

Impact of Different Times and Methods of Pollination on Fruit Set and Productivity of Barhi Date Palm

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Abstract

This study investigated the effect of different pollination methods, traditional pollination (hand pollination), spraying pollen suspension and dusting pollen and different pollination times (at same spathe cracking day and after two days from spathe cracking) on fruit set (%), yield as well as some fruit physical and chemical properties of “Barhi” date palm cultivar. The used palms grown in new reclaimed sandy soil at private orchard located at Al Assiuty valley, Assiut, Egypt during two consecutive seasons (2020 and 2021). Results cleared that the most effective treatments in this investigation is using hand pollination at same spathe cracking day followed by spraying pollen suspension at same spathe cracking day, these treatments gave the highest fruit set% with economical yield and high fruit quality with high content of total and reducing sugars. However, delaying the pollination two days after spathe cracking resulted in decreasing fruit set, yield and fruit quality compared with pollination at the same spathe cracking day.

Keywords: *Date Palm, Suspension, Spathe cracking, Pollination.*

Introduction

Date palm (*Phoenix dactylifera* L.) is considered as one of most important fruit crop in arid and semi-arid regions on the world, especially in Arab world. Egypt considered one of the top date producers, FAO (2019). There are more than 100 million palm trees around the world produce more than 1.5M tones, about 70% in the Arab world, Egypt’s production amounts to about 16% of world production and about 24% of the production of Arab countries (Boubaker *et al.*, 2018). The date palm is dioeciously, inflorescences male and female on separate individual trees. Natural pollination done by wind, bees and insects (Bashir *et al.*, 2019). Stigma doesn’t still receptive a long period, the period of receptivity varies according to weather and cultivars (Marzouk *et al.*, 2002). Howev-

er, fruit set percentage by natural means is very low, due to many problems including pollination methods, such as time of pollination. It is important to know the period during female flower still receptive to pollination. In this respect (Iqbal *et al.*, 2018; Lemlem *et al.*, 2018) stated that female spathe after opening need to be pollinated within 2 to 4 days. Therefore, hand pollination is one of the most important reasons for obtaining high fruit set, yield and fruit quality Khushk *et al.*, (2009) There are many pollination techniques were use in date palm production as using fresh male strands, dried pollen and pollen suspensions Sayed *et al.*, (2018). Newly many investigations use other techniques in date palm pollination; Abdalla *et al.*, (2011) found that applying pollen suspension contains 1.5 g/L of pollens plus either 2

g/L ascorbic acid or 0.2 g/L boric acid mixed with 10% Vinous increased the fruit quality and total yield of “Zaghloul” cv. Also Ahmed and Jahjah, (1985) reported that spraying pollen grains suspension 10% sucrose and 20 ppm GA₃ increased the fruit set % and dates quality. Sayed *et al.*, (2018) stated that, the best yield and quality of date palm fruits cvs. “Khalas” and “Sagae” were obtained by spraying pollen grains extract at 800 ppm. On the other hand, Soliman *et al.*, (2017) observed that the highest fruit quality in “Sagae” dates can be obtained by spraying palms with suspension culture consists of 2g/L pollen grains powder mixed with 2g/L sugar. Delaying pollination for a few days reduce fruit set and bunches weight than the pollination in the first day of spathe opening. The 4th to the 7th day after of spathe opening considered the high length of receptivity for give a good yield and high fruit quality of many cultivars (Moustafa, 1998; Damas, 1998; Abdallah *et al.*, 2002 and Samih, 2006).

The target of this experiment conducted to study the impact of different pollination methods and times (spray a solution or dusting with pollen grain powder on yield, fruit set (%), as well as physical and chemical properties of “Barhee” fruits.

Materials and Methods

This investigation was conducted during two consecutive seasons of 2020 and 2021 on Barhi date cultivar, at private orchard located at El wady Al Assiuty. The date palms were grown on sandy soil with 8×8 meters apart under drip irrigation system and the palms under study received the same horticultural practices. Eighteen

date palm trees (15-years old) selected at random to apply the different pollination methods and times. The palms were divided into six treatments each treatment contained three replicates with one palm for each replicate. Seven spathes nearly equal size were left on each palm, these spathes were pollinated by using pollen grains from the same male palm in both seasons, to avoid metaxenia effect. The treatments of this experiment arranged in a randomized Complete Block Design (RCBD).

