

## Impact of Pollen Source on Yield and Fruit Quality of Hayany Date Palm (*Phoenix dactylifera* L.)

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THE INFLUENCE of pollens introduced from three different locations., Aswan, New Valley and Balteem on yield and fruit quality of Hayany dates were estimated in the experiment conducted in a private orchard, Egypt during 2009 and 2010 seasons. Nine Hayany female trees grown in Beheira governorate and three male palm trees (M<sub>1</sub>, M<sub>2</sub> and M<sub>3</sub>) were selected, one from each location, respectively. Results indicated that pollen source significantly affected the final fruit retention percentage as minimum fruit drop was observed from trees pollinated with M<sub>1</sub> (Grown in Aswan). Fruit weight, flesh weight and fruit volume were significantly improved with pollens from M<sub>1</sub> palm trees compared to other male trees. Soluble solids, ascorbic acid, anthocyanin and total and reducing sugars were the highest in fruit pollinated with M<sub>1</sub> and M<sub>2</sub>, respectively. Whereas the highest level of tannin and crowed fibers were recorded in fruits pollinated with M<sub>3</sub>. In conclusion, the pollen source had significant impact on the physicochemical properties of date palm cv. 'Hayany'. Results suggested that the best pollen source (Male trees) should be selected for female trees to get the most desired characteristics.

**Keywords:** Date palm, Fruit quality, Pollen source, Different locations

Date palm (*Phoenix dactylifera* L.) is an important fruit crop in Egypt. Palm trees are widely distributed and the total production of dates is about 1,440,000 tons / year (FAO, 2012). There are three main types of dates based on fruit moisture content, i.e., soft, semi-dry and dry cultivars. Beheira governorate is considered one of the main locations of soft dates production in Egypt. Hayany cultivar is one of the main soft date cultivars that widely grown in Beheira. Date palm is a dioecious tree like Papaya, Pistachio and Kiwi fruit having male and female flowers on two separate trees. Pollination occurs naturally, artificial pollination is a necessary practice for successful fruit setting in commercial production (Hussain *et al.*, 1979). Pollen grains from different male pollinizers affects fruit setting, yield and characteristics.

The pollens have a direct effect on fruit physical and chemical characteristics (metaxenia phenomenon), which affects ripening time, color, weight, size and other qualities of the fruit (Abdelal *et al.*, 1983, Gasim, 1993, El-Salhy *et al.*, 1997, Iqbal 2004, El-Ashry 2009 and Shafique *et al.*, 2011). It was reported that the significant effect of pollens on fruit qualities vary from one pollinator to another (Abdel Hamid, 2000., Helail & El-Kholey, 2000., Osman & Soliman, 2002., Marzouik *et al.*, 2002., El-Kosary & Soliman, 2003, Iqbal *et al.*, 2009 and 2011. Al-Hamoudi *et al.* (2006) tested three male types., Ghanamy, Farad and Bovi and reported that Ghanamy pollens have highly significant effect on fruit set, bunch weight, fruit diameter and pulp weight. Shaheen *et al.* (1989) reported a metaxenic effect on the mineral content of the fruit. It has been reported that the metaxenic influence on reducing time to fruit maturity in areas of arid climate as high temperature is the dominant factor enhancing fruit growth and development (Farag, 2005).

The main objective of this study was to evaluate pollen sources and their possible effects on bunch yield and fruit quality with respect to certain physical and chemical characteristics of " Hayany " date palm cultivar under Beheira governorate conditions, Egypt.

