



EFFECT OF POLLINATOR CULTIVARS ON SOME DATE PALM YIELD CHARACTERISTICS

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Abstract

Field and laboratory experiments were carried out to determine the effect of the pollinator cultivar on yield characteristics of date palm (*Phoenix dactylifera* L.). Experiments were conducted in palm orchards in central Baghdad during the 2018 season. Khyara variety was used as female, whereas, the pollinators used were Barhee, Assabaa Alaross, Khadrawi, Umarani and for the control a traditional pollination were used.

Males and females spadix were labeled and bagged and isolated with cloths bags before and after opining of the spathes. The isolation lasted for three weeks and then the isolation bags were lifted, each female spathe on each tree were pollinated with one male cultivar and one by use traditional pollination (control) by placing 7 spikelet (strand) of male flowers. Yield characteristics were measured: Fruit set percent, fruit weight, length and diameter, flesh weight and thickness, kernel weight, length and diameter, the degree of adhesion of the cortex to the flesh, The shape of the fruit skin (Epicarp) at the following stages: yellow khalal, half and complete ratub stages.

The results indicated that the percentage of fruit set were 83, 87, 89 and 98% when using a pollen from Umarani, Barhee, Khadrawi and Assabaa Alaross cultivars respectively, compared to 86% when traditional pollination was used. Fruits weight were 17.66, 22.25, 22.30 gm when Khadrawi, Umarani and Barhee pollinator were used respectively compared to 20.80 gm when traditional pollination were used at yellow khallal stage. Whereas, at half rutab and rutab stage the fruit weight were 15.8, 12.5, 18.7, 14.5, 19.5 and 15.6 gm with the use of pollinators Khadrawi, Umarani and Barhee, respectively compared to 16.9 and 13.5 gm for traditional pollinator respectively. The pollinator Barhee gave the highest percentage of flesh weight 93.3% from total fruit weight. The results of the chemical analysis indicated that there was an effect of the pollinator cultivar in the sugar content of the fruits. The pollinator Barhee gave the highest percentage of saccharids 67.60% and least when Umarani pollinator was used (62.42%) compared to 52.73% for traditional pollination.

These results can be used in programs to improve the production of dates as well as by selecting the pollinated cultivars that give the best specification of the crop. As well as propagation of these pollinator through the tissue culture and planted in palm orchards according to their compatibility with female cultivars for yield improvement.

Key words: Date palm, Pollination, Pollinators, Khyara cultivar.

Introduction

The date palm (*Phoenix dactylifera* L.) is dioecious plant, In order to obtain edible fruits; pollen must be transferred from male to female palm, in order to be fertilized (Al-Akidi, 2009). It has been known to farmers

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over many years that the source of pollen (male cultivar that pollen taken from) in date palm has a clear effect in the fruit set and some specifications and quality and called the phenomenon Metazenia, the effect of a pollen parent on the developing maternal tissues of a seed or fruit outside the embryo and endosperm such as the shape of

the fruit, size, color and maturity. The first to be noted by Nixon in 1936 and called by Sonnevile in 1926 was the phenomenon of metazinia (Zaid and Arias, 2002). Therefore, each of the palm growing areas in the world has a specific number of varieties of pollinators preferred for pollination because of its advantages in improving the crop characteristics. It was found that the date of the appearance of pollen on the palm affected by several factors, including weather conditions and especially temperatures. Early flowering occur in hot weather areas, as well as the variety of the pollinator. Floral inflorescence does not appear at the same time and may extend to 40 days (Shabana *et al.*, 2002).

Al-Okidi, (2009) reported that the pollen of a given cultivar differs from that of another in terms of its suitability for female pollination of a specific variety of palm. Where differences were found between them in the proportion of the fruits set. It must be ascertained from the selection of male pollinator and should be named and propagated vegetatively to use its pollen in the fertilization of the specific female cultivar which is sexually compatible. But farmers usually use the traditional method of pollinating their palm trees using a mixture of pollen from more than one pollinated species to overcome this phenomenon, but it is better to choose a specific male cultivar because pollen has an important effect on fruit specification.

Zirari lesson, (2010) studied the determination of the period of acceptance of female palm trees Njdah for pollination of different varieties of male dates palm, he found from the test of three pollinator tested NP3, NP4 and local cultivar, he studied pollination times after 1, 7, 10 and 15 days and the results showed that the pollination with NP3, NP4 has improved the maturity of fruits when pollinated after 7-10 days of blooming and achieved increased the length of the fruit by 1 cm, in width 3 mm and increase in the weight of the fruit by 35% and improved the quality of the fruit compared to local pollinator. Sedra, (2003) shows that date palm pollination plays an important role in the quantity and quality of date production, as well as, that the conditions and dates have

Table 1: Dates of the emergence of female inflorescence of some date palm varieties under the conditions of the central region of Iraq for the season of 2018.

