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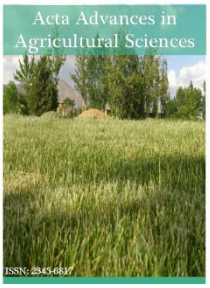

Research Article

Enhancing Date Palm (*Phoenix dactylifera*, L.) Productivity, Ripening and Fruit Quality Using Selected Male Palms

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ABSTRACT

Egypt is one of the largest producers of dates with a total annual production estimated at 1.4 million tons. The effect of male pollinizers on fruit set; bunch weight and fruit physical and chemical characteristics was studied at a private orchard, located in kafr El-Sheikh Governorate, Egypt during 2012 and 2013 seasons. Fruit set, fruit weight, flesh weight, and bunch weight.were affected by the source of pollen, while fruit dimensions were not affected. Fruit set improved by 28.30% with pollen of male 1 (Meghal 1), whereas pollen of male 2 (Meghal 2) improved fruit set by 25.50%. Maximum weight of bunch, fruit and flesh were 20.50kg, 25.70g and 23.45g, respectively when bunches were pollinated with pollens of male (2). Using same pollens also resulted in maximum soluble solids content (SSC), vitamin C, total and reducing sugars were 32.89%; 7.75 mg/100g flesh weight, 28.51% and 20.01%, respectively; in addition to a reduction in fruit firmness and tannin content. Moreover, fruit reaches ripening stage twenty days earlier than bunches pollinated with pollens of male (2).

Introduction

Date palms can grow from 12.7 to 27.5 °C average temperature, withstanding up to 50 °C and sustaining short periods of frost at temperatures as low as –5 °C (Chao and Krueger. 2011). Egypt is a subtropical country which lies between 22° and 31° North latitudes and between 25° and 35° East longitudes. Its climate (comprising a mild and wet winter from November to April and a hot and dry summer from May to October) is suitable for the production of many field and horticultural crops (Directorate of Intelligence, 2011). Egypt is considered one of the largest producers of dates, which is widely cultivated in different regions of the country (Mohammed et al., 1983; Askari et al., 2003) with a total annual production estimated at 1.4 million tons (FAO, 2013). There are three main types of dates based on fruit moisture content, i.e., soft, semi-dry and dry cultivars (Al-Hooti et al., 1997). Zaghloul date

(*Phoenix dactylifera*, L.) is a popular soft date in Egypt. It is an early season cultivar that is extensively cultivated in the North Delta region, of Egypt. The fruits are edible at the mature (khelal) stage (Omar 2013). Date palm is dioecious and naturally cross pollinated. For commercial cultivation, artificial pollination is required using compatible pollen source. Pollen source has been reported to effect fruit set, ripening and quality (Monselise 1986; AI-Obeed and Abdul-Rahman 2002). The direct effect of pollen on fruit physical and chemical characteristics is known as metaxenia, which affects fruit ripening, color, weight and size (Al-Delamiy and Ali 1970; El- Ghayaty 1982, Abdelal et al., 1983; and Gasim 1993). Iqbal 2005, El-Ashry 2009; Shafique et al., 2011 and Omar et al., 2014 reported that the direct effect of pollens on date fruit quality varies according to the male parent used in female pollination. Therefore, it is important to select and identify superior male for pollination to optimize fruit quality. At present, very little is known about the role of pollen source and number of required times of pollination on yield and fruit quality of date palm cv. 'Zaghloul'. This study was conducted to elucidate the effect of different pollen sources on fruit setting, yield, and physio-chemical characteristics of 'Zaghloul' cultivar.

