



Article

Influence of Pollinator Type on Fruit Quality of Medjool Date Palm

Hamdy I. M. Ibrahim* ; Farouk H. Abd El Aziz; F.F. Ahmed and Hassan A. A. Mohamed

Horticulture Depart. Fac. of Agric. Minia Univ., Egypt.

*Corresponding author: hamdy_france@yahoo.com



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Abstract: The present investigation focused on the response of fruit physico-chemical parameters of 'Medjool' date palm to pollen grains source. However, three pollinator's cvs namely; Ghanami, Jarvis and Boyer were examined. Furthermore, increasing the frequencies of pollination from two to four times were studied also. The obtained data showed that the pollinator type significantly varied the fruit physical properties (i.e. fruit weight, seed weight, pulp weight, pulp: seed ratio, fruit length and fruit diameter of 'Medjool' date palm, during the two experimental seasons. In this concern, the palms pollinated with 'Ghanami' shows significantly superior rather than those pollinated with 'Jarvis' or 'Boyer' pollinators. Furthermore, pollinator type had a significant effect on fruit reducing and non-reducing sugars, total acidity, crude fiber and soluble tannins. Whereas, in this concern Ghanami pollinators present superiority compared to using Jarvis or Boyer cvs. as a pollinator. While, non-significant differences were observed in fruit pulp TSS% and total sugars %. Furthermore, increasing the frequencies of pollination significantly improved fruit physical and chemical properties. While, non-significant differences in most physical and chemical properties as a result of increasing the frequencies of pollination from three to four times.

Key words: Medjool date palm, pollinator, fruit quality, tannin, Total sugars.

INTRODUCTION

The date palm tree (*Phoenix dactylifera* L.) is one of the main species of phoenix genus belong to *Palmaceae* Family. However, all known date palm varieties descended from genus *Phoenix*. Since date palm is a dioecious fruit trees, male and female flowers being borne on separate trees. So, for commercial production artificial pollination methods are necessary (Ghnaim & Al-Muhtaseb, 2006 and Salomon-Torres *et al.*, 2018 & 2020). Addition to its commercial and nutritional value, date palm characterized by higher resistance to water stress, tolerates climate

variables change, and tolerance of high salinity levels (Zaid & Wet, 2002; Hodel & Johnson, 2007; Eshrawy, 2010 & 2015 and FAO, 2020).

Egypt is one of the major countries in date palm cultivation and date production (FAO, 2020). Medjool cultivar is one of the most important international varieties of dates, which demand for foreign markets (Ghnaim & Al-Muhtaseb, 2006 and Salomon-Torres *et al.*, 2017). It is one of the famous semi-dry high quality international cultivars. It can grow successfully in warm climate conditions, so its cultivation intensive in middle Egypt region. Currently, Medjool considered as one of the main dates cultivars in Egypt. Its fruit has a sweet, caramel taste and soft chewy texture. It has a higher nutritional contents, it reaches in Calories, protein, carbohydrates, vitamins and mineral nutrients. It also a good source of phytonutrients (plants compounds have many health benefits).

The present study focused on the effect of pollen grains source (pollinator's type; Ghanami, Jarvis and Boyer *cv.s.*) as well as the frequencies of pollination (two, three and four times) on fruit physical and chemical properties of 'Medjool' date palm, grown in sandy soil under El-Minia Governorate conditions.

MATERIAL AND METHODS

The present study was conducted during 2020 and 2021 seasons on twenty-seven, fifteen years, 'Medjool' date palms uniform in vigor, grown in private farm located at Western desert road, Malawi district El-Minia Governorate – Egypt. Where, the orchard soil texture is sandy. Drib irrigated system was adopted, using groundwater well as a source of water. Pruning was performed to maintain leaf / bunch ratio at 8:1. However, the number of female spathes per palm was adjusted to 10 spathes by removing excess bunches (earliest, latest and small bunches). The selected 'Medjool' female palms are subjected to regular horticulture practices commonly applied in Medjool orchard trees.

Soil and water analysis

A composite sample of soil and irrigation water were collected and subjected to physico-chemical analysis according to the procedures outlined by Wilde *et al.* (1985), the obtained data are illustrated in the following table.