Early Varieties-Time of female spathe appearance 15-2-2018		Intermediate Varieties-Time of female spathe appearance 1-3-2018		Late Varieties-Time of female spathe appearance 20-3-2018	
1	Khadrawy of Basrah	1	Umarani	1	Maktoom
2	Zahdi	2	Assabaa Alaros	2	Tibarzal
3	Bream	3	Hillawi	3	Barban
4	Ashracy	4	Al-Mandilawi	4	Khyara
5	Sugary	5	Al-Makawi	5	Ashrasi

a greater impact in it. The maturity of female flowers is a key factor in this, especially in terms of acceptance of female flowers of pollen and that the period of 3-4 days after the blooming is considered the best period and may sometimes extended to reach 13 days, but this is influenced by species and climatic conditions. Pollen viability is considered as the main indicator to determine the fertility of varieties as it represents the ability of the pollen to germinate and grow through the style, as it is also has an effect on morphological date specifications and quantity and quality of date production (Swingle, 1928; Westwood, 1978). The size of fruits and yield is affected by several factors including: nutrition, climate, chemicals, fruit bunch thickness and genetic factors of the genotypes. In the case of the match of the pollination, the genetic material has the greatest effect on the fruit and the characteristics of the nucleus (Sedgley and Griff, 1989). Through various studies in the countries of the world showing the effect of the type of pollinator in the chemical composition of fruits, including sugars (Mohammed and Shabana, 1980).

The research aims to test four pollinator cultivars: Barhee, Assabaa Alaros, Khadrawi, Umarani and traditional method of pollination as control, Khyara cultivar was used as female, to find out the effect on specifications of the product and the percentage of fruit set at the conditions of palm orchards in the central region of Iraq.

Materials and Methods

Location of experiment orchard

The experiment was carried out in palm orchards at the site: Latitude: 33.1270, Longitude: 44.82124, according to the Global Positioning System (GPS), which is located in the area of Mada' in (30 km south of Baghdad)

In orchards where 15-year-old palm trees were planted for females and the males pollinators were collected from other orchards in the same area.

Cultivars used in the experiment

The cultivar Khyara was chosen as female. The varieties Barhee, Assabaa Alaros, Khadrawi, Umarani were chosen as pollinator and traditional pollination method (by mixing the pollen from different varieties) as control, another group was left without pollination.

Dates of the emergence of female flowers

Dates of female inflorescences (Spadix) of the common varieties in the area were divided into three categories: early, intermediate and late inflorescences emergence with a range of 15-20 days

Table 2: Temperature and relative humidity at the site of the experiment in the palm orchards / Baghdad during the dates of emergence of female flowering.

Year and Months	Temperature°C			Relative Humidity		
	Min.	Max.	Mean	Min.	Max.	Mean
December 2017	8.5	21.7	15.1	22.2	65.8	44.0
January 2018	9.5	19.1	14.3	26.2	71.3	48.8
February 2018	10.1	21.3	15.7	33.8	77.1	55.4
March 2018	14.7	28.5	21.6	16.6	57.5	37.1



Fig. 1: Isolation of spathe and pollination.

between the group and Others (Table 1).

Climate conditions at the site of the orchards of the experiment

Temperature (Maximum and Minimum) and relative humidity were recorded at the site of the experiment. For this purpose, the American-made Watch Dog-2000 was used.

Isolation, blooming and Pollination

Spadix was observed for male and female flowers and upon completion (before opening) isolated canvas bags (Fig. 1). The opening of male and female flowers (Spathe) was monitored according to each pollinator cultivar, 7 male Spikelet were taken from each pollinator, it was taken into account a complete isolation of the Spikelet, then transferred to female flowers. The

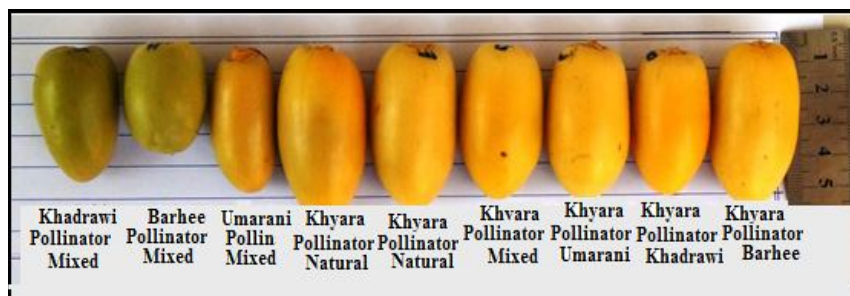


Fig. 2: The length of the fruit in the yellow Khalal stage of the variety of Khyara and some other varieties fertilized with different kinds of pollinators.

pollination and re-isolation were carried out immediately after pollination. For this purpose, three trees of the Khyara as females were chosen, female spikelet were isolated, after being labeled for pollination with each male species alone. One fruit punch of the female tree was pollinated with a pollinator cultivar of one of the pollinator cultivars used in the experiment. The total number of fruit punches three were (replicates) for each test of the effect of the pollinator cultivar.