Materials and Methods

Plant materials:

This study was conducted during two successive seasons of 2012 and 2013 on female date palms (*Phoenix dactylifera*, L.) of "Zaghloul" cultivar. Two different male trees (Meghal 1 and Meghal 2) were selected for the experiment. Palms were at the same age (8 years) and grown in loamy sand soil at a private orchard, kafr El-Sheikh Governorate, Egypt. Six female with ten spathes were chosen / female palm. Three females (each female as replicate) were pollinated with pollens collected from Meghal 1 and other three female were pollinated by Meghal 2. Hand pollination was carried out by placing desired male pollen strands (8 strands/spathe) inside the female spathe. All bunches were covered with a big craft paper, after pollination, for two days. Regular agricultural practices were applied to all palms. Fruit set (%) was done on samples of 2 strands taken at random from each bunch/palm. The number of unfertilized flowers and number of flowers on each strand was counted. Then the percentage of fruit setting was calculated as a number of the total number of flowers/strands by the following equation:

Fruit fruit % *= Number of fruits x100/Total number of flowers*, according El-Makhton (1981). Harvest started at khelal stage during the third week of September in both seasons, and the following parameters were measured as follows:

Total Yield (kg): Each spathe was separately weighted using a field balance and weight was expressed as kilogram (kg).

Fruit weight (g): Ten fruit were selected randomly from each strand per palm. Average fruit weight was calculated and expressed as grams (g).

Flesh weight (g): Flesh of the same 10 fruit was weighed and average flesh weight was calculated in grams (g).

Firmness measurements were taken using an Effegi penetrometer with an 11 mm diameter head and the level were expressed in Newton.

Soluble solid concentrations **(SSC)** were calculated from refractive indexes using a hand refractometer requiring a drop of undiluted juice (Model K-0032, Cosmo, Japan) and expressed in percentages.

Titrable acidity was also calculated from the titrated volume of standard 0.1 N NaOH to pH 8.1 and expressed as mg of malic acid per 100 cc of

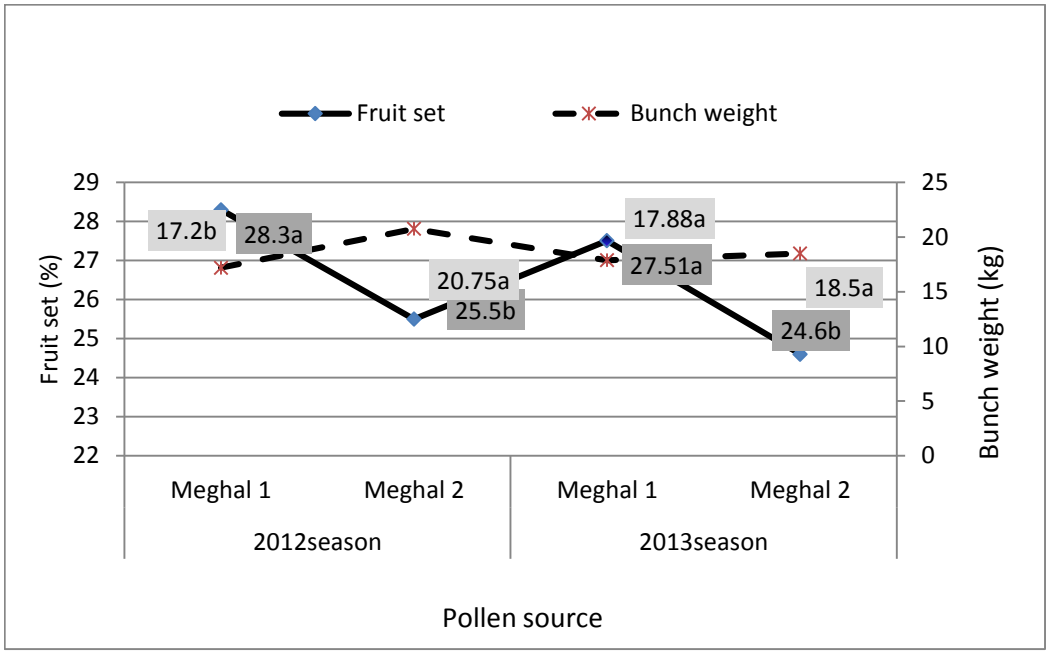

Fig. 1: Influence of pollen source on fruit set (%) and bunch weight (Kg) of Zaghloul date palm during 2012 and 2013 seasons.

