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EVALUATION OF MALE PALMS USED IN POLLINATION AND THE EXTENT OF ITS RELATIONSHIP WITH CULTIVARS OF DATE-PALMS (*PHOENIX DACTYLIFERA* L.) GROWN IN REGION OF OUED RIGH, ALGERIA

AISSA DJEROUNI[1*], ADEL CHALA[2], AHMED SIMOZRAG A[1], RADHOUANE BENMEHAIA[3] AND MEBAREK BAKA[1]

[1]*Laboratoire de Développement et Valorisation des Ressources Phytogénétiques, Département de biologie et d'écologie, Université des Frères Mentouri Constantine, Algérie*
[2]*Laboratory of Applied Mathematics. University Med Khider, P.O. Box 145, Biskra, 07000, Algeria*
[3]*Department of Natural Sciences and Life, M'sila University, Algeria*
[*]*Corresponding author e-mail: aissadjerouni@yahoo.fr*

Abstract

This experiment was administrated in order to compare the 08 elite males morphologically and biometericaly. It was observed that there was a significance difference between them in which variety Deglet Nour was the biggest in the size during both seasons. Furthermore, the laboratory studies proved there was a difference between the male elite. Thus, Male 07 scored the highest value of vitality, whereas in germination verities, Ghars scored the highest value. These results were fairly steady during both seasons. From all the results obtained we noticed that the farmers of this region lay?? on distinguishing between the elite males from their size and the quantity of the grains. However this study confirmed that the set percentage is affected by the quality of pollen grains, but with a high degree of compatibility in the female grains. Clearly, the male palms scored different percentage of set from one cultivar to another. In cultivar's Itima it was high in all the male palms trees, whereas in Degla Bida no compatibility was observed.

Key words: Date palm, Pollen grains, Incompatibility.

Introduction

Date palm (*Phoenix dactylifera* L.) is a monocotyledonous, dioecious, perennial tree that belongs to the Arecaceae family. Date palm has an ancient history of cultivation and utilization in North Africa and the Middle East. This plant is found particularly in the regions of arid and semi-arid areas (Kriaa *et al*., 2012). Pollination of fruitful trees is a vital step for having a good product (Pourghayoumia *et al*., 2012; Fattahi *et al*., 2014). Many studies confirmed that there are morphological differences between the male palms' vegetative characteristics and the spaths (Al-Ghandi *et al*., 2002; Iqbal *et al*., 2009). In addition to that, pollen grains differ in diameter and shape (Al-Khalifah, 2006; Soliman & Al-Obeed, 2013a; Daluz *et al*., 2013). There is another study which born out the difference between elites in vitality, germination's percentage and the length of the pollen tube (Liu *et al*., 2013; Mortazavi *et al*., 2010; Ismail, 2014). Also many researches proved that the set percentage differ between cultivars and that pollen grains effect directly the female flowers. (Abbas *et al*., 2005; Haffar *et al*., 1997; Awad & Al-Qurashi, 2012; Iqbal *et al*., 2012; Omar *et al*., 2014). The female flowers' acceptability differs between varieties, this is due to the sexual in compatibility or other genetical reasons which prevent the flowers' set (Al-Obeed & Abdurahman, 2002; Bacha *et al*., 2000; Abbas *et al*., 2012). Furthermore, pollen grains influence directly the quality and the quantity of the fruits. This latter is known as Metaxenia (Soliman & Osman, 2001; Farag *et al*., 2012; Rezazadeh *et al*., 2013; Usman *et al*., 2013; Hafez *et al*., 2014).

Materials and Methods

This study was conducted during the two successive seasons of 2013 and 2014 at El-Ghafain institution I.T.D.A.S at the department of Djamaa, the state of Oued Souf in Algeria. It aimed to compare between the spaths and the pollen grains of the male palm trees, thus, eleven cultivars from the same station were chosen in order to compare the influence of both cultivars and varieties, and also the receptivity of pistillate flowers for the pollen grains. It was also taken into consideration that the varieties had the same length, age and power whereas, the female palms aged ten years old. Table 1 shows the names and the origins of palm trees.

Table 1. Palms' varieties, cultivars and origins.