### Material and Methods

#### *Plant materials and fruit samples*

This work was carried out during 2009 and 2010 seasons, on nine- 13 years old female palm trees (*Phoenix dactylifera* L.) of Hayany cultivar grown in loamy sand soil at a private orchard, Beheira governorate, Egypt. The experimental palm trees were uniform in size and growth. All selected palm trees received regular agricultural practices as other palm in the orchard. Nine female spathes (chosen) were selected from each palm of equal size, same age and labeled during both seasons. Three of the nine female spathes on each palm tree were received pollens from one of the three sources, where male date palm trees were selected from three different locations., Aswan (Dry varieties area., M<sub>1</sub>), New Valley (Semi-dry varieties area., M<sub>2</sub>) and Balteem (Soft varieties area., M<sub>3</sub>). Mature pollen grains of Aswan were collected in last week of February, pollen from New Valley and Balteem were collected in third week of March in each year to pollinate the female palms in experiment. Male pollen strands were placed within female spathe by hand in both seasons. Subsequently, the experiment consisted of three treatments., each treatment was replicated three times with three female spathes for each palm tree in a complete randomized design. All spathes were bagged after pollination, a big paper bag which was tied at the base of the each spathe to prevent contamination from air or other surrounding treatments. After one week of pollination, all the bags were removed.

#### *Measurements*

*Fruit retention (%)*: This was measured according to El-Makhton (1981).

*Yield at harvest (kg)*: Palms pollinated by pollens from Aswan (M<sub>1</sub>) and New Valley (M<sub>2</sub>) were harvested at full color (Khelal stage) during the second week

of September, whereas palms pollinated by pollens from Balteem were delayed until the first week of October in both seasons. Total yield were measured at harvest by weighing each spathe separately using a digital balance and was expressed in kilogram (kg).

*Physical characteristics:* Physical characters were measured at harvest time for quality determination.

*Fruit volume (cm<sup>3</sup>):* Fruit volume (cm<sup>3</sup>) was measured by water displacement of 10 randomly selected fruits from each strand per replicate.

*Fruit, Flesh and seed weight (g):* Fruit, flesh and seed weight (g) were measured as an average of 10 randomly selected flesh and seed from each strand/replicate.

*Soluble solids content (SSC):* Digital refractometer (RX 5000, Atago, Japan) was used to determine SSC, expressed as °Brix.

*Total and reducing Sugars (%):* Total and reducing sugars (%) were determined according to in A.O.A.C. (1995).

*Ascorbic acid (mg/100g flesh weight):* Ascorbic acid contents were determined according to the method reported by Ruck (1969). Ten ml of juice were diluted with 0.4% oxalic acid solution and 5 ml of filtered aliquot were titrated with 2, 6-dichlorophenol indophenol dye until color turning pink. Ascorbic acid was determined as mg /100 g flesh weight.

*Anthocyanin (mg/100g flesh weight):* Anthocyanin was extracted from 0.5 g fruit peel by using 25 ml of ethanolic HCl (980 ml ethanol 95% + 20 ml absolute HCl). The extracted solution was filtered and the optical density of the filtrate was measured using a Lambda 3 Perkin-Elmer spectrophotometer at 530 nm. Anthocyanin was expressed as mg/100 g flesh weight, according to Rabino *et al.*, (1977), with the following equation:

$$\text{Anthocyanin/100 g flesh weight} = 100 \times \text{extraction volume} \times \text{Optical density} / \text{Sample weight} \times 98.2$$

*Tannins contents (g FW):* Tannins content was determined using Indigo carmine indicator. Titration was carried out with 0.1 N potassium permanganate solution. Tannins were expressed in grams per 100 g flesh fresh weight according to the following: 1ml oxalic acid (0.1N) = 0.00416 g. (Schanderi, 1970).

*Crude fibers content:* was determined according to A.O.A.C (1995) by using the following equation:

$$\text{Crude Fiber} = 100 \times (W_3 - (W_1 \times C_1)) / W_2$$

Where: W<sub>1</sub> = Bag tare weight, W<sub>2</sub> = Sample Weight, W<sub>3</sub> = Weight of organic matter (Loss of weight on ignition of bag and fiber), C<sub>1</sub> = Ash corrected blank bag factor (running average of weight loss on Ignition of blank bag /original blank bag).

### Statistical analysis

One way ANOVA was run using SAS program (SAS Institute Inc., 2000). Means were compared using least significant differences (LSD) at  $P \leq 0.05$  (Snedecor and Cochran, 1980).

### Results

#### *Effect of pollen source on percentage of fruit retention, bunch weight and some fruit physical properties*

*Final fruit retention (%)*: Pollen source significantly affected the percentage of fruit retention. Maximum fruit retention (36.07 and 38.63%) was recorded with  $M_1$  from Aswan compared to  $M_2$  (New Valley) and  $M_3$  (Balteem) during two experimental seasons (Table 1).  $M_3$  (Male from Balteem) recorded the lowest percentage of final fruit retention of "Hayany" fruits during both seasons.