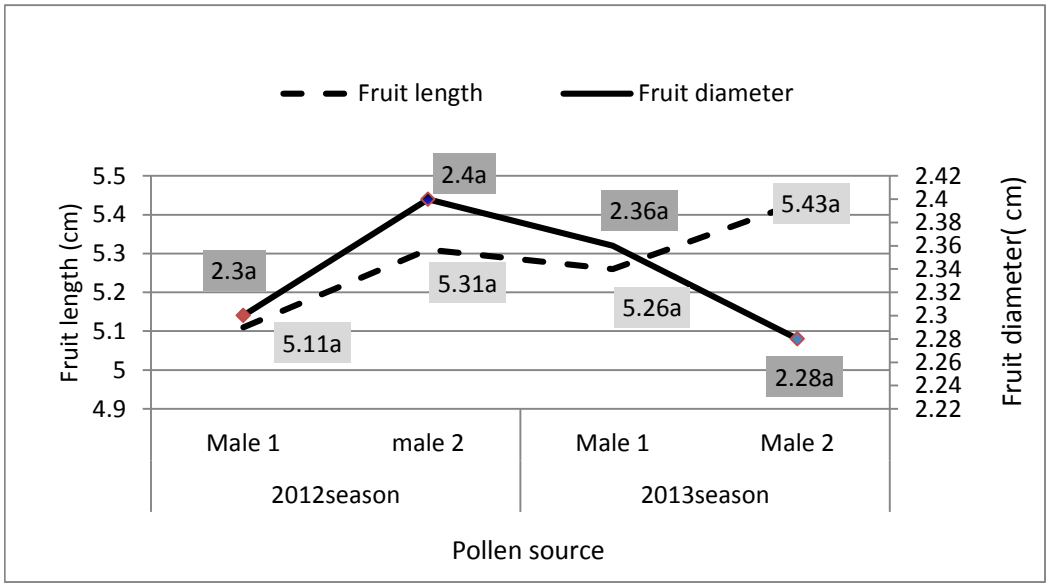

Fig. 2: Influence of pollen source on fruit length and fruit diameter (Cm) of Zaghloul date palm during 2012 and 2013 seasons.

juice (AOAC, 1995). *Soluble tannins* were determined for sweet persimmon according to Woolf, et al. (1997).

Ascorbic acids (Vitamin C) were determined also using 2, 6 Dichlrophenol indophenols for the titration of juice and presented as mg/100 cc of fruit extract (AOAC, 1995).

Total and reducing sugars were determined as a percentage of fresh weight according to AOAC (1995).

Experimental design and statistical analysis:

The experiment was designed in a complete randomized model with three replicates per

treatment. One way ANOVA was run using SAS program (2000). Means were compared using least significant differences (LSD) at $P \leq 0.05$ (1971).

Results

***Fruit set** (%):* Results in Fig (1) indicated that pollen source affected fruit set percentage of 'Zaghloul' date palm in both seasons. Meghal 1 had higher fruit set percentage (28.30 and 27.51%) than Meghal 2 (25.50 and 24.60%) in 2012 and 2013, respectively.

***Bunch weight** (kg):* Bunch weight is considered as an index for the total yield. Results showed that pollination of 'Zaghloul' date palms with pollens from the Meghal 2 recorded the highest significant bunch weight (20.75kg/palm) compared to bunch weight from palms that were pollinated with Meghal 1 (17.2 kg/palm) in 2012 only, Fig (1).

***Fruit dimensions** (cm):* Fruit length and diameter were not significantly affected by any of the two pollen sources in both seasons (Fig. 2); however, data indicated that Meghal 2 generally increase fruit dimensions than Meghal 1.

***Fruit weight and flesh weight** (g):* The highest significant fruit weight (22.01 and 25.71g) was recorded in palms pollinated by Meghal 2 as compared to fruit weight in palms pollinated by Meghal 1 (20.3 and 23.77g) during 2012 and 2013. On the other hand, palms pollinated with Meghal 2 recorded the highest flesh weight (20.01g) in compared with flesh weight in palms pollinated with Meghal 1during 2012 only, Fig (3).

***Fruit firmness** (Newton):* Fig (4) showed that the lowest fruit firmness were fruit pollinated with Meghal 1 during 2012 and 2013 seasons. And the differences were significant compared to Meghal 2 in both seasons.