Male	Origin	Female	Origin
Degla Bida	Algeria	Degla Bida	Algeria
Deglet Nour	Algeria	Deglet Nour	Algeria
Ghars	Algeria	Ghars	Algeria
Dgel 01	Algeria	Tinicin	Algeria
Male 05	USA	Mch degla	Algeria
Mch Degla	Algeria	Sbaa Bdra	Algeria
Male 07	USA	Dgel El-gaid	Algeria
Dgel 02	Algeria	Baydh Hmam	Algeria
		Abd El-aziz	Algeria
		Itima	Algeria
		Massri	Egypt

Note: The male palms were named locally according to their vegetative traits by a group of experienced farmers in this domain, those letters belong to the institution of El-Ghafain were they worked for many years. Whereas, the male 05 and 07 are originally from the USA.

Pollen grains extraction: Five male grown spaths were taken from all the eight varieties before their opening, these pollen grains were extracted in a dry place to prevent from putrefying of the flowers. After being dehydrated, pollen grains were collected in well closed boxes separately. Finally, one part was sent to be studied in a laboratory, whereas, the other one was kept to be used of pollination by using cotton balls full of it.

The pollination operation: Eleven cultivars were being chosen, three spaths were taken from each one. The spaths were covered before their opening by paper bags in order to prevent pollen grains from being transmitted by the wind. Pollination took place between 25th of February and 5th of March. This happened by dividing each spath into 8 equal parts, and each one was later on pollinated by a given kind of pollen grain. All these happened by putting cotton balls full of pollen grains inside the femals' spikes. Finally, each part was covered by paper bags. (Shafique *et al*., 2011).

The studied characteristics

Morphological study on the male spaths: Spaths males were taken in order to be measured (Iqbal *et al*., 2009).

- Spaths' weight (Kg): were measured directly after being cut.
- Spaths' diameters (cm): the length was measured from the first appeared spike until its end. Whereas, the width was measured from the middle.
- After taking off the cover, the number of spikes was counted in each spath and the number of flowers in every five spikes.

Laboratory study of pollen grains

Pollen's vitality and germination study: The vitality of the pollen grains, which were used for the study, was tested (Qureshi *et al*., 2009) by adding a drop of acetocarmine to the pollen grains. Also some of them were put in a slide, and examined by a microscope optic by using 10x magnification (Fig. 1a). Lastly, the percentage was calculated by using the following equation:

$$\text{The pollen grain vitality \%} = \frac{\text{Colorized pollen grains}}{\text{The total number of pollen grains (100 grains)}} \times 100$$

In the germination of the pollen grains according to Kavand *et al*. (2014a) and Mortazavi *et al*. (2010). A milieu which was composed of different concentration was used in the germination of the pollen grains; Glucose 15%, Acid Boric 0.5%, Calcium Nitrate Tetrahydrate 0.3%, Magnesium sulphate 0.2% and Potassium Nitrate 0.1%. then, it was put in 100 ml of distilled water from Agar, and sterilized in 120°C for 20 minutes. After that, it was heated in an oven for 27°C for 24 hours (Fig. 1b), the germination percentage was measured using the following relation:

$$\text{The germination percentage} = \frac{\text{Germinated pollen grains}}{\text{The total number of pollen grains (50 grains)}} \times 100$$

Lenght of the Pollen Tube (Um): The fully grown samples were taken in the same calculation milieu in which the germination rate was measured (Fig. 1c). According to Kakani *et al*. (2005) and Al-Khalifah (2006), the microscopic objects were measured by using ocular micrometer equipped to the eyepiece of the microscope under magnification 40X.

The Pollen Grains' Diameters (Um): After putting a set of pollen in the Thoma slide with these settings (0.0025 mm$^{2)}$ this latter will be used as a criterion to compare it to single pollen. Later on 40x magnification was chosen to take a picture (Fig. 1d). Finally, the programme of Image Tool 3.00 was used to measure the specific length (Laiadi *et al*., 2013).