Table (1). Physical and chemical analysis of orchard soil and irrigation water

Soil analysis		Water analysis	
Constituent	Value	Constituent	Value
Sand %	82.2	E.C (µS/cm)	853
Silt %	10.5	Hardness	17.6
Clay %	7.3	pH	7.31
Texture	Sandy	Ca (mg/L)	28.2
EC (1 : 2.5 extract) mmhos / cm / 25 C	2.5	Mg (mg/L)	20.3
Organic matter %	0.75	K (mg/L)	4.17
pH (1 : 2.5 extract)	7.63	Na (mg/L)	78.7
Active lime %	6% (CaCO ₃)	Alkalinity (mg/L)	165
N (mg/kg)	173	Chlorides (mg/L)	119
Phosphorus (ppm)	19.8 ppm	Nitrate (mg/L)	9.1
Available K (meq/100g)	0.46	Sulphates (mg/L)	44.1

Experimental work

The present study was achieving in order to declare the effect of pollen grains source and frequencies of pollination on fruit physical and chemical properties of ‘Medjool’ date palm. The investigation included the following nine treatments from three sources of pollen grains (Ghanami, Jarvis and Boyer pollinators *cvs.*) and three frequencies of pollinations (two, three and four times), it were arranged as followed: Pollination two times with ‘Ghanami’ pollen grains, Pollination three times with ‘Ghanami’ pollen grains, Pollination four times with ‘Ghanami’ pollen grains, Pollination two times with ‘Jarvis’ pollen grains, Pollination three times with ‘Jarvis’ pollen grains, Pollination four times with ‘Jarvis’ pollen grains, Pollination two times with ‘Boyer’ pollen grains, Pollination three times with ‘Boyer’ pollen grains, Pollination four times with ‘Boyer’ pollen grains. The treatments were arranged in a complete randomized block design (CRBD) according to **Snedecor and Cochran (1990)**. Each treatment was replicated three times, one palm per each one.

Measurements and determination: Sample of one hundred fruits from the yield of each palm was taken randomly and the following physic-chemical characteristics were measured:

1- Fruits physical properties

Average weight of fruit, seed weight and flesh weight (g) were estimated by using top pan balance of 0.01g sensitivity. Then, the flesh / seed ratio was calculated. Fruit dimensions (length and diameter (cm) were measured by using vernier caliper. Edible to non-edible portion or flesh: seed ratio (w/w) was estimated by dividing the flesh weight by the seed weight.

2- Fruits chemical properties

Sample of 100 gram of fruit pulp was added to 100 ml distilled water and stand 4 hours. Then the samples minced will with electric blender for the following chemical parameters determination: Percentage of total soluble solids (TSS %) was determined by using hand refractometer. Percentage of total reducing sugar was determined by using volumetric method according to the protocol outlined by Lane and Eynone (**Rangana, 1990**). Percentage of total acidity (expressed as grams malic acid per 100 grams of flesh) by titration against 0.1 NaOH using phenolphthalein as an indicator (according to **A.O.A.C., 2000**). Crude fiber %: crude fibers content as a percentage was determined by using acetic acid glacial and nitric acid at 10: 1 solution, as outlined in the official methods described in **A.O.A.C., (2000)**.

RESULTS AND DISCUSSION

1- Effect of pollen source on Fruit physical properties

Data concerning the effect of pollen grains source (Ghanami, Jarvis and Boyer pollinators) and frequencies of pollination (two times, three times and four times) on the physical properties of fruit (in terms: fruit weight, fruit dimensions, pulp weight, seed weight and pulp to seed ratio) of ‘Medjool’ date palms, grown in sandy soil under Minia Governorate conditions, during 2020 and 2021 seasons, are presented in Tables (2 and 3).

Fruit weight (g) and seed weight (g)

The obtained data in Table (2) displayed that, regardless the frequencies of pollination the pollinator type has a significantly varied the fruit weight (g) and seed weight (g) of ‘Medjool’ date palm during the two experimental seasons. Using ‘Ghanami’ date palm pollen grains shows significantly superior in fruit weight rather than ‘Jarvis’ or ‘Boyer’ pollinators. While, ‘Medjool’ date palms pollinated with

'Jarvis' present higher and significant seed weight (g) rather than those pollinated with the two other pollinators (Ghanami and Boyer *cvs.*). Contrary the palms pollinated with Ghanami present the lowest seed weight. These findings are true in both seasons.

Increasing the frequencies of pollination from 2 to 4 times significantly improved fruit weight (g) and decrease seed weigh (g). Whereas, pollenated 'Medjool' palms four times with 'Ghanami' pollen grains present the highest fruit weight (24.1g and 24.4 g) and lowest seed weight (1.32 g and 1.32 g), during the two experiment seasons respectively. Contrary, those pollenated two times with 'Jarvis' pollen grains present the lowest fruit weigh (19.3 g and 19.8 g). On the other hand 'Medjool' female date palms pollenated two times with 'Boyer' pollen grains present the highest seed weight (1.43 g and 1.44 g), during 2020 and 2021 seasons respectively.