***SSC** (%):* There was significant difference between both pollen sources during 2013 season only. Meghal 2 pollen resulted in highest significant SSC (32.89%) compared to Meghal 1 (30.35%) in 2013 (Fig 4).

***Vitamin C** (mg/100g flesh weight):* Vitamin C content was higher in fruits pollinated with Meghal 2 (6.83 and 7.75 mg/100 g flesh weight) than Meghal 1 (6.53and 7.01 mg /100 g flesh weight) in 2012 and 2013, respectively. The differences between treatments were non-significant during 2012 and 2013 seasons (Fig 5).

Tannins (%): It is quite clear that in both seasons "Zaghloul " dates pollinated with pollens from Meghal 2 was lower in Tannin percentage (0.072 and 0.070 %) than those pollinated with Meghal 1 (0.080 and 0.075%), but the differences between treatments were non- significant during 2012 and 2013 seasons (Fig 5).

***Total and reducing sugars** (%):* Palms pollinated with pollens from Meghal 2 showed higher significant percentage of total and reducing sugars (28.33, 28.51, 18.75 and 20.01%, in 2012 and 2013 seasons, respectively). While lower percentages were 24.79, 25.00, 16.33 and 18.75% in palms pollinated with pollens from Meghal 1 during 2012 and 2013, respectively Fig (6).

Discussion

Different males vary in their pollen viability, germination percentage and genetic makeup which ultimately affect the retention of the fruit after fertilization. Results showed that different males caused variation in fruit set percentage in 'Zaghloul' palms. This is in agreement with the findings of Ghalib et al., (1998) who reported that different pollen source have significant effect on fruit drop of 'Sayer' and 'Hallawy' dates.

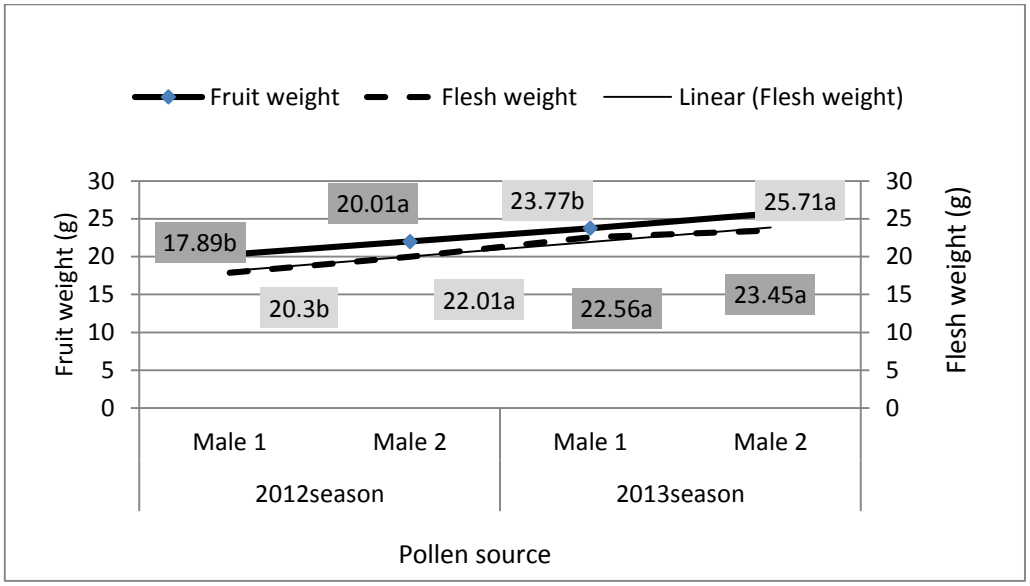

Fig. 3: Influence of pollen source on fruit weight and fresh weight (g) of Zaghloul date palm during 2012 and 2013 seasons.

