INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print), 2222-5234 (Online)
http://www.innspub.net
Vol. 14, No. 5, p. 16-23, 2019

RESEARCH PAPER OPEN ACCESS

Enhancing seed germination through pre-sowing treatment in date palm (*Phoenix dactylifera*) cultivars

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Key words: Date palm, Seed treatment, Germination, Attributes, Germplasm, Chance seedlings.

http://dx.doi.org/10.12692/ijb/14.5.16-23 Article published on May 02, 2019

Abstract

The current investigation was performed with the aim to achieve higher germination in seeds of date palm cultivars of elite quality. The proposed research work was taken up at Lath House of Horticultural Research Institute, Faisalabad. The research was designed according to Completely Randomized Design (CRD) with three treatments having four replicates. Seeds of twenty date palm varieties were sown in pre-defined sterilized growing media. Different parameters such as, number of days taken to start of germination, number of germinated seeds, number of seeds survived, success and survival percentages were noted. The results revealed that pre-sowing with water treatment of seeds significantly enhanced all the observed attributes of the date palm seeds. Minimum numbers of days were recorded for the variety Bharee treated with sun heated water at 30 ˚C. Maximum success percentage (71.75) was measured in variety Zahidi at T2 (immersion in sun heated water at 30 ˚C) treatment. Also, the highest survival percentage (63.63) was found in Zahidi variety at the same treatment. The study suggest that seed emersion in sun heated (27-30 ˚C) may be used to break seed dormancy in date palm. Additionally, Zahidi was proved best in the studied attribute among all the investigated exotic date palm germplasm.

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Introduction

Date palm (*Phoenix dactylifera* L.), a monocotyledonous, dioceous plant is an important member of family Arecaceae that includes 200 genera and above 2000 species (Diaz *et al.,* 2003). Date palm (*Phoenix dactylifera* L.) is a multipurpose and magical tree having nutritional, ornamental and medicinal significance. The date fruit is especially used during many festivals, ceremonies and for fast breaking among the Muslim belief. Date palm plays an essential part in the socioeconomic welfare of the people living throughout the world. Additionally, date palm fruit play contributory role in everyday diet and in management of several diseases of severe kind, e.g. abdominal problems, ulcerations and inflammations etc. (Sulieman *et al.,* 2012). With the current uncertainty of the world food supply chain and the assumed increase in demand of food, the date fruit could be a good option as a food having high nutritional status. Pakistan is among the leading date producers of the world. The dates are the third most important fruit after citrus and mango in Pakistan. Despite the marvelous benefits which can be derived from *P. dactylifera*, its cultivation in many regions of the world, e.g. Pakistan, continues to be a big challenge because of the trouble of its establishment through seeds. Introduction of exotic date palm germplasm to our climate can be a great achievement in order to produce quality dates to meet the criteria of international market. However, germination of date seeds is quiet difficult because of its hardiness. Germination success can be improved through adopting appropriate pre-sowing techniques (Koirala *et al.,* 2000; Alamgir and Hossain, 2005a; 2005b; Azad *et al.,* 2006a; 2006b). Amy (2010) reported that the record of germination success of most palm seeds was poor, while viable date palm seeds can germinate between 14 and 21 days under ideal growing conditions, although healthy seeds may be taken up to 100 days to germinate because of the dormancy problems. Resultantly, during some studies the researchers investigated seed germination and dormancy breaking methods of wild types of date palm (von Fintel *et al.,* 2004) and other related palms (Green *et al.,* 2013). Nevertheless, currently available investigations on *P. dactylifera* were geared towards its proximate analyses, i.e. phytochemicals screening, nutritional and medicinal properties. However, little attention has been paid to dormancy in date palm seed. This study aimed to assess the efficacy of dormancy breaking method on seed germination and early seedling growth of date palm (*Phoenix dactylifera*). Intensive plantation in agroforestry and home garden is limited because of destitute seed germination and delayed nursery establishment (Azad *et al.*, 2010a; 2010b). The chance seedlings development is an easy way to develop the variety but the date palm seeds do not germinate easily. So, these studies have been conducted to improve the germination of the date seeds.

Materials and methods

Experimental site

The study has been carried out during 2017-18 in Horticultural Research Institute, Ayub Agricultural Research Institute, Faisalabad, which is the central part of the biggest province (Punjab) of the country. The study area is located about 184 m above the sea level. The geographic position of the study area is situated between 2017-18 at 31.38° N – 73.04° E. The climate of the study area is known as subtropical in nature, like the other part of the country having severe Winter, hot Summer with Spring and Autumn. In July-August there comes rains (monsoon). Relatively mild winter starts from November and ends in February, but the temperature fluctuation during the winter is very low. Temperature fluctuates at 7–12°C in winter and increases up to 25–32°C in summer, but very occasionally, it might rise up to 36–40°C. The air temperature and relative humidity recorded were 18–27°C and 65%–85%, respectively, during the experiment.

