage of 93.33±11.54 within 4 (96 hours) days. The seeds under control treatment gave the least germination percentage of 86.67±11.54 and took a longer period to germinate (eleven days.) Indian jujube**(***Ziziphus maurtiana*) seeds on the other hand, gave the highest germinationpercentage (93.33±5.77) withscarification, followed by soaking in hot water for 30minutes (46.57±11.54), while the lowest germination percentage was recorded for seeds in the untreated control (3.33±5.77). Based on the result, pre-treatment of Sweet dattock(*Detarium microcarpum*) seed with hot water at 100^0C for 30 minutes and scarification of Indian jujube(*Ziziphus maurtiana*) seed is recommended for effective germination.

Keywords: Seed treatments, germination,indigenous tree species,Sweet dattockand Indian jujube.

1.0 INTRODUCTION

The history of agricultural progress from the early days of man has been the history of seeds of new plants varieties brought under cultivation. In early days it was achieved through the cultivation of indigenous but useful plants and those taken through introductions and selection of superior types from cultivated plants constituted the next stage of progress [1].

To perpetuate all these uses of trees, some measures must be taken in view of the degrading vegetation due to deforestation, agricultural and pastoral pressure on forested land. The measures to be taken include; identifying, collecting seeds, pre-testing the seeds, preparing the potting mixture, sowing and watering of seeds, tending the seedlings in the nursery, site preparation and seedling plantation[2].

Many seeds have difficulty in germination such that their propagation is adversely affected by seed coat dormancy leading to poor growth potential. Most of these species have hard

seed coat which is one of the several strategies for survival in specifically and temporally variable environment [3]. In several species, seeds germinate rather slowly, and at times even fail to germinate [4]. This is because the seeds easily loose viability exhibited through the evolution of an oxygen and water to the embryo [5]. If stored for a long time most seed lose their viability, since they are not normally sown, until sometimes after collection, so pre-germination treatment is important to prevent wasting time and money in sowing seeds with poor germination ability. This poor germination ability may be due to seeds dormancy or insect attack, some of such indigenous plant includes *Detarium microcarpum*(Taura)and*Ziziphus mauritiana*(Magarya) among others.

In arid and semi-arid regions, desert encroachment due to excessive deforestation led to dwindling agricultural field coursed by the resultant poor soil status [6]. Consequently, the land is no longer able to meet the upsurge in demand for forest products, food, fodder, fuel wood and other minor forest products. There is an urgent need to enlighten the local people for quick move forwards methods of pre-germinating, raising and tending indigenous species. Meanwhile the neglect of these species lead to death of information on more efficient method of treating seeds to break dormancy and induce quick germination of tree species such as*Detarium microcarpum*(Taura) and*Ziziphus mauritiana* (Magarya). In Nigeria, deforestation and forest degradation have been factors that threaten forest productivity and sustainability [7] 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 resources which can consequently lead to resource destruction as well as extinctions. Tropical forest is over exploited 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[8], popular indigenous plants with high economic value are coming under increasing exploitation pressure. 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 [9]. Seed that have hard, thick seed coats that physically prevent water or oxygen movement into seed have physical dormancy [10]. Such indigenous plants are *Detarium microcarpum* and *Ziziphus mauritiana* which is being threatened of going into extinction because of its inability of not been able to regenerate under natural condition.

The two species were threatened by increasing rate of exploitation for various uses, wildfires, habitat change and climatic change factors. In Botswana, very little effort has been directed towards using indigenous trees in afforestation programmes. The main problem encountered in propagating seedlings of most indigenous trees for afforestation programmes in arid and semi-arid areas is dormant seeds. This dormancy must be broken before germination can occur because it blocks the completion of germination of an intact viable seed under favorable external conditions.

Little is known about the germination requirements of indigenous trees species and therefore the present study was carried to find out how different pre- germination

treatments can facilitate germination of *Detarium microcarpum* and *Ziziphus mauritiana* seeds.