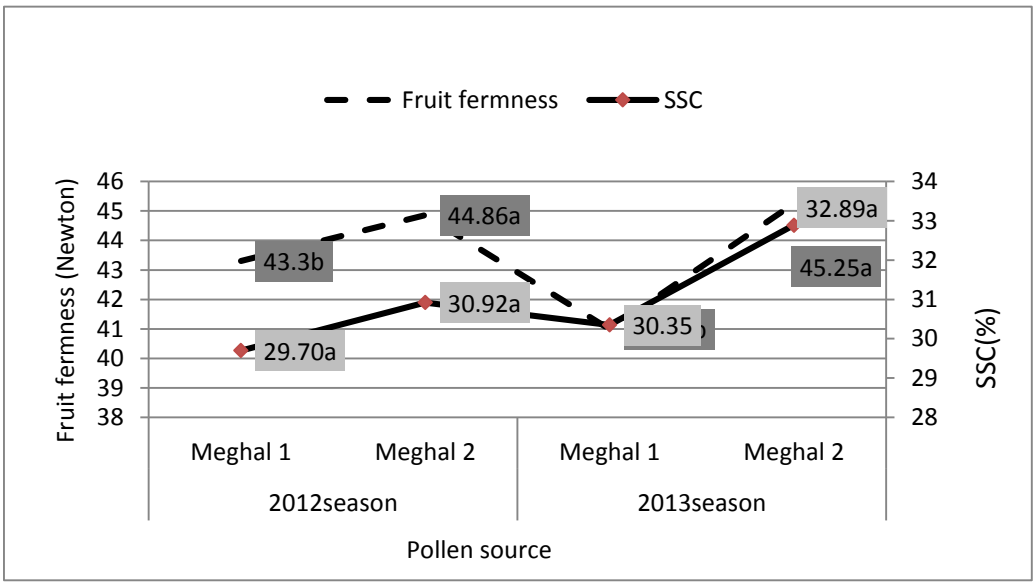

Fig. 4: Influence of pollen source on fruit fermness (Newton) and SSC (%) of Zaghloul date palm during 2012 and 2013 seasons.

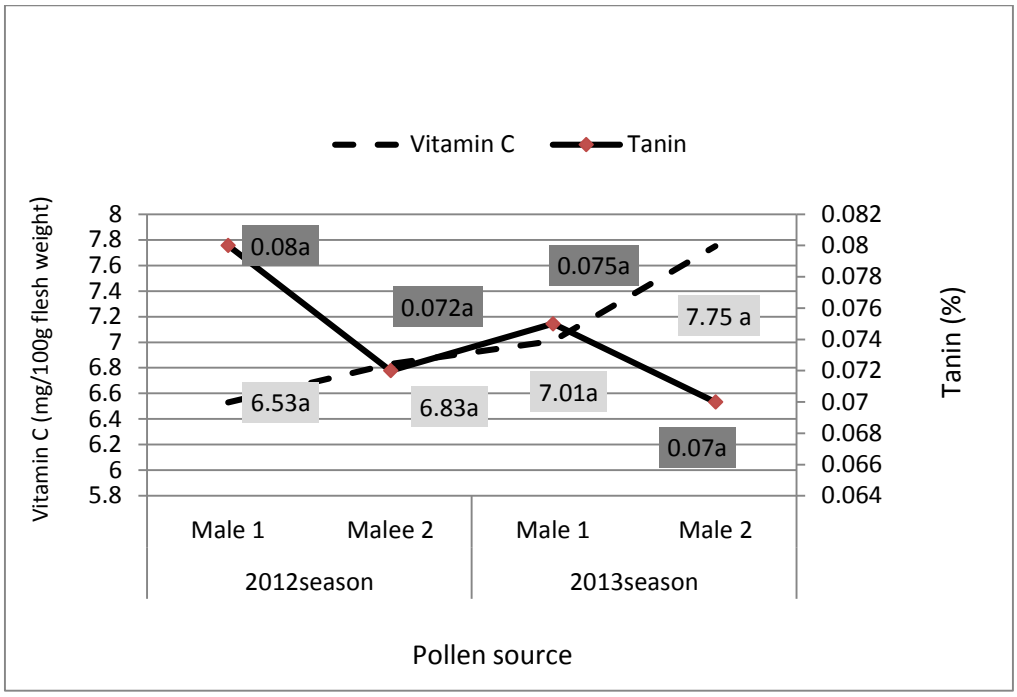

Fig. 5: Influence of pollen source on Vitamin C (mg/100 g fresh weight) and tannin (%) of Zaghloul date palm during 2012 and 2013 seasons.