Plant material source

Exotic varieties of dates were purchased from a renowned super store. The seeds of the dates were extracted afterwards from fruits. Healthy and uniform sized seeds of all the varieties were selected for further use in experiment and deformed or undersize seeds were discarded in order to get maximum viable

seeds for assessment. The details of varieties investigated are given in Table 1.

Procedural details and experimental design

Healthy seeds were extracted from high quality fruits collected form market; size and viability were selected to perform a comprehensive study. Four to five washings with clean water were given to the freshly extracted seeds in order to clean the seeds. After the cleaning operation, date palm seeds were dried for eight hours in muslin cloth in shade. Damaged, stained/ discolored, seeds were discarded. The experiment was conducted under four treatments i.e. To; Control (without immersion), T1; soaking in normal water at ambient temperature (25 °C) for 10 hours, T2; immersion in sun heated water (27-35 °C), T3 immersion in hot water (50°C) for 10 hours. The seeds were sown in polythene bags filled with predefined growing media (sand + silt+clay in equal ratio). Each treatment comprised of twenty seeds of each variety. The study was carried out with factorial arrangements under Completely Randomized Design (CRD). The collected data was analyzed through Analysis of Variance technique by employing a statistical package STATISTIX. However, the significance of the differences between means was checked through HSD or Tuckey's test.

Results

Number of days to germination

The detailed results concerning number of days taken by the seeds to germinate are given in Table 2.

Significant variation is present among the date palm varieties for this aspect as considerably different number of days were taken by the seeds of different varieties. Maximum days for germination initiation (69.50) was taken by the seeds of Rabiyyah variety at control treatment (without water treatment), however, days taken by the same variety were reduced at T2 (58.50). However, Minimum numbers of days were recorded for the variety Bharee when treated with hot water at 30°C. Describing the treatment means, maximum mean values (61.25) for number of days were given by the control treatment when seeds were sown without pre sowing water treatment. While, T2 (immersion in hot water at 30°C) treatment gave minimum mean values (52.07) in this regard.

Table 1. List of date palm germplasm assessed for germination.

Sr. No.	Name of variety	Sr. No.	Name of variety
1.	Ajwa	9.	Sharifa
2.	Mabroom	10.	Bahree
3.	Anbarah	11.	Deglet Nour
4.	Rabiyyah	12.	Sugai
5.	Khudri	13.	Pamazo
6.	Zaihdi	14.	Sukkari
7.	Baid	15.	Rabi
8.	Bairam		

Number of seeds germinated

The mean values for number of germinated seeds are given in Table 3, depicting effect of pre-sowing seed treatment on seed germination. The analyzed data showed that, maximum seed germinated (61.75) were recorded in variety Zahidi which was treated with immersion in sun heated water (27-35 °C), followed by the Mabroom (56.75) at the same treatment. However, minimum numbers of seeds were germinated in case of Rabi variety (19.50). When the seeds were sown without any treatment, the results were statistically at par to that of Sukkari (22.25) at the same treatment level. As far as treatment means are concerned, the treatment T2 (27-35°C) was found best for improving germination in date palm seeds as it gave maximum mean value (53.02) for number of seeds germinated followed by the T3 treatment (50.55). Moreover, minimum seeds were germinated when seeds of all varieties were sown without provision of pre-sowing water treatment.

Table 2. Effect of pre-sowing seed treatment (water treatment at various temperatures) on number of days to start of germination.

Varieties	Treatments				Mean
	0	1	2	3	
Ajwa	67.25	62.00	58.50	61.75	62.38ab
Mabroom	63.25	61.25	53.75	58.50	59.19c
Anbarah	64.50	62.50	58.50	60.50	61.50b
Rabiyyah	69.50	65.00	59.75	62.25	64.13a
Khudri	62.25	55.50	50.25	51.50	54.88
Zahidi	53.50	50.50	44.50	50.75	49.81gde
Baid	59.00	53.75	49.25	51.50	53.38ef
Biarum	61.50	55.50	50.75	51.50	54.81de
Pamazo	61.25	55.25	51.00	58.00	56.38d
Sharifa	61.50	55.25	51.50	53.50	55.44d
Bharee	53.50	53.00	44.25	49.25	50.00g
Deglet Nour	54.50	59.75	54.50	55.50	56.06d
Sugai	66.50	58.25	54.50	56.75	59.00c
Sukkari	57.25	53.25	49.50	51.50	52.88f
Rabi	63.50	51.25	50.50	55.50	55.19de
Mean	61.25a	56.80b	52.07c	55.22d	56.33

Number of seedlings survived

The numerical data regarding the survived seedlings is presented in Table 4. Statistical analysis of the collected data revealed that significant differences were present among the investigated varieties regarding this attribute. Maximum numbers (50.75) of survived seedlings were recorded in Deglet Nour at T2 treatment which was statistically at par to that of Zahidi (50.50) at the same treatment level. Moreover, minimum mean values (14.25) were possessed by Sukkari variety followed by Khudri at To (control treatment). Comparing the treatment means, maximum mean values (45.83) were found in the treatment level T2 where seeds were treated with warm water at 27-35°C temperature before treatment.

