



Yield and fruit quality of Hayany date palm as affected by different pollen grain sources

Merwad, M.A., E.A.M. Mostafa, M.M.S. Saleh, A.A. Mansour

Pomology Department, National Research Centre, Dokki, Giza, Egypt

Abstract: The present study was carried out during two successive seasons (2013 and 2014) at a private orchard in El-Badrashin district, Giza governorate, Egypt. Pollen grains from different regions (Giza, Aswan, Rashid, Noubaria and New valley) were used to pollinate female Hayany date palm. All studied characters were significantly affected by different pollen grain sources used in this trial. Rashid pollen grains gave the highest fruit set, retention, bunch weight and yield per palm in both seasons comparing with the other pollen grain sources. In addition, the same pollen grain source recorded the highest fruit characteristics (fruit dimensions) and chemical composition of fruit (total soluble solids, reducing sugars, non-reducing sugars and total sugars). However, it could be recommended that Rashid seems to be the most suitable source of pollen grains to pollinate Hayany female date palm under this experiment conditions, since this pollinizer had improved fruit set, fruit retention and enhanced fruit dimensions, bunch weight and yield per palm in both studied seasons.

Key words: Bunch weight, Chemical properties, Fruit set, Physical properties, Pollination.

Introduction

Date palm (*Phoenix dactylifera* L.) is one of the ancient domestic fruit crops in the Middle East countries and its fruits play an important role in the nutrition pattern of many people, as well as strategic crops in food and biochemical industries¹.

Hayany is the best soft type of date palm cultivars. It can grow well under drastic environmental conditions which may be not suitable for many fruit species. Pollination is one of the major practices to ensure good fruit production. Artificial pollination is considered the major means for commercial date palm production.

It is well known that type of pollen grains, used in pollination of date palm cvs has a metaxinic effect on various fruit properties. Also, pollen types could affect the time of fruit ripening. This phenomenon was reported in date palm²⁻⁶. All of them found that pollen types had direct effects on both physical and chemical fruit properties.

The main objective of this study is to maximize the fruit retained and yield as well as to improve the fruit quality of Hayany date palm by select the most suitable pollen grain source.

Materials and Methods

This study was conducted at a private orchard located in El-Badrashin district, Giza governorate, Egypt, for two successive seasons (2013 and 2014) on Hayany date palm (*Phoenix dactylifera* L.).

Nine date palms from Hayany cv. of uniform vigor, 30years old, grown on a loamy soil were selected

according to their bearing of approximately the same number of spathes and leaves. All palms were subjected to the same horticultural practices in both seasons. The number of inflorescences per palm was adjusted to 8 by removing excess earliest, latest and small clusters.

Pollen grains were selected from five locations namely Giza, Aswan, New valley, Noubaria and Rashied.

Pollination was achieved by inserting the male strand into each of the female bunches. Five bunches on each female Haynay palms were received pollens from the five different males (one bunch for each male on the same female palm). To prevent contamination of pollens, every bunch was bagged after inserting the male strands with news paper bags which were removed after 3 weeks.

The experiment was arranged in a complete randomized design including five treatments of three replications.

Fruit set and fruit retention percentages were evaluated after one month of pollination and just before harvest, respectively. Five female strands per each bunch were randomly selected from each replicate, number of fruit set was recorded, then both fruit set and fruit retention percentages were calculated using the following equations:

$$N_s \quad \text{Fruit set \%} = \frac{\quad}{N_t} \times 100$$

N_t

N_r

$$\text{Fruit retention (\%)} = \frac{N_r + N_f}{N_r + N_f} \times 100$$

$N_r + N_f$

Where:

N_s = Number of setting fruits/strand.

N_t = Total number of flowers/strand.

N_r = Number of retained fruits/strand.

N_f = Number of flower scars/strand.

Yield was estimated as average bunch weight (kg) for each treatment crossing the number of bunches/palm.