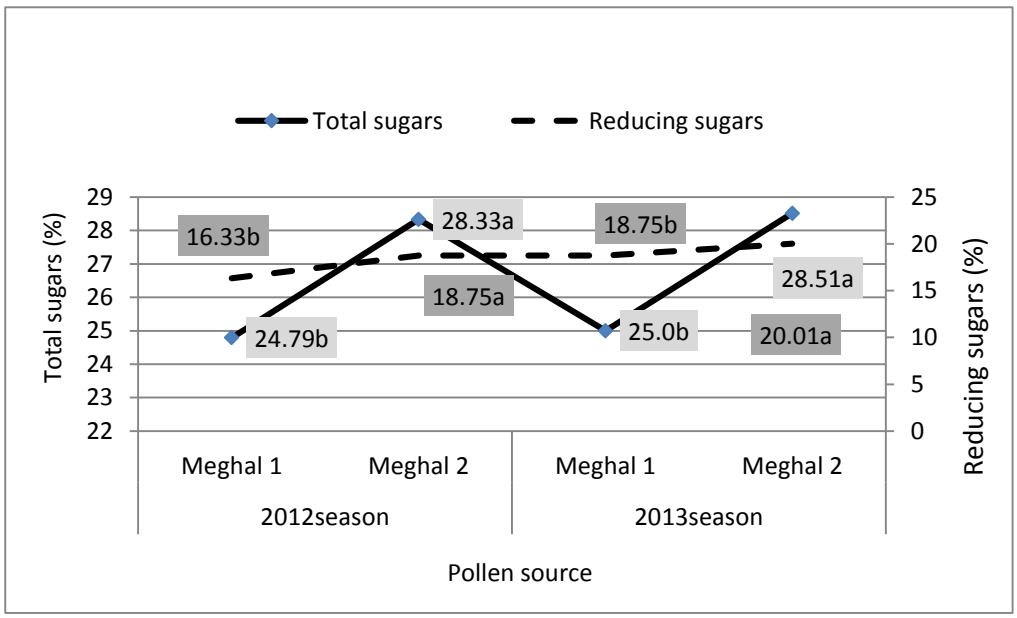

Fig. 6: Influence of pollen source on total and reducing sugars (%) of Zaghloul date palm during 2012 and 2013 seasons.

On the other hand, the variation in bunch weight refers to the differences in pollen source, viability, male and female compatibility (Al-Ghamdi et al., 1988). The differences in yield could be due to variation in pollen quality, pollen germination percentage and pollen tube growth. 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.

The pollen source also affects the growth of ovary tissues. Nixon (1965); El- Makhtoun and Abdel-Kader, (1993) and El-Makhtoun et al., 1995 reported significant effect of pollen source on fruit weight and flesh weight of date palm fruit. This may be due to the released hormones by growing endosperm and embryo tissues that diffuse into the ovary tissue and induce fruit growth.

SSC: results support the previous findings of Abdelal (1983) and El-Ashry (2009) who reported significant effect of pollen source on SSC of the date fruits. This effect might be due to the differences in genetic makeup, palm growth and health, and spathe characteristics (Nasir *et al.,* 1986)**.**

The amounts of produced sugars during photosynthesis are responsible for the ascorbic acid synthesis (Vitamin C, Fig. 5) (Harris 1975); however, the effect of pollen source and pollination frequency on the ascorbic acid synthesis in date palms in not clear and needs still needs further investigation (Shafique et al., 2011; Omar et al., 2014).

The effect of pollen source on sugar content of the fruit is might be due to the activities of the enzymes system initiated by the metaxenia effect and other biochemical changes in the fruit. Similarly the hydrolytic enzymes, such as polygalacturonase and cellulose may also be involved in these biochemical changes by solubilizing the pectin and cellulose of the cell wall (Hasegawa and Smolensky 1971; Muhtaseb and Ghanim 2006). The effect of pollen source on the physiology and biochemical reactions involved in the biosynthesis of sugars is still not fully clear (Helail and El-Kholey 2000; El-Ashry 2009; Omar et al., 2014).

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