In several plant species, seed germination is slow, and at times some species even fails to germinate [4]. This is because the seed easily loose viability exhibited through the evolution of an impervious protective covering which normally prevents the entry of oxygen, and water to embryo [5]. If stored for a long time most seeds lose their viability, since they are not normally sown until sometimes after collection. This poor germination ability may be due to seed dormancy or insect attack. In ability of a viable seed to respond to the favorable environmental condition for germination is known as dormancy. Most forest tree species have hard seed coat *Detarium microcarpum* and *Ziziphus mauritiana* have hard seed coat also therefore, total germination percentage of these two species is difficult without applying methods of breaking hard seed hardness.

Successful germination of seeds is essential in natural and artificial establishment of forest trees. This however largely depends on some factors such as seed viability, availability of adequate moisture and other physical conditions in the area where the seeds are deposited. To determine seed viability and ensure adequate moisture penetrate into seed coats of most forest trees seeds with hard seed coat, application of different methods of seed treatment is necessary. Therefore, this study aimed to verify the effect of different methods of seed pre-sowing treatments on the germination of two indigenous tree species, viz: *Detarium microcarpum* and *Ziziphus mauritiana* for their medicinal and environmental protection role in the Sudan savanna zone of Nigeria.

The main objective of the study is to determine the effect of different seed priming methods on germination of *Detarium microcarpum* and *Ziziphus mauritiana*

2.0 MATERIALS AND METHODS

Study was carried out in the Tree seedling nursery of the Faculty of Agriculture Kebbi State University of Science and Technology, Aliero (KSUSTA) located at the Faculty of Agriculture premises (lat. 12°18.64'N; long.4°29.85'; 262 above sea level).

The minimum and maximum Temperatures are 19^0C and 34^0C respectively with mean annual temperature of 27^0C and relative humidity of 52% to 55%.

2.1Treatments and Experimental Design

Treatments consisted of Boiled water (100^0C) for 10 minutes, 20 minutes and 30 minutes;three levels of diluted sulphuric acid (H_2S0_4) soaking time for 10minutes, 20 minutes and 30 minutes; Seed scarification and control. The treatments were arranged in Completely Randomized Design (CRD) with three replications per treatment.

2.1.1 Procedure for experimentation

Experiment 1 (Hot Water Treatment):Water was boiled for 100^0C and seeds were added to the boiled water and allowed it to soak for three different times 10, 20, and 30 minutes. Then the seeds were removed and allowed to cool.

Experiment 2 (Acid treatment): The seeds were soaked in concentrated sulphuric acid (H_2S0_4) for three different period (10, 20, and 30 minutes). After the soaking the seeds were removed, washed and rinsed in running tap water to remove any remaining acid.

Experiment 3 (Scarification treatment): Mechanical scarification filling treatment was followed by sand papering and cracking the seed very well. Seeds were scarified with sandpaper.

Experiment 4 (Control): Sweet dattock (*Detarium macrocarpum*) and Indian jujube (*Ziziphu smauritiana*) seeds sown without any pre-treatment served as control.

Data Collection

Seeds Germination was monitored for 40 days and data were collected on Days of emergence (Number of days taken for first emergence), rate of germination (Number of seeds germinated) and germination percentage.

Data Analysis

Data from germination were analyzed using descriptive statistics (percentages) and Analysis of Variance (ANOVA) using SPSS statistical package [11] and where significant different occurred among the means, least significant difference (LSD) were used for means separation.