Some of the phenotypic traits of the Khyara variety

Some morphological characteristics of the Khyara variety were examined: the average length of the leaf, the number of leaflet per leaf, the distance between the leaflets, the length of the spathe, the thickness of the spathe, length of spikelet (inflorescences), the number of spikelet in the spadix.

Effect of the pollinator on the percentage of the fruit set

The percentage of the fruits set was calculated in each spadix, by pollinator type and method of pollination during the Hanabuk phase and according to the following equation:

$$\text{Fruit set (\%)} = \frac{\text{No. of fruits setting on the strand}}{\text{Total No. of flower per strand}} \times 100$$

(El-Salhy *et al.*, 2010)

The proportion of the fruit set calculated after one month of pollination, this is in 5 spikelet of every spadix chosen randomly.

Effect of pollinator on some of the phenotypic traits of the fruit of the Khyara cultivar

The total weight of fruit was calculated, fruit flesh weight, flesh thickness, fruit length, fruit diameter, seed weight, seed length, seed diameter, The degree of adhesion of the cortex to the flesh, The shape of the fruit skin (Epicarp) at the following stages: yellow khalal, half and complete rataab stages. Ten fruits were randomly selected for this purpose from each fruit punch in each tree according to the method of pollination and the variety of the pollinator.

Effect of the pollinator cultivar on the sugar content of fruits

Ten fruits were collected randomly from each fruit punch, according to the pollinator cultivar in the yellow khalal and half and complete rataab stages and stored



Fig. 3: The shape and length of the fruit and the flesh of the Khyara variety at the yellow khallal stage.

under freezing until chemical analysis. The amount of sugar content in fruit was calculated based on Karkacier *et al.*, (2003). Using High- Performance Liquid Chromatography (HPLC) device.

Experimental design and statistical analysis

Experiments are designed in a field using a complete randomized design in terms of trees and fruit punch on one tree. Data were analyzed using Genstat software, means were tested according to least significant difference (LSD) and Duncan Multiple Range Test (DMRT).

Results and Discussion

Environmental conditions and flowering

The results in table 2 indicate that the environmental conditions during the formation and emergence of male

Table 3: Dates of isolation, bloom and pollination to test the effect of the pollinator cultivars on the characteristics of the yield in the date palm.

Fruit punch No.	Isolation date	Emergence date	Pollination date	Pollinator cultivar
1	18/3/2018	22/3/2018	23/3/2018	Barhee
2	20/3/2018	24/3/2018	24/3/2018	Assabaa Alaros
3	23/3/2018	27/3/2018	27/3/2018	Khadrawi
4	23/3/2018	26/3/2018	28/3/2018	Umarani
5	Not isolated	26/3/2018	27/3/2018	Traditional pollination

Table 4: Some phenotypic characteristics of palm leaves and leaflets of palm varieties Khyara under the conditions of the central region orchards of Iraq for the 2018 season.

Trait		Leaflet position	Leaf position		
			Basal	Middle	Lateral
Mean leaf length(m)	4.57	basal	3.1	3.5	2.7
Leaflet / leaf	218	Middle	2.3	2.5	2.5
Distance between leaflet (cm)	4	lateral	1.4	1.7	1.7
			50	47	44

and female inflorescence in the experimental orchards, the temperature ranged between 15.1-21.6°C and relative humidity 37.1%-44.0% during the period from December 2017 to March 2018. The dates of appearance of male and female flowers and emergence dates (Table 3). The results indicates that the dates of isolation of female spathes were during the period between March 18 and March 23 and the process of pollination after a day or two of the process of blooming and according to compatibility and availability of pollen from the pollinator cultivar.

Some of the phenotypic traits of the Khyara variety

The results indicated that the mean leaf length in the Khyara variety was 4.57 m and the number of leaflets in leaf was 218 leaflets. The length of the leaflet was longer at the base part of the leaf and reached 50, 47, 44 cm at the basal, median and lateral part of the leaf, respectively. The width of the leaflet in the basal portion of the leaf was more than the median and terminal (Table 4). The total length of the fruit punch is 176 cm (peduncle and spikelet). The width of the spathe is 4.5 cm at the base part and is reduced at the peripheral part to 3.5 cm, while the thickness of 2.1 cm and less when moving away from the trunk to reach at the tip to 1.8 cm. The length of the spikelet was different, with a length of 49, 50 and 28 cm at the base, middle and lateral parts of the spadix respectively (Table 5).

