

## New Pollination Technique in Date Palm (*Phoenix dactylifera* L.) Cv. “Barhee” and “Medjol” under Jordan Valley Conditions

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**Abstract:** Pollination is a critical process in date palm production, which may affect fruit quality, development and yield. Developing of new pollination method could be caused acceptable level of fruit set with a minimum amount of pollen grains required for date palm production. During 2015/2016 seasons, the effect of pollen grains-water suspension applications at different concentration (1, 2, 3 and 4 g/L tap water in addition to the control as traditional method) on fruit set, were examined on two date palm cultivars “Barhee” and “Medjol”. The obtained results showed that the traditional method of pollination (control) produced the highest number of fruits per bunch, fruit set percentage, fruit number per spike, bunch weight and total yield per tree in compare to the water-suspension treatments that resulted maximum fruit fresh weight. On the other hand, pollen grain treatments have lower effect on total number of spikes per bunch.

**Key words:** Pollination • Palm. Barhee • Medjol • Water-Suspension. Jordan Valley

### INTRODUCTION

The palm belongs to *Arecaceae* family which containing more than 2450 species, distributed throughout tropics and subtropics regions. Most palms inhabit forested areas but a few occur in savannas or even deserts [1- 7]. Date Palm (*Phoenix dactylifera* L.) development is very slow because its perennial, dioecious nature and lack of adequate vegetative propagation methods. *P. dactylifera* is grown in the arid Arab regions and North Africa [8-10]. In Jordan there is about 0.5 million Date Palm trees, covers 3500 hectares. The most important cultivars are Medjol and Barhee whom planted at the middle of the Jordan Valley (Al-Karameh), due to the suitable environment [11]. Palms needs be 4 to 5 years for fruit to bears and it will reach full bearing after 10 to 15 years [12].

Pollination is a critical process in the date palm because it’s a dioecious plant, so it requires an artificial pollination to ensure enough fertilization process [13- 15]. However, pollination was suggested in date palm occurs by wind, but Barfod *et al.* [1], showed that insects can be

responsible for pollination and mainly beetles are considered the most important pollinators in palms. In many cases pollination process is dependent on wind and insects. Therefore, artificial pollination could be becoming a necessary to increase the yield and produce good fruit quality [16]. As reported by Zaid and De Wet [17] the simple method is using male strands flowers from a freshly opened male Spathe and place 5-10 of these strands between the strands of the female inflorescence and tie the pollinated female cluster. Therefore, this method needs the availability of large number of male spathes for early flowering season cultivars [18 - 21].

Using mechanical pollination, dilution of pollen with wheat flour might be used for high rate fruit set [22]. According to Awad [14] pollen grains-water suspension gave fruit set percentage of 75-88 % depending upon concentration, which was lower than control that produced 90 % fruit set, also bunch weight was lower than that of the control treatment. Another study by Ashour *et al.* [18] showed that mixing pollen grains with various carriers was beneficial for obtaining an economical yield with good fruit quality. Some fruit types

respond to fruit thinning, others are not, according to Marashi and Mousavi [23]; “Medjol” cultivar respond to fruit thinning, that will reflect on fruit size, while “Barhee and Lulua” cultivars do not respond to fruit thinning. Awad [15] reported that spray pollination was significantly increased fruit setting using 1.5 or 2.0 g/L than all other treatments [13]. On the other hand, Abdalla *et al.* [24] reported that using 1.5 and 3 g pollen grains/L, did not increase the percentage of initial fruit set, fruit retention and bunch weight. On the other hand, fruit quality in term of fruit weight was improved. This means that different pollination techniques showed significant effect on yield of fruit per bunch and the maximum fruit yield per bunch [25]. Zaid and De Wet [17] reported that flower resulted better quality of fruits compared to late fruit thinning. Water spray following pollination generally decreased fruit set percentage to different extent depending on the time of application; according to Awad [14]. The most effective treatment was water spray after 4 h following pollination.

The process of pollination is one of the most important agricultural operations; since date palm is a dioecious plant, it requires a transfer of pollen grain from male to female trees [7]. To do this, farmers have to climb up palm trees to deliver floral note to floral feminine, but the process is not easy, laborious and costly in terms of effort, physical effort to reach the top of the palm and it takes time for at least 20 min at least to complete this process for each palm. In addition, cost of buying the pollen (the plant) due to the lack of the amount used in this technique [12, 24]. In Jordan, there is a need to develop a new pollination modern technique that will be used to improve fruit setting percentage, reduce the cost of the pollination process and reduce the required amounts of pollen grains in addition to eliminate the required time of pollination of “Medjol and Barhee” date palm cultivars. Therefore, the aim of this study was to develop a new pollination technique to improve fruit settings in date palm.