At ripening, when 3-4 fruits on each bunch were reached softening stage, 30 fruits from each bunch were randomly selected to determine the physical properties such as fruit weight (gm), fruit volume (cm³), fruit dimensions (cm), fruit shape index, fruit pulp and seed%, also chemical properties as total soluble solids content, acidity, reducing sugars (%), non-reducing sugars (%), total sugars and tannins as out lined in A.O.A.C. methods⁷.

Statistical analysis:

The obtained data were tabulated and statistically analyzed using MSTAT program and the significant differences among the probability at 0.05 were performed⁸.

Results and Discussion

- **Effect of different pollen grain sources on fruit set, fruit retention, bunch weight and yield per palm:**
- **Fruit set (%):**
Results in Table (1) show that the highest significant fruit set was obtained due to Rashied pollen (78.6 and 76.0%) in both studied seasons, followed by Noubaria pollen grains (75.6%) in the first season and (70.6%) in the second one. The lowest fruit set percentage was recorded by Aswan pollen grains (70.3 and 69.6%) in both seasons.
- **Fruit retention (%):**
Results illustrated in Table (1) indicate that the highest retained fruit at harvest was obtained from treatment of Rashied pollen grains (42.3 and 41.0%) in the first and second seasons, respectively. Meanwhile, the least retained fruit value at harvest was recorded by Aswan pollen grains (29.6%) in both seasons.

- **Bunch weight (kg):**

Results in Table (1) show that palm pollinated with Rashied grains gave the heaviest bunches (16.3 and 17.3 kg) as compared with the analogous ones pollinated with Aswan grains (10.6 and 12.0 kg) in both seasons.

- **Yield per palm (kg):**

Results in Table (1) clear that palms pollinated with Rashied grains recorded the highest yield per palm (130.6 and 138.6 kg) as compared with that of Aswan pollen grains (85.3 and 96 kg/palm) in both seasons, respectively.

The variation in palm yield due to the effect of different pollinizer sources confirmed with results reported on Barhee³; on Zaghloul and Siwi¹⁰; on Amhat date palm⁴, since the researchers found that changes in yield could be affected by the pollen grains sources in the extent that differ with the variety of female parent.

Table 1. Effect of different pollen grain sources on fruit set, fruit retention, bunch weight and yield / palm

Pollen sources	Fruit set (%)	Fruit retention (%)	Bunch weight (kg)	Yield/palm (kg)
First season				
Giza	75.3 b	34.0 c	14.6 b	117.3 b
Aswan	70.3 d	29.6d	10.6 d	85.3 d
New valley	72.0 c	31.0 d	12.0 cd	96.0 cd
Rashied	78.6 a	42.3 a	16.3 a	130.6 a
Noubaria	75.6 b	35.6 b	13.3 bc	106.6 bc
Significances	S	S	S	S
Second season				
Giza	70.6 b	32.0 c	16.0 a	128.0 a
Aswan	69.6 b	29.6 d	12.0 b	96.0 b
New valley	70.3 b	32.3 bc	11.3 b	101.3 b
Rashied	76.0 a	41.0 a	17.3 a	138.6 a
Noubaria	70.6 b	34.3 b	15.6 a	125.3 a
Significances	S	S	S	S

- Means having the same letters are not significantly differed

- **Effect of different pollen grain sources on fruit physical and chemical properties:**

A) Physical properties:

1- Fruit dimensions(cm):

Results in Table (2) show that fruit length and diameter of Hayany date fruits was influenced by different pollen grain sources. In this respect, Rashied pollen grains recorded the highest fruit length and diameter in both seasons. The lowest values of fruit dimensions were obtained due to Aswan pollen grains (4.5 and 2.5 cm) in the first season. Meanwhile, the lowest fruit dimensions in the second season were recorded from Giza pollen grains (4.8 and 2.1 cm). Similar results were previously observed on Barhee and Amhat date palms^{3,4}.