Effect of the pollinator on the percentage of the fruit set

The results indicate a significant effect of the pollinator cultivar on the ratio of the fruit set (Table 6), the pollinator Assabaa Alaros gave the highest percentage of fruit set (98%) and the lowest when using the Umarani (83%) compared to the traditional pollination rate (86%). As for the fruit punch that was left without pollination, the percentage of the fruit set was 21%, this depends on the availability of the number of male cultivars grown in orchards, wind and pollinated insects. This confirms what Westwood, (1978) points out that a high fruit set indicates high fertility of the pollinator cultivar. As indicated by the need to choose a male cultivar compatible with the female cultivar. It is also possible to propagation of male varieties by means of tissue culture and according to compatibility with the female cultivars and according to each region where the most common varieties are grown. This is what Zaid

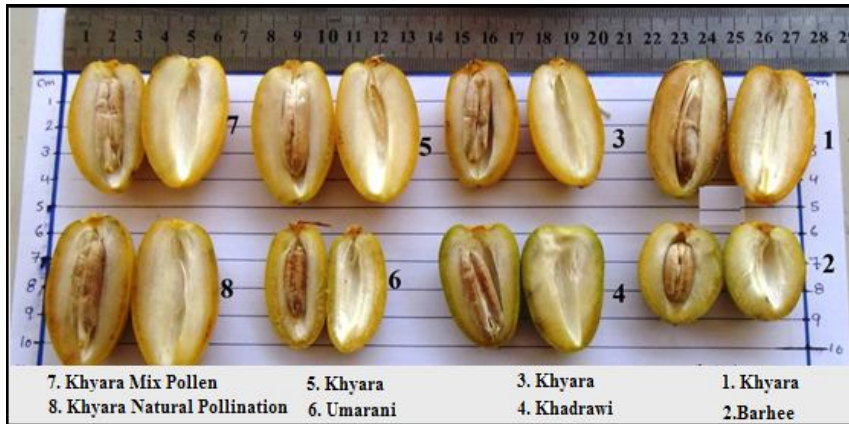


Fig. 4: Morphological characteristics of fruits by type of at the yellow khallal stage.

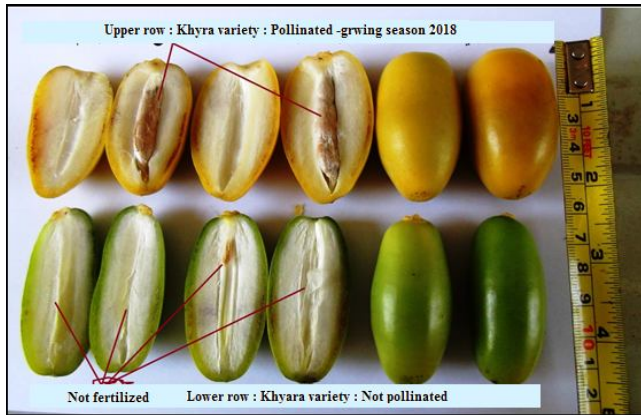


Fig. 5: Pollination effects on shape and color of the fruit.

and Arias, (2002) pointed out that the source of the pollen (the male cultivar that pollen was taken from) has a clear effect on the percentage of the fruit set and some of its

Table 5: Some phenotypic characteristics of palm fruit punch for variety Khyara under the conditions of the central region orchards of Iraq for the 2018 season.

Trait			Basal	Middle	Lateral
		Total	176	-	-
	From trunk to	134	-	-	-
	From spikelet to	42	-	-	-
Spathe width (cm)	-	-	4.5	4.2	3.5
spathe thickness (cm)	-	-	2.1	1.9	1.8
Spikelet length (cm)	-	-	49.0	50.0	28.0
Number of spikelet/spadix	-	61	-	-	-



Fig. 6: Thickness and length of the yellow khallal of Khyara variety.

phenotypes. These findings confirm what Mohammed and Shabana, (1980) and Zaid and Arias, (2002) have pointed out that each of the world’s palm growing areas has a specific number of male palm cultivars for its advantages in improving yield characteristics. In Iraq, for example, prefer the pollinator (Ghanami green, Ghanami red, Gray, Semisemi, Grately and Pink) but these require further studies to determine their compatibility with the female varieties to determine the most appropriate ones.

The viability of the pollen is the main indicator for determining the fertility of the cultivars because they represent the ability of the pollen to germinate and grow during the style (Wetswood, 1978). This confirms the need to choose the most suitable male cultivar with the female cultivar. The viability of pollen varies according to species and climatic conditions, Mohammed *et al.*, (1978) found differences in the viability of pollen among three species of male palm trees in Iraq: Ghanami green, Ghanami red and Khakry, this is reflected in the period of storage and yield specifications. Al-Akidi, (2009) pointed out that the fruit set resulting from the completion of the fertilization process is better in the case of the use of a particular cultivar of male palm tree. Therefore, it is necessary to ensure that the pollinator male is identified, named and vegetatively propagated to use its pollen to pollinate compatible female cultivars sexually, this confirms the results of this research.

Ahmed *et al.*, (2013) found that the date of pollination after the emergence of female inflorescence from the Spathe has an impact on the quantitative and qualitative qualities of the crop. It was found that the best period of pollination is after a day or two of the emergence of the female flower and gave the best physical and chemical specifications of the product when conducting a study on one of the palm varieties in Saudi Arabia. These findings support many researchers (Eeta, 1986; Abbas, 2005; Alabri *et al.*, 2006; Awad, 2010; Mosten *et al.*, 2010), about the effect of male cultivar and the amount and viability of pollen on fruit set.