3.0 RESULTS

3.1 Sweet dattock (*Detarium macrocarpum*)

Table 1: Germination ofSweet dattock (*Detarium macrocarpum*) in Hot water (HW)

HW treatment period/mins	Mean number of days taken for first emergence	Mean number of seed germinated	Germination percentage
10	6.00±0.00[b]	0.9333	93.33±11.54[a]
20	5.56±1.52[b]	0.9333	93.33±1154[a]
30	6.00±0.00[b]	1.00	100.00±0.00[a]
SE±	**0.00**		**0.00**
Sig	ns		ns

Mean followed by the same letter (s) along the same column are not significantly different (P>0.05), ns= not significant

Table 2: Germination of Sweet dattock (*Detarium microcarpum*) in sulphuric acid treatment

Sulphuric acid treatment period/mins	Mean number of days taken for first emergence	Mean number of seed germinated	Germination percentage
10	4.00±0.00[c]	1.00	100.00±0.00[a]
20	4.00±0.00[c]	0.9333	93.33±11.54[a]

30	4.00±0.00 c	1.00	100.00±0.00 a
SE±	**0.00**		**0.00**
Sig	ns		ns

Mean followed by the same letter (s) along the same column are not significantly different (P>0.05), ns= not significant

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Table 3: germination of Sweet dattock (*Detarium microcarpum*) in scarification treatment

Scarification treatment time	**Mean number of days taken for first emergence**	**Mean number of seed germinated**	**Germination percentage**
Scarification	4.00±0.00c	1.00	100.00±0.00a
SE±	**0.00**		**0.00**

Mean followed by the same letter (s) along the same column are not significantly different (P>0.05)

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Table 4: Germination of Sweet dattock(*Detarium microcarpum*) in control (no treatment)

Control (no treatment)	**Mean number of days taken for first emergence**	**Mean number of seed germinated**	**Germination percentage**
Control	8.00±0.00a		0.8666
SE±	**0.000**		**6.667**

Mean followed by the same letter (s) along the same column are not significantly different (P>0.05)

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Table 5: Germination of Indian jujube(*Ziziphus mauritiana*) in Hot Water (HW)

HW treatment period/mins	**Mean number of days taken for first emergence**	**Mean number of seed germinated**	**Germination percentage**
10	16.00±0.00a	0.3333	33.33±5.77 c
20	15.67±0.57 a	0.366	36.67±5.77 c
30	16.00±0.00 a	0.466	46.67±11.54 c
SE±	**0.00**		**0.00**
Sig	ns		ns

Mean followed by the same letter (s) along the same column are not significantly different (P>0.05), ns= not significant

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Table 6: Germination of Indian jujube(*Ziziphus mauritiana*) in sulpheric acid

H_2SO_4Sulpheric acid treatment period/mins	**Mean number of days taken for first emergence**	**Mean number of seed germinated**	**Germination percentage**
10	16.00±0.00 [a]	0.70	70.00±10.54 [b]
20	15.33±1.15 [a]	0.733	73.33±11.54 [b]
30	11.00±0.00[ab]	0.766	76.67±5.77 [b]
SE±	**0.000**		**16.00**

Mean followed by the same letter (s) along the same column are not significantly different (P>0.05)

Table 7: Germination of Indian jujube(*Ziziphus mauritiana*) in scarification

Scarifications treatment	**Mean number of days taken for first emergence**	**Mean number of seed germinated**	**Germination percentage**
	15.33±1.15 [a]	0.9333	93.33±5.77 [a]
SE±	**0 .667**		**3.333**

Mean followed by the same letter (s) along the same column are not significantly different (P>0.05)

Table 8: Germination of Indian jujube(*Ziziphus mauritiana*) in control

Control treatment	**Mean number of days taken for first emergence**	**Mean number of seed germinated**	**Germination percentage**
	5.67±9.81[b]	0.0333	3.33±5.77[d]
SE±	**5.667**		**3.333**

Mean followed by the same letter (s) along the same column are not significantly different (P>0.05)