## MATERIALS AND METHODS

An experiment was conducted during the 2015/2016 seasons on two Date Palm cultivars “Barhee and Medjol” of 8 year old. Palms selected for study were chosen to be vigorous in growth. The study was conducted at the central of Jordan Valley at Al-Edwan farms. To prevent contaminations; female parts were isolated using paper bags before blooming and after doing the water-suspension treatments as developed by Abu-Zahra and Al-Abadi [27].

Pollen grain were extracted from the male palm “Azzazi” cultivar; spathes were cut and spread over white paper at constant room temperature (25°C) at the beginning of blooming during the period of (5-12/3/2015). Pollen shed over night was cleaned and collected by passing it through a 100 µm mesh sieve. Then sealed in plastic bags and stored in the refrigerator at -18°C as recommended by Iqbal *et al.* [25], until pollination process was started from 25 to 30/3/2015. Female palm trees produced different number of bunches, only four bunches were left per tree and the other bunches were removed, so each tree was received the same treatment for their four bunches.

Pollination treatments were applied at 11:00 a.m. in a well sunny day; five treatments were applied: the control (traditional pollination method) which was done according to the farmer’s procedures, in which pollen grain was dispersed by hand over the female parts. The other treatments were consisting from different four amounts of pollen grain-water suspension with 1, 2, 3 and 4 g of pollen grain/L of tap water. Pollen grains were suspended in water directly before the pollination process. Spraying was done using a one-liter hand sprayer, that was shaken every time before spraying to ensure mixing the pollen with water and each bunch was received about 100 ml of the suspension. In all treated palm trees, female inflorescences were treated once a time and replicated four times for each cultivar. Control treated bunches (clusters) were left uncovered, while the pollen-suspension treated bunches were covered with paper bags -to prevent contaminations from other pollen sources- until early results were taken at 7<sup>th</sup> of May/2016. On the other hand, final results were taken at the time of harvesting which takes place at the end of summer season (depending upon cultivars).

### Measured Parameters

**Number of Fruits per Bunch:** At the end of the experiment, only one bunch was removed from each tree, fruits were removed and counted and its number were added to that of the early thinned or harvested fruits.

**Percentage of Fruit Set:** It was calculated by dividing the total number of fruits per bunch over that of the control treated bunches [28].

**Average Number of Fruits per Spike:** The total number of fruits per bunch were divided by the total number of spikes in the bunch.

**Total Number of Spikes per Bunch:** At the end of the experiment, all of the produced spikes per bunches were counted and average readings were considered per bunch.

**Average Fruit Fresh Weight (g):** Readings were taken at a three different time intervals depending upon harvesting; each time a twenty fruits per replicate were weight and average readings were taken per one fruit.

**Bunch Weight (kg):** At the end of the experiment, only one bunch was removed from each tree and weight, also the early harvested fruit weights were added to it.

**Total Yield (kg) per Tree:** At the end of the experiment, the remained fruits were removed from bunches and weight, also the early harvested fruit weight were added to them.

**Statistical Analyses:** Each experiment containing five treatments with four replicates (one tree for each replicate) was used. The experiment designed was randomized completely block design (RCBD). The results were statistically analysed according to the methods developed by Steel and Torrie [29]. Differences between individual means will be determined by Least Significant Difference (LSD) test at the 0.05 level of probability. Data will be analyzed using SAS software.

## RESULTS AND DISCUSSION

Both cultivars showed a high percentage of fruit set, that required further fruit thinning, which was applied early in summer and the removed fruits were considered when counting the final fruit number.

**Total Number of Fruits per Bunch and Fruit Set Percentage:** All of the used pollen grain concentrations in “Medjol” cv., were produced a lower significant total number of fruits (Table 1) in compare to the natural pollination process (control) which is used by the farmers; on the other hand, same results were observed in the “Barhee” cv, but without significant difference between the control and the 4 g of pollen grain. Which means high concentrations of pollen grain used in the control and in the 4 g water suspension, is responsible for the high number of the produced fruits per bunch. Table (1) represents fruit set percentage. The results showed that different pollination methods produce the fruit set

percentage in both cvs. Maximum fruit set percentages were obtained by the control treatment. Also, Pollen grain water suspension produced a fruit set percentage from 66-87 and 79-96 % in “Medjol” and “Barhee” dates, respectively, which was considered as a high fruit set percentage and required a further fruit thinning.

In this study, using 1.0 g/L spray pollination “Madjol” cv., produce 66 % fruit set without thinning (Table 1). Thus, spray pollination could be used to increase fruit set and regulates tree bearing without thinning process. These results were similar to previous findings by Khan and Ghaffoor [30] on date palm.

**Number of Fruits per Spike:** All of the used pollen grain concentrations were produced lower number of fruits per spike in compare to the control that produced the highest significant fruit number per spike, but no significant differences were observed between the control and the highest pollen grain concentration (4 g/L) in “Madjol” date cv. (Table 2), which is due to the high availability of pollen grains in the traditional pollination method and in the highest water-suspension treatment [31].

