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Breaking of Dormancy and Its Effects on Seedling Establishment of Date Palm (Phoenix Dactylifera L.)

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Abstract
A study was carried out in the Botanical Garden of the Department of Plant Science and Technology, University of Jos, Nigeria, to determine the most effective method of breaking seed dormancy in Date palm (*Phoenix dactylifera* L.). The treatments comprised two types of seed (fresh; seeds less than six month old and the dry seeds were more than six months old) with four different methods of breaking seed dormancy (seeds soaked in acid for 5 minutes, 5 minutes in boiling water, 24 hours in cold water and mechanical scarification) and the control (seeds were not treated). The experiment was laid out in a completely randomized design and each treatment was replicated five times. Germination rate (%) was measured weekly for four weeks and seedling height (cm) was measured at 2 weeks interval (beginning from 35 days after planting) for a period of eight weeks. The results showed that the different methods of breaking seed dormancy enhanced the germination of the Date palm and seedling growth. The boiling and cold water treatments had significantly ($P<0.005$) higher germination rate of 100% at 42 days after planting than the control which had 86.67%. The dry seeds had a significantly ($P<0.05$) low (26.67) germination rate at 35 days after planting but, did not differ significantly with the fresh seeds at 35 DAP. The boiling water treatment also had a significantly ($P<0.005$) high seedling height (25.00 cm) at 77 days after planting. The control had the lowest seedling height of 6.72 cm at 35 days after planting. The seeds treated with acids for 5 minutes, did not germinate at all. The result indicates that optimum germination and seedling establishment in Date palms occurred in fresh seeds and the most effective method of breaking the dormancy is through the use of boiling water.
Keywords: Date palm (*Phoenix dactylifera* L.) seeds, breaking dormancy and Seedling establishment

1. Introduction

Date palm (*Phoenix dactylifera* L.) is believed to have been introduced into Nigeria in the early 8th Century by Arab traders from North Africa. Date fruit called 'Dabino' in Hausa is a highly valued delicacy among many communities in Nigeria, particularly the northern part of the country. The fruits are especially used during ceremonies, festivals and during breaking of fast among the Muslim faithful.

Despite the tremendous benefits that can be derived from growing *Phoenix dactylifera*, its cultivation in Nigeria has continued to be a challenge because of the difficulty of its establishment using seeds. Reports have it that most palm seeds have a poor record of germination success. Whereas, viable Date palm seeds can germinate between 14 and 21 days in ideal conditions, healthy date seeds may take as much as 100 days to germinate (Amy, 2010), because of dormancy problems.

Seed dormancy is defined as nature's way of setting a time clock that allows seeds to initiate germination when conditions are normally favourable for germination and establishment of the seedlings (Baskin and Baskin, 2004). Viable seeds that do not germinate are said to be dormant. Therefore, dormancy is a mechanism plants use to prevent germination during unsuitable conditions, that is, when the probability of seedling survival is low (Black and Halmer, 2006).

Different mechanisms used to break dormancy in nature include physical rubbing of the seed coat to make it thinner so that water and gases can diffuse into seed, seeds passing through the gut of animals, long wet and or frosty conditions and fire. However, some of the conventional methods used are scarification, treatment of seeds with chemicals like acids, soaking of seeds in water.

The inclusion of Date palm in the current tree planting campaign (Green Wall) across the country will produce useful results, as the Date palm tree naturally thrives in desert environment. The trees could effectively be used to curb desertification in the country while also serving as a cash crop. This can only be achieved by mass-production of the seedlings. This study is therefore, aimed at exploring the various methods of breaking seed dormancy in Date palm (*Phoenix dactylifera* L.) to enhance production.

2. Materials and Methods

2.1 Experimental site

The study was carried out in the Botanical Garden of the Department of Plant Science and Technology, University of Jos, Nigeria, located in the Jos North Local Government Area of Plateau State (08^0 53'E, 09^0 57'N; 1,159 m above sea level).

2.2 Source of Materials

The seeds (fresh; seeds within the age grade of one month and the dry seeds were more than more one month) used in the study were procured from the Jos Terminus Market, while the Tetraoxosulphate (vi) acid (H_2SO_4) was obtained from the Chemistry Laboratory of the Federal College of Forestry Jos, Plateau State. The polyethylene bags were also procured from Federal College of Forestry Jos.

2.3 Experimental Design

The trial was laid out in a completely randomized design with five replications. The treatments comprised two types of seeds (fresh and dry) and five pre-planting treatments; acid (seeds soaked in acid for 5 minutes before planting), scarification (seeds scarified before planting), ordinary water (seeds soaked for 24 hours in cold water before planting), boiling water at 100°C (seeds soaked in boiling water for 5 minutes before planting) and the control (seeds not treated).

