Khadijah M.D *et al*, International Journal of Advances in Agricultural Science and Technology,
Vol.7 Issue.6, June-2020, pg. 50-67 **ISSN: 2348-1358**
Impact Factor: 6.057
NAAS Rating: 3.77

EFFECT OF SOME PRE SOWING TREATMENT ON GERMINATION OF DATE PALM (*Phoenix dactylifera*)

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ABSTRACT

Phoenix Dactylifera is a dioecious plants belonging to the family Arecaceae consisting of more than 2000 genera and over 2000 species (Diaz et Al, 2003) the plant is distributed throughout the drier and semi desert region of the world extending from north west Africa and Asia. Seed dormancy is a trait that prevents germination when condition is suitable for germination. A field experiment was carry out at nursery of the faculty of agriculture Bayero University, Kano to assess the effect of pre sowing treatment on germination of Date palam (Phoenix Dactylifera) under four different treatment (Hot water, Concentrated sulphuric acid, water at room temperature, and control) with varying of time soaking in (Hot water) at 5minutes, 10minutes, 15minutes.Acid at 3minutes, 5minutes and 8minutes, water at room temperature at 12hours, 24hours and 36 hours. Giving 4 treatment combinations laid out in completely randomize design with 4 replications. Germination rate was recorded highest in acid for 3minutes and hot water at 15minutes throughout the experiment. Acid at 8minutes did not germinated this mean that the acid probably kills the seed embryo that is why did not germinate. In term of hot water and water room temperature germination increase with increase in time of soaking seed dormancy is among the major problem of date palm cultivation and such need to be tackle in a causative term to meet global food demand.

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Impact Factor: 6.057
NAAS Rating: 3.77

INTRODUCTION

Phoenix dactylifera, is a dioecious plant belonging to the family arecaceae consisting of more than two hundred genera and over two thousand species (Diaz *et al.*, 2003). The plant is distributed throughout the drier and semi desert regions of the world extending from North – West Africa and Asia. There are many species of the genus *Phoenix*, but the species *P. dactylifera* is the most widely cultivated doubtlessly because of the edible fruits they produce (Robinson *et al.*, 2012). The date palm (Phoenix dactylifera L.) has been known for as long as recorded history. Apart from its importance as a food source for man and animals, all parts of the plant have their use in medicine, pharmacognosy, chemistry, and religion, and in the fishing, horticulture, and construction industries. Like all economic plants, dates are also afflicted by a number of diseases from microbes, insects, and rodents. Dates are one of the few foods that have a high potassium content and, at a certain stage of development, have a low sucrose content. As knowledge in agriculture, medicine, and industry develops, so does the number of new agents that are found to be harmful or useful to man. In the last two decades, there has been a dramatic increase in the number of foods that have been found to be allergenic, and accidental consumption of these foods by susceptible individuals has led to fatalities. Date fruit and pollen are no exception. Results of recent research have revealed that both date pollen and fruit peptides from certain date cultivars can elicit allergic responses in susceptible individuals and share a number of cross-reactive epitopes with some well-known allergens. The beneficial properties of the date are such that its cultivation should be expanded (A A A Kwaasi, 2003)

In Nigeria, *Phoenix dactylifera* was believed to have been introduced by the Arab traders of Northern Africa as far back as the 8th century. It is mostly found in the savannah region of the country which covers mainly the North West and North East region of Nigeria. “Dabino” as it is popularly called in Hausa, *P. dactylifera* is an important delicacy among many communities in Nigeria particularly in the Northern part where is predominantly found. The fruits are especially used during ceremonies, festivals and during breaking of fast among

ISSN: 2348-1358
Impact Factor: 6.057
NAAS Rating: 3.77

the Muslim faithful during the holy month of Ramadan. The national consumption of date palm in Nigeria in 2009 was estimated at over 8000 metric tons which place the country among the world top consumers of date (Sani *et al.*, 2010). However, despite suitable soil and climatic conditions for date palm cultivation and existence of local varieties with good fruiting qualities, the cultivation of date palm is still at subsistence level. Attempt to improve commercial date palm production in Nigeria was hindered by many factors among which is its poor germination success which is largely associated to dormancy of its seeds. 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). There is need therefore, to research more into various possible ways to tackle the problem of poor germination in this species.