The results indicate an effect of the male pollinator on the weight and some phenotypes of the fruit (Table 7). Umarani

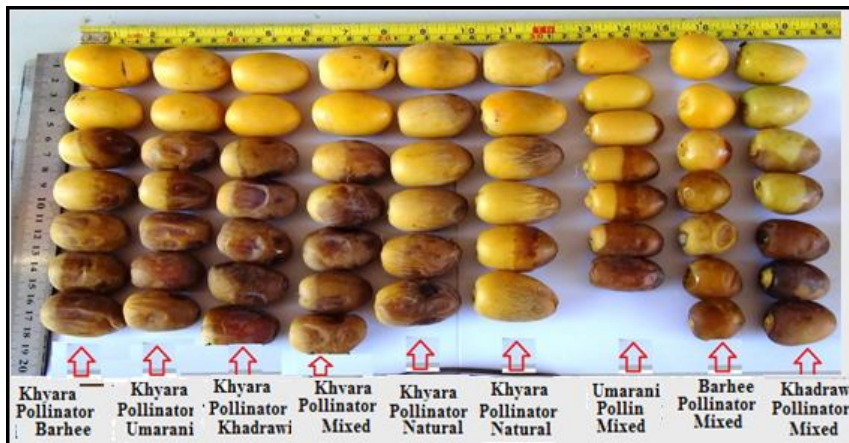


Fig. 7: The fruits of the variety Khyara pollinated with different pollinators at rutab and half rutab stages.

Table 6: Effect of the pollinator variety on the percentage of the fruit set in the date palm variety Khyara.

Treatment	Total number of flowers		Total Fruit set		Fruit set %
	For 15 spikelet	Mean	For 15 spikelet	Mean	
♂ Barhee ♀ × Khyara	300	20.0	261	17.4	87
♂ Assabaa Alaros ♀ × Khyara Khyara	295	19.6	289	19.3	98
♂ Khadrawi ♀ × Khyara	280	18.7	249	16.6	89
♂ Umarani ♀ × Khyara	290	19.3	241	16.1	83
♂ Traditional Pol. ♀ × Khyara	275	18.3	236	15.7	86
Not pollinated					
Not pollinated ♀ × Khyara	285	19.0	54	3.6	19

The value of the least significant difference at the probability of 5% of the fruit set: 1.0171 and Barhee gave the highest fruit weight of 22.25, 22.30 gm respectively compared to 17.66 and 20.80 gm when using the Khadrawi pollinator and traditional pollination respectively.

While the fruit did not reach the stage of yellow khallal when pollination with the Assabaa Alaros due to break of the fruit punch because of the high weight of the fruit punch due to high fruit set (Table 6), although

Table 7: Effect of the pollinator on some morphological characteristics of the fruits of the date palm cultivars (The stage of yellow Khallal) 30/7/2018.

Treatment	Fruit Weight gm	Flesh Weight gm	Flesh thickness mm	Fruit length mm	Fruit diameter mm	Seed weight gm	Seed length mm	Seed diameter mm
♂ Barhee ♀ × Khyara	22.30	20.92	9.13	51.97	27.90	1.74	33.52	7.54
♂ Assabaa Alaros ♀ × Khyara	Fruit punch is broken as a result of her weight because of high fruit set							
♂ Khadrawi ♀ × Khyara	17.66	16.31	9.20	46.56	26.84	1.46	29.28	7.16
♂ Umarani ♀ × Khyara	22.25	20.64	9.83	52.98	29.33	1.58	31.7	7.24
♂ Traditional Pol. ♀ × Khyara	20.80	19.01	9.94	48.78	27.92	1.78	31.42	7.89
Not pollinated								
Not pollinated* ♀ × Khyara	24.62	23.11	10.19	51.51	29.88	1.61	32.34	7.53

*Fruit set

Positioning and supporting the bunches on more than leaf, we were unable to do fruit thinning, for the purpose of conducting calculations in the experiment.

When leaving the fruit punch without pollination, there is an increase in the weight of the fruit, where the weight ranged from 24.62 to 26.67 gm. this can be explained by the low fruit set (Table 6), which leads to increasing the weight of the fertilized fruit at the expense of the unfertilized, which remained atrophied and small and did not turn into the Yellow Khalal stage and the seed was not formed or atrophied. The rest of the female’s cultivars that used traditional pollination gave fruits weighing 13.17, 14.02 and 17.42 g for Umrani, Barhee and Khadrawi respectively. The results showed differences in the weight of the flesh and the length of the fruit due to the effect of the pollinator type and at the same degree of effect on the total fruit weight. The Pollinator Umrani and Barhee gave the highest effect, whereas, Khadrawi and traditional pollination gave the least effect. Minor differences in kernel (seed) weight and diameter (Table 7) and (Fig. 2, 3, 4, 5, 6) were also observed.

These results confirm that of Zirari, (2010) who found that the use of different pollinators improved the maturity of fruits and improved the length, width and weight of the fruit compared to traditional pollination method. Sedgley and Griff, (1989) showed that the size of fruits and fruits yield is influenced by several factors, such as pollinator compatibility and genetic material.