*Bunch weight (kg)*: It is considered as an index for the yield and proof the best promising treatments used in this study. As shown in Table (1), pollen source of  $M_1$  and  $M_2$  (Males from Aswan and New Valley, respectively) significantly increased bunch weight in comparison to  $M_3$  during 2009 and 2010 seasons. A significant variations among pollen sources were found in both seasons. The highest bunch weight (20.16 and 19.15 kg) were recorded with  $M_1$  (Male from Aswan) in during 2009 and 2010 seasons respectively.

*Fruit volume (cm<sup>3</sup>)*: Table 1 indicated that there were significant differences among all pollen sources during both seasons.  $M_1$  recorded the highest volume of Hayany fruit compared to the other two pollen sources.

**TABLE 1. Effect of pollen source on final fruit retention and some physical characters of Hayany date palm fruit during 2009 and 2010 seasons.**

Treat.	Final fruit retention (%)		Bunch weight (kg)		Fruit volume (cm <sup>3</sup> )	
	2009	2010	2009	2010	2009	2010
$M_1$	36.07a	38.63a	20.16a	19.15a	12.53a	18.40a
$M_2$	32.27ab	33.33b	17.83b	17.25b	11.60b	17.33b
$M_3$	30.63b	30.77c	16.67b	16.17b	10.13c	16.01c
LSD 5%	4.29	1.30	1.06	1.72	0.50	0.83

$M_1$ = Male from Aswan area,  $M_2$ = Male from New Valley area,  $M_3$ = Male from Balteem area, LSD = Least significant difference at  $p \leq 0.05$ . Means not sharing any letter differ significantly at  $p \leq 0.05$ .

*Fruit, Flesh and seed weight (g)*: Pollen source significantly affected fruit and flesh weight. Fruit from palms pollinated with  $M_1$  exhibited higher fruit and flesh weight in comparison to palms pollinated from  $M_2$  and  $M_3$  during 2009 and 2010 seasons (Table 2). Hayany fruit pollinated with  $M_1$  recorded 35.58, 36.22, 33.69 and 34.07 g of fruit and flesh weight during 2009 and 2010 seasons, respectively, whereas fruits from palms pollinated with  $M_3$  recorded the lowest fruit and flesh

weight (29.52, 30.94, 27.36 and 28.79 g) during 2009 and 2010 seasons. On the other hand, seed weight of fruit pollinated with M<sub>3</sub> was significantly greater than those pollinated with M<sub>1</sub> and M<sub>2</sub> during the first season only.

**TABLE 2. Effect of pollen source on finale fruit retention and some physical characters of Hayany date palm fruit during 2009 and 2010 seasons.**

Treat.	Fruit weight (g)		Flesh weight (g)		Seed weight (g)	
	2009	2010	2009	2010	2009	2010
M <sub>1</sub>	35.58a	36.22a	33.69a	34.07a	1.89c	2.14b
M <sub>2</sub>	31.88b	34.74a	29.79b	32.47a	2.07b	2.27a
M <sub>3</sub>	29.52c	30.94b	27.36c	28.79b	2.16a	2.16b
LSD 5%	1.88	2.24	1.87	2.24	0.03	0.05

M<sub>1</sub>= Male from Aswan area, M<sub>2</sub>= Male from New Valley area, M<sub>3</sub>= Male from Balteem area, LSD = Least significant difference at p≤0.05. Means not sharing any letter differ significantly at p≤0.05.

*Effect of pollen source on some chemical characteristics of Hayany fruit*

*Soluble solids Content (SSC %)*

Percentage of SSC was changed significantly with all treatments in comparison to control. Highest SSC was recorded with M<sub>1</sub> (38.06 and 35.60%) followed by M<sub>2</sub> (31.37 and 31.03%) and M<sub>3</sub> (27.40 and 30.12%) during 2009 and 2010 seasons (Table 3).

