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The Effect of Priming and Artificial Dormancy Breaking Techniques on Germination and Seedling Establishment of Date Palm

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Research Article

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ABSTRACT

Effect of Priming and Artificial Dormancy Breaking Technique in Date Palm (*Phoenix dactylifera* L) was a study conducted in Sokoto metropolis, Sokoto. The treatments were made up of two (fresh and dry) seed with five different methods of breaking seed dormancy, seeds were soaked in acid (NHO_3), boiling water, cold water and scarified mechanically while control seeds were not treated. Experiments were laid out in a completely randomized design (CRD) and each treatment was replicated two times. Germination rates were measured weekly (%) for four weeks and seedling height (cm) was measured at 2 weeks interval beginning from 29 days after sowing in a period of eight weeks. Higher germination rate of 100% was observed in the fresh seed treated with cold water and boiled water while scarified seed showed (93.33%) then seed treated with acid (NHO_3) showed (0.00%) at day 50 after sowing. No significant difference observed between the treatments (P>0.05). The height of the plants was also measured after germination at day 71 after sowing. It was found that the control of the fresh and dry seed had 22.98 cm height, seed treated with boiled water showed 26.00 and 24.32 cm for the fresh and dry seed respectively; dry and fresh seed treated with cold water showed 24.26 and 23.22 cm respectively and lastly, scarified dry and fresh seeds attained 23.76 and 23.22 cm respectively. The results indicated an optimum germination and seedling establishment in Date palms occurred in fresh seeds. It is recommended that the number of days should be increased in each treatment before planting so as to identify if there is significant different between fresh and dry seeds for the effect of priming and artificial dormancy breaking technique in date palm using various treatment.

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. Date palm fruits are especially used during ceremonies, festivals and during breaking of fast among the Muslim faithful. The species name dactylifera means `finger- bearing` which refers to the fruit clusters produced by this plant. The Greek word `dactylus` means `finger` and the latin word ferous, means `bearing [1].

Looking at the tremendous benefits that can be derived from growing *P. dactylifera*, there is continues challenge of cultivation in Nigeria and difficulty of its establishment using seeds. Reports have shown that most palm seeds have a poor record of germination success. Whereas, viable date palm seeds can establish itself between 14 and 21 days in an ideal conditions, healthy date seeds can require up to 100 days to germinate [2], due to its dormancy problems.

Seed dormancy can be defined as the nature's means of setting a time clock that may allow seeds to initiate germination when conditions become favorable for germination and establishment of the seedlings [3]. Therefore, dormancy is a mechanism plants use to prevent germination during unsuitable conditions, that is, when the probability of seedling survival tends low [4].

Many mechanisms are 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.

Making Date palm to be part of the current tree planting campaign (Green Wall) across the country will yield useful results, as the tree naturally thrives in desert environment. While also serving as a cash crop, the trees could effectively be used to curb

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desertification in the country. It can be achieved through mass-production of the seedlings. This study is aimed at exploring the various methods of breaking seed dormancy in Date palm (*P. dactylifera* L.) to enhance production. Date palm (*P. dactylifera* L.) is considered the oldest fruit tree in the world. It has been cultivated in North Africa and the Middle East for millennia, although the exact origin of date palm has not been verified [5]. Some reports cite that it has been used since 4000 BC in Mesopotamia and by the Egyptians since 2000-3000 BC [6]. Therefore, date palms are plants that are equally well adapted to environmental disturbances as other plants which tend to have such features. Date palm (*Pheonix dactylifera* L.) can thrive under the conditions generated by the agriculture field practices of tillage, irrigation, fertilization, and row spacing that minimize normal growth-limiting stresses of drought, low fertility, limited light, and high pest levels. Dates play an important role in the social life of the people who live in these regions [7] both in their diet and medicinally for treating e.g., obesity [8].

There are more than 2000 different cultivars of date palm known worldwide but only a few of them have been used for their agricultural productivity and fruit quality [9]. Botanically, date palm is a monocotyledonous plant that belongs to the Arecaceae (previously known as Palmaceae or Palmae) family which contains 200 genera and more than 2000 species [10].

There are many species of the genus Phoenix, but the species of Phoenix dactylifera is the one most cultivated for their edible fruits, whereas other species produce fruits which can be used by animals and birds [11]. And they also produce an annual average yield of between 400-600 and 100-150 kg/tree for fresh crop and dry crop respectively [12]. There are more than 100 million date palm trees throughout the world. Fruits production from the trees starts at an average age of 5 years after established, with their production lasting up to 60 years [12].