2.4 Treatment Application and Planting of Seeds

Soil samples collected at the depth of 30 cm from Federal College of Forestry was mixed with manure (dried cow dung) in a ratio of 3:1 to improve the soil nutrients. Two kilogram (2 kg) of the mixed soil was weighed into the polyethylene bags before the seeds were planted.

Cleaned seeds (fresh and dry) of Date palm were soaked in cold water for 24 hours and in boiled water for 5 minutes in two separate beakers (50 ml capacity) labeled as fresh and dry respectively, before planting. For the acid treatment, the fresh and dry seeds of Date palm were also soaked in two separate beakers (50 ml capacity) labeled as fresh and dry, respectively for 5 minutes before planting. Some of the seeds were scarified by the use of sand paper. The seeds were gently rubbed between the sand papers to degrade the seed coat before planting. Control seeds were planted without any pre-planting treatments.

A minimum of ten seeds were planted in each polyethylene bag. A total of fifty (50) polyethylene bags were used for both the fresh and the dry seeds having twenty-five each. The experimental set up was watered daily. Weeding was done by hand-picking the weeds.

2.5 Data Collection and Analysis

2.5.1 Germination Rate (%)

After planting, the following observations were made. The number of germinated seeds was recorded weekly. The germination rate was computed as the ratio of germinated seeds to the total number of seeds planted (Okunlola *et al*., 2011) at 35, 42, 49 and 56 days after planting (DAP).

$$\text{Germination Rate (\%)} = \frac{\text{Number of germinated seeds at time, t}}{\text{Number of planted seeds at time, t}} \times 100$$

2.5.2 Seedling Height

The seedling height of the *Phoenix dactylifera* L. sampled was measured using meter rule and a string. The meter rule was placed from the base of the shoot to the tip of the plant.

Data collected were subjected to analysis of variance test (ANOVA) and the least significant difference (LSD) was used to compare the means.

3. RESULTS

3.1 Germination Rate (%) of *Phoenix dactylifera* L.

Table 1 and Figure 1 shows the effect of different methods of breaking seed dormancy on the germination rate of the fresh and dry seeds of *Phoenix dactylifera*. The result obtained showed that fresh seeds of *Phoenix dactylifera* had significantly ($P<0.05$) higher (100%) germination rate at 42 days after planting in the cold and boiled water treatments, than the dry seeds which had 86.67% in both the cold and boiling water treatments. The fresh seeds in the control treatment attained a 100% germination rate at 56 days after planting, while the dry seeds attained 86.67% germination rate at 56 days after planting. In the scarification method, the fresh seed recorded 86.67% and 93.33% germination rate at 42 and 56 days after planting, whereas the dry seeds recorded 60% and 86.67% at 42 and 56 days after planting, respectively (Table 1 and Figure 1). There was no germination from both the fresh and dry seeds of *Phoenix dactylifera* treated with tetraoxosulphate (VI) acid ($H_2 S0_4$) (Table 1 and Figure 1) probably because the acid have destroyed the embryo of the seeds.

Table 1: Effect of Pre-planting Treatments on the Mean Germination Rate (%) of *Phoenix dactylifera* L.

Treatment	Days after planting							
	35		42		49		56	
	Fresh	Dry	Fresh	Dry	Fresh	Dry	Fresh	Dry
Control	26.67±0.84	26.67±0.81	86.67±1.30	60.00±1.19	93.67±1.31	86.67±1.23	100.00±1.33	86.67±1.25
Acid (H_2SO_4)	0.00±0.84	0.00±0.81	0.00±1.30	0.00±1.19	0.00±1.31	0.00±1.23	0.00±1.33	0.00±1.25
Boiling H_2O (100°C)	42.67±0.84	40.67±0.81	100.00±1.30	86.67±1.19	100.00±1.31	86.67±1.23	100.00±1.33	86.67±1.25
Cold Water	40±0.84	26.67±0.81	100.00±1.30	86.67±1.19	100.00±1.31	86.67±1.23	100.00±1.33	86.67±1.25
Scarification	40±0.84	40.00±0.81	86.67±1.30	60.00±1.19	86.67±1.31	60.00±1.23	93.33±1.33	86.67±1.25