**Total Number of Spikes per Bunch:** Pollen grain treatments have lower effect on this parameter. There were no statistical differences between all of the used pollination treatments in “Madjol” (Table 2). Using 4 g/L resulted significant differences “Barhee” date palm. Moreover, 4 m/L showed lowest number of spikes per bunch compare to all other pollination methods.

**Average Fruit Fresh Weight:** All of the used water-suspension treatments in both cultivars improved fruit weight in compare to the traditional pollination treatment (control) that is used by farmers (Table 3), which is due to the high fruit set in the control treatment that reflected on the size of the fruit. These results coincide with that obtained by Abdalla *et al.* [24], who found that the percentage of fruit set was decreased by using the pollen grains suspension, while the fruit quality in term of fruit weight were improved.

**Bunch Weight:** Data revealed that maximum bunch weight was obtained by the control treatment and with the used of 2.0 g/L of pollen grain water-suspension treatments in both date palm cultivars (Table 3) due to the high availability of pollen grains in both treatments that produced the highest fruit set and reflected on the bunch weight. This data is in agreement with that obtained by

Table 1: Effect of spray with pollen on fruits number per bunch and fruit set percentage of “Medjol” and “Barhee” Date Palm cultivars\*

Trt/Cultivars	“Medjol” cv.		“Barhee” cv.	
	No. of fruits/bunch	% of fruit set	No. of fruits/bunch	% of fruit set
Control	885 a**	100	2380 a	100
1.0 g of pollen grain	853 d	66	1884 d	79
2.0 g of pollen grain	653 cd	74	2096 bc	88
3.0 g of pollen grain	691 b	78	2005 cd	84
4.0 g of pollen grain	771 b	87	2293 ab	96
LSD <sub>0.05</sub>	82.5	82.5	162	

\*Values are the mean of four replicates.

\*\* : Means within each column having different letters are significantly different according to LSD at 5 % level.

Table 2: Effect of spray with pollen on number of fruits per spike and number of spikes per bunch of “Medjol” and “Barhee” Date Palm cultivars\*

Trt/Cultivars	No. of fruits/spike		No. of spikes/bunch	
	“Medjol”	“Barhee”	“Medjol”	“Barhee”
Control	27.1 a **	42.2 a	38.3 a	61.7 a
1.0 g of pollen grain	18.3 b	35.3 b	35.8 a	54.0 ab
2.0 g of pollen grain	18.1 b	37.2 b	40.3 a	59.7 ab
3.0 g of pollen grain	20.8 b	37.8 b	37.7 a	61.0 a
4.0 g of pollen grain	22.5 ab	38.3 b	38.3 a	51.7 b
LSD <sub>0.05</sub>	5.3	3.84	6.5	8.14

\*Values are the mean of four replicates.

\*\* : Means within each column having different letters are significantly different according to LSD at 5 % level.

Table 3: Effect of pollen grain spray on average fruit fresh weight, bunch weight and yield per tree of “Medjol” and “Barhee” Date Palm cultivars\*

Trt/Cultivars	Av. Fruit fresh wt. (g)		Bunch wt. (kg)		Yield/tree (kg)	
	“Medjol”	“Barhee”	“Medjol”	“Barhee”	“Medjol”	“Barhee”
Control	17.3 b**	14.5 b	22.3 a	48.1 a	65.1 a	159 a
1.0 g of pollen grain	19.5 a	16.2 a	15.5 d	41.5 b	40.3 c	121 c
2.0 g of pollen grain	20.3 a	17.3 a	19.2 bc	37.3 b	56.7 b	141 b
3.0 g of pollen grain	20.2 a	17.1 a	17.2 cd	39.3 b	63.4 ab	135 b
4.0 g of pollen grain	19.3 a	17.1 a	21.1 ab	47.7 a	59.3 ab	162 a
LSD <sub>0.05</sub>	1.6	1.3	2.4	5.5	7.2	12.7

\*Values are the mean of four replicates.

\*\* : Means within each column having different letters are significantly different according to LSD at 5 % level

Iqbal *et al.* [25] who recorded that maximum fruit yield per bunch was obtained by placement method in compare to the water suspension methods that produced a lower bunch weight.

**Total Yield per Tree:** Data indicated that pollen grain water suspension treatment reduced the total yield per tree in both cultivars in compare to the control treatment (Table 3), due the lower fruit set that reflected on the total yield per tree, but even though the yield was decreased, but the quality was improved.

## CONCLUSION

The traditional method of pollination produced the highest number of fruits per bunch, fruit set percentage, fruit number per spike, bunch weight and total yield per

tree in compare to the water-suspension treatments that resulted maximum fruit fresh weight. On the other hand, pollen grain treatments have lower effect on total number of spikes per bunch.

This study indicated both “Barhee and Medjol” can be pollinated by spray of pollen grain-water suspension with optimum amount of pollen grains. Using 1 g/l in Madjol did not require any fruit thinning. However, further study is needed to justify the optimum concentration of pollen grain-water suspension and the response of each date palm cultivar to this pollination technique.

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