Globally, Nigeria is the only country where date palms have two harvesting seasons in a year. Date palm trees enjoy rainy and dry fruiting season in the savannah region of Nigeria which covers North West and North East. However, despite the advantage of double harvesting season in a year, the country produce less than 20% of what is consumed in country and the remaining 80% is imported (Aliyu M.H, 2018). Difficulties and challenges, i.e. germination failure and longer duration of germination time have been encountered when cultivating date palm through seeds as a result of seed dormancy problem. Amy (2010), reported that the germination successes in most palm seeds were found to be low, depending on some certain conditions, date seeds may take up to 100 days to germinate. Based on these facts, the present study aimed to document the various pre sowing treatment of breaking seed dormancy in date palm seed.

Date Palm Overview

Date palm (*Phoenix dactylifera* L.) is a monocotyledonous plant belonging to the family Arecaceae, which contains 200 genera and more than 2, 000 species (Diaz *et al.*, 2003). Date palm is considered the oldest fruit tree in the world (Zaid *et al.*, 2002), and has been cultivated in North Africa and the Middle East for millennia. It is suggested that date

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Impact Factor: 6.057
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palm originated from Mesopotamia since 4000 BC, and by the Egyptians since 2000-3000 BC (Manickavasagan *et al.*, 2012). It is also noted that either the Indian date palm (*P. sylvestris*) or the African date palm (*P. reclinata*) may have been the progenitor of *P. dactylifera* (Zaid *et al.*, 2002).

P. dactylifera are distributed in tropical and subtropical regions including North Africa, southern Asia, North America and Australia. The scientific name *P. dactylifera* comes from the Phoenician word, *Phoenix* which means date, while *dactylifera* was probably derived from the Greek words *daktulos* which mean a finger (Biglari, 2009).However, there are many species of the genus Phoenix, but the species *P. dactylifera* is the widely most cultivated for its edible fruits, whereas other species produce fruit which is being consumed by many animals and birds (Robinson *et al.*, 2012). Fruits production from *P. dactylifera* starts at an average age of 5 years, with their production lasting up to 60 years (Al-Shahib and Marshall, 2003). They can produce annual average yield between 400-600 and 100-150 kg/tree for fresh crop and dry crop, respectively (Al-Shahib and Marshall, 2003). The yield and fruit quality of dates are dependent on factors such as pollination, fertilization, water relations and cultivar (Marzouk and Kassem, 2011). *P. dactylifera* play an important role in the socioeconomic well-being of many people both in their diet and medicinally for treating various diseases such as obesity (El-Sharnouby *et al.*, 2009).

Distribution and Global Production of Date Palm

Date palm is cultivated globally however; the core areas of date palm production are in the Middle East and North Africa, where approximately 90% of the global production comes (Manickavasagan *et al.*, 2012). The highest producer countries are Egypt, Iran and Saudi Arabia with annual production of 1.3, 1.0 and 0.9 million tons, representing almost half the global production, respectively (Food and Agriculture Organization, 2008; Abdul Qadir *et al.*, 2011).

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Description of Date Palm

Date palm (*Phoenix dactylifera* L.) is a tall tree that can reach a height of 15-20 m (Shamsi and Mazloumzadeh, 2009). The tree parts consist of roots, trunk, leaves, flowers and fruits. The roots originate from a bulb at the trunk base and have a fasciculated fibrous system similar to a maize plant, with their length reaching 4 m on average and up to 10 m in light soil (Manickavasagan et al2012). In a deep loamy soil approximately 85% of date palm roots are distributed in a zone to 2 m deep and 2 m on both lateral sides. These roots can withstand wet soil for months, but if such conditions continue for longer periods they may harm the roots and thus the fruit production (Zaid *et al.*, 2002). The trunk of date palm, also called a stipe or stem, is brown in colour and is a single vertical cylinder which can extend to 30 m in length. It is covered by leaf bases that are enclosed in fibre which protect the trunk from animals and insects, and in addition reduce loss of water (Zaid *et al.*, 2002; Manickavasagan *et al.*, 2012).