2- Fruit shape Index:

Table 2 shows that the highest fruit shape index value (2.3) was obtained from New Valley pollen grains in the first season. Meanwhile, fruit shape index was not affected significantly by different pollen grain sources in the second season.

3- Fruit weight (gm):

As shown in Table (2), the average fruit weight was significantly increased due to pollen grains under investigated conditions. In this concern, Noubaria pollen grains gave the heaviest fruits (27.3 and 29.6 gm in the first and second seasons, respectively), followed in descending order by Rashied pollen grains (26.3 gm in the first season and 28 gm in the second one). However, Aswan pollen grains gave the lowest fruit weight in both seasons. The obtained results are agreed with those detected before on Barhee and Amhat date palms^{3,4}.

Table 2. Effect of different pollen grain sources on fruit length, fruit diameter, fruit shape, fruit weight

Pollen sources	Fruit length (cm)	Fruit diameter (cm)	Fruit shape	Fruit weight (gm)
First season				
Giza	4.8 c	2.2 c	2.2 ab	22.3 c
Aswan	4.5 d	2.2 c	2.0 b	20.6 d
New valley	5.3 b	2.3 bc	2.3 a	24.6 b
Rashied	5.7 a	2.5 a	2.2 ab	26.3 a
Noubaria	5.5 a	2.5 ab	2.2 ab	27.3 a
Significances	S	S	S	S
Second season				
Giza	4.8 d	2.1 b	2.3 a	20.6 d
Aswan	5.0 cd	2.3 ab	2.1 a	20.6 d
New valley	5.2 c	2.4 a	2.2 a	26.3 c
Rashied	5.7 a	2.5 a	2.3 a	28.0 b
Noubaria	5.4 b	2.5 a	2.2 a	29.6 a
Significances	S	S	NS	S

- Means having the same letters are not significantly differed

4- Seed percentage:

The obtained results (Table 3) indicate that different pollen grain sources for Hayany cv. significantly affected seed percentage in both seasons.

Aswan pollen grains recorded the highest seed percentage (14.6 and 14.5% in bot seasons, respectively). Meanwhile, the lowest seed percentage was obtained from bunches treated with Noubaria pollen grains (9.5 and 8.8% in the first and second seasons, respectively).

The obtained results concerning seed percentage are in agreement with those showed previously on Barhee and Amhat date palms^{3,4}.

5- Pulp percentage:

Pollen grain source as shown in Table (3) had a clear effect on pulp percentage. The highest pulp percentage was obtained from Noubaria pollen grains (90.5 and 91.2% in the two seasons, respectively). While as, the lowest pulp percentage was recorded from Aswan pollen grains (85.4 and 85.5% in both seasons, respectively). These results are agreed with those recorded on Barhee and Amhat date palms^{3,4}.

6- Fruit volume (cm³):

Results in Table (3) indicate that the fruit volume was significantly affected by different pollen grains sources in both seasons. Noubaria pollen grains gave the highest fruit volume of Hayany cv. (26.1 and 28.6 cm³ in both seasons, respectively). The obtained results are similar to those observed on Amhat date palm since all of them found variations among different female cultivars and pollen sources⁴.

Table 3. Effect of different pollen grain sources on fruit volume, pulp and seed percentages

Pollen sources	Fruit volume (cm ³)	Pulp %	Seed %
First season			
Giza	21.3 c	86.5 c	13.5 b
Aswan	20.0 d	85.4 d	14.6 a
New valley	23.5 b	88.6 b	11.4 c
Rashied	25.2 a	89.3 b	10.7 c
Noubaria	26.1 a	90.5 a	9.5 d
Significances	S	S	S
Second season			
Giza	19.8 d	85.6 c	14.5 a
Aswan	20.0 d	85.5 c	14.5 a
New valley	25.3 c	89.4 b	10.6 b
Rashied	27.0 b	89.9 b	10.1 b
Noubaria	28.6 a	91.2 a	8.8 c
Significances	S	S	S

- Means having the same letters are not significantly differed

B) Chemical properties:**1- Total soluble solids (TSS %):**

Results concerning total soluble solids content are shown in Table (4) since TSS % was significantly increased by different pollen grains under this investigation conditions. However, Noubaria pollen grains recorded the highest value of total soluble solids in the two seasons, since it reached 32.5 and 32.6 % in the first and second seasons, respectively. The obtained results are in agreement with those recorded on date palms, since TSS content was differed according to the source of pollen grains^{3,4,9,10}.

