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EFFECT OF PRE-GERMINATION TREATMENTS AND POTTING MIXTURES ON GERMINATION AND SEEDLING EMERGENCE OF FOUR CULTIVARS OF DATE PALM IN SOKOTO STATE, NIGERIA

S. Abdullahi[1], S.A. Yahaya[1] and B. Ahmed[2]

[1]Department of Forestry and Environment, Usmanu Danfodiyo University Sokoto, Nigeria
[2]Department of Forestry and Wildlife Management Federal University Dutse, Jigawa State

ABSTRACT

Date palm production is widely limited by poor stand establishments and nutrient deficiencies especially in drought prone environment. This experiment was conducted in Forestry and Fisheries Laboratory for Germination test and at Agricultural Research Farm of Usmanu Danfodiyo University Sokoto, Nigeria to determine the effect of pre-germination treatments and potting mixtures on germination and seedling emergence of four cultivars (Nifor hybrid1, Nifor hybrid 2, Deglet, and Trigal) of date palm. Seeds of the study species were soaked in hot water for 0, 5, 10 and 15 minutes and cold water for 0, 6, 12 and 24 hours. Two potting mixtures were also used (River sand and Farmyard Manure, River sand and poultry droppings) in 2:1 ratio, respectively. Fifteen days after soaking (DAS) Deglet and Trigal soaked in hot water had significantly higher ($P<0.05$) germination percentage (80% each) at 5 and 10 minutes respectively, while Nifor hybrid 1 and Deglet soaked in cold water gave the highest germination (70% each) at 6 and 24 hours respectively. River sand and poultry droppings gave significantly higher ($P<0.05$) seedling emergence (80-100%) in all the study species. It is therefore concluded that, Soaking (hot and cold water) for 5 minutes and 24 hours respectively could be used to accelerate and improve seeds germination while River sand and Poultry droppings in 2:1 ratio proved to be promising for seedling emergence of this important tree species.

Keywords: Date palm; pre-germination treatments; potting mixtures

INTRODUCTION

Date palm (*Phoenix dactylifera L.*) is a monocotyledonous plant belonging to the family *Arecaceae* which contains 200 genera and more than 2000 species (Diaz *et al.,* 2003). It is suggested that date palm originated from Mesopotamia since 4000 BC, and by the Egyptians since 2000-3000 BC (Manickavasagan *et al*., 2012). Date palm is considered the oldest fruit tree in the world (Zaid and De Wet, 1999), and is distributed in tropical and subtropical regions where it has been cultivated in North Africa and the Middle East for millennia. (Mrabet *et al*., 2008). Dates play a vital role in the socio-economic well-being of

the people living in the aforementioned regions and elsewhere. In addition, date palm plays instrumental role in their daily diet and in treatment of several diseases, e.g. treatment of abdominal problems, ulcer and inflammation (Suleiman *et al*., 2012). Date palm (*Phoenix dactylifera L*.) plays an important social, environmental, and economic role for many people living in arid and semiarid regions of the world. Fruits of the date palm are very commonly consumed in many parts of the world and considered as a vital component of the diet and a staple food in most Arab countries (Al-Farsi and Lee, 2008).

The world production of dates has increased from about 4.6 million tons in 1994 to 7.68 million tons in 2010, with expectations of continuous increase (Al-Farsi and Lee, 2008). Nearly 2000 cultivars of date palm are known in the world, but only some have been evaluated for their performance and fruit quality. The importance of fruits as a source of nutrient has attracted attention of various researchers throughout the world, especially in Nigeria. However, most Date palms propagated by seeds usually produce a differentiated population with no two palm seedlings alike, and so decreases the chances of producing quality fruits (Moustapha *et al*., 2010). Major issues for consideration in Date palm establishment in Nigeria include, lack of high-quality date cultivars, lack of appropriate silvilcultural /propagation techniques and poor technical know-how which are necessary for Date palm cultivation (Anhwange *et al*., 2004; Hassan and Umar, 2004; Umar *et al*., 2007)

Germination is a complex process that is controlled by several biological (species, seed viability, seed dormancy, seed size) and environmental (moisture availability, temperature, relative humidity, light intensity and duration) factors. Since plant species vary in their response to these factors, hence the need to identify the appropriate pre-germination treatments and potting mixtures that fit within the climatic conditions and production system of the study area for optimum production of these important species.