The leaves of date palms have a normal life span of 3–7 years and can reach up to 6 m in length and half a meter in width. The leaf narrows at the midrib and towards both leaf ends. The mature trees have approximately 100- 125 leaves and can produce 10- 26 new leaves annually. The leaves can support the production of date clusters from 1–1.5 kg under good conditions (Zaid *et al.*, 2002; Manickavasagan *et al.*, 2012). Separate male and female flowers are produced, which are arranged in strands that attach to a rachis forming an inflorescence called a spadix. The spathe encloses the immature inflorescence, which splits longitudinally in order to help the pollination of mature male and female flowers.

Pollination can achieve naturally by wind or artificially by man (Manickavasagan *et al.*, 2012). Artificial pollination in date palm helps improve yield and quality of the date fruit (Bechar *et al.*, 1999). However, Iqbal *et al.* (2010) reported that hand pollination gives a better yield than natural pollination. The fruits are called dates only after pollination. The dates develop from one fertilized ovule to form a single carpel whilst other ovules are aborted

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but remain visible at the fruit calyx. The developing fruit is characterized by a membranous endocarp surrounding the seed which is the edible part of the fruit (Zaid *et al.*, 2002).

Date Palm Seed

The seeds are oblong in shape with a ventral groove and range from 0.5 cm to 1.5cm in length with a seed groove from one side and a microphyl through which the radical and plumule emerges during germination. The cell wall of *P. dactylifera* seed consists almost entirely of linear mannan molecules which confer a fibrillar texture (De Mason *et al.*, 1983) and hardness to protect the seeds against mechanical damage (Rodriguez-Gacio, 2012). The seed contains a small embryo which is located in the middle of the seed, and is surrounded by a thick walled endosperm. Jones (1969) and Obata (1979) found that the difference between date palm seed endosperm and other seed endosperms is the apparent lack of an active metabolism. Storage polysaccharides are present in many seeds as mannan, glucomannan, or galactomannan, with the mannans being important in *P. dactylifera* seeds (Buckeridge, 2010).

Uses of Date Palm Seed

Presently, date seeds are used mainly by animal feed industries. However, given their excellent nutritional profile, value-added utilization of date seed powder has a potential use for human food industries and applications as well (Al-Farsi *et al.*, 2005). Date seeds have also been shown to have excellent nutritional quality due to their high amounts of minerals, vitamins, lipids, and protein. Additionally, date seeds contain phenolics and flavonoids, which have a chelating agent role in contrast to heavy metals accumulation. Almana and Mahmoud (1994) found bread containing 10% coarsely milled date seed fraction gave a product similar to wheat bread, whereas fine milled seed fraction caused an increase in bread odour, flavour and colour, uniformity and overall acceptability. Date seeds could be an excellent source of functional food component because they contain a balance of fats, proteins, minerals and carbohydrates. Date palm seed powders as a coffee substitute have also been recently introduced to the markets (Rahman *et al.*, 2007), either as pure powder or

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in the form of mixture of the date palm seed with coffee powder (Al-Farsi *et al.*, 2007). In the past, date seeds have been used mainly for animals feed, e.g. camels, cattle, sheep, poultry and fish, but nowadays, it is used as ingredient for making coffee, baking breads, biscuits, etc. A study by Hussein *et al.* (1998) showed that the addition of date seed to broiler chick diets gave a similar improvement in their body weight to that of a diet containing soybean and/or corn meal. In another study by Khiyami *et al.* (2008) highlighted that a mix of date palm flesh and seed wastes with crab shell and shrimp wastes could be a good fertilizer for plants, and is an environmentally friendly composting process for treating date waste. Furthermore, it has been proved that carbon of date seeds has a high efficiency as a filter aid in removing oxidation products from fried oils (El-Anany *et al.*, 2008).