Percentage of Fruits Set: After fifteen days from pollination (Abed & Abbas, 2007), the cover paper was taken and the flower set was measured. From each part three spikes were selected in order to calculate the flower set according to the following equation:

$$\text{Flowers set \%} = \frac{\text{The number of retained fruits}}{\text{The number of fruits + the number of the dropped flowers position}} \times 100$$

Results and Discussion

Comparison between the males spaths' morphological characteristics: Table 2 shows that there is an obvious difference in the morphological characteristics of the whole 08 studied male spaths, and these results were determined by the statistical analysis. Clearly, the heaviest male spath was Deglet Nour with (3.150, 3,288 kg) on that order for the two seasons. On the other hand, the light male spath was Male 07 with (0.815, 0.812 kg). After measuring the diameters, the tallest spath was Degla Bida with (85.00, 88.00 cm) on that particular order while the shortest was Ghars (57.800 - 57.2500 cm). Meanwhile, the widest spath was varieties Deglet Nour (19.100-20.1 cm) and the narrowest one was Dgel 01 (8.825-8.475 cm). The most numbered spike in the first season was Dgel 02 with (208.9) but in the second season, varieties Deglet Nour spath was produced more and became the most numbered with (2215.600). On the other hand, the least numbered spike was Dgel 01 with (105.57-109). According to the number of flowers in each spike, the highest value was recorded in varieties Deglet Nour (98-89.8) whereas the lowest in Dgel 01 (38.57- 42.75). On the other hand, the tallest spike was in varieties Deglet Nour (25-26.275 cm) and the shortest in Ghars (15.875cm) whereas, in the second seasons, the shortest was recorded in Dgel 01with the value of (13.95 cm). We noticed during both seasons that Deglet Nour was the distinguished variety in the majority of the morphological characteristics. This variety was characterized by its huge size, plentifulness. In addition to that, during the research we did not record any noticeable difference between the American male spaths and the local ones. Consequently, a diversity was observed due to the genetical dissimilarity between the male palms. This diversity is due to the fact that the majority of male palms are originated from seeds. It also helps the farmers in choosing the best variety for pollination. All the results obtained confirmed the results of Shaheen *et al*. (1989) who proved that there are

differences between the male and female date palms. Soliman *et al*. (2013b) proved in his study of the morphological traits of some male palm varieties, the Succary male was the most remarkable in its vegetative and flower characteristics between the others. In his study, Al-Ghandi *et al*. (2002) reported that Succary males were distinguished from others by their morphological traits. Moreover, the study of Iqbal *et al*. (2009) born out the same results when he examined 15 varieties of elites. It was recorded that male 13 scored the highest length, but male 10 and male 12 both scored the largest width but male 08 had the longest spike and male 11 the greatest number of flowers. Where the study focused on four types of pollen. All these aspects showed that the male palms are different.

Analysis statistics: Data were statistically analyzed according to One way ANOVA using Xlstat program (2009.3.02), each characteristic was done separately to compare the male types in terms of similarities and differences, and the extent of compatibility between the male and female trees.

Comparison between the biometeric characteristics of male palms: The data illustrated in Table 3 shows the difference between the eight palms. Male 07's pollen grains scored the highest vitality percentage in the first season with (94.5%), and also in the second season with (92.875%) whereas, the lowest percentage was of Dgel 01 which scored (77.1%) in the first season and (76.49%) in the second one. The highest percentage of germination was scored by Ghars with (92.22-99.444%). On the other hand, the lowest germination percentage was recorded in Dgel 02 with (62.556- 60.333%). Moreover, the tallest pollen grain was that of Degla Bida (42.203-39.368 Um) in both seasons and the shortest was that of Male 05 (33.636 Um) in the first season, while in the second season it was Dgel 01 (33.636 Um). After measuring the width of pollen grains no difference was recorded during the first season, however, in the second season, two groups formed and a slight difference was observed between the males. Consequently, the width was limited between (12.87-14.05 Um) and a clear difference was observed in the lenght of the pollen tube in all the studied characteristics. The highest value was recorded in season 01 for Male 05 (311.823 Um) while in season 02, Ghars was the highest. On the other hand, Dgel 01 and Mch Degla scored the lowest value (189.907-188.060 Um) on this order. The length of the pollen tube was not fixed in both seasons. We infer from the biometeric study that the male varieties differ in many characteristics based on the conducted studies in the Laboratory.