MATERIALS AND METHODS

Study Area

Germination test was conducted in the Forestry and Fisheries laboratory of Usmanu Danfodiyo University Sokoto (Situated between Longitude 5^0 11'E to 5^0 14'E and Latitude $13^0$8'N to 137'N (Annonymous, 2015). Seedling emergence counts was carried out at Agricultural Research Farm, Usmanu Danfodiyo University, Sokoto, Permanent site in Wamakko Local Government Area of Sokoto State, Nigeria on Latitude 13^0 12N, and Longitude 5^0 12E (SERC, 2014). Sokoto lies between Longitude $4^0$8'E to $6^0$54'E and latitude 12^0N to $13^0$58'N with an altitude of 351m above sea level within Sudan Savanna Region of Nigeria. The climate of the area is hot, semi-arid tropical type. It is characterized by a long and severe dry season lasting from October to May, and short but intensive wet season from May/June until September. The rainfall pattern is characteristically distributed with a peak in August. Sokoto falls under the Sudan savanna agro-ecological zone. The area has annual rainfall range of 550-700 mm and mean annual temperature ranging from 38 to 42^0C or more around April. The lowest mean temperature in December-January (Harmattan period) is about 13-15^0C. The mean maximum temperatures are highest generally from Mach to June. The mean relative humidity reaches its peak of over 90% in August and lowest in December and January (10-30%) (SERC, 2014). There are hot humid days during the raining days (Adejuwon, 2016). The soil of the area is sandy-loam. Wind direction is North-West and south-west for dry and wet seasons respectively (SERC, 2014).

Treatment and Experimental Design

Treatments consisted of factorial combination of four date cultivars (Nifor hybrid1, Nifor hybrid 2, Deglet, and Trigal) two pre-treatments (Soaking in Hot water for 0,5, 10 and 15 minutes/Soaking in cold water for 0, 6, 12 and 24 hours) laid out in completely randomized design (CRD) replicated three (3) times. Two potting mixtures were used viz; River sand and Poultry droppings, River Sand and Farm yard manure in 2:1 ratio respectively.

Germination Test

Four seed cultivars (Nifor hybrid1, Nifor hybrid 2, Deglet, and Trigal) were sourced from National Institutes for Oil Palm Research (NIFOR), Out Station, Jigawa State, and the germination test was carried out in the Forestry and Fisheries Laboratory, Usmanu Danfodiyo University, Sokoto. The seeds (were soaked in Hot for 0, 5, 10, and 15 minutes and Cold water for 0,6,12 and 24 hours. The pre-treated seeds were washed each and every day until they germinated. A seed was considered germinated if the radical breaks and opens the seed coat (exposed).

Potting Mixture and Sowing

The experimental site was well levelled manually using hoe and rake. Polythene pots of 15×20 cm sizes were used with two different potting mixtures viz; River sand and poultry droppings, River sand and Farmyard manure in 2:1 ratio, respectively. Planting was done using hand to make a small hole and the pre-treated seeds were planted into the polythene pot.

Data collection

Field Emergence Count

This was done by counting the number of seedlings that emerged out of the soil.

Germination Count

Germination was observed and recorded at 15 days after sowing (DAS), and germination rate was computed according to Okunlola *et al*. (2011) using the following formula:

$$Germination\ percentage = \frac{Total\ seeds\ germinated}{Total\ seeds\ soaked}\ X\ 100$$

Emergence count

Seedling Emergence was observed and recorded at 15 DAS. Seedling emergence was computed according to Okunlola *et al*. (2011) using the following formula:

$$Emergence\ percentage = \frac{Total\ seedling\ emerged}{Total\ seeds\ sown}\ X\ 100$$

Data Analysis

Data collected were analyzed using descriptive statistics representing the germination and Emergence percentage of the study species. Graphical assessment of the significant differences was achieved with the aid of bar charts with error bars using MS Excel chart module.