Pests and Diseases of Date Palm

Date palm is afflicted with many diseases and pests, but the nature and severity of the problems vary with cultivar, location, weather and cultural practices (Zaid *et al.*, 2002). Most reported diseases of date palm associated with pathogen are attributed to fungi. However, there are several reports of phytoplasma-associated disorders. One of the most serious fungal diseases in North Africa is the Bayoud disease incited by *Fusarium oxysporum* and *Fusarium albedinis* which had caused large losses of date palm (Howard *et al.*, 2001). Apart from diseases, various insects also attack date palms, but specific insect problems vary with geographical area and cultivar. Various practices are used to control insect pests of date palm including chemical, biological, pheromone trapping, quarantine, and sanitation.

Germination

Before considering dormancy, which imposes a block to the completion of germination, it is appropriate first to consider the processes that comprise germination. Germination commences with the uptake of water by the dry seed-imbibition-and is completed when a part of the embryo, usually the radicle, extends to penetrate the structures that surround it.

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Method of Seed Pre Treatment:

Seed is a reproductive material, ripened/matured ovule resulting from the processes of pollination and fertilization of flower. It is enclosed within a fruit and containing an embryo (miniature plant) nutritive tissue (cotyledon) and the seed coat (testa). It usually has one scar representing point of attachment to the ovary wall. The seed is an indispensable means of plant survival. Its main functions for the plant include nourishment of the embryo made possible by the presence of the cotyledon(s), aiding dispersal to new location, dormancy during unfavourable conditions and source of planting stock. However, some seeds are believed harder than others and as such they require special treatments before planting in order to improve their germination. Some the methods include the following;

Hot water treatment:

The most appropriate seed treatment with respect to least damage, economy, efficiency and application is hot water soaking. It is an old age practice based on treatment with hot water whose temperature is high enough to kill pathogen but not high enough to harm the seed, hence a very good technique to control many seed-borne diseases. (S.Singh et al, 2020)

This method of treating seed has been found to enhance seed growth and germination and continue to be a standard method of pathogen elimination which is more eco- friendly and effective compared to chemical treatments, however, if not properly undertaken, they can cause the loss of seed viability.

Seed soak in inorganic chemicals:

Pre sowing seed treatment where seeds are soaked in inorganic chemicals such as; sulphuric acid (H_2SO_4), $CaCl_2$, $ZnSO_4$, cobalt sulphate/chloride, K_2SO_4, KH_2O4, $CuSO_4$, sodium molybdate, boric acid, manganous sulphate and other (Mariappan *et al*., 2013) or growth regulators viz., ascorbic acid, kinetin, benzyl adenine, GA, CCC and other (Agboola, 2003) alone or in combination found to speed up germination process, increased germination

rate and seedling vigour, improved resistance to water and salinity stress and increased crop yields (Krishnaveni *et al*., 2010).

The Role of Improved Seed in Developing Economy

Seed is a key input for improving crop production and productivity. Increasing the quality of seeds can increase the yield potential of the crop by significant folds and thus, is one of the most economical and efficient inputs to agricultural development (FAO, 2006). Agricultural sectors in developing countries have an important opportunity to further develop the seed production sector. Generation and transfer of new technologies are critical prerequisites for agricultural development particularly for an agrarian based economy such as Nigeria. Seed, especially that of improved varieties, is an essential input for increasing crop productivity. This suggests the need to place much emphasis on sustainable and efficient seed production systems. Improved seed production is regarded as effective tool in enhancing crop productivity since it dramatically changed the productivity of crops during the Green Revolution of the1960s to 1980s. Among others, unavailability of quality seeds at the right place and time coupled with poor promotion system, is one of the key factors accounting for limited use of improved seeds, which further contributing for low agricultural productivity. Poor availability and promotion of improved seeds is due to inefficiency of the seed systems of the country.

