

ASSESSING THE EFFECTIVENESS OF THREE METHODS OF POLLINATION IN DATE PALM (*Phoenix dactylifera* L.) CV. 'MEJHOUL' IN MOROCCAN OASES

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ABSTRACT

At the date palm tree (*Phoenix dactylifera* L.), artificial pollination is necessary to improve fruit setting and enhance economical yield. This study was conducted at a private farm of date palm production cv 'Mejhoul' in a conventional farm during 2016 season, under pedoclimatic conditions of Tinejdad, Errachidia region, Morocco. The experiment was designed to compare the effectiveness of three pollination methods and their response to fruit setting percentage, yield and fruits characteristics. Two pollinizers (symbolized M1 and M2) combined with Three pollination methods were compared i.e. hand pollination as well as traditional technique, the dusting of pollen and the liquid spray of pollen. Three 'Mejhoul' female trees were selected for the experiment, on the female tree, six spathes were selected, each spathe was pollinated by one pollen source according to a method. Fruit samples were collected during 'Tmar' stages. Results revealed that different pollination techniques had significantly affected all studied parameters, metaxenic effect was observed between pollinizers (M1 and M2). Moreover, the highest fruit set of 65.06% and 59% was recorded in the placement method for two pollen sources M1 and M2, respectively. However, the lowest fruit set (53.25 and 50.29%) were observed in liquid spraying pollen method for M1 and M2, respectively. The highest date yield was recorded for dusting pollen from pollinizer M1 (58.23 kg/palm). Liquid spray of pollen method produced the minimum yields for both pollinizers (50.42 Kg/palm for M 1 and 43.67 kg/palm for M2). The dusting of pollen engendered dates with maximum linear dimensions for both pollinizers. Indeed, lengths of dates from M1 and M2 were 48.2 mm and 48.38 mm, the maximum widths were 24.97 mm and 24.72 mm, respectively. However,

the hand pollination produced dates having a majority of minimum parameters for the M2 pollinizer (fruit width: 22.17 g; fruit weight: 11.69 g; pulp weight: 10.59 g). It was concluded that the dusting of pollen method was found instrumental in improving the yield and quality of 'Mejhoul' date palm.

Keywords: Palm date (*Phoenix dactylifera* L.); Mejhoul; pollination methods; fruit set; yield and fruit quality.

INTRODUCTION

Date palm (*Phoenix dactylifera* L.) is the most successful and important fruit crop in the arid regions [1], it is widely cultivated and occupies a very important place in Sahara agriculture and the national economy. According to the Food and Agriculture Organization (FAO) of the United Nations, in Morocco, the global date production has increased from 74000 tons in 2000 to 101537 tons in 2019 [2]. This species is a dioecious crop where male and female inflorescences are on separate palms [3]. To ensure good fertilization, the transfer of pollen from the male spadix to the female spadix is necessary [4,5]. Artificial pollination of the date palm is a practice that arose very early in the evolution of date crop [6]. Bonavia (1885) first attempted mechanical pollination of date palm in India [7], quality of date fruits is severely affected by natural pollination as it is ineffective in the efficient fruit set and yield [8,9].

The most common manual technique of pollination in date palm is the placement of two to three male strands into female spathes [10]. Mechanical pollination has been investigated in the Middle-East, results of several experiments reported to have several advantages including high efficiency, decrease in pollen consumption, saving of time [4,7,9]. In Pakistan, Iqbal et al. [9] reported that the placement method (i.e. the male strands were removed from inflorescence and placed on the top of opened spathes) was found instrumental for improving yield and quality in 'Dhakki'cv. date palm. In Morocco, there are a few researches published related to this pollination techniques, very little is known about the effect of used methods of pollination on yield and fruit quality of date palm. The present experiment was intended to study the effect of different methods of pollination on fruit set and physical characteristics of date fruits cv. 'Mejhoul'.

MATERIALS AND METHODS

Experimental Conditions

This experimentation was carried out during 2015 season, in a model orchard for production of 'Mejhoul' dates (organic, 8 x 8m, drip irrigated), located in South-East of Tinjdad village, according to pedoclimatic conditions of Errachidia region in Morocco (Fig. 1).

Experimental Design

The pollen was collected from two male trees M1(X: 31° 52';Y: -04° 99') and M5 (X:31° 53'; Y: -04° 84') used by elite farmers. The mature male spathes were collected and dried, then strands were cut off and spread on paper sheets to dry slowly during few days in clean rooms.