Table 8: Effect of the pollinator cultivar on some phenotypic traits of the fruit of the date palm cultivar Khyara (Half and Rutab stage).

Treatment	Fruit Weight gm		Flesh Weight gm		Flesh thickness mm		Fruit length mm		Fruit diameter mm		Seed weight gm		Seed length mm		Seed Diameter mm		Adhesion of the cortex to the flesh	Shape	Maturity Stage
	Half Rutab	Rutab	Half Rutab	Rutab	Half Rutab	Rutab	Half Rutab	Rutab	Half Rutab	Rutab	Half Rutab	Rutab	Half Rutab	Rutab	Half Rutab	Rutab			
Barhee × ♂ Khyara	19.5b	15.6	18.2b	14.2	7.7	46.7	27.2a	26.5	1.3a	1.2	30.5b	30.8	7.4a	7.0		curly			
Fruit punch is broken as a result of her weight because of high fruit set																			
Assaba Alaros × ♂ Khyara	15.8a	12.5	14.3a	11.4	6.8	43.3	28.2b	25.8	1.2a	1.1	32.3c	29.5	6.7a	6.7		curly		Early mature	
Khadrawi × ♀ Khyara	18.7b	14.5	17.3b	13.5	6.6	50.3	32.0c	30.3	1.3a	1.1	27.5a	24.1	6.9a	6.4		curly			
Umarani × ♀ Khyara	16.9a	13.5	15.7a	12.3	6.2	45.2a	26.9a	23.7	1.3a	1.1	29.1b	27.8	6.9a	6.3		curly			
Traditionl Pol × ♂ Khyar																			
Not Pollinated	23.1c		21.7c		9.2c	48.6b	28.6b		1.2a		30.1b		7.1a					Late mature	

+++ Weak adhesion, ++ adhesion, + adhesion good. Means followed by the same letters and the same column did not differ significantly according to the DMRT at the probability of 5%.

These findings also confirm what Sudhersan *et al.*, (2009) found that the fertilized female palm flowers produce natural fruits with seeds after fertilization and unfertilized flowers yielding fruits which is not edible.

Effect of the pollinator on some of the phenotypic traits of Khayra at half rutab and rutab stages

The results in table 8 indicate the effect of the pollinator cultivar on the characteristics of the yield in the half rutab and rutab stages. The pollinators Umrani and Barhee gave the highest fruit yield in the half rutab and rutab stages 18.7, 19.5 gm and 14.5 and 15.6 gm respectively and least weight when the use of Khadrawi and traditional pollination. Whereas, for the fruit punch that was left without pollination, gave higher weight of the fruit set than the rest of the cases referred to. This is due to the low percentage of fruit set and the atrophied unfertilized fruit that remained in the green Khalal stage (Fig. 5), it did not reach the half rutab and rutab stages, which reflected the increase in fertilized fruit weight. Also, the pollinator cultivar effect on the characteristics of flesh thickness, fruit length, diameter and kernel length (Table 8) and fig. 7, 8, with no significant effect on the weight and diameter of the kernel. The degree of adhesion of the cortex to the flesh and the shape of the fruit crust was not different when different pollinators were used in the pollination.

The effect of pollinators at the maturity stage, the Khadrawi cultivar gave early in the maturity period up to 10 days, while the rest of the pollinators did not show an effect in the maturity period. The thickness of the flesh of the fruit, Khadrawi pollinator was given to the highest yield of 7.7 mm, compared to the traditional pollination (6.2 mm). The Umarani pollinator gave maximum length of the fruit (50.3 mm), compared to 45.1 mm in conventional pollination. Also. The Umarani pollinator gave maximum fruit diameter (32 mm), compared to 26.9 mm in conventional pollination. Whereas, the Barhee pollinator gave the highest kernel length 30.8 mm compared to 27.8 mm in conventional pollination. Besides, the Barhee pollinator gave the highest kernel diameter 7 mm



Fig. 8: The fruit of the Khyara variety at rutab stage.

Table 9: Effect of the pollinator cultivar on weight of the flesh of the fruit and the weight of the kernel from total fruit weight for Khyara cultivar.

Treatment	Flesh and Kernal weight to total fruit weight %			
	Half Rutab		Rutab	
	Flesh %	Kernal %	Flesh %	Kernal %
♂ Barhee ♀ × Khyara	93.3	6.7	91.7	8.3
♂ Alaross Assaba ♀ × Khyara	Fruit punch is broken as a result of her weight because of high fruit set			
♂ Khadrawi ♀ × Khyara	91.8	8.2	91.2	8.8
♂ Umarani ♀ × Khyara	93.6	6.4	93.5	6.5
♂ Trad.Pol ♀ × Khyara	92.3	7.7	91.9	8.1
Not Pollinated				
Not Pollinated ♀ × Khyara*	94.8	5.2	Not mature	Not mature

*Fruit set only

compared to 6.3 mm in conventional pollination. These results confirm what Muhammad and Shabana, (1980) found in their study of the mitazine effect of the pollinator on the size, weight, percentage, shape and color of flesh and kernel in the resulting fruit. This is what Al-Okidi, (2009) has pointed out about the effect of the pollen validity of a given male in pollination the female for a variety of date palm. Where he pointed to the effect of the proportion of the fruit set and specifications of the fruits in terms of size, shape, color and maturity and the size of the kernel (seed). As for the percentage of the weight of the fruit flesh to the ratio of the seed (kernel), the cultivator Umarani gave the highest percentage of color of fruit flesh 93.5% compared to the lowest percentage when using the pollinator Khadrawi, reaching 91.2% in the full Rutab stage, this percentage did not exceed when the traditional pollination were used in pollination of different female cultivars (Table 9).