*Total and reducing sugars (%)*

The trend of total and reducing sugars was almost similar to that of soluble solid content, however the only dramatic changes in total sugars (70.62% and 70.72%) and reducing sugars (51.10% and 52.39%) were shown with M<sub>1</sub> treatment in comparison to other treatments during 2009 and 2010 seasons (Table 3).

**TABLE 3. Effect of pollen source on some chemical characters of Hayany date palm fruit during 2009 and 2010 seasons.**

Treat.	SSC (%)		Total Reducing (%)		Reducing sugars (%)		Tannin (%)	
	2009	2010	2009	2010	2009	2010	2009	2010
M <sub>1</sub>	38.06a	35.60a	70.62a	70.72a	51.10a	52.39a	0.055c	0.080a
M <sub>2</sub>	31.37b	31.03b	59.79b	69.01b	47.44b	51.20ab	0.063b	0.087a
M <sub>3</sub>	27.40c	30.12b	57.52b	59.37b	46.53b	49.34b	0.098a	0.092a
LSD 5%	2.78	2.66	2.74	1.67	3.32	2.08	0.005	NS

M<sub>1</sub>= Male from Aswan area, M<sub>2</sub>= Male from New Valley area, M<sub>3</sub>= Male from Balteem area, LSD = Least significant difference at p≤0.05. Means not sharing any letter differ significantly at p≤0.05.

*Tannins content (%)*

As shown in Table 3, changes in tannins were only significant among treatments during 2009 season.

*Ascorbic acid (mg/100g flesh weight)*

Pollen from Aswan (M<sub>1</sub>) significantly increased ascorbic acid when compared to other treatments during both seasons (Table 4). On the other hand, pollen from Baltiem (M<sub>1</sub>) significantly decreased ascorbic acid content when compared to other treatments during the first season. The highest ascorbic acid content was 1.48 mg/100g flesh weight in the second season by M<sub>1</sub> (Male from Aswan).

*Anthocyanin (mg/100g flesh weight)*

Like ascorbic acid, pollen from Aswan (M<sub>1</sub>) significantly increased anthocyanin content of Hayany dates when compared to other treatments during both seasons (Table 4).

*Crude Fiber Content (%)*

Spathes pollinated with M<sub>1</sub> had significantly greater crude fibers than those pollinated with M<sub>2</sub> and M<sub>3</sub> in both season. In general, crude fibers were low during 2009 than 2010 in all treatments (Table 4).

**TABLE 4. Effect of pollen source on some chemical characters of Hayany date palm fruit during 2009 and 2010 seasons.**

Treat.	Ascorbic acid (mg/100g flesh weight)		Anthocyanin (mg/100g flesh weight)		Crowed Fibers (%)	
	2009	2010	2009	2010	2009	2010
M <sub>1</sub>	1.35a	1.48a	7.72a	8.41a	1.40a	1.67a
M <sub>2</sub>	1.41a	0.69b	6.34b	6.62b	1.35b	1.63b
M <sub>3</sub>	1.14b	0.92ab	5.40c	6.28b	1.30c	1.61b
M <sub>3</sub>	1.14b	0.92ab	5.40c	6.28b	1.30c	1.61b
LSD 5%	0.078	0.59	0.16	0.50	0.022	0.023

M<sub>1</sub>= Male from Aswan area, M<sub>2</sub>= Male from New Valley area, M<sub>3</sub>= Male from Balteem area, LSD = Least significant difference at p≤0.05. Means not sharing any letter differ significantly at p≤0.05.

### Discussion

Results showed that Hayany dates exhibit "metaxenia" effect, since fruit quality has affected by pollen source (Kahn *et al.*, 1994. Chaudhary & Dessay, 1995 and Nerd & Mizrahi, 1997). Impact of pollen source on time of fruit development has been reported for date palm (Swingle, 1928), raspberry (Colbert and de Oliveria, 1990) and blueberries (Gupton and Spiers, 1994). The effect of pollen source on the development of fruit tissue called "metaxenia" effect. Similarly, pollen source can influence the size and the shape of the seed