The different pre-treatment showed substantial variation in germination percentage after eight days for Sweet dattock (*Detarium microcarpum*) and seventeen (17) days ofIndian jujube (*Ziziphus mauritiana*) (Table 1). For Sweet dattock (*Detarium microcarpum*) seed immersion in hot water 30 min had germination percentage of (100.00±0.00). While immersion in hot water for 10 min and 20 min had equal percentage of (93.33±11.54), but for Indian jujube (*Ziziphus mauritiana*) the percentage germination of seeds soaked in 100^0C hot water (table 5) for 30 min was significantly higher and gave percentage germination of (46.67±11.54) than those of all other hot water treatment of 10 m and 20 min. The seed treated with hot water at 100^0C for 10m gave germination percentage of (33.33±5.77) and for 20m gave (36.67±11.54)

Under sulpheric acid pre-treatment (Table 2) for Sweet dattock (*Detarium macrocapun*), seed treated with sulpheric acid H_2S0_4 10 min, and 30 min, gave the highest germination percentage of (100.00±0.00) and 20 min, soaking treatment observed for (93.33±11.54) while for Indian jujube(*Ziziphus mauritiana*), the percentage germination of seeds treated with 30 m, soaking of sulpheric acid was significantly higher for (97.67±5.77) than those for 10 min, that had (70.00±10.54) and for 20 min which gave (73.33±33.54) (table 6).

Sweet dattock (*Detarium microcarpum*) seeds mechanically scarified (Table 3). With sand paper had germination percentage of (100.00±0.00), as well as Indian jujube (*Ziziphus mauritiana*) also the germination percentage of all the scarified seeds had germination percentage of (93.33±5.77) (table 7).

Control (Table 4): of Sweet dattock (*Detarium microcarpum*) seeds sown gave (86.67±5.47 germination percentage, and for Indian jujube (*Ziziphus mauritan*) control gave percentage germination of (3.33±5.77) (table 8).

DISCUSSION

Seed dormancy occurs in many tropical tree species to varying degrees [5]. While various pre-treatment methods have been advocated to reduce dormancy and hasten germination, which was overcome with chemical and mechanical pre-treatments resulting in improved germination because Scarification of seed coupled with sulphuric acid and hot water treatments improved germination of these two species of Sweet dattock and Indian jujube(*Detarium microcarpum* and *Zizipus mauritiana*)can infer that dormancy of their seeds is physical and is related to the hard coat of the seed. There for this type of dormancy is primary concern.

Effect of hot water treatment on Sweet dattock (*Detarium microcarpum*) germination

The fact that hot water 30 min treatment, gave highest germination percentage (100.00±0.00) followed by hot water 10 and 20 minute that had 93.33±11.54 within shortest time indicate that the more rapidly the seed coat is ruptured, the faster the rate of germination. This is contrary to the findings of Gill *et al.,* [12] which stated that seeds of *Calliandra prototricensis* failed to germinate in hot water. It is also contrary to the work of Agboola and Etejere, [13] where the seeds of *Parkia biglobosa* treated with hot water showed the least performance in germination percentage as a result of its effect on the seed coat that must have ruptured or damaged the seed embryo, sudden dip of dry seed in boiling water may lead to the rupture of the seed coat allowing water to permeate the tissues causing physiological changes and subsequent germination of the embryo.This is in tandem with the observation of Robertson and small,[14] that over-soaking seeds in water may reduce germination through oxygen deficiency. However this result confirm the work of Owunubi*at el.,* [15] whose reported that soaking of *Azadrachta indica* seeds for one and two hours resulted in increasing rate of seeds germination and also corrobote the work of Ibrahim and Otegbeye [16] on the seeds of *Adansonia digitata*.

Effect of sulphuric acid (H_2SO_4) treatment on Sweet dattock (*Detariummicrocarpum*) germination

The result from this work supports the finding of Dugama *et al.,*[17] who noted that Sulphuric acid treatment is the most effective way of improving seed coat permeability in seeds of *Leucaena leucocephala*. In a similar study, Aliero [18] discovered that treatment of the seeds of *Parkia biglobosa* with sulphuric acid induced germination of seeds. Reports of earlier works on *Enterolobium cyclocarpum* [19], *Pilostigma reticulatum* and *Adansonia digitata* [20] found that treatment with acid significantly promoted germination of the species seeds. This finding is also similar to prior reports of Dachung and Verinumbe[21] that acid treatment of seed removes the waxy layer of the seed coat by chemical decomposition of the seed coat components that similar to breakdown processes where seed coat is ruptured, the faster the rate of germination. Nikoleave, [22] reported that sulphuric acid is thought to disrupt the seed coat and expose the lumens of the macroscleids cells.