Effect of the pollinator cultivar on the sugar content of fruits

The results in table 10 indicate the effect of the pollinator in the amount of sugars content in fruits during the half and Rutab stages. The Barhee pollinator gave the highest amount of sugars in fruits at the Rutab stage

Table 10: Effect of the pollinator cultivar on fruits sugar content for Khyara variety

Treatment	Percentage of sugars							
	Fructose		Glucose		Sucrose		Total	
	Yellow Khallal	Rutab	Yellow Khallal	Rutab	Yellow Khallal	Rutab	Yellow Khallal	Rutab
♂ Barhee ♀ × Khyara	29.27	24.19	35.12	43.41	0.000	0.000	64.39	67.60
♂ Khadrawi ♀ × Khyara	27.31	27.35	34.71	37.86	0.000	0.000	62.02	65.21
♂ Umarani ♀ × Khyara	26.38	27.13	34.15	34.78	0.028	0.051	60.81	62.42
♂ Trad. Pol ♀ × Khyara	27.13	24.29	28.45	28.44	0.000	0.000	55.58	52.73
Not Pollinated ♀ × Khyara	21.00	27.68	31.80	28.58	0.028	0.000	53.08	57.26
LSD _{0.05} mg / gm fruit	0.0172	0.0161	0.081	0.1700	-	-	0.0192	0.0196

(67.60%) and the lowest when using Umarani pollinator (62.42%) compared to 52.73%. When conventional pollination is used, the total glucose content was higher than fructose when all pollinators were used, with the highest amount of glucose (43.41%) when Barhee pollinator was used and the lowest in conventional pollination (28.44%). As for sucrose, it was found only in a small amount when Umarani pollinator was used (0.028%), while it is not found in the fruits when the rest of the pollinators were used.

These results show the effect of the pollinator species on the sugar content of the fruits and the conformity of these results with the sugars estimate of the Saudi Standards, Metrology and Quality Authority issued by the National Center for Agricultural Technology in the Kingdom of Saudi Arabia (Al-Jazi, 2016). Which indicate that dates contain high rates of simple sugars (glucose and fructose), while the sucrose do not exist in the dates or in a small amount. The results of this research support the finding of Jassim, (1978), that the source of the pollen effect on the percentage of total and reduced sugars of the fruits of the two varieties Khadrawi and Maktoum, where it was affected by the source of the pollen, where it was found that the fruits of Khadrawi pollinated with the red Ghanami contained the lowest proportion of reduced total sugars from Maktoum cultivar. The physical and chemical properties of the product may be affected by the timing of the pollination after opening the female inflorescence. Ahmed *et al.*, (2013) found that the best date for pollination is a day or two after the female inflorescences open, in a study conducted on the pollination of one of the varieties at different dates after the opening of female inflorescences.

Based on results presented in table 11, when pollination of the females of the variety Khyara, we recommend using Assabaa Alaros for the purpose of

Table 11: Increase rates in some yield characteristics of date palm variety Khyara when using different pollinators.

Trait	Pollination Method / Pollinator		Rate of Increase%
	Method	Pollinator	
Fruit Set %	Traditional	86.0	+ 12.0%
	Asabaa Alaros	98.0	
Fruit weight (Rutab stage)	Traditional	13.5	+ 15.6 %
	Barhee	15.6	
Fruit / Fruit punch	Traditional	957.7	+ 10.8 %
	Barhee	1061.4	
Yield /Fruit punchNo. spikelet /fruit punch61	Traditional	12.9	+ 28.7%
	Barhee	16.6	
Yield / tree kg Average fruit punch/tree=6	Traditional	75.6	+ 31.7%
	Barhee	99.6	
Fruit length (mm)	Traditional	45.1	+ 11.5%
	Umarani	50.3	
Fruit Diameter (mm)	Traditional	23.7	+ 27.8%
	Umarani	30.3	
Saccharide/Fructose %	Traditional	24.29	+ 3.06%
	Khadrawi	27.35	
Saccharide/Glucose %	Traditional	28.44	+ 14.97%
	Barhee	43.41	
Saccharide/Sucrose %	Traditional	00.00	No difference
	Umarani	0.051	
Total Sugar content %	Traditional	52.73	+ 14.87%
	Barhee	67.60	

increasing the percentage of the fruit set and the Barhee to increase the weight of the fruit and the Umarani to increase the length of the fruit and diameter, but to increase the proportion of sugars the pollinator Barhee can be used.