Pulp weight (g) and flesh: seed ratio

It is clear from the data in Table (2) that varied the source of pollen grains (Ghanami, Jarvis and Boyer pollinators *cvs.*) and frequencies of pollination from two to four times have an announced and significant effect on fruit pulp weight (g) and pulp: seed ratio, during 2020 and 2021 seasons. Regarding the source of pollen grains (Ghanami, Jarvis and Boyer *cvs.* pollinators) the integrated treatment showed that the 'Medjool' date palms pulp weight (g) varied significantly with varying the pollenated type. However, the 'Medjool' palms pollenated with 'Ghanami' pollen grains four times present the highest pulp weight (22.25 g and 23.18 g) and highest pulp: seed ratio (17.30 and 17.56). Contrary, those pollenated two times with 'Jarvis' pollen grains present the lowest pulp weight (17.87 g and 18.38 g) and lowest edible to non-edible portion ratio (12.49 and 12.94), during the two seasons respectively. Increasing the frequencies of pollination from two to four times were significantly parallel to increasing fruit pulp weight and edible to non-edible portion. It is clear from the obtained data that both pollen grains source (pollinator) and frequencies of pollination was capable to varying significantly both the pulp weigh and pulp / seed ration during the two experimental seasons.

Fruit dimensions (length and diameter)

The obtained data concerning the effect of pollen grains source and frequencies of pollination on fruit dimensions (length and diameter) of 'Medjool' date palms grown in sandy soil under El-Minia Governorate conditions, during 2020 and 2021 seasons, are presented in Table (2). Data in Table (3) displayed that, regardless the frequencies of pollination, pollinator type significantly varied the fruit length and diameter (cm) of 'Medjool' date palm fruit during the two experimental seasons (2020 and 2021). Using 'Ghanami' date palm pollen grains present significantly superior in fruit length and fruit diameter (cm) rather than using pollen grains of 'Jarvis' or "Boyer" pollinators.

In addition, non-significant differences were observed in fruit diameter (cm) between the 'Medjool' fruits pollenated with 'Jarvis' and those pollenated with 'Boyer' pollen grains. Moreover, pollenated 'Medjool' female date palms four times with Ghanami pollen grains present the highest fruit length (7.2 cm and 7.4 cm) and fruit diameter (2.8 cm and 2.9 cm). On the opposite side, those pollenated with 'Jarvis' pollen grains present the lowest fruit length (6.1 cm and 6.1 cm) and fruit diameter (1.9 cm and 2.1 cm). These data were true during the two experimental seasons.

The effect of pollen grain on fruit physical properties scientifically (called also metaxenia phenomena), this important phenomenon, which greatly affected the productivity and fruit quality of date palms cultivars, has attracted many date palm scientists and has been extensively studied by many

researches such as: **El-Salhy *et al.* (2010 & 2021)** on Saïdy *cv.*; **Al-Wusaibai *et al.* (2012)** on Khalas and Sheshi *cv.*s.; **Rahnama and Rahkhodaei (2014)** and **Torres *et al.* (2017)** on Medjool *cv.*; **El-Badawy *et al.* (2017)** on Sewi *cv.*; **Mohammadi *et al.* (2017) & Zargari *et al.* (2021)** on Barhi *cv.*; **Aubied and Hamzah (2019)** on Sultani *cv.*; **Garcia-Gonzalez *et al.* (2019)** on Medjool *cv.* under Mexico conditions; **Homed (2020)** on Al-Maktoum *cv.* and **Kadri *et al.* (2022)** on ‘Deglet Nour’ date palm.

Table (2). Effect of pollen grain source on average fruit weight (g), average seed weight (g), pulp weight (g) and pulp: seed ratio of Medjool date palm, during 2020 and 2021 seasons

Treatments		Fruit weight (g)		Seed weight (g)		Pulp weight (g)		Pulp : seed ratio	
Pollinators	Frequency	2020	2021	2020	2021	2020	2021	2020	2021
Ghanami	2 time	21.6	21.7	1.35	1.36	20.25	21.37	15.01	15.71
	3 times	22.7	22.9	1.33	1.31	21.37	21.59	16.07	16.48
	4 times	24.1	24.4	1.32	1.32	22.78	23.18	17.30	17.56
Jarvis	2 time	19.3	19.8	1.43	1.42	17.78	18.38	12.49	12.94
	3 times	21.8	22.3	1.42	1.43	20.38	20.87	14.35	14.59
	4 times	22.1	22.1	1.40	1.42	20.70	20.68	14.79	14.56
Boer	2 time	20.4	20.9	1.43	1.44	18.97	19.46	13.27	13.51
	3 times	22.9	22.7	1.42	1.44	21.48	21.26	15.13	14.76
	4 times	23.5	23.6	1.42	1.42	22.08	22.18	15.55	15.62
New LSD at 5 %		1.1	1.3	0.07	0.08	0.9	1.1	1.2	1.3