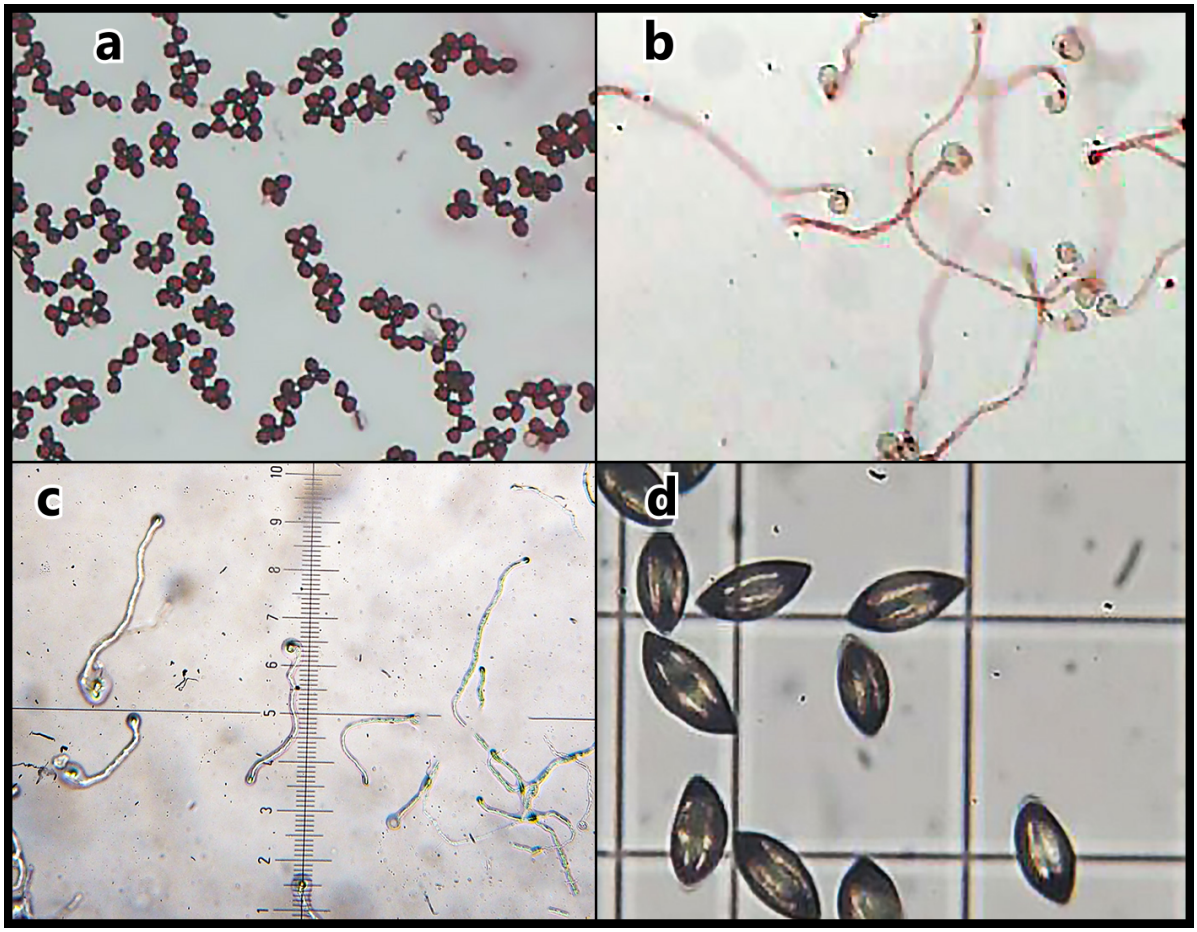

Fig. 1. Diameters according to the laboratory study. a. Vitality of pollen grains b. Germination percentage c. Pollen tube's length d. Diameters of the pollen grain in its natural state.

Table 2. Comparison between the male spaths in the morphological characteristics during the two seasons of study.