Traditional pollination were done with ten dried strands/ spathe, spraying pollen grains at (5 g pollen +10g sucrose /L) sprayed by hand sprayer (2 liter capacity) on female bunches each bunch received 50ml, dusting done by dried pollen grains which mixed with flour (5 g pollen +10 g flour) and dusted on open female spathe. The experimental work including six treatments arranged as follow:-

T₁- Hand pollination at same spathe cracking day.

T₂- Hand pollination after 2 days from spathe cracking.

T₃-Spraying with Pollen suspension at same day of spathe cracking.

T₄-Spraying with Pollen suspension after 2 days from spathe cracking.

T₅-Dusting at same day of spathe cracking.

T₆-Dusting after 2 days from spathe cracking.

Initial fruit set was counted by using 10 strands per bunch after four weeks from pollination using the following equation:

$$\text{Initial fruit set (\%)} = \frac{\text{Average number of fruit set /strand}}{\text{Average number of fruit set + Averages number of flower scars}} \times 100$$

The fruit retention percentages were determined at the harvest time at the same strands using the following equation:

$$\text{Fruit retention (\%)} = \frac{\text{Average number of retained fruit}}{\text{Average number of retained fruit} + \text{Average number of flower scars}} \times 100$$

All fruit bunches were harvested at the full color stage, bunches weight was recorded then total yield was estimated using the equation:

Yield/palm (kg) = number of bunches multiply average bunch weight

A Sampling of twenty date fruits from each bunch were taken at random to study the different fruit properties

- 1- Fruit weight, flesh weight and seed weight (g.) were determined using electronic balance.
- 2- Fruit length and diameter (cm) were measured by using vernier caliper.
- 3- Total soluble solids percentages were determined by using hand refractometer, acidity, reducing, non-reducing and total sugars

were determined according to A.O.A.C. (1995).

Statistical analysis:

Data were tabulated and subjected for statistical analyzed of variance according to the randomized complete block design using LSD test for recognizing the significance Differences between means using Statistics 8.1 software (Analytical Software, 2005).

Results and Discussion

1. Initial and horticulture fruit set percentages, bunch weight (kg) and total yield (kg):

Data in Table (1) cleared that pollination of Barhi date palm with hand pollination, spraying pollen suspensions at same spathe cracking day significantly or slightly increased the fruit set, fruit retention percentage, bunch weight and total yield compared with other pollination treatments during the two seasons of this study.

Table 1. Effect of different methods and times of pollination Initial fruit set% horticulture fruit set%, bunch weight and total yield on Barhi date palm (2020 and 2021 seasons).

Characters Treatments	Initial fruit set %		Fruit retention%		Bunch weight(kg)		Total yield (kg)	
	2020	2021	2020	2021	2020	2021	2020	2021
T ₁	69.80	71.87	56.33	59.90	16.23	18.90	113.61	132.30
T ₂	65.53	67.66	53.29	54.00	15.57	16.32	108.99	114.24
T ₃	71.30	74.53	65.00	65.67	16.84	19.30	117.88	135.10
T ₄	67.20	69.27	52.30	56.33	16.76	19.01	117.32	123.07
T ₅	57.63	59.90	46.73	48.93	13.67	14.90	95.69	104.30
T ₆	54.83	57.93	40.73	43.83	11.78	13.03	82.46	91.21
LSD at 5%	2.72	2.80	0.94	1.30	1.20	1.25	3.88	9.75

T₁ Hand pollination at same spathe cracking day T₄ Spraying Pollen suspension after 2 days from spathe cracking
 T₂ Hand pollination after 2 days from spathe cracking T₅ Dusting at same spathe cracking.
 T₃ Spraying Pollen suspension at same spathe cracking. T₆ Dusting after 2 days from spathe cracking

The highest Initial and horticulture fruit set, bunch weight and total yield obtained with T₃ (spraying with pollen suspension at same spathe cracking day) (71.3 and 74.53%) (65.00 and 65.67%) (16.84 and 19.30kg) (117.88 and 135.10kg) during 2020 and 2021 respectively followed by T₁ (hand pollination at same spathe cracking day) (69.80, 71.87) (56.33 and 59.90) (16.23 and 18.90) (113.61 and 132.30) during 2020 and 2021 respectively while the least values recorded under T₅, T₆ (dusting at same spathe cracking day and after two days from cracking).