Table (3). Effect of pollen grain source on average fruit length (cm) and average fruit diameter (cm) weight of Medjool date palm, during 2020 and 2021 seasons

Treatments		Fruit length (cm)		Fruit diameter (cm)	
Pollinators	Frequency	2020	2021	2020	2021
Ghanami	2 time	6.7	6.8	2.5	2.5
	3 times	6.9	7.0	2.6	2.6
	4 times	7.2	7.4	2.8	2.9
Jarvis	2 time	6.1	6.1	1.9	2.1
	3 times	6.4	6.3	2.2	2.3
	4 times	6.5	6.5	2.4	2.4
Boyer	2 time	6.1	6.2	2.3	2.2
	3 times	6.3	6.3	2.2	2.4
	4 times	6.5	6.4	2.3	2.4
New LSD at 5 %		0.3	0.4	0.2	0.2

2- Effect of pollen grain source on fruit chemical properties

The obtained data illustrated in Tables (4 and 5) concerning the effect of pollen grains sources (Ghanami, Jarvis and Boyer pollinators *cv.s.*) on the chemicals properties of ‘Medjool’ date palms fruits during the present study (in terms of TSS%, total sugars%, reducing and non-reducing sugars contents, total acidity%, total soluble tannins% and crude fibers%), during 2018 and 2019 seasons.

TSS% and sugars contents

It is clear from the obtained data that varying the source of pollen grains (Ghanami, Jarvis and Boyer pollinators *cv.s.*) or the frequencies of pollinations failed to vary significantly the TSS% content and total sugars% in fruit pulp, neither in the first seasons nor in the second season. Contrary, Table (4) showed that, the distribution of sugars rates contents (reducing and non-reducing percentages) in ‘Medjool’ fruit pulp significantly affected by the source of pollen grains (Ghanami, Jarvis and Boyer pollinators *cv.s.*), also called the metaxinea phenomena effects. The same table also shows that ‘Medjool’ date palms pollinated with ‘Ghanami’ pollen grains present the lowest and significant reducing sugars % and highest non-reducing sugars %, rather than those pollinated with ‘Jarvis’ or ‘Boyer’ pollen grains. While, non-significant differences were observed between ‘Medjool’ palms pollinated with ‘Jarvis’ and ‘Boyer’ pollen grains in fruit pulp reducing and non-reducing sugars percentages.

On the other hand, the frequencies of pollinations don’t have any significant effect on the TSS% or sugars contents %, except the case of using the Ghanami *cv.* pollen grains. Whereas, increasing the frequencies of pollination from two times to four times with ‘Ghanami’ pollen grains significantly increased the non-reducing sugars % and decreases the reducing sugars % in ‘Medjool’ fruits pulp, during the two seasons (2020 and 2021).

Table (4). Effect of pollen grain sources (Ghanami, Jarvis and Boyer *cv.s.*) on TSS% and reducing sugars% of “Medjool” date fruits, during 2020 and 2021 seasons

Treatments		TSS %		Total sugars %		Reducing sugars %		Non-reducing sugars %	
Pollinators	Frequency	2020	2021	2020	2021	2020	2021	2020	2021
Ghanami	2 time	63.6	62.2	61.5	60.1	13.2	13.1	48.3	47.0
	3 times	62.9	63.2	60.8	61.1	12.2	12.3	48.6	48.8
	4 times	63.2	63.7	61.1	61.6	11.1	11.7	50.0	49.7
Jarvis	2 time	63.1	63.7	61.0	61.1	14.2	14.1	41.8	47.5
	3 times	62.9	63.6	60.8	61.5	14.3	14.2	46.5	47.3
	4 times	63.3	63.2	61.2	61.1	14.1	14.4	47.1	46.7
Boyer	2 time	62.4	62.7	60.3	60.6	14.3	14.2	46.0	46.4
	3 times	62.8	63.1	50.7	61.0	14.5	14.3	46.2	46.7
	4 times	62.3	61.9	60.2	59.9	14.1	14.4	46.1	45.4
New LSD at 5 %		NS	NS	NS	NS	0.9	1.1	1.5	1.4