Morphological characteristics	Weight (Kg)	Length (cm)	Width (cm)	Number of spike	Number of flower	Length of spike (cm)
Males palms	**2013 season**					
Degla Bida	2,383 b	88,000 a	17,000 bc	156,000 d	76,000 b	25,500 a
Deglet Nour	3,150 a	79,500 b	20,100 a	205,250 ab	98,000 a	26,275 a
Ghars	1,663 c	57,250 e	16,575 c	193,500 b	62,750 c	15,875 c
Dgel 01	0,930 d	69,000 c	08,475 d	109,000 f	42,750 e	16,075 c
Mal 05	2,662 b	81,280 ab	18,080 b	192,200 b	63,600 c	20,500 b
Mch Degla	1,364 c	69,860 c	17,240 bc	173,200 c	57,600 cd	20,020 b
Mal 07	0,812 d	68,200 cd	17,060 bc	123,800 e	65,000 c	19,280 b
Dgel 02	0,936 d	62,420 de	15,960 c	208,600 a	52,800 d	16,260 c
LSD	**0,322**	**6,439**	**1,447**	**13,69**	**7,995**	**2,219**
Males palms	**2014 Season**					
Degla Bida	2,294 b	85,000 a	17,110 bcd	163,800 e	71,800 b	24,640 a
Deglet Nour	3,288 a	79,200 b	19,100 a	215,600 a	89,800 a	25,440 a
Ghars	1,782 bc	57,800 d	16,120 d	193,000 c	65,000 c	16,420 c
Dgel 01	1,365 cd	69,750 c	8,825 e	105,750 g	38,750 f	13,950 d
Mal 05	2,580 ab	83,000 ab	18,467 ab	194,000 bc	63,667 cd	21,233 b
Mch Degla	1,424 cd	69,100 c	17,780 bc	174,800 d	58,600 de	19,620 b
Mal 07	0,815 d	69,000 c	16,520 cd	123,000 f	66,750 bc	20,900 b
Dgel 02	1,263 cd	60,750 d	16,225 d	205,000 ab	55,000 e	16,800 c
LSD	0,74	6,2	1,376	5,568	10,718	1,88

LSD = Least significant difference at p≤0.05.
Means followed by same letters do not differ significantly (p<0.05)

Table 3. Biometeric comparison between the 08 sources of the different pollen grains during 2013 and 2014.

Laboratory measurments	Pollen grain Vitality %	Pollen grain germination %	Length of the pollen grain (Um)	Width of the pollen grain (Um)	Length of the pollen tube (Um)
Pollen source	**2013 season**				
Degla Bida	87,429 b	75,667 b	41,203 a	13,997 a	232,102 bcd
Deglet Nour	79,875 c	66,667c	39,200 ab	13,728 a	218,048 cd
Ghars	94,222 a	92,222 a	36,034 c	13,690 a	285,239 ab
Dgel 01	77,100 d	67,111 c	36,498 bc	13,384 a	205,699 cd
Mal 05	91,875 a	67,111 c	30,636 d	13,015 a	311,823 a
Mch Degla	93,000 a	77,222 b	35,595 c	13,228 a	189,907 d
Mal 07	94,500 a	69,700 c	34,732 c	14,089 a	251,275 bcd
Dgel 02	85,778 b	60,333 d	39,183 ab	13,924 a	175,739 d
LSD	**2,708**	**3,88**	**3,025**	**1,088**	**55,57**
Pollen source	**2014 season**				
Degla Bida	88,900 b	76,222 b	39,368 a	14,049 a	244,579 ab
Deglet Nour	78,889 d	63,778 d	36,057 bc	13,428 ab	209,729 bc
Ghars	92,444 a	93,444 a	33,480 cd	13,281 ab	291,029a
Dgel 01	76,500 d	67,750 c	33,067 d	12,873 b	188,060 c
Mal 05	91,556 ab	67,600 c	34,461 cd	13,358 ab	278,819 a
Mch Degla	93,333 a	75,857 b	34,466 cd	13,166 ab	220,547 bc
Mal 07	92,857 a	73,778 b	33,310 cd	14,129 a	251,010 ab
Dgel 02	84,000 c	62,556 d	38,980 ab	14,189 a	179,054 c
LSD	**3,144**	**3,588**	**2,858**	**1,142**	**48,904**

LSD = Least significant difference at p≤0.05
Means followed by same letters do not differ significantly (p<0.05)

Alson, Al-Helal (1994) & Shaeen *et al*. (1989) proved that the vitality and the germination percentage differ from one male to another, Daluz *et al*. (2013) confirmed in their studies that pollen grains have different volumes. Also, Soliman *et al*. (2013a) pointed out that between 11 varieties there was a noticeable difference in the shapes and volume of the pollen grains, hence, the Safary surpassed and Succary followed it. Mortaztiv *et al*. (2010) confirmed after testing out the storage of three different varieties of pollen grains: Ghamami, Gheibane and Samsmani. Inspite of the storage circumstances, germination was different between varieties. Similarly, Ismail (2014) pointed out in his study that pollen grains were influenced by the planting milieu. The Barthe's response for pollen tube is the highest where there was Glucose. Furthermore, storage has an influnce on the pollen grains' response to vitality and germination (Ateyyeh, 2012; Osman *et al*., 2010) after testing three varieties of pollen grains he borned out that Giza pollen has the highest germination if compared to Aswan and Rashid pollen. Also Wang *et al*. (2003) studied about the role of Boron in the length of the