Three selected 'Mejhoul' palms were healthy, same age (12 years) and uniform in growth vigor and fruiting. At the creamy yellowish stage of the flowers i.e. 3 to 4 days after natural cracking of female spathes. six spathes per palm were marked and pollinated as follows: 1) two spathes were pollinated manually by inserting 3 male strands; 2) Two others spathes were pollinated by dusting pollen mixed with talcum powder at 1:9 ratio; 3) Two remaining spathes were pollinated by spraying the pollen diluted in distilled water at 1:9 ratio. For the three pairs of female spathes used, one spathe received the pollen of M2 while the second is pollinated by the pollen of M2. All inflorescences were covered by paper bags after pollination, for three days. All cultural practices in the field for the experimental palms were carried out according to the standard schedule.

Agronomic Parameters

Fruit set percentage

Fruit set percentage was calculated by counting normal (fertilized) and abnormal (unfertilized)

fruits on each spathe selected after four weeks of pollination, the following formula was proposed by Iqbal et al. [9]:

$$\text{Fruit set \%} = \left(\frac{\text{Number of normal fruits} - \text{Number of abnormal fruits}}{\text{Total number of fruits}} \right) \times 100$$

Yield quantification

On each palm, all spathes were harvested at 'Tmar' stage and weighed by an electronic balance; values of treatment were expressed in the Kg/palm tree.

Pomological Characters

Fruit, pulp and seed weights

Morphometric measurements were carried out on a composite sample containing 30 fruits from each treatment. The fruit weight, fruit pulp weight and seed weight were measured using an analytical balance (Denver mark. Germany).

The quality ratios were measured according to the following formulas:

$$\text{P/D ratio (\%)} = \frac{\text{Flesh weight}}{\text{Date weight}} \times 100$$

$$\text{S/D ratio (\%)} = \frac{\text{Seed weight}}{\text{Date weight}} \times 100$$

Fruits dimensions

Fruit length (cm) and fruit width (cm) were measured with a digital calliper (Mitutoyo CD - 15GP. Mitutoyo Co., Japan).

Statistical Analysis

All analytical determinations were performed in triplicate. Values of different parameters were expressed as the mean \pm standard deviation. Data were subjected to the analysis of variance to study the differences between group means. To assess for differences in the studied parameters, Duncan and Student-Newman-Keuls tests at 5% level were applied using the Statistical Package for the Social Sciences SPSS (20.0).

RESULTS AND DISCUSSION

Fruit Set %

The results in Table 1 show the effect of pollination methods on the fruit set. The results show that different pollination techniques significantly affected the fruit set percentage for both pollinizers. The significantly highest fruit set

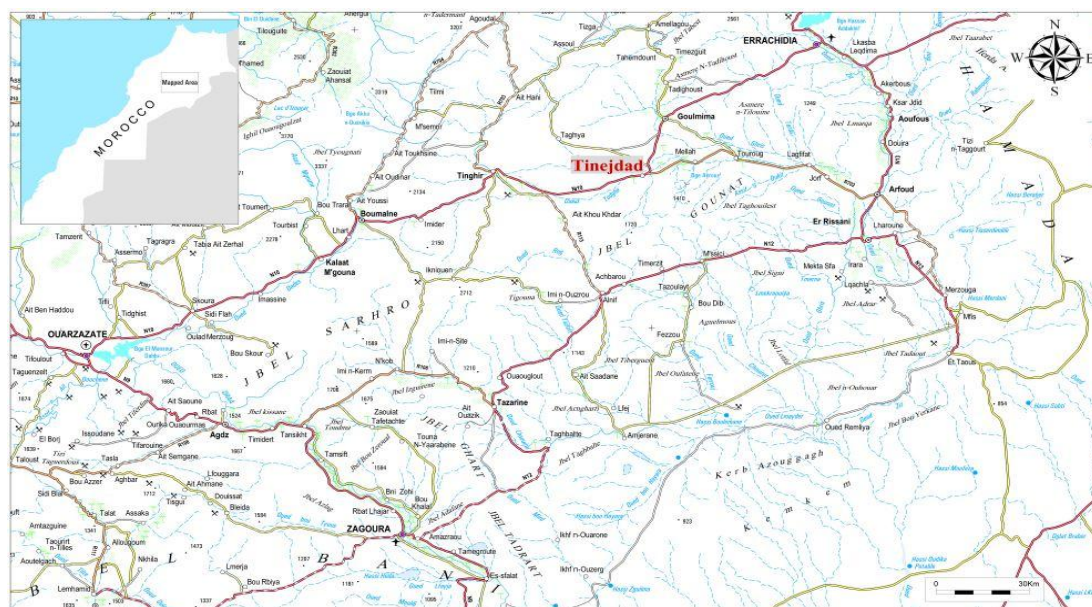


Fig. 1. Topographic map illustrating the geographical location of experimental site

(65.06% and (59%) was recorded in the placement method for the two pollen sources M1 and M2 respectively. However, the lowest fruit set of 53.25% and 50.29 % were observed in the liquid spraying pollen method for M1 and M2 respectively. These results are in opposition to those demonstrated by many researchers [7,9,11], they obtained a maximum fruit set by hand pollination, in comparison with the mechanical method. In addition, other investigators [12] did not find any significant difference in fruit set between the hand pollination and the mechanical dusting of pollen.