Effect of scarification treatment on Sweet dattock (*Detariummacrocpum*) germination

The result of this work find out that mechanical scarification mechanical by sand paper had the highest speed of germination, which agrees with the report of Tomlinson and Nikiema[23] that seed dormancy resulting from an impermeable seed coat may be overcome by peeling off the coat. This is more so, since a very- wide spread course of seed dormancy is the presence of hard seed coat which prevents the entrance of water, exchange of gases and or mechanically constrained. Jacson [24] also found that as soon the seed coat is softened by scarification, the process of hydrolysis would commence to release simple sugars that could be readily utilized in protein synthesis, there by encouraging germination. According to Esenowo, [25], the most effective method of pre-treatment was scarification which gave 86% and 98% germination on *Parkia biglibosa*

Effect of (untreated seed) on germination of Sweet dattock (*Detariummicrocarpum*)

The seeds under control experiment gave the least percentage germination of *Detarium microcarpum* seed (86.67±11.54), and took a longer period to germinate (eleven days.) this disagreed with the result reported by El-Nour*et al.,*[26] were they found that control untreated of *Balanites aegyptiaca* seed gave significantly higher germination then seeds boiled in hot water.

Effect of hot water treatment on Indian jujube (*Zizizphus mauritiana*) germination

An assessment of hot water soaking duration on seeds of *Zizizphus mauritiana* indicate that hot water 30 minute gave the highest germination percentage of 46.67±11.54, followed by 20 minute that gave 36.67±5.77, then 10 minute which gave the least germination percentage of 33.33±5.77, but here was no significance difference between 10, 20, and 30 minute treatment. The result from this work supports the finding of Dugama *et al.,*[17] who noted that hot water is the most effective way of improving seed coat permeability in seeds of *Leucaena leucocephala*. But Gill *et al.,* [12] stated that seeds of *Calliandra prototricensis* failed to germinate in hot water. However, owunubi*at el.,* [15] reported that

soaking of *Azadrachta indica* seeds for one and two hours resulted in increasing rate of seeds germination corroboting the work of Ibrahim and Otegbeye [16] on the seeds of *Adansonia digitata*.

Effect of sulphuric acid treatment on Indian jujube (*Ziziphusmauritiana*) germination

Thirty (30) minute soaking in H_2SO_4 gave the highest germination percentage of 76.67±5.77, though there was no significant differences between the other 2 level (10, 20) which gave 70% and 73% respectively. This result is similar to Aduradola and Adidere, [19] on *Enterolobium cyclocarpum, Pilostigma reticulatum* and *Adansonia digitata* [20] found that treatment with acid significantly promoted germination of the seeds. This finding is also similar to prior reports of Dachung and Verinumbe[21] that acid treatment of seed removes the waxy layer of the seed coat by chemical decomposition of the seed coat components that, the faster the rate of germination. While Danthu*et al.,*[3]affirmerd that treatment with sulphuric acid for six to twelve hours led to germination of more than 90% of seeds within twenty days of sowing. Aleiro[18] concluded that 98% concentrated sulphuric acid gave the highest percentage of germination for *Parkia biglobosa* and within the shortest period of time. Agbogidi*et al.,*[27] noted that soaking of *Dacyodes edulis* seed in sulphuric acid H_2SO_4 reduce the germination period considerable and concluded that it was the best method, though, dangerous to handling.