Methodology

Study Area

The study was carried out at Nursery of the Faculty of Agriculture, Bayero University Kano, Kano. (latitude 11˚58', N and longitude 8˚ 26' E)

Source of Material

Dry seeds of *P. dactylifera* were procured from Sharada market in Kano state Nigeria. The sulphuric acid was obtained from the Department of Animal Science Laboratory Bayero

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University Kano. The polyethylene bags were also procured from Department of Agronomy Faculty of Agriculture, Bayero University Kano.

Experimental Design

The experiment was laid out in a Completely Randomise Design with four replicates. A method of breaking seed dormancy described by Al-Fredan and Ali (2008) was adopted. This method includes soaking of seeds in either acid, cold water or hot water. The treatments comprised four conditions:

(i) Acid treatment 98% (12 seeds were soaked in concentrated sulphuric acid (H_2SO_4) in a plastic container with gentle stirring using a glass rod for 3, 5 and 8 minutes

(ii) Normal water treatment at room temperature (12 seeds were soaked in cold water in a plastic container for 12, 24 and 36 hours

(iii) Hot water treatment (at boiling point (12 seeds were soaked in hot water in a plastic container with gentle stirring using a glass rod for 5, 10 and 15 minutes and;

(iv) Control (untreated seeds).

Soil sample collected at the depth of 30 cm from Bayero University Kano was mixed with dried cow dung in a ratio of 3:1 to improve the soil fertility. The soil was weighted into the polyethylene bags before the seeds were planted. A minimum of three seeds were planted in each polyethylene bag. A total of fourty (40) polyethylene bags were used for the experiment. The experimental set up was watered daily. Weeding was done by hand-picking the weeds.

Data Collection and Analysis

Germination Percentage

Germination percentage was calculated using the following formula at 28, 35, 42 and 49 days after planting;

Germination percentage (%) $= \frac{Number\ of\ germinated\ seed}{\text{total number of seeds planted}} \times 100$.....1

Number of germinated seedling

The number of germination seedling was recorded at 4, 5,6,7 weeks after sowing

Data Analysis

Data generated from this study was subjected to analysis of of Variance (ANOVA) was use to analyse the data at $P<0.05$ level