We conclude from the results of this research that a test should be carried out to determine a pollinator cultivar that is compatible to a specific female cultivar and according to each palm growing area in order to obtain a crop with specific physical and chemical characteristics. Such as increasing the production or obtaining desirable specifications such as color, length of fruit, the nature of the crust and the proportion of the weight of the flesh to the weight of the seed and the sugars content in order to use by diabetics in terms of components of monosaccharide and disaccharides.

References

- Abbas, Kazem Ibrahim (2005). The effect of the pollinator species and the duration of its storage in the percentage of the fruit set in ten agricultural varieties of female date palm (*Phoenix dactylifera* L.). *Basra Journal of Palm Date Research.*, **M4(1-2)**: 159-159.
- Ahmed, M.A., A.M. El-Saif, S.S. Soliman and A.K.H. Omar (2013). Effect of pollination date on fruit set, yield and fruit quality of "Rothana" date palm cultivar under Riyadh condition. *J. of Applied Sciences Research.*, **9(4)**: 2797-2802.
- Alabri, N., K. Al-Busaidi and S. Alhemaimee (2006). Effect of pollen grain suspension on fruit set and physicochemical characteristics of two date palm (*Phoenix dactylifera* L.) cultivar Qut. Conf. on date palm production and processing technology, 9-11 May 2006, Muscat, Oman. 19.
- Al-Okidi, Khaled Hassan (2009). Dates Palm: Lady of trees and Dora of fruit. Amina for publication, distribution and printing. Jordan 396.
- Awad, M.A. (2010). Pollination of date palm (*Phoenix dactylifera* L.) Lulu with pollen grains water suspension. *Acta Horticulture, I.S.F.S.*, **882**: 337-343.
- Eeta, M. (1986). Analysis of some tips about date palm pollination. Plant and Seed Registration and Certification Institute, Karaji, Iran, 51.
- El-salhy, A.M., A.A. El-Bana, H.A. Abdei-Galil and E.S. Ahmed (2010). Effect of pollen grains suspensions spraying on yield and fruit quality of "Saïdy cultivar" date palm. *Acta Horticulture, I.S.F.S.*, **882**: 329- 336.
- Jassim, Abbas Mahdi (1978). Influence of pollen on date of maturity and characteristics of fruits of the varieties Khadrawi and Maktoom. Master Thesis. University of Baghdad.
- Jazzy, Hail (2016). Best sugars for diabetics. National Center for Agricultural Technology, King Abdulaziz City for Science and Technology. [Http://mawdoo3.com](http://mawdoo3.com). Accessed 11/2/2018.
- Karkacier, M., M. Erbas, M.K. Uslu and M. Asku (2003). Comparison of different extraction and detection method for sugars using Amino-Bonded phase HPLC. *J. of Chromatographic Science*, **41**: 331-333.
- Mohammed, S. and H.R. Shabana (1980). Effect of Naphthaleneacetic acid on fruit size, quality and ripening of Zahdi date palm. *Hort. Science.*, **15(6)**: 724-725.
- Mohammed, S., H.R. Shabana and F.M. Aziz (1978). Investigation on the storage viability and germination of date pollen of different male cultivars. Palm & Dates Research Center, Technical bulletin, 1/78, Baghdad, Iraq.
- Mostean, A., S.S. Marashi and A. Izadeh (2010). Development of a new Date palm pollinator. *Acta Horticulture, ISFS*, No. **882**: *Acta Horticulture, I.S.F.S.*, **882**: 315-320.
- Sedgley, M. and R. Griff (1989). Sexual reproduction in tree crops. Academic press, London, 224.
- Sedra, My. H. (2003). Le palmier Dattier base de lamise en valeur

- des Oais au Maroc; Techniques phoenicoles et creation d'Oasis. Edition INRA-Maroc, 272.
- Shabana, Hassan Abdel Rahman, Zayed, Abdul Wahab and Sunbal, Abdul Qader Ismail (2004). The fruits of the palm: its physiology, harvest, circulation and post-harvest care. International Food and Agriculture Organization. 147.
- Sudharsan, C., Y. Al-Shayii and S. Jibi manuel (2009). Date Palm crops improvement *via* TXD hybridization integrated with *in vitro* culture technique. *Acta Horticulture, I.S.F.S.*, **882**: 212- 224.
- Swingle, W.T. (1928). Metaxenia in the date palm. *J. Heredity.*, **19**: 257-268.
- Westwood, M.N. (1978). Temperature zoon pomology. W.H. Freeman and Company. Sanfrancisco, 594.
- Zaid, A. and E. Arias (2002). Date palm cultivation. United Nation, Food and Agriculture Organization FAO. *Plant Production and protection.*, **paper 156**: 192.
- Zirari, A. (2010). Effect of time of pollination and of pollen source on yield and quality of “ Najda” date palm cultivar (*Phoenix dactylifera* L.) under Draca valley conditions in Morocco. *Acta Horticultura, I.S.F.S.*, **882**: 89-94.