pollen tube of *Picea Megeri*, in spite of what (Kavand *et al*., 2014b) found that after examining two types of pollen grains i.e. Shahani Jahron and Zahdi, he cleared out that the milieu has a direct influence in germination, but only if the same cultivating milieu is applied. The difference in pollen tube from a variety to another as it was confirmed by Liu *et al*. (2013) when he studied Area pollen, that pollen tubes growth is related to the time and the content of the milieu. After examining three pollen grain varieties it was found that Beraem has the highest percentage of germination followed by Fard and Jarvis male palm (Kavand *et al*., 2014a). (Mortaazavi *et al*., 2010b) also studied three varieties of specific elite types and a difference in the degree of vitality was recorded, and the highest value was scored by male Samsmavi. They found that there is a difference in the diameters and the germination percentage of the pollen grains.

The effect of pollen grains on the eleven females set percentage: Table 4 shows that a great significance exists between the female cultivars in the set percentage and this is due to the effect of pollen grains. After comparing the Male elite Degla Bida effect in the set percentage, it scored the highest value in the cultivar Sbaa Braa (91.620- 89.660 %) in both seasons, the lowest value of it was recorded in the cultivar Degla Bida (22.039, 23.526%). Varieties Deglet Nour scored the highest value in the cultivar Massri (97.7-96.222%) on that order, and the lowest value was on the female cultivar Degla Bida (47.335-48.673%). Male 05 scored the highest value in the cultivar Deglet Nour (93.553%) in season one, whereas in season two in the cultivar Sbaa Dra (95.108%), the lowest value of it was scored in the female Cultivar Dgel El-gaid (48.925-46.556%) on that order. Varieties Degl 01 scored the highest percentage of set in the cultivar Itima (95.446-93.581%) and the lowest in Baydh Hmam (22.382-21.074%) respectively. Male 05 scored highest value which was recorded by the female cultivar in Massri (91.914, 90.914) and the lowest value in Dg (57.374) during the first season, whereas in the second season it was scored in Degla Bida (60.016%). The male elite Male 07 scored the highest value in Sd in the first season with the percentage of (90.874, 90) and the lowest was in Ghars (42.845%), whereas in the second season it was scored in Dgel El-gaid (43.996). The Dgel 02 elite male recorded the highest set percentage in Itima (93.691-95.464%). and the lowest in Baydh hmam (32.201-28.232%). It is significant to state that Degla Bida elite male have the same names of the female varieties, however, they are incompatible, this is due to the bad morphological diagnosis or the large number of similar characteristics. For this reason they should be analysed separately in order to put the names of the elite males. It is clear that there is a great effect of the elite males on the set percentage in which this percentage differs from one elite to another. This was proved by Abbas *et al*. (2012) that the set percentage is affected by the pollen type used. After pollination of three different cultivars Dahki, Shakri and Zahdi with five kinds of pollen grains, Iqbal *et al*. (2012) inferred that the set percentage and fruits drop were influenced by the variety of the pollen grains used. Moreover, in a study (Shafique *et al*., 2011) in which they pollinated Dahkki with three different varieties of pollen grains and it was found that the third variety had the lowest percentage of fruits drop. Also, Haffar *et al*. (1997) confirmed that the yield was influenced by the way of pollination rather than the pollen grains used. Similarly, in the study of Bacha *et al*. (2000) of four varieties of date palms, Barhi pollen recorded a self incompatibility whereas Nebut Seif and Succary the fertilizing percentage was too high in all the varieties of the pollen grains. Consequently, the number of suitable males should be grown, because pollen grains effect directly the set percentage and the quality of fruits, this later was confirmed by El-Marid *et al*. (2007).

Table 4. The effect of pollen grains types on the percentage of fruit set of the eleven cultivars in 2013 and 2014 seasons.