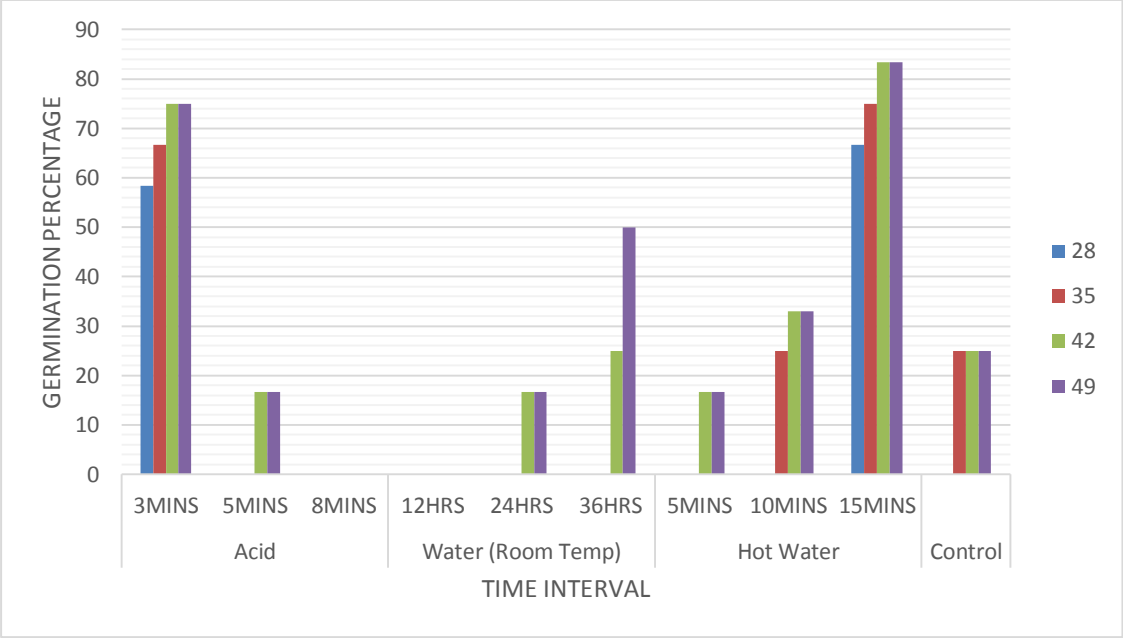
Result

Effect of some pre sowing treatments on the germination of *P. dactylifera* seeds

Results from this study indicated that the different methods of breaking seed dormancy significantly ($p<0.05$) affected the germination rate of *P. dactylifera* (Figure 1). At twenty eight days after sowing, it was observed that the pre-treatment of hot water at 15 minutes had the highest germination percentage with 66.67% germination which is closely followed by pre-treatment of acid at three minutes which had a germination percentage of 58.33%, the acid pre-treatment at 8 minutes and water at room temperature treatment at 12 hours recorded the lowest germination percentage of 0%. At thirty five days after sowing, the hot water at 15 minutes still had the highest germination percentage followed by acid treatment at 3minutes. Observed was a new germination percentage on pre-treatment of hot water at ten minutes and control with germination percentage of twenty five percent each. At forty two days after sowing, there was germination percentage recorded at almost all the pre-treatment levels except acid treatment at 8 minutes and water at room temperature at 12 hours. Hot water treatment had the highest percentage with 83.33% while the pre-treatment

ISSN: 2348-1358
Impact Factor: 6.057
NAAS Rating: 3.77

of acid at 5 minutes, water at room temperature at 24 hours, and hot water at 5 minutes had the lowest germination percentage with 16.67% each. At 49 days after sowing which is the last day of data collection, Hot water at 15 minutes had the highest germination percentage of 83.33% which is followed by acid treatment at 3 minutes with 75% germination percentage, which is followed by water at room temperature treatment at 36 hours with 50% germination percentage, acid treatment at 8 minutes and water treatment at room temperature at 12 hours recorded 0% germination percentage.



Germination percentage of *P. dactylifera* seeds recorded in different treatments.

*Key: Days After Sowing (DAS).

The effect of pre sowing treatments on the cumulative germination of *P. dactylifera*

From the table below, it shows that the germination rate of date palm seed was statistically significant at twenty eight days after sowing, acid at 3min and hot water at 15min were significantly different from the pre-treatment methods with a mean of 1.75 and 2.00 respectively while the rest treatment did not germinate. At thirty five days after sowing, acid

ISSN: 2348-1358
Impact Factor: 6.057
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at 3min and hot water at 15min has the highest means but are not statistically different from each other, followed by hot water at 10mins and control with means of 0.75 each while the rest didn't germinate. At forty two days after sowing, there was significant increase in the number of means of the different pre-treatments with acid treatment at 3min and hot water at 15min being statistically different from the remaining treatments as seen in the table. At fourty nine days after sowing, there was more statistical difference between the treatments administered, acid at 3min and hot water at 15min has the highest means and are statistically similar followed by water at room temperature at 24hrs and 36hrs which are also statistically similar but are different from the remaining treatments.

The effect of pre sowing treatments on the cumulative germination of *P. dactylifera*