RESULTS AND DISCUSSION

Germination Percentage of *P. dactylifera* Seeds

Various silvilcultural treatments on germination and seedling emergence of *P. dactylifera* seeds were tried and the results in Figures 1 & 2 show how seeds responded to different pretreatment methods. In hot water treatments it was observed in Figure1 that, control treatment took 15 days after germination to reach 40% germination in all the cultivars except for Nifor hybrid 2 with 30% germination. Deglet and Trigal recorded significantly higher ($P<0.05$) germination percentage (70-80%) in hot water treatments for 5,10 and 15 minutes, while Nifor hybrid 1 and 2 recorded the least at 5,10 and 15 minutes (30%-40%). Cold water treatments at 15 days after germination and control treatments in all the cultivars recorded 40% germination percentage. Except in Nifor hybrid 2 with 30% (Figure 2) Nifor hybrid 1, Deglet and Trigal soaked in cold water for 6,12 and 24 hrs having similar value (60-70%) which produced higher ($P<0.05$) values compared to Nifor hybrid 2 that gave the least germination percentage. The trend of the results is in line with other studies (Al-Fredan and Ali, 2008; Dewir *et al*., 2011) who observed that hot water increased the rate of germination by its action on the seed coat of *Sabal palmetto* and *Thrinax morrisii* palms, consequently breaking down the bonds between the chemical compounds in the seed coat responsible for causing dormancy. Similarly, 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 (ordinary room temperature 15-25^{0}C), compared to the action of hot water. Similar finding was reported by Vleeshouwers *et al*. (1995). Singh *et al*. (2010) also reported that, the rate of germination in *Rhododendron niveum* increases with increasing temperature, and then decreased at temperatures above 25^{o}C. 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).

It was noted that nearly all seeds treated with hot and cold water showed more than 30% germination rates but the highest germination percentage recorded in hot water treatments was from Deglet and Trigal (80% each at 5 and 15 min.). On the other hand, in cold water the highest percentage was recorded in Nifor hybrid 1 and Deglet (70% each at 6 and 24 hrs.) confirming the effectiveness of all the pretreatments methods in breaking seed dormancy for *P. dactylifera*. With respect to varieties, Trigal soaked in Hot water was observed to respond more to the different treatments, compared to other varities soaked in hot water. The probable explanation for this might be that Trigal has a shorter dormancy period, compared to other date cultivars (Bewley and Black, 2012).

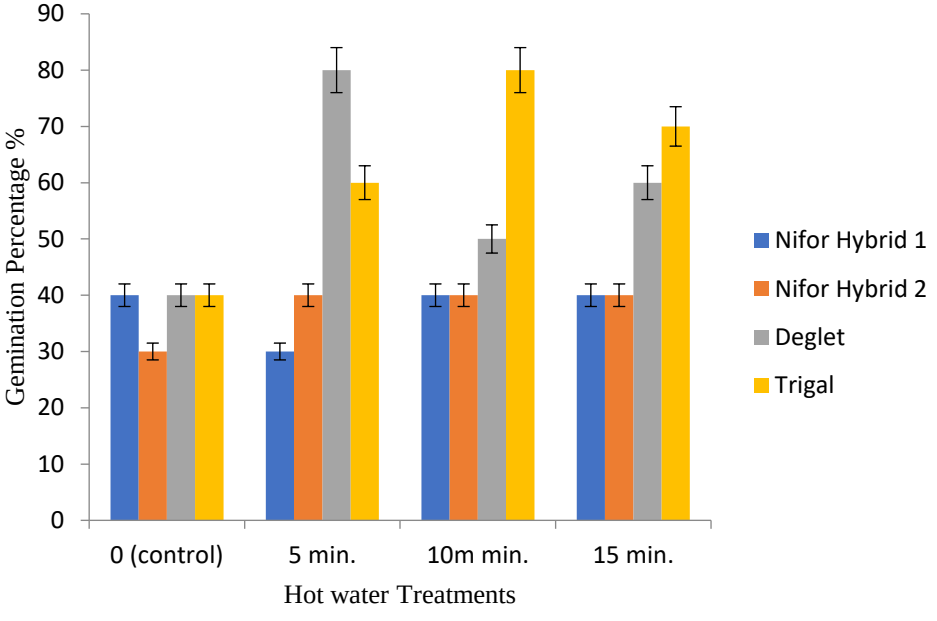

Figure 1: Effect of hot water treatments on seeds germination of four Date palm cultivars at 15 days after germination