Seedlings with control treatment performed poor in comparison to all treatment levels.

Table 3. Effect of pre-sowing seed treatment (water treatment at various temperatures) on seed germination.

Varieties	Treatments				Mean
	0	1	2	3	
Ajwa	34.25	44.25	49.50	47.50	43.88cde
Mabroom	32.00	41.50	56.75	52.50	45.69bc
Anbarah	30.75	35.25	52.50	49.50	42.00efg
Rabiyyah	29.75	35.25	52.50	50.25	41.94fg
Khudri	25.25	32.00	54.75	51.25	40.81gh
Zahidi	42.50	48.50	61.75	57.50	52.56a
Baid	32.00	40.50	54.75	53.50	45.19bcd
Biarum	30.50	35.50	50.50	47.50	41.00gh
Pamazo	33.50	39.50	51.75	49.25	43.50def
Sharifa	38.25	43.00	51.25	48.50	45.25bcd
Bharee	24.00	32.25	50.50	50.25	39.25hi
Deglet Nour	37.75	43.75	53.50	51.25	46.56b
Sugai	25.75	32.75	54.25	51.50	41.06gh
Sukkari	22.25	27.50	50.50	49.25	37.38ij
Rabi	19.50	28.50	50.50	48.75	36.81j
Mean	30.53d	37.33c	53.02a	50.55b	42.86

Success percentage

The detailed results about success percentage are given in Table 5. It was revealed from the observed data that water treatments considerably improved the success percentage in all tested varieties. The analyzed data showed that maximum success percentage (71.75) was in variety Zahidi at T2 treatment followed by that of Mabroom at same level. However, at control treatment level success percentage in Karbla was recorded 51.39. Minimum mean values (28.19) for success percentage were noted in case of Sukkari variety at control treatment. Describing the treatment means, minimum mean values (39.11) were given by the control treatment while, maximum results were found (66.59) in T2 treatment.

Table 4. Effect of pre-sowing seed treatment (water treatment at various temperatures) on number of survived seeds.

Varieties	Treatment				Mean
	0	1	2	3	
Ajwa	29.75	37.00	40.75	37.50	36.25cde
Mabroom	22.50	28.50	49.50	46.75	36.81cd
Anbarah	19.50	23.75	48.25	43.50	33.75fg
Rabiyyah	23.25	27.50	48.00	43.50	35.56def
Khudri	19.00	23.75	49.25	46.25	34.56ef
Zahidi	38.50	44.50	50.50	48.50	45.50a
Baid	24.25	32.50	48.50	44.75	37.50c
Biarum	25.50	30.50	40.50	38.75	33.81fg
Pamazo	25.50	31.75	42.50	39.50	34.81ef
Sharifa	21.25	28.50	46.50	46.00	35.56def
Bharee	20.00	24.25	44.75	41.25	32.56gh
Deglet Nour	31.75	35.25	50.75	45.75	40.88b
Sugai	19.50	23.50	44.50	41.00	32.13gh
Sukkari	14.25	19.50	40.50	39.50	28.44i
Rabi	19.50	24.75	42.75	38.75	31.44h
Mean	23.60d	29.03c	45.83a	42.75b	35.30

Survival percentage

The detailed results regarding survival percentage are given in Table 6. The mean values are presented in the table showing the fact that pre-sowing seed treatment significantly improved seedling survival percentage in date palm varieties. Highest survival percentage (63.63) was found in Zahidi variety when the seeds of the mentioned variety were treated with the warm water at 27-35°C temperature, followed by Mabroom at the same treatment. However, lowest survival percentage (17.63) was found in Sukkari when the seeds were not provided with any water treatment.

Table 5. Effect of pre-sowing seed treatment (water treatment at various temperatures) on success percentage in date palm.