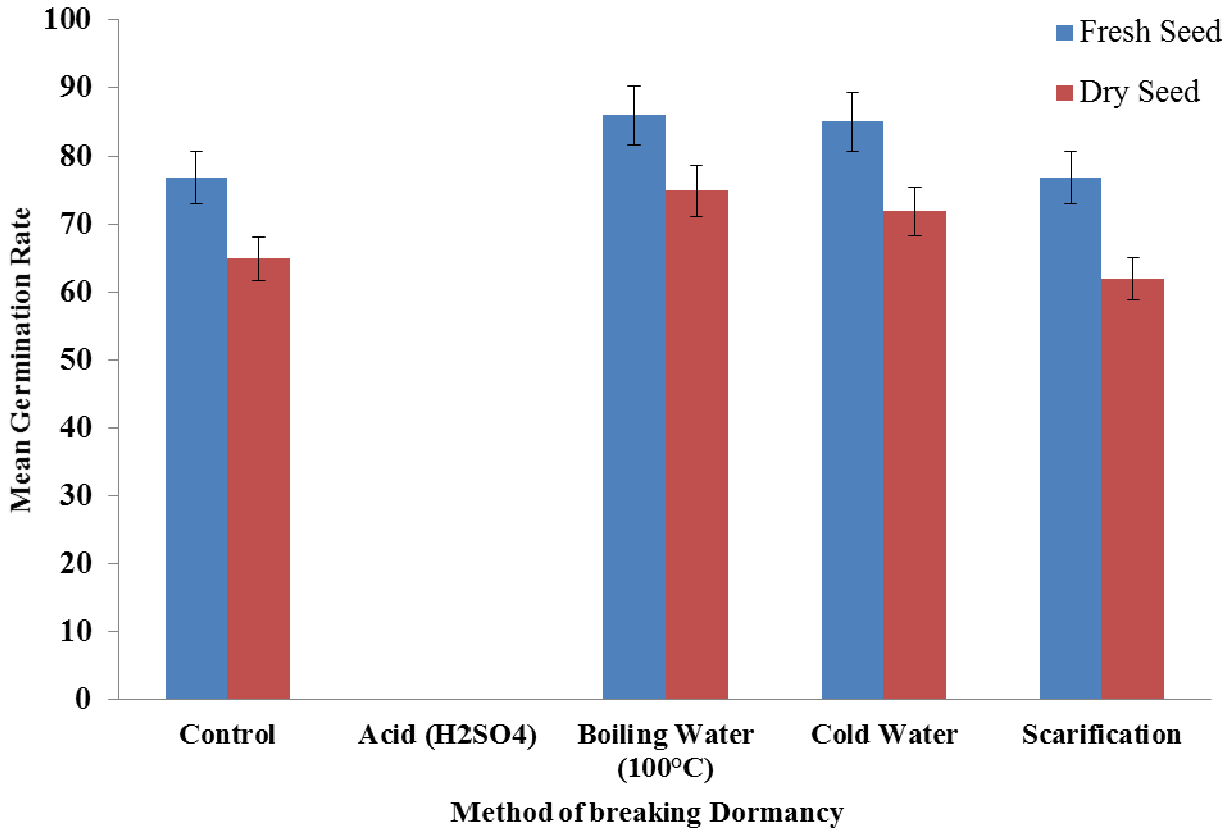

Figure 1. Effect of Method of breaking Dormancy on Mean Germination Rate of Fresh and Dry seeds of *Phoenix dactylifera* L.

3.2 Seedling Height (cm) of *Phoenix dactylifera* L.

The mean seedling height of *Phoenix dactylifera* L. as affected by the different methods of breaking seed dormancy is presented in Table 2 and Figure 2. The results showed that mean seedling height increased with time in all the treatments. The fresh seeds soaked in boiling water (100°C) treatment had a significantly ($P<0.05$) higher mean seedling height of 25.00 cm at 77 days after planting than the dry seeds in the control which had 6.72 cm at 35 days after planting (Table 2). It was closely followed by cold water treatment which had the mean seedling height of 24.26 cm for fresh seeds at 77 days after planting. The scarification treatment performed better than the control in both the dry and the fresh seeds throughout the period of this experiment, but the differences were not significantly ($P<0.05$) different at 49, 63 and 77 days after planting. There was germination in the seed treated with tetraoxosulphate (VI) acid (H_2SO_4). It was observed that the fresh seeds of *Phoenix dactylifera* L. performed better than the dry seeds in all the treatment combinations (Table 2 and Figure 2).

Table 2: Effect of Pre-planting treatments on the Mean Seedling Height (cm) of *Phoenix dactylifera* L.