The aim of this research work was to study the Effects of priming and artificial dormancy breaking techniques on germination and seedling establishment of date palm.

METHODOLGY

Study area

This study of Effects of priming and artificial dormancy breaking techniques on germination and seedling establishment of date palm was carried out in Biological Sciences laboratory of Sokoto State University, Sokoto, Sokoto State. Located to the extreme northwest of Nigeria, between latitudes 11°30' N and 13°58' N and longitudes 4°8' E and 6°54' E. It is boarded with the Republic of Niger to the north, Kebbi State to the west and southwest and Zamfara State to the east. Sokoto is on altitude of 308 m above sea level and is within Sudan Savannah ecological zone [13]. The climate is hot, semi-arid type and characterized by long dry season from October to May and short raining season from June to September with an annual mean of 724 mm for a period of six months. The mean monthly temperature ranges between 15°C in December and 40°C in April. The mean annual temperature averaged 27°C [14]. Therefore, the coolest months are November and January while the hottest months are March and May.

Source of materials

The seeds (fresh seeds within the age grade of one month and the dry seeds were more than one month)used in the study were procured from the Shehu Shagari Central Market, Sokoto , while the nitric acid was obtained from the Chemistry Laboratory of the Sokoto State University, Sokoto, State. The polyethylene bags were also procured from Floristry.

Experimental design

The trials were laid in a Completely Randomized Design (CRD) using five replications. The treatments is made up of two types of seeds (fresh and dry) and five pre-sowing treatments; acid (seeds soaked in nitric acid for up to 5 minutes before sowing), scarification (seeds scarified before planting), normal untreated water (seeds soaked for 24 hours in cold water before sowing), boiled water at about 100°C (seeds soaked in boiling water for 5 minutes before sowing) and the control (seeds not treated).

Treatment application and planting of seeds: Soil samples collected at the depth of 30 cm from Sokoto State University was mixed with manure (dried sheep droppings) at a ratio of 3:1 to help in improving the soil nutrients. 1.5 kg of the mixture of soil was weighed in a polyethylene bags, wet for three days before sowing the seeds.

The purified seeds (fresh and dry) of Date palm was soaked in cold water for up to 24 hours and in boiled water for up to 5 minutes into two separate beakers (50 mL capacity) labeled as fresh and dry respectively, before sowing. 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 sowing. Some of the seeds were scarified by the use of sandpapers in order to degrade the seed coat before sowing. The seeds were gently rubbed between the sand papers to degrade the seed coat before sowing. Control seeds were sowed without any pre-sowing treatments.

A minimum of ten seeds were sowed in each polyethylene bag. A total of ten polyethylene bags were used for both the fresh and the dry seeds having ten each. The experimental set up was watered daily. Weeds removal also involved hand picking.

Data collection and analysis

Germination rate (%)

After sowing, the following observations were made. The number of germinated seeds was recorded weekly. The germina-

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tion rate was computed as the ratio of germination seeds by the total number of seeds sowed [15] at 29, 36, 43 and 50 days after sowing (DAS).

Germination Rate (%)=Number of germinated seeds at time, t X 100.

Number of sowed seeds at time, t.

Seedling height

The seedling heights of the *P. dactylifera* L. samples were measured by using meter rule and a string. The meter rule was placed between the base of the shoot up to the tip of the plant.

Statistical analysis

Data collected was subjected using analysis of variance test (ANOVA) and the least significant difference (LSD) was used to compare the means. Genstat statistical package [16] was used for the analyses. The level of significance was set at $p<0.05$.

RESULTS

Germination rate (%) of *P. dactylifera* L.

After 50 days of pre sowing, it was observed that, for the fresh seed, boiling water and cold water treatments showed the same effect with the control (100.00%) followed by scarified treatment (93.33%) then acid (NHO_3) treatment (0.00%). However, there was no significant difference for the effect of the treatments on pre-sowing of fresh *P. dactylifera* L. Seed. Similarly, for the dry of *P. dactylifera* L. Seed, it was found that, control, boiling water, cold water and scarified treatments attained 86.67% as compared with the control of the fresh seed while the seed treated with acid (NHO_3) showed 0.00% and there was no significant different ($P>0.05$) **(Table 1)**

Table 1: Effect of Pre-sowing Treatments on the Means Germination Rate (%) of *P. dactylifera* L. At 50 days.