Treatments	28 DAS	35 DAS	42 DAS	49DAS
Acid at3mins	$1.75^{b} \pm 0.50$	$2.00^{b} \pm 0.87$	$2.25^{b} \pm 0.50$	$2.25^{de} \pm 0.50$
Acid at 5mins	$0.00^{a} \pm 0.00$	$0.00^{a} \pm 0.00$	$0.50^{a} \pm 0.58$	$0.50^{ab} \pm 0.58$
acid at 8mins	$0.00^{a} \pm 0.00$	$0.00^{a} \pm 0.00$	$0.00^{a} \pm 0.00$	$0.00^{a} \pm 0.00$
HWT at 5mins	$0.00^{a} \pm 0.00$	$0.00^{a} \pm 0.00$	$0.58^{a} \pm 0.29$	$0.50^{ab} \pm 0.58$
HWT at10mins	$0.00^{a} \pm 0.00$	$0.75^{a} \pm 0.96$	$1.00^{a} \pm 0.82$	$1.00^{bc} \pm 0.82$
HWT at15mins	$2.00^{b} \pm 0.82$	$2.00^{b} \pm 0.87$	$2.50^{b} \pm 0.58$	$2.50^{e} \pm 0.58$
WTT at12hrs	$0.00^{a} \pm 0.00$	$0.50^{a} \pm 1.00$	$0.00^{a} \pm 0.00$	$0.00^{a} \pm 0.00$
WTT at 24hrs	$0.00^{a} \pm 0.00$	$0.00^{a} \pm 0.00$	$0.50^{a} \pm 0.58$	$0.50^{ab} \pm 0.58$
WTT at 36hrs	$0.00^{a} \pm 0.00$	$0.00^{a} \pm 0.00$	$0.75^{a} \pm 0.96$	$1.50^{cd} \pm 0.58$
Control	$0.00^{a} \pm 0.00$	$0.75^{a} \pm 0.96$	$0.75^{a} \pm 0.96$	$0.75^{abc} \pm 0.96$

Values within columns followed by the same letter are not significantly different at $P<0.05$ according to Duncan range multiple test used for the post hoc analysis.

 ISSN: 2348-1358
Impact Factor: 6.057
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Key: *Days after sowing (DAS), *mean±standard deviation*Acid- Acid Treatment *HWT-Hot water treatment *WTT-water at room temperature

DISCUSSION

This research demonstrated the effectiveness of various method of breaking dormancy on *Phoenix dactylifera* seeds. It also shows how seed respond to when subjected to the different pre-treatment conditions. The results indicated that seed dormancy in *Phoenix dactylifera* arises from the hardness of the seed coat. This research finding is in accordance with the work of (Muhammad *et al*. (2017) who reported that the seed dormancy in *p. dactylifera* was associated with the hardness of the seed coat. The increase in the germination rate of the date palm seed could be attributed to the removal of the cuticule and softening of the seed coat by the different pre-treatment methods tested for breaking dormancy of *Phoenix dactylifera*

Treatment of seed with the concentrated sulphuric acid at 3min and hot water at 15min was found to induce the highest germination rate compared to the other treatments, this could be attributed to the influence of the acid at three minutes and hot water at 15min on the seed coat which might have degraded it and given the embryo easy access to water after sowing. With regards to the acid treatment at 3min and hot water treatment at 15min, it is enough treatment for the seed coat and any chemical compound that may be inhibiting germination causing the dormancy without damaging the embryo, this observation is in line with the work of northcut et al., 2012 and purobrt, 2015. It was noted that acid at 8min did not germinate throughout the experiment; this is probably because at eight minutes of exposure of the date palm seed to the acid, the acid killed the seed embryo and cause it not to germinate

On the other hand, seed treated with water at room temperature shows progressive germination rate throughout the data collection period. This is probably because the germination rate of the seed was determined by how long the seed was soaked in water

considering the fact that the water used is at room temperature compared to the vigorous action of acid. Similar findings were reported by Vieceshouwes et al., (1995).

CONCLUSION

Based on these research findings, dormancy in date palm arises from the hardness of the seed coat, there is therefore the need to overcome this hindrance in the propagation of date palm. Date palm seed dormancy can be overcome by immersing the seed in a concentrated sulphuric acid 98% for three minute or immersing in hot water at 100^0c for 15min. It is essential to treat the seeds of *Phoenix dactylifera* with acid for three minutes or hot water for 15 minutes before sowing the seeds to obtain a good germination percentage

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 ISSN: 2348-1358
Impact Factor: 6.057
NAAS Rating: 3.77

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