Treatment	Seedling Height (cm)							
	35		49		63		77	
	Fresh	Dry	Fresh	Dry	Fresh	Dry	Fresh	Dry
Control	7.44b	6.72a	13.94c	11.64b	18.40b	16.14cd	22.98b	22.98b
Boiling Water (100°C)	9.22a	8.02a	16.40a	14.84a	20.50a	19.64a	25.00a	24.32a
Cold Water	9.00a	8.02a	15.16b	14.10a	19.42a	18.76a	24.26ab	23.34ab
Scarification	8.16a	7.62a	14.16c	13.62a	18.74b	18.72a	23.76ab	23.22ab
L. S. $D_{0.05}$	1.59	1.45	0.37	0.89	1.46	1.22	1.27	1.30

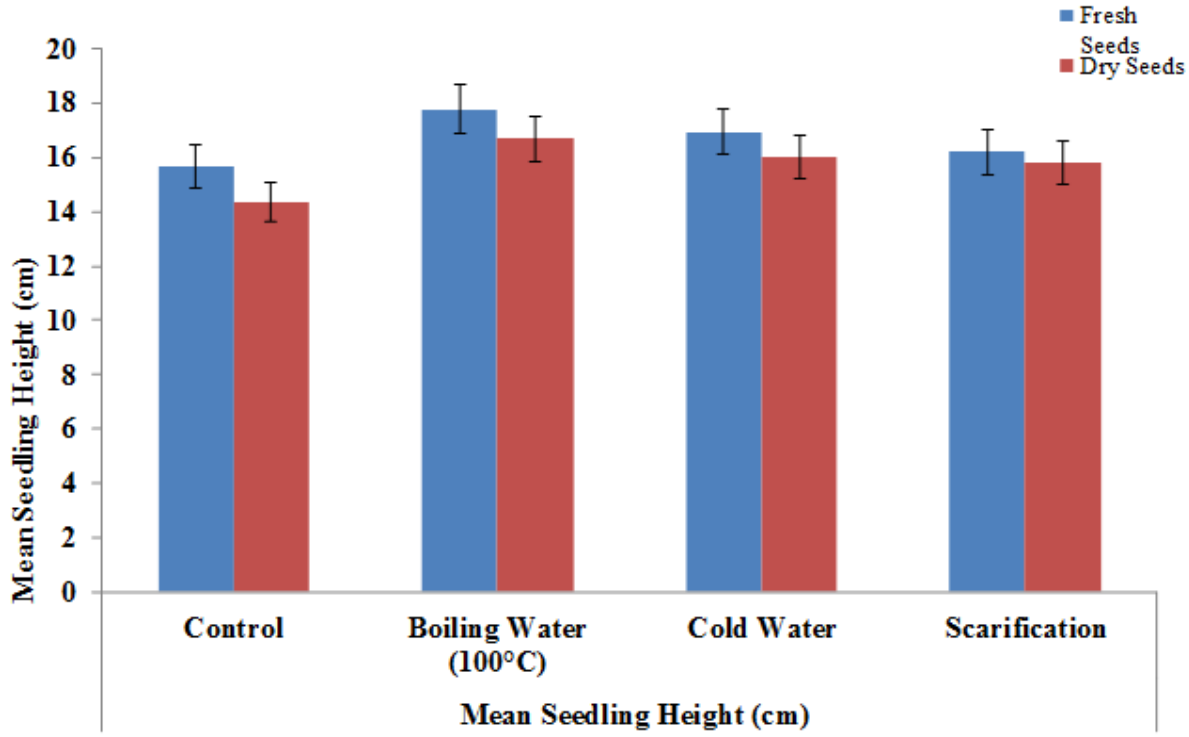

Figure 2. Effect of Method of Dormancy Treatment on Mean Seedling Height of Fresh and Dry seeds of *Phoenix dactylifera* L.

4. Discussion

The increase in germination rate and plant height of Date palm with the different pre-sowing treatments from this study could be attributed to the removal of the cuticle of the seed coat by the various methods of breaking dormancy used. Altering the seed coat either by scarification or soaking in cold/hot water enhances the permeability of the seeds to water and gases, which resulted in early germination and subsequent establishment of the seedlings (Vleeshouwers *et al*., 1995). Germination rate and seedling height were increased by soaking of seeds of some economic forest trees (*Parkia biglobosa* and *Terminalia ivorensis*) in cold/hot water (Agboola, and Etejere, 1991; Oni, 1991; Okunlola *et al*., 2011). The inability of the seeds immersed in the acid for 5 minutes to germinate at all, could be due to its deleterious effects on the embryo of the seeds. Okunlola *et al*. (2011) reported that immersion of seeds of *Parkia biglobosa* in H_2SO_4 for 5 minutes could either be insufficient to break dormancy or lead to damage of the embryo, depending on the integumental resistance of the seeds.

Differences in the response of the fresh and dry seeds to the methods of breaking dormancy used were also observed in this study. Although the fresh and dry/dry seeds responded positively to the pre-planting treatments, the fresh seeds performed better. Storage durations and methods are known to affect seed viability. This could be responsible for the low performances of the dry seeds. The longer a seed stays in a store, the less viable it becomes.

5. Conclusion

It could be deduced from this study that fresh seeds of Date palm are to be used for optimum germination and the use of cold/boiling water is effective in promoting their germination. However, more work needs to be done to investigate the effect of tetraoxosulphate (VI) acid in breaking seed dormancy in Date palm.

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