2- Total acidity percentage:

Results shown in Table (4) indict that the total acidity value was significantly affected by different pollen grain source in both seasons of the study. However, Giza pollen grains gave the highest value of acidity (0.22 and 0.23%) in the first and second seasons, respectively. These results are in accordance with those obtained before on Siwi and Zaghloul date palm⁹.

3- Sugars content:**3.1. Reducing sugars content:**

Concerning the effect of pollen grains sources on reducing sugars in the fruit, results in Table (4) revealed that Rashied pollinizer significantly increased this parameter as compared with the other pollinizer source in both studies seasons. The highest values of reducing sugars (79 and 80 %) were produced due to Rashied pollinizer in the two studied seasons. These results are in agreement with those reported on Siwi, Zaghloul and Amhat date palms^{4,9}.

3.2. Non-reducing sugars content:

It is clear from the results tabulated in Table (4) that pollen grains of Rashied gave the highest value of non-reducing sugars (9.6 and 8.6 %) in the two studied seasons.

3.3. Total sugars content:

Results in Table (4) revealed that pollen grain sources markedly affected total sugars fruit pulp, hence palms pollinated with Rashied pollen grains produced comparatively the highest sugars value (88.6 %) in both studied seasons.

The effect of pollen grain sources on sugars content might be due to the activities of enzymes system initiated by the metaxenia effect and later on that passed into extra cellular sites, get dissolved readily into water and invert the sugars. Similarly, the hydrolytic enzymes like polygalacturonase and cellulase may also be involved in these biochemical changes by solubilizing the pectin and cellulose in date palm fruit¹¹.

Regarding the effect of pollen grains on reducing sugars content, it took the similar trend of total sugars content. These findings could be explained due to the previous researches on date palm which included that the specific pollens may possibly affected cell number in early fruit development response of the female tissue to hormones or auxins introduced in the ovary by pollen sources¹².

Table 4. Effect of different pollen grain sources on TSS, acidity, reducing, non-reducing, total sugars and Tannins content

Pollen sources	TSS %	Acidity %	Reducing Sugars %	Non reducing sugars %	Total sugars %	Tannins %
First season						
Giza	30.43 c	0.22 a	75.6 b	8.7 c	84.5 b	1.7 b
Aswan	30.20 c	0.20 b	72.0 c	8.8 bc	80.5 c	2.0 a
New valley	30.20 c	0.22 a	70.6 c	9.0 b	79.6 c	2.0 a
Rashied	31.50 b	0.19 b	79.0 a	9.6 c	88.6 a	2.0 a
Noubaria	32.50 a	0.19 b	72.0 c	8.6 c	80.6 c	1.9 a
Significances	0.62	0.012	1.57	0.20	1.81	0.20
Second season						
Giza	30.50 b	0.23 a	75.6 b	8.4 b	84.4 b	1.8 c
Aswan	31.40 b	0.21 b	71.3 cd	7.9 c	79.2 c	1.9 b
New valley	31.16 b	0.21 b	72.0 c	8.0 c	80.0 c	2.0 ab

Rashied	32.60 a	0.20 c	80.0 a	8.6 a	88.6 a	2.1 a
Noubaria	32.60 a	0.19 c	70.3 d	8.5 ab	78.8 c	1.7 c
Significances	1.18	0.008	1.30	0.20	1.65	0.13

- Means having the same letters are not significantly differed

4- Tannins content:

Results shown in Table (4) indicated that the percentage of tannins in Hayanydate palm fruits was affected by pollen grain sources. However, Giza pollen grains significantly reduced tannins value in the first season comparing with the other sources. While in the second season, both of Giza and Noubariasignificantly decreased tannins percentage in compare with the other pollen grain sources. The variation in the effect of pollen grain source on tannins content confirmed with the results recorded on Zaghoul" dates pollinated with pollens from Meghal 2 which gave lower tannin percentage than those pollinated with Meghal 1¹³.