Increasing bunch weight and total yield due to increasing initial fruit set and fruit retention. These results are agreement with these found by Iqbal *et al.* (2010) the heaviest fruit setting obtained with the replacement method. Attalla, *et al* (1998) found that fruit yields were increased by different pollination methods, Ibrahim and Haggag (1993) recorded that hand pollination gave good yield than natural pollination. Samouni-Mona *et al.*, (2016) stated that non-significant

differences in bunch weight due to dusting of pollen grains powder at 50 or 25% compared to the control. Iqbal *et al.*, (2018) noticed that pollination at spathe cracking day was more effecting to get maximum fruit set and total yield. Iqbal *et al.* (2004), reported that earlier pollination time in Dhakki date palm gave the best fruit set, Al-Obeed and Soliman (2011) who recorded that the heaviest fruit set in Sayer date palm at spathe cracking day.

2. Physical properties (fruit weight, pulp, seed weight, fruit dimensions)

Data observed in Table (2) cleared a significant difference between the different methods and times of pollination on fruit weight, Pulp weight and fruit length. An increase were observed when the date palm pollination done at same spathe cracking day especially under (T₃) spraying pollen suspension at same spathe cracking day which gave highest values (13.18, 14.41) (12.43, 12.92) (3.53, 3.62) on fruit weight, pulp weight and fruit length during the two seasons of study respectively.

Moreover, there are no significant differences on all fruit properties between (T1) hand pollination and (T3) spraying pollen suspension on the two seasons of this study. In addition the least values of such fruit properties were obtained under dusting pollen at same spathe cracking day and two days later. The results of this study are dissimilar with Attalla *et al.*, (1998) who found no significant differences in Dhaki fruit weight with different pollination methods. El-Refaey and El-Dengawy (2017) found that most pollination techniques (dusting of pollen and natural pollination had improved the physical Properties (Fruit length, width and size) of Hayany dates. Al-Wasfy (2014). suggested that pollination Zaghloul date palms by using spraying pollen grains at 4 g pollen grains +

2ml treacle + 2 g ascorbic acid + 1 g boric acid per liter water during two days after spathe opening increased final fruit set, total yield and fruit quality, Abu-Zahra and Shatnawi, (2019); Sayed *et al.*,(2018) and Soliman *et al.*, (2017)) on different palm cvs, indicated that application of 6 g/L pollen suspension enhanced significantly fruit and pulp weight and fruit length. In addition the results are not agreement with El-Sharabasy *et al.*, (2020) which they concluded that hand pollination of “Barhee” dates is one of the most important practices to give high yield and fruit quality. The beneficial treatment in this study is spraying female spathes with 100 g/L sugar and dusting with 1g pollen + 2g flour with bagging, which gave high fruit weight and dimensions.

Table 2. Effect of different methods and times of pollination on Fruit weight (g), Pulpweight (g), Seed Weight (g) fruit length and diameter on Barhi date palm (2020 and 2021 seasons).

Characters Treatments	Fruit weight(g)		Pulp weight(g)		Seed weight(g)		Fruit length (cm)		Fruit diameter (cm)	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
T ₁	12.98	13.41	11.76	12.18	1.22	1.23	3.47	3.54	2.36	2.48
T ₂	11.81	12.01	10.78	10.97	1.03	1.05	3.25	3.25	2.12	2.19
T ₃	13.18	14.10	12.43	12.92	0.75	1.18	3.53	3.62	2.40	2.50
T ₄	12.28	12.49	11.37	11.53	0.91	0.96	3.45	3.51	2.24	2.25
T ₅	11.14	11.16	10.22	10.24	0.92	0.93	3.10	3.18	2.14	2.22
T ₆	10.41	10.42	9.387	9.39	1.02	1.02	2.85	2.99	1.89	1.89
LSD at 5%	0.45	0.85	0.47	0.75	0.15	0.16	0.04	0.05	0.04	0.04

T₁ Hand pollination at same spathe cracking day T₄ Spraying Pollen suspension after 2 days from spathe cracking
 T₂ Hand pollination after 2 days from spathe cracking T₅ Dusting at same spathe cracking.
 T₃ Spraying Pollen suspension at same spathe cracking. T₆ Dusting after 2 days from spathe cracking

3-Chemical properties (acidity, TSS, reducing, non red-sugars, total sugars)

Concerning to data in Table (3) it's clear that treatment (T3) spraying pollen suspension at same cracking day) decreased the total acidity com-

pared to the other treatment. The values were (0.37, 0.36%) during the two seasons followed by T4 (0.38, 0.37%). also the same treatment (T3) gave the highest TSS (36.47, 37.14), total sugar (35.00, 35.54) and reducing sugar (26.67, 27.07) respectively.