Effect of mechanical of scarification treatment on Indian jujube (*Zizizphusmauritiana*) germination

Zizizphus mauritiana scarified with sand paper overcome dormancy and gave 93.33±5.77 germination. Mechanical scarification on the seeds of *Ziziphus mauritiana* course early germination (11 days) as against their normal period of dormancy which is 35-40 days. This is in agreement with earlier findings of Dugama*et al.,*[17] who observed that mechanical scarification is an efficient way of improving seed coat permeability of *Pterocarpus angolensis* and *Leucaenia leucocephala* seeds. Tomlinson and Nikiema[23] affirmed that seed dormancy resulting from an impermeable seed coat may be overcome by peeling off the coat. According to Agbogidi*et al.,*[27], the result of the study showed that scarification gave the highest mean percentage germination than either immersion in hot water or sulphuric acid, but there was no significant difference between one (96.67%) and two (86.67%) scratches for *Acacia sieberiana* but *Acacia seyel* recorded 83.33% and for one and two scratches.

This result also agrees with earlier report by Owunubi*at el.,* [15]on seed germination of *Pterocarpus osun* when subjected to filling and clipping at their micropyle end. Similarly Owunubi*at el.,* [15] stated that seeds of *Pinusbruatia*ger mination improved when it was rubbed with sand paper at the micropyle end. Dugama*et al.,*[17] affirmed that seed scarification is the most effective way of improving seed coat permeable in seed of *L. leucocephala.*

Effect of untreated seed on Indian jujube (*Zizizphus mauritiana*) germination

The lowest germination percentage was found for seeds in the untreated control which gave 3.33±5.77. This disagree which the result reported by El-Nour*et al.,*[26] where they found that control untreated seeds of *Balanitesa egyptiaca* had significantly higher germination then seeds boiled in hot water.

Conclusion

Result from this study showed that various pre-germination treatments stimulated and enhanced germination of this two species of Sweet dattockand Indian jujube (*Detarium microcarpum* and *Zizipus mauritiana*). For Sweet dattock (*Detarium microcarpum*) soaking the seed in hot water 100^0C for 30min and soaking the seed in sulphuric acid H_2SO_4 for 10min and 30min, and mechanical scarification of the seeds before sowing reduced the time taken for the seed to germinate, from 40 days to 11 days and gave the high germination percentage of (100.00±0.00).

It is evident that the seeds ofIndian jujube (*Ziziphus mauritiana*) have dormancy and would not germinate early and easily. Therefore the study of the Indian jujube(*Ziziphus mauritiana*) seed pre-treatment showed that seed mechanically scarified improved seed germination. Mechanical scarification can be concluded to be the best method for breaking dormancy of Indian jujube(*Ziziphus mauritiana*) which resulted in an increase germination percentage of 93.33±5.77 and gave the highly quality seedlings.

Recommendation

Soaking in hot water and sulphuric acid (H_2SO_4) for 10 minute each is recommended for effective pre-sowing treatment to promote germination of Sweet dattock (*Detarium microcarpum*) seed, while scarification is recommended as an effective pre-sowing treatment to promote germination of Indian jujube (*Ziziphus mauritiana*) seeds.

In addition hot water (100^0C) and scarification pre- sowing treatments should be adopted, in situation where the use of acid pre-sowing treatment might be limited by availability and risk factors.

Ethical: NA

Consent: NA

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Appendix

Plate 1: *Detariummicrocarpum*in Hot water 30 minute

Plate 2: *Detariummicrocarpum* in Sulphuric acid 10 minute

Plate 4: *Detariummicrocarpum* in Control (un treated seeds)

Plate 5*: Detarium microcarpum* seedlings

Plate 6: Experimental layout

Plate 7: *Zizipusmauritiana* (Scarification)

Plate 8: *Zizipusmauritiana* in hot water 30 minute

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Plate 9: *Zizipusmauritiana* in Sulpheric acid

Plate 10: *Zizipusmauritiana* in control