Conclusion

As the pollination considered is one of the most important horticultural processes that lead to improve yield and fruit quality of date palms, it could be recommended that Rashied seems to be the most suitable source of pollen grains to pollinate Hayany female date palm under this experiment conditions, since this pollinizer had improved fruit set, fruit retention and enhanced fruit dimensions, bunch weight and yield per palm in both studied seasons.

References

1. Khayyat M, Tafazoli E, Eshaghi S, Rajae S. Effect of nitrogen, boron, potassium and zinc spray on yield and fruit quality of adult palm. Amer. Eurasian J. Agric. and Environ. Sci., 2007,2(3): 289-296.
2. Bacha MAA, Aly MA, Al-Obeed RS, Abdul-Rahman AO. Compatibility relationship in some date palm cultivars (*Phoenix dactylifera* L.). J. King Saud Univ. Agric. Sci., 2000, 12(2): 81 -95.
3. El-Kosary S. Characteristics of four Barhee dates strains as affected by pollen source and pollination time. Journal of Horticultural Science & Environmental plants, 2009, 1 (3): 79-91.
4. Mustafa EAM, Heiba SAA, Saleh MMS, Ashour NE, Dorria A Mohamed, Abd El-Migeed MMM. Effect of different pollinizer sources on yield, fruit characteristics and phylogenetic relationships with Amhat cv. date palm (*Phoenix dactylifera* L.) in Egypt using RAPD markers. International Journal of Agricultural Research, 2014, 9 (7): 331-343.
5. Malaka A Saleh, El- Shamma MS, Omaira M Hafez, EssamMostafa A, Naguib MM. Improving Pollination Process of Samani Date Palm Cultivar Using the Bio-Activator MilagroStimcrop. International Journal of Plant & Soil Science, 2014,3(10): 1200-1209.
6. Omaira M Hafez, Malaka A Saleh, Mostafa EAM, Naguib MM, Ashour NE. Effect of pollen sources on yield and fruit quality of Samany Date palm. Intern. J. Agric. Res., 2014, 9(3): 164-168.
7. AOAC. *Official Methods of Analysis*. 15th Ed., Association of Official Analytical Chemists, Washington, DC, 1995, pp. 440-510.
8. Duncan DB. Multiple range and multiple "F" tests. Biometrics, 1955,11: 1-42.
9. Khamis MM, Shrf MM, El-Bana AA, Ghazawy HS. Evaluation of some pollen grain sources on fruiting and fruit quality of Siwi and Zaghoul date palm Cvs. Egypt. J. Appl. Sci., 2010, 25(1): 25-39.
10. Melegy SE. Effect of pollen sources on fruit characteristics of date palm (Samani cv. and Barhee seedling. (M.Sc. Thesis) - Cairo University, Faculty of Agriculture. Pomology Department, 1993, 98p.
11. Hasegawa S, Smolensky DC. Cellulase in dates and its role in fruit softening. J. Food Sci., 1971,36(6): 966-967.
12. Hussain F, Moustafa S, Mahmoud L. The direct effect of pollen (metaxenia) on fruit characteristics of dates grown in Saudi Arabia. Proceeding of The Third Conference on the Biological Aspects of Saudi Arabia, January 24-27, 1979, Al-Hassa, Saudi Arabia, pp. 69-78.
13. Alaa El-Din K Omar, Abd El-Naiem A El-Abd. Enhancing date palm (*Phoenix dactylifera* L.) productivity, ripening and fruit quality using selected male palms. Acta Advances in Agricultural Sciences, 2014,2 (6): 11-19.