Yield kg/Tree

The data regarding yield is given in Fig. 2. The results show that different pollination techniques significantly affected the yield for both males. The M 1 pollinizer produced a high yield compared to M 2 for all three pollination methods. The highest date yield was recorded for the dusting of pollen from M 1 (58.23 kg/palm). The use of pollen from M 2 combined with the liquid spray method engendered a minimum yield (43.67 kg/palm). Depending on the pollination method, the dusting of the pollen resulted higher yields (58.23 and 50.08 kg / palm for M 1 and M 2 respectively). However, the liquid spray of pollen method produced the minimum yields for both pollinizers (50.42 kg/palm for M 1 and 43.67 kg/palm for M 2). These results are in agreement with those reported by El-Kassas et al. [12] who reported a significant improvement in the yield of palm trees pollinated by mechanical spraying. Essentially, the yield of date palm depends on several factors that are the cultivar and the efficiency of the pollination method. Indeed, in Saudi Arabia, Al-Wusaibai et al. [7] demonstrated the existence of a significant difference between pollination methods depending on the cultivar; the mechanical

spraying of pollens on 'Khalas' cv. gave better yields compared to the traditional method. However, in 'Sheshi' cv. no significant effect of the pollination method was recorded. Mohamed Awad et al. [13] found that the two methods of pollination (traditional and spraying) affect the yield of 'Nabbut-Ali' cv. However, the yield of 'Sabbaka' cv. did not show any significant effect.

Morphometric Characteristics Fruits

Table 2 represents morphometric measurements of dates obtained from two pollinizers and according to three different methods. In all obtained dates from pollinator M 2, the majority of characteristics measured are significantly high compared to dates obtained from M 1. Different pollination methods exhibited a significant effect on the fruit characteristics, spathes pollinated by liquid spray of pollen produced dates of large caliber, in terms of fruits weight and pulp weight. The maximum average weight of dates was recorded for dates from M 1 pollinizer (17.58 g) with also a maximum pulp weight (16.54 g). In comparison with two other methods, the application of dusting pollen for M2 generated a maximum weight (weight dates: 15.61 g and weight pulp: 14.51 g).

The dusting of pollen engendered dates with maximum linear dimensions for both pollinizers. Indeed, the lengths of dates from M1 and M2 were 48.2mm and 48.38 mm, the maximum widths were 24.97 mm and 24.72 mm, respectively. However, the traditional method by inserting the pollen strands into spathes produced dates having a majority of minimum parameters for the M2 pollinizer (fruit width: 22.17 g; fruit weight: 11.69 g; pulp weight: 10.59 g). These results are in agreement with those reported by other researchers [4,7].

Table 1. Effect of different pollination methods on fruit set of date palm cv. 'Mejhoul'

Pollinizer	Pollination method		
	Hand pollination	Dusting of pollen	Liquid spray of pollen
Male 1	53,25 ± 3,54 b	65,06 ± 2,51 a	55,21 ± 3,02 ab
Male 2	50,293,12 b	59 ± 3,04 ab	52,6 ± 3,80 b

Average value ± Standard error. Averages with the same letters in the same column are not significantly different at (p = 0.05); Duncan test

Table 2. Effect of different pollination method on morphometric characteristics of date fruits cv. 'Mejhoul'