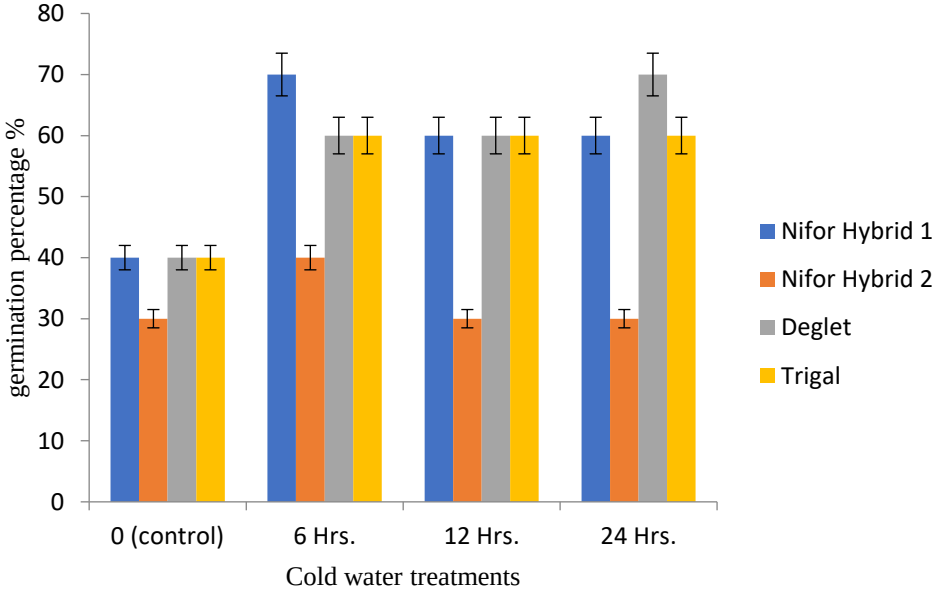

Figure 2: Effects of cold water treatments on seeds germination of four Date palm cultivars at 15 days after germination

Seedling Emergence of *P. dactylifera*

The study revealed that all the treatments had an effect on seedling emergence of *P. dactylifera*. However, seedlings treated with hot water had less emergence percentage when compared to cold water treatments. In hot water treatments (figure 3), control took 15 DAS to reach 50% emergence in all the cultivars. However, at 10 and 15 minutes Nifor hybrid 1 and Trigal recorded significantly higher ($P<0.05$) emergence (83.33 - 85.70%). The least emergence was recorded at 15 minutes in Nifor hybrid 1 (62.50%). For cold water treatment, it was observed that control took 15 DAS to attained 50% emergence in all the cultivars (Figure 4). Subsequently, at 12 and 24 hours Nifor hybrid 1 and Deglet was recorded significantly higher ($P<0.05$) (80-100%) emergence. The least emergence was recorded in Nifor hybrid 2 (60-62%). This is not surprising because as stated earlier, hot water treatments had the greatest influence on the seed germination rate. This facilitated early germination rate could have caused the seeds soaked in hot water to lose their stored food reserve (food substances) in the endosperm. This agrees with Nedeva and Nikolova (1999) who stated that as a seed develops, it uses up the reserve food material stored in the endosperm.