followed by (T1) recorded (35.67 and 37.95) (34.44 and 34.57) (26.12 and 26.20) respectively. The lowest values of TSS (31.73, 32.07) and total sugar (26.97, 27.63) recorded under T6. The highest non reducing sugar recorded with T₂ (hand pollination after two days from spathe cracking the values (9.21, 9.32) during the two seasons. Moreover, its notice that there are no significant differences between T₁ (hand pollination) and T₃ (pollen suspension on the same characteristics (TSS, total and reducing sugar). These results are in agreement with El-Sharabasy *et al.*, (2020) stated

that hand pollination (Placing 20-25 male strands on female spathe with bagging), were gave the highest total sugars and reducing sugars content. Al-Wasfy (2014) reported that pollination by using suspension of pollen grains at 4.0 g pollen is considered important to give high chemical characteristics. Ahmad *et al.* (2013) found that when delaying the pollination significantly increased reducing sugars. Same result obtained by Al-Wasfy (2005) found that when late pollination by 6-9 days after female spathe opening enhancing fruit chemical properties.

Table 3. Effect of different methods and times of pollination on acidity, TSS, reducing, non red- sugars total sugars, on Barhi date palm (2020 and 2021 seasons).

Characters Treatments	Acidity (%)		TSS (%)		Reducing sugar		Non reducing sugar		Total sugar	
	2020	2021	2020	2021	2020	2021	2020	2021	2020	2021
T ₁	0.39	0.38	35.64	37.95	26.12	26.20	8.30	8.37	34.44	34.57
T ₂	0.39	0.38	33.53	35.85	19.77	20.00	9.21	9.32	28.98	29.32
T ₃	0.37	0.36	36.47	37.14	26.67	27.07	8.33	8.47	35.00	35.54
T ₄	0.38	0.37	35.53	36.89	24.50	25.50	8.74	8.07	33.24	33.57
T ₅	0.41	0.39	32.47	33.81	21.30	21.30	6.86	7.27	28.17	28.57
T ₆	0.39	0.38	31.73	32.07	18.80	19.33	8.17	8.30	26.97	27.63
LSD at 5%	0.02	0.01	0.95	0.92	0.57	0.50	0.73	0.81	0.96	1.20

T₁ Hand pollination at same spathe cracking day

T₂ Hand pollination after 2 days from spathe cracking

T₃ Spraying Pollen suspension at same spathe cracking.

T₄ Spraying Pollen suspension after 2 days from spathe cracking

T₅ Dusting at same spathe cracking.

T₆ Dusting after 2 days from spathe cracking

Conclusion

Result indicated that for increasing fruit set, total yield and fruit quality of Barhi date palm cultivar, it is recommended that using hand pollination or spraying pollen suspension at same spathe cracking day to obtain high yield with good fruit quality. In addition it could be distinguished for saving effort, time and cost and a lot of practical suitable for the big farms, it could be recommend spraying pol-

len suspensions at same spathe cracking day.

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تأثير ميعاد وطرق التلقيح المختلفة على انتاجية وعقد ثمار نخيل البلح البرحي

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الملخص

تمت هذه الدراسة خلال موسمي ٢٠٢٠ و ٢٠٢١ على صنف النخيل البرحي المنزرع في اراضي رملية حديثة الاستصلاح بمزرعة خاصة في الوادي الاسيوطي، محافظة اسيوط وذلك لدراسة تأثير كلا من ميعاد وطرق التلقيح المختلفة على المحصول الكلي وجودة الثمار وبعض الصفات الطبيعية والكميائية للثمار وكانت المعاملات هي التلقيح باليد والتلقيح برش معلق حبوب اللقاح (٥ جرام حبوب لقاح + ١٠ جرام سكروز لكل لتر) وايضا التعفير (٥ جرام حبوب لقاح + ١٠ جرام دقيق) وذلك خلال ميعادين هما اولاً نفس يوم تشقق الاغريض المؤنث والثاني بعد يومين من تشقق الاغريض، ووضحت النتائج ما يلي: كانت أفضل المعاملات في هذه الدراسة هي استخدام التلقيح باليد في نفس يوم تشقق الاغريض يليها استخدام الرش بعلق حبوب اللقاح في نفس يوم تشقق الاغريض حيث اعطوا اعلى نسبة للعقد والذي ينعكس على المحصول الكلي بجانب جودة الثمار وايضا السكريات الكلية والمختزلة. كما ان تاخير التلقيح لمدة يومين بعد تشقق الاغريض ادى الى انخفاض نسبة العقد مقارنة بالتلقيح في نفس يوم تشقق الاغريض.