Pollinationmethod	Male pollinizer	Lenght fruit (mm)	Width fruit (mm)	Weight fruit (g)	Weightpulp (g)	Weightseed (g)	Ratio P/D (%)
Hand pollination	M 1	38,62 ± 0,35 d	22,17 ± 0,19 b	11,69 ± 0,23 d	10,59 ± 0,23 d	1,09 ± 0,02 a	90,46 ± 0,19 e
	M 2	41,10 ± 0,52 c	24,15 ± 0,27 a	16,23 ± 0,28 b	15,22 ± 0,27 b	1,01 ± 0,02 a	93,72 ± 0,12 a
Dusting of pollen	M 1	37,82 ± 0,38 d	22,93 ± 0,25 b	12,94 ± 0,22 c	11,93 ± 0,23 c	1,00 ± 0,02 a	92,22 ± 0,14 c
	M 2	46,12 ± 0,62 b	24,30 ± 0,24 a	17,58 ± 0,24 a	16,54 ± 0,24 a	1,04 ± 0,16 a	94,04 ± 0,1 a
Liquid spray of pollen	M 1	48,2 ± 0,48 a	24,97 ± 0,28 a	15,61 ± 0,27 b	14,53 ± 0,28 b	1,07 ± 0,02 a	93,08 ± 1,13 b
	M 2	48,38 ± 0,25 a	24,72 ± 0,23 a	12,80 ± 0,17 c	11,74 ± 0,17 c	1,06 ± 0,02 a	91,62 ± 0,16 d
Mean ± Standarderror		43,37 ± 1,07	23,87 ± 0,34	14,46 ± 0,38	11,52 ± 0,37	1,35 ± 0,02	89,54 ± 0,21

Average value ± Standard error. Averages with the same letters in the same column are not significantly different at (p = 0.05), Student-Newman-Keuls test

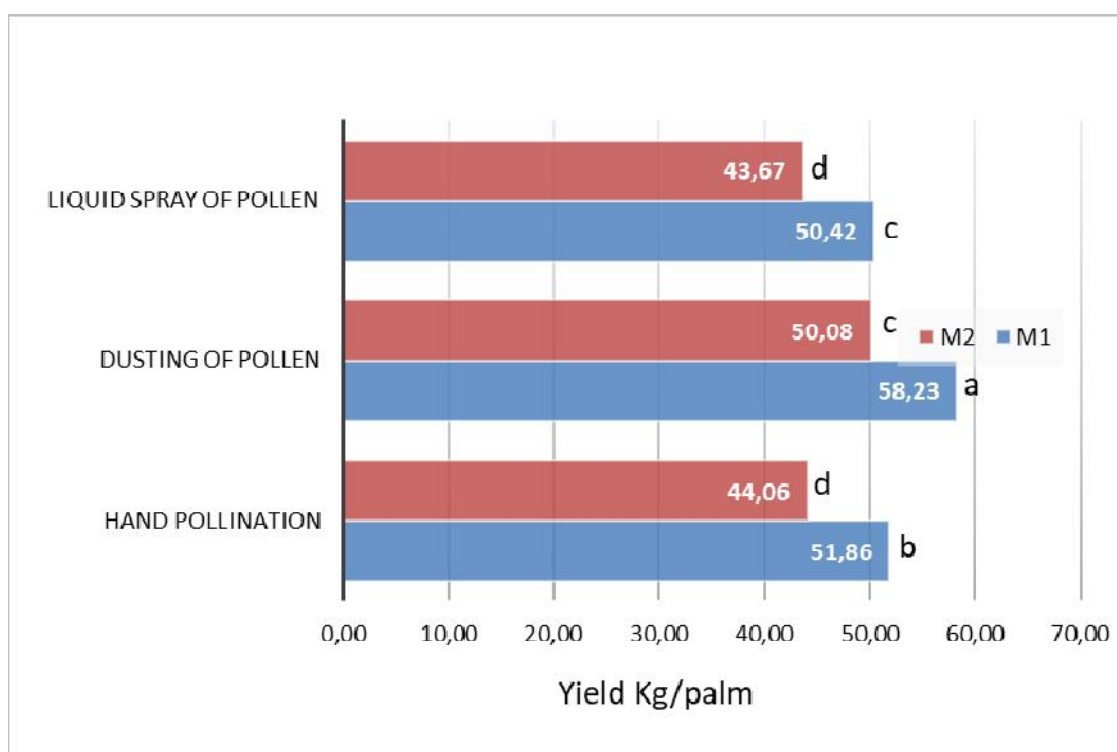


Fig. 2. Effect of different pollination methods on the yield of date palm cv. 'Mejhouli'

Indeed, a net improvement was obtained at the level of physical characteristics of dates by liquid spraying pollen compared to the traditional method. In contrast, Iqbal et al. [9] and Hamood et al. [14] did not found the effect of the pollination method on the caliber of dates.

CONCLUSION

It can be concluded from the result findings that for obtaining maximum fruit set, economic yield and fruits caliber in 'Mejhouli' date palm, the dusted of pollen mixed with inert matter (such as talcum powder) may be adopted in pollination. However, more investigation is required to justify the optimum concentration of grain-talcum powder and grain-water suspension and the response of other date palm cultivar to these pollination methods.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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