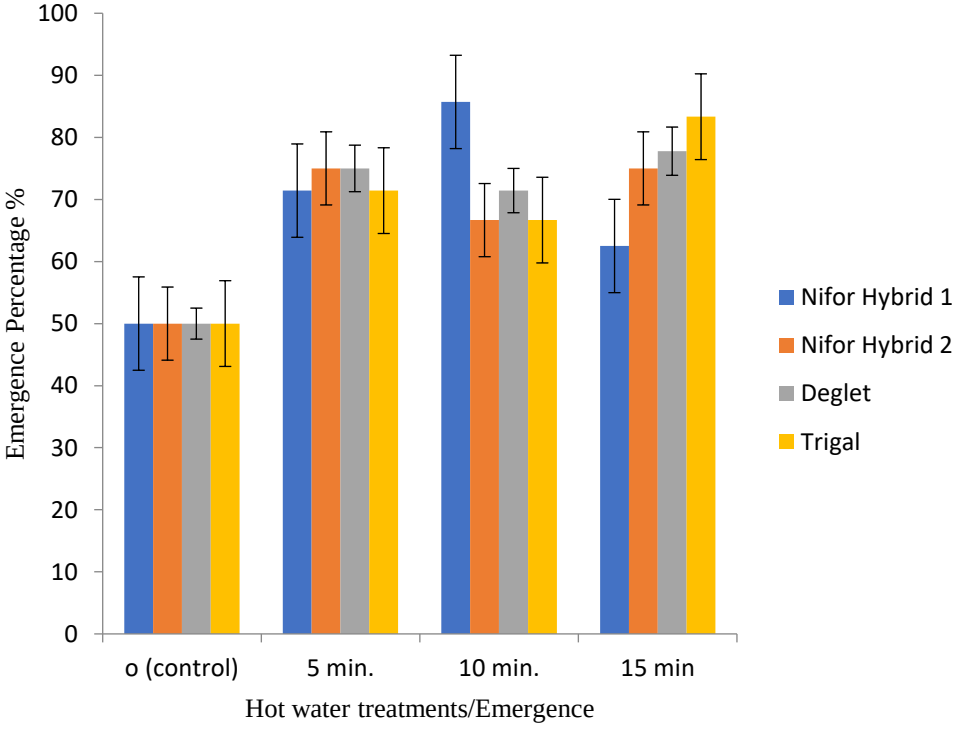

Figure 3: Effect of hot treatments on seedling emergence of four Date palm cultivars using river sand and poultry dropping at 15 days after sowing

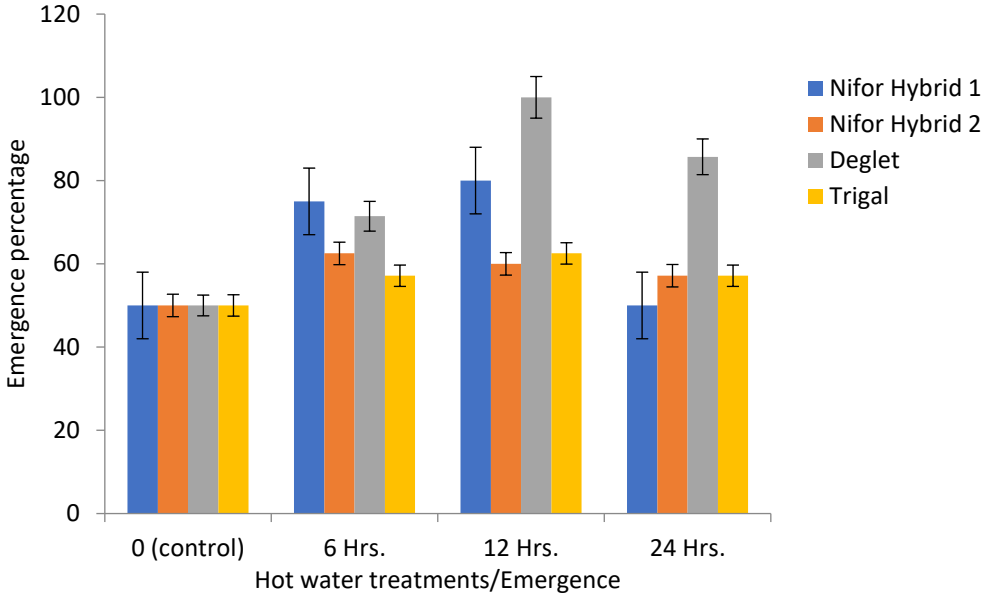

Figure 4: Effect of cold water treatments on seedling emergence of four Date palm cultivars using river sand and poultry dropping at 15 days after sowing.

CONCLUSION

It is therefore concluded that, soaking (hot and cold water) for 5 minutes and 24 hours, respectively could be used to accelerate and improve seeds germination, while river sand and poultry droppings in 2:1 ratio proved to be promising for seedling emergence of this important tree species. Further studies should be carried out to observe the effect of pretreatments methods on seedling growth parameters. Application of hot pretreatments to overcome *P. dactylifera* seeds dormancy is crucial especially for local farmers, and large-scale date palm cultivators, to minimize cost of production where it is adequately not accessible.

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