("xenia" effect) (Nixon, 1936 and Reuveni *et al.*, 1986). Results showed that pollen from Aswan (M<sub>1</sub>., dry varieties area) was the best in comparison to pollen from New Valley (M<sub>2</sub>., semi-dry varieties area) and Balteem (M<sub>3</sub>., soft varieties area) in terms of bunch weight, fruit retention to spathes, fruit quality and duration to fruit ripening (Tables 1, 2, 3 & 4). Less time of fruit development and ripening is an important result for growers, since early-ripe fruit is more valuable than late-ripe fruit. Lichtenzveig *et al.*, (2000) reported that differences in the time to fruit ripening might be due to variable growth rates of pollen tubes. Thus the source of pollen is an important variable to consider in order to improve fruit quality and ripening time. Pollen from New Valley showed the same trend in ripening time with less fruit quality compared to pollen from Aswan. The results are in line with the findings of Ghalib *et al.* (1987) who reported that different pollen sources have a significant effect on fruit dropping of 'Sayer' and 'Hallawy' dates. On the other hand, the variation in bunch weight refers to the difference in pollen source, viability, male and female compatibility (Al-Ghamdi *et al.*, 1988). The difference in yield could be due to variation in pollen quality, germination percentage and pollen tube growth. Therefore, pollen source (male trees) has significant effect on the ultimate fruit yield. Similarly, positive impact of pollen sources have been reported on the yield of 'Siwi' and 'Ahmadi' (El-Ghayaty 1983), 'Zaidi' (Ghaffar and Iqbal 2003), 'Shahani' (Rahemi 1998), 'Hallawy' and 'Khadrawy' (Helail and El-Kholey 2000), 'Hayyani' (Muhtaseb and Ghnaim 2007), 'Zaghloul' (El-Ashry 2009) and 'Dhakki' (Shafique *et al.*, 2011 ) dates. Therefore, it is important to select and identify superior male for best fruit quality.

### Conclusions

This study showed that pollen source has significant effect on final fruit retention, date of ripening, bunch weight and quality of date palm cv. 'Hayany'. Pollen from Aswan (Dry varieties) was found more effective in comparison to other pollen sources New Valley (Semi-dry varieties) and Balteem (soft varieties). Results suggest that best pollen source should be selected for female trees to get optimum fruit quality. Further experiments are necessary to investigate the effect of different pollen sources on biochemical processes related to dates quality.

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## تأثير مصادر اللقاح علي المحصول وجودة ثمار نخيل البلح الحياتي

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تأثير حبوب لقاح منتجة من فحول نامية في ثلاث أماكن مختلفة ( أسوان – الوادي الجديد – بلطيم) علي المحصول وجودة ثمار البلح الحياتي قد تم دراستها بمزرعة خاصة خلال موسمي ٢٠٠٩-٢٠١٠م، حيث تم انتخاب تسع نخلات من الصنف الحياتي بمحافظة البحيرة ، بالإضافة الي ثلاث فحول ( $M_1$ - $M_2$ - $M_3$ ) من مناطق هي : أسوان- الوادي الجديد- بلطيم ، علي التوالي. وقد أظهرت النتائج أن لمصدر اللقاح تأثير معنوي علي نسبة الثمار المتبقية، تقليل نسبة تساقط العقد للنخلات الملقحة من الفحل الاول  $M_1$  (النامي بمنطقة أسوان). وزن الثمرة ، وزن اللحم للثمرة ، حجم الثمرة قد تحسنت معنوياً في الثمار الناتجة من تلقيح الفحل الاول مقارنة بلقاح الفحول الاخرى. المواد الصلبة الذاتية الكلية ، حمض الاسكوريك، الانثوسيانين، السكريات المختزلة والكلية قد زادت في الثمار الملقحة من الفحل الاول ( $M_1$ ) والثاني ( $M_2$ ) علي التوالي. كما وجد أن محتوى الثمار من التانينات والالياف كانت أقل في الثمار الملقحة من الفحل الثالث ( $M_3$ ). أجمالاً فإن مصدر اللقاح ذو تأثير معنوي علي الصفات الطبيعية والكيمائية لثمار البلح الحياتي، وتوصي الدراسة بضرورة انتخاب الفحول لتلقيح النخلات للحصول علي أعلي محصول وأحسن صفات للثمار.