Total acidity %, total soluble tannins % and total crud fibers %

Regarding the ‘Medjool’ fruit contents in total acidity, varying the source of pollen grains (Ghanami, Jarvis and Boyer pollinators *cvs.*) was associated with significant variation in fruit pulp total acidity%, soluble tannins % and total crud fibers % (Table 5). However, ‘Medjool’ female palms pollinated with ‘Ghanami’ pollen grains present the lower and significant content of ‘Medjool’ fruit total acidity, total soluble tannins and total crud fibers rather than those pollinated with ‘Jarvis’ or ‘Boyer’ pollen grains. The palms pollinated with ‘Boyer’ pollen grains present the highest and significant total acidity, total soluble tannins and total crud fiber in fruit pulp. While, the ‘Medjool’ palms pollinated with Jarvis pollen grains present intermediate percentage of total acidity, soluble tannins and crud fibers in their fruits pulp. These findings were true during the two experimental seasons. The obtained data also showed that increasing the frequencies of pollination from two to four times be failed to significant varied the total acidity, total soluble tannins and total crude fiber percentages, during the 2020 and 2021 seasons. Even to, the frequencies of pollination times from two to four times don’t varied the ‘Medjool’ fruit pulp significantly, the type of pollinator has a significant effect in these three traits in both experimental seasons.

The remarkable favorable effect of pollen grains source (metaxinea phenomena) on chemical composition of ‘Medjool’ date palm fruits could be explained by the effect of genetic composition of pollen grains its can a high positive effect on sugars synthesis activity and improving effect of plant tolerances to abiotic stress, that may be lead to more carbohydrates productions and accumulations in fruits. Thus, can be explained its major effect on enhancing fruit chemical properties. So, it may be cause an enhancement of vitamins, amino acids as well as antioxidant biosynthesis, these can play an important role in improve fruit chemical properties, i.e. decreasing of total acidity%, total soluble tannins and crude fiber %.

Table (5). Effect of pollen grain sources (Ghanami, Jarvis and Boyer *cvs.*) on total tannins % and crude fiber % of “Medjool” date fruits, during 2020 and 2021 seasons

Treatments		Total acidity %		Total soluble tannins %		Total fibers %	
Pollinators	Frequency	2020	2021	2020	2021	2020	2021
Ghanami	2 time	0.209	0.208	0.38	0.38	0.87	0.82
	3 times	0.211	0.212	0.37	0.35	0.89	0.90
	4 times	0.201	0.203	0.36	0.36	0.89	0.80
Jarvis	2 time	0.297	0.288	0.57	0.55	1.09	1.07
	3 times	0.296	0.291	0.51	0.53	1.05	1.01
	4 times	0.303	0.301	0.53	0.52	1.02	1.04
Boyer	2 time	0.318	0.322	0.61	0.62	1.22	1.31
	3 times	0.324	0.329	0.62	0.61	1.21	1.21
	4 times	0.337	0.332	0.60	0.63	1.23	1.24
New LSD at 5 %		0.031	0.033	0.12	0.16	0.19	0.21

Similar findings concerning the response of female date palm fruits to the source of pollen grains (metaxenia phenomena) on fruit chemical properties of date palm fruits were observed by: **Iqbal *et al.* (2011)** when they examined nine sources of pollen grains on fruit chemical properties of ‘Dhakki’ *cv.*; **Rezazadeh *et al.* (2013)** when they studied the influence of 12 pollen sources on ‘Barhi’ date palm fruit quality as well as **Zargari *et al.* (2021)** on the same cultivar; **Abbas *et al.*, (2014)** when they studied the effect of metaxenic phenomena of Ghanami Akdhar and Khiri Adi *cvs.* on chemical properties of ‘Hillawi’ date palm fruit; **Omar *et al.* (2014 and 2015)** during investigated the effect of Metaxenic of male palm (*Phoenix dactylifera* and *Phoenix canariensis*) on the fruit quality of Khalas *cv.* and **Salomon-Torres *et al.* (2018 and 2020)** during their studied the sources of pollen grains (Deglet Noor, Khadrawy, Medjool and Zahidi *cvs.*) and its effect on chemical composition of ‘Medjool’ date palms.

Conclusion

Based on the obtained results during the two experimental seasons (2019 and 2020). The Medjool date palms pollinated by Ghanami *cv.* produced the best fruit physical properties (increasing fruit weight, fruit dimensions, pulp weight & pulp to seed ratio and decreased seed weight) and chemical parameters (decreasing total acidity, total crude fiber and total tannins). Contrary varying the source of pollen grains or the frequencies of pollinations failed to vary significantly the TSS% content and total sugars% in fruit pulp, but significantly varied the distribution of sugars rates contents (reducing and non-reducing percentages) in ‘Medjool’ fruit pulp. Furthermore, increasing the frequencies of pollination from two to four times it has a significant effect on chemical and physical fruit parameters.

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