Pollen source	Dgla Bida	Deglet Nour	Ghars	Dgel 01	Male 05	Mch Degla	Male 07	Dgel 02
Cultivars	**2013 season**							
Itima	85,191 **ab**	92,181 **ab**	92,439 **a**	93,581 **a**	90,715 b	85,890 **b**	87,323 **a**	95,464 **a**
Sbaa Bdra	89,660 **a**	90,550 **abc**	91,550 **ab**	79,780 **bc**	79,310 **c**	71,430 **d**	90,000 **a**	94,100 **a**
Deglat Nour	78,569 **bc**	88,126 **abc**	93,553 **a**	86,058 **b**	87,777 b	90,914 **a**	67,304 **c**	76,333 **c**
Massri	75,018 **cde**	96,222 **a**	81,814 **bc**	83,638 **b**	94,435 **a**	86,027 **b**	73,443 **b**	78,151 **bc**
Tinicin	75,447 **cd**	83,334 **bcd**	76,011 **cd**	76,812 **c**	60,667 **f**	83,644 **b**	84,757 **a**	65,926 **d**
Mech Degla	80,210 **abc**	75,217 **d**	54,521 **fg**	54,594 **de**	67,182 **de**	85,771 **b**	66,352 **c**	82,718 **b**
Abd El-Aziz	68,234 **de**	60,931 **e**	65,620 **e**	55,900 **de**	69,929 **d**	70,570 **d**	59,212 **d**	55,057 **e**
Baydh Hmam	50,652 **f**	85,992 **bc**	86,832 **ab**	21,074 **f**	65,966 **e**	78,043 **c**	53,034 **e**	28,231 **f**
Dgel El-Gaid	76,093 **c**	78,575 **cd**	46,556 **g**	58,035 **d**	40,189 **g**	57,374 **e**	43,051 **f**	81,963 **b**
Ghars	66,912 **e**	88,535 **abc**	68,400 **de**	50,500 **e**	37,770 **g**	58,338 **e**	42,845 **f**	54,895 **e**
Degla Bida	23,526 **g**	48,673 **f**	56,082 **f**	53,729 **de**	38,977 **g**	58,931 **e**	47,152 **f**	56,599 **e**
LSD	**7,752**	**10,478**	**8,608**	**6,534**	**3,751**	**3,532**	**4,405**	**4,92**
Cultivars	**2014 season**							
Itima	86,342 **ab**	95,515 **a**	93,365 **a**	95,446 **a**	88,698 **b**	88,152 **ab**	89,982 **a**	93,691 **a**
Sbaa Bdra	91,429 **ab**	96,599 **a**	95,108 **a**	79,213 **cd**	82,577 **c**	80,313 **c**	90,874 **a**	91,711 **a**
Deglat Nour	78,208 **c**	86,612 **b**	94,628 **a**	85,208 **bc**	87,596 **b**	91,914 **a**	69,578 **bc**	77,816 **c**
Massri	75,227 **cd**	97,773 **a**	84,536 **b**	83,488 **cd**	96,702 **a**	88,230 **ab**	75,242 **b**	80,185 **b**
Tinicin	76,670 **c**	81,914 **bc**	78,560 **b**	78,517 **d**	59,186 **f**	83,205 **bc**	86,931 **a**	65,693 **d**
Mech Degla	78,333 **bc**	76,038 **c**	56,955 **d**	55,231 **e**	66,262 **e**	84,993 **abc**	69,293 **bc**	82,692 **b**
Abd El-Aziz	67,350 **d**	60,132 **d**	65,427 **c**	57,227 **e**	70,558 **d**	70,202 **d**	61,621 **cd**	56,113 **e**
Baydh Hmam	77,553 **c**	85,588 **b**	48,924 **e**	90,042 **ab**	42,383 **g**	61,292 **e**	43,996 **e**	82,636 **b**
Dgel El-Gaid	58,906 **e**	86,166 **b**	84,991 **b**	22,382 **f**	67,119 **de**	78,351 **c**	53,332 **de**	32,201 **f**
Ghars	59,113 **e**	82,978 **bc**	78,433 **b**	52,073 **e**	36,201 **h**	61,345 **e**	48,021 **e**	55,976 **e**
Degla Bida	22,093 **f**	47,733 **e**	54,915 **de**	54,832 **e**	39,961 **g**	60,016 **e**	45,664 **e**	57,036 **e**
LSD	**8,517**	**7,447**	**7,221**	**6,311**	**3,254**	**6,577**	**10,833**	**2,4**

LSD = Least significant difference at $p \leq 0.05$

Means followed by same letters do not differ significantly ($p<0.05$)

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