Treatment	Fresh *P. dactylifera* L.	Dry *P. dactylifera* L.
Control	100.00 ± 1.33	86.67 ± 1.25
Acid (NHO_3)	0.00 ± 0.00	0.00 ± 0.00
Boiling H_2O (100°C)	100.00 ± 1.33	86.67 ± 1.25
Cold Water	100.00 ± 1.33	86.67 ± 1.25
Scarification	93.33 ± 1.33	86.67 ± 1.25

Seedling Heights (cm) of *P. dactylifera* L.

The results showed that mean seedling height increased with time in all the treatments. After 71 days of after germination, it was observed that, It was found that the control of the fresh and dry seed had 22.98 cm height, seed treated with boiled water showed 26.00 and 24.32 cm for the fresh and dry seed respectively; dry and fresh seed treated with cold water showed 24.26 and 23.22 cm respectively and lastly, scarified dry and fresh seeds attained 23.76 and 23.22 cm respectively, there was a significant different ($P>0.05$) between the treatments shown in **Table 2** below.

Table 2: Effect of Pre-sowing treatments on the Mean Seedling Height (cm) of *P. dactylifera* L. After Germination at 71 days.

Treatment	Fresh *P. dactylifera* L.	Dry *P. dactylifera* L.
Control	22.98	22.98
Acid (NHO_3)	26.00	24.32
Boiling H_2O (100 ° C)	24.26	23.34
Cold Water	23.76	23.22
Scarification	22.98	22.98
L. S. $D_{0.05}$	1.27	1.3

DISCUSSION

This research demonstrated the effectiveness of various methods of seed breaking dormancy on *P. dactylifera* seeds. Results indicated that seed dormancy in *P. dactylifera* comes from hardiness of seed coat. These results is the same with that of [13] who also reports that seed dormancy in *Parkia biglobosa* (known as daddawa in hausa) was related with the hardness of the seed coat. The rise in the germination rate of the date seeds could be associated with the removal of the cuticle and softening of the seed coat from the different methods tested for breaking seed dormancy of *P. dactylifera*. Treatment of seeds with boiled water was found to induce the highest germination rate compared to the other four treatments. This could largely be attributed to the influence of the boiled water that acted on the seed coat. This also may have penetrated the seed coat and inhibited the chemical compounds causing the dormancy. Much more possible explanation for the high germination rate in boiled water compared to the other treatments was likely due to the high temperature of the boiled water. This was observed to be in line with other studies [14], who also observed boiled water increased in the rate of germination by its action on the seed coat, consequently breaking down the bonds between the chemical compounds in the seed coat responsible for causing dormancy [15].

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On the other hand, seeds treated with cold water showed progressive germination rate throughout the days after soaking. This is probably because the germination rate of the seeds was determined by how long the seeds are soaked in cold water considering the fact that the temperature of the cold water was low, compared to the action of hot water. Similar finding was reported by [16]. However, at 36 days after planting, it was noted that nearly all seeds in all the treatment conditions showed more than 75% germination rate except those treated with nitric acid (showing 0%). The inability of the seeds immersed in the acid for 5 minutes to not germinate at all, could be due to its deleterious effects on the embryo of the seeds [13] 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. Furthermore, the probable explanation for this might be fresh seeds has a shorter dormancy period, compared to dry seeds [17]. In addition, from a physiological perspective, there could be differences in the embryonic development stages between fresh and dry.

Differences in the response with the fresh and dry seeds to the methods of breaking dormancy used were also observed in this study. Although the fresh and dry seeds responded positively to the pre-planting treatments, but 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.

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 nitric acid in breaking seed dormancy in Date palm.

RECOMMENDATIONS

i. The use of hot and cold to overcome *P. dactylifera* seed dormancy is crucial especially for local farmers, and large-scale date palm cultivators.

ii. The experimental methods used in this study should be tried in the natural environment (field) to observe the influence of different soil types on the germination rate of date palm seedlings.

iii. At genetic and molecular levels, further research should be of essence to find out if the use of nitric acid could change the DNA sequence of the *P. dactylifera* which may possibly cause mutation in the form of chemical mutagen and become lethal.

iv. Further research should be carried out to see the effectiveness of different methods of breaking seed dormancy on the seedling growth of date palm, such as seedling vigor.

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