Varieties	Treatment				Mean
	0	1	2	3	
Ajwa	43.57	54.50	62.63	58.65	54.84d
Mabroom	42.08	49.75	70.50	66.98	57.33bc
Anbarah	38.49	44.50	65.59	61.99	52.64e
Rabiyyah	37.07	45.00	66.39	62.57	52.76e
Khudri	32.04	40.25	67.10	63.74	50.78
Zahidi	51.39	59.75	75.50	71.50	64.54a
Baid	42.15	50.50	68.60	68.61	57.46bc
Biarum	40.38	44.50	63.01	60.50	52.10ef
Pamazo	42.07	51.25	65.25	61.56	55.03d
Sharifa	47.71	55.75	63.32	60.75	56.88c
Bharee	31.12	40.25	65.25	60.31	49.23g
Deglet Nour	47.84	53.25	69.04	65.25	58.85b
Sugai	32.21	42.50	68.82	64.00	51.88ef
Sukkari	28.19	35.25	64.50	61.06	47.25h
Rabi	30.30	35.50	63.27	60.50	47.39h
Average	39.11d	46.83c	66.59a	63.20b	53.93

Discussion

Dormancy breaking techniques

Delayed germination, always been an important obstacle in date palm propagation through seeds. Many authors discussed about pre sowing treatments of seed germination to break down the seed dormancy and thereby increase the germination rate and speed up the germination process. Seed dormancy can vary species to species, stage of maturity of seed, degree of drought, etc. Therefore, pretreatment should be adjusted accordingly. Physical seed dormancy may be defeated either by physical scarification of seed coat by clipping, nicking, piercing, flaming, or filing with the aid of needle, knife, hot wire burner, abrasion paper, etc. (Catalan and Macchiavelli, 1991).

Equally acid treatment (Kobmoo and Hellum, 1984) or hot water treatment (Kobmoo and Hellum, 1984; Khasa, 1992; Airi *et al.*, 2009) can also conquer physical seed dormancy. Generally, the untreated palm germinated slowly and irregularly, and the seeds with hard, solid, and inflexible seed coat were reported to recover germination with pre sowing treatments (Meerow, 1990).

Table 6. Effect of pre-sowing seed treatment (water treatment at various temperatures) on survival percentage in date palm.

Varieties	Treatment				Mean
	0	1	2	3	
Ajwa	36.09	45.50	50.00	46.77	44.59de
Mabroom	27.96	34.75	62.03	56.78	45.38cd
Anbarah	22.07	30.25	59.30	54.75	41.59fg
Rabiyyah	28.36	34.50	58.50	55.75	44.28de
Khudri	22.87	31.25	61.50	57.21	43.21ef
Zahidi	47.84	55.75	63.63	60.00	56.81a
Baid	31.73	40.75	59.75	56.62	47.21c
Biarum	33.10	41.25	52.56	50.41	44.33de
Pamazo	32.68	40.25	53.61	50.50	44.26de
Sharifa	27.90	34.75	58.48	54.50	43.91de
Bharee	22.18	29.50	56.62	51.87	40.04g
Deglet Nour	40.37	46.00	60.81	57.29	51.12b
Sugai	22.45	30.50	57.78	51.95	40.67g
Sukkari	17.63	25.25	52.07	48.88	35.96i
Rabi	22.43	30.25	52.11	47.15	37.99h
Mean	29.04d	36.70c	57.25a	53.36b	44.09

The results of current investigation revealed that the exotic date palm germplasm showed great diversity in their germination behavior and time taken to start germination. This might be due to the variation in their genetic makeup. Besides this variation, one common observation was made in all varieties, that the pre-sowing seed treatment significantly ($P<0.05$) enhanced the germination and survival percentages when compared to control treatment. The findings of the current study are in agreement of those of (Azad *et al.,* 2011), who reported that the seed germination treated with soaking in normal water for 12 h and sun-heated water for 12 h (84%) was significantly higher than that of Control. Varying the seed coat structure either through scarification or immersion in hot/cold water enhances the permeability of the seeds to water and gases, which resulted in early and rapid germination and subsequent establishment of the seedlings (Vleeshouwers *et al.*, 1995). Results of same kind were also observed by (Agboola, and Etejere, 1991; Oni, 1991; Okunlola *et al.*, 2011), who narrated that germination rate and seedling height were increased by soaking of seeds of some economic forest trees (*Parkia biglobosa* and *Terminalia ivorensis*) in

water. 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. Meerow (1990) mentioned pre-sowing treatment palm seeds under socking in water can also improve the germination success percentage. He also explained that the water temperature at which seed treatment has been done can also play an important role for seed germination percentages. He also argued that 30–35°C temperature of water for pre- soaking will enhance the germination process. Nearly same temperature range proved best in current investigation.

Fig. 1. Fruits of different date palm varieties assessed for germination.

Conclusion

All the tested date palm varieties showed diverse genetic behavior in all the attributes studied either in control or with seed treatment. Treatment found best in the current study can successfully employed for development of chance seedlings in case of date palm as it is the fruit with nutritional value but not easy to germinate because of its hard seed coat and dormancy issue. The study suggests the hydro-priming of date palm seeds as a potential tool to get earlier germination for chance seedling development in varietal development programs.

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