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Influence of pollen source in some qualitative characteristics of date palm fruits propagated by offshoots and tissue culture techniques

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Abstract. The current study was carried out in the private orchard in Kitiabn region in Basrah governorate to study the effect of two male cultivars (Ghanamy akhdar, Khikri adi) and two methods of date palm propagation (offshoots and tissue culture techniques) on physico-chemical characteristics of date palm fruits during the developing stages (Habbabuk, Kimri and Khalal). Twelve trees of the Barhi cultivar were selected as similar as possible in age (5 years), growth and had the same agricultural practices. Six flower clusters (spadix) were selected from each tree and removed the rest. An experiment was designed according to Randomized Block Design (RCBD) with three replicates and the mean differences were compared by using the least significant difference (L.S.D) test at the probability level of 0.05. Results showed that Barhi date palm pollinated with Khikri adi pollen grains and propagated by offshoots were superior in the most studied characteristics at habbabuk stage. At Kimri stage, the date palms propagated by offshoots and pollinated with Ghanamy akhdar was the best in the most studied characteristics, while at Khalal stage results indicated to the superiority of Ghanamy akhdar pollen grains and tissue culture techniques method in most of the physico-chemical characteristics.

1. Introduction

The date palm *Phoenix Dactylifera* L. belongs to the family *Arecaceae* which includes about 220 genus and 2600 species. The date palm originated in Mesopotamia and from there spread to the Arabian Peninsula, North Africa and the Middle East about 5000 years ago [1]. Iraq has many cultivars of date palms that reached more than 600 cultivars, some of which are cultivated on a commercial level [2]. The date palm is a dioecious where the male and female flowers carried on separate trees.

The effect of genes introduced by pollen especially on endosperm and embryo development, called *Xenia*, while the direct effect of the pollen on the parts of the seed and fruit lying outside the embryo and endosperm is called " *metaxenia* " these effects include differences in the volume, shape, time of ripening and chemical composition of fruits. The causes of this phenomenon are the internal hormones of the pollen that have a direct or indirect effect [3].

Rahnama and Rahkhodaei [4] used a date pollinizers (Ghanamy, wardy and semenemi) on Medjhol cultivar and found that the use of wardy pollen grains increased the fertility percent and fruit yield.

Gupta [5] studied the effect of pollen source on date palm. The study included four date palm cultivars (Hillawi, Zahidi, Khadrawi and Shamran) and two pollinizers (*P dactylifera* and *P sylvestris*)



and the results mentioned that maximum fruit set (81.98%) was recorded in cv Khadrawi, maximum fruit length (4.69 cm) and bunch weight (35.87 kg) in cv Hillawi and highest fruit breadth (2.63 cm) and weight of seed (1.64 g) in cv Zahidi using *P Sylvestris* as pollen source. The pollinizer *P Dactylifera* with cv Khadrawi resulted in maximum fruit weight (14.17 g) and fruit pulp (12.44 g), while fruit maturity was one week earlier in all the cultivars when *P sylvestris* was used as pollen source.

The present study was conducted to investigate the effect of two male cultivars (Ghanamy akhdar, Khikri adi) and two methods of date palms propagations (offshoots and tissue culture techniques) on physico-chemical characteristics of date palm fruits during the developing stages (Habbabuk, Kimri, Khalal).

2. Materials and methods

The present study was conducted in one of the private orchards in Ktaban region in Basrah governorate to study the effect of two male cultivars (Ghanamy akhdar, Khikri adi) and two methods of date palms propagations (offshoots and tissue culture techniques) on physico-chemical characteristics of date palm fruits during the developing stages (Habbabuk, Kimri, Khalal). Twelve trees of the Barhi cultivar were selected as similar as possible in age (5 years), growth and had the same agricultural practices. Six flower clusters (spadix) were selected from each tree and removed the rest. The pollination was carried out in the early morning during the growing season 2018 by using pollen grains of two male cultivars (Ghanamy akhdar and Khikri adi). After the pollination process, flower clusters were covered well by bags of brown paper and removed after 30 of pollination. Treatments can be arranged as follows:

1. Barhi cv. trees propagated by offshoots and pollinated with pollen grains of Ghanamy akhdar male cultivar
2. Barhi cv. trees propagated by offshoots and pollinated with pollen grains of Khikri adi male cultivar
3. Barhi cv. trees propagated by tissue culture techniques and pollinated with pollen grains of Ghanamy akhdar male cultivar
4. Barhi cv. trees propagated by tissue culture techniques and pollinated with pollen grains of Khikri adi male cultivar.

Studied characteristics included a length, diameter, weight and volume of fruits, weight of seeds, weight of flesh, firmness of fruits that determined by pressure test instrument, fruit water content, the percentage of dry matter and the percentage of total soluble solids of fruits that determined by using hand refractometer and the results were corrected to 20 °C.

Randomized Block Design Randomized Design (CRBD) was used with three replicates. The results were analyzed by the analysis of variance and mean values were compared using the Revised Least Significant Difference Test at 0.05 probability level [6].

3. Results and discussion

Table (1) showed that the pollen grains of Khikri adi male cultivar significantly superior to Ghanamy akhdar in the most studied characteristics (fruit length, fruit diameter, fruit weight, fruit volume, seed weight, flesh weight, water content and total soluble solids of fruits), that were 3.52 mm, 14.31 mm, 1.65 g, 1.65 cm³, 0.18 g, 1.46 g, 87.77% and 6.25% respectively, whereas Ghanamy akhdar gave the highest percentage of fruit firmness and the percentage of dry matter, which were 3.52% and 16.68% respectively.

On the same table, fruits of Barhi cultivar propagated by offshoots were the best than that of propagated by tissue culture techniques in fruit length, fruit diameter, fruit weight, fruit volume and fruit flesh which were 13.91 mm, 14.40 mm, 1.62 g, 1.49 cm³, 1.47 g respectively, while the Barhi cv. propagated by tissue culture techniques gave the highest percentage of TSS which was 6.08. As for the interaction between male cultivars and methods of date palms propagations results showed the superiority of Khikri adi male cultivar and the propagation method by offshoots in seed weight, fruit volume, fruit firmness, water content of fruits and the percentage of dry matter. This is may be due to metaxenic impact of Khikri adi male cultivar that caused the increment in the most studied

characteristics. In addition to the stimulating effect of male cultivar on the activation of some inactive genes that increase the effectiveness of the internal hormones in the fruit [5].

Table 1. Effect of pollen source and propagation method and the interaction between them on qualitative characteristics of date palm fruits cv. Barhi at “Hababuk” growth stage

male cultivars	methods of propagation	Fruit length (mm)	fruit diameter (mm)	fruit weight (gm)	Fruit Volume (cm ³)	Seed Weight (gm)	Flesh Weight (gm)	Fruit firmness Kg/cm	TSS (%)	Water content (%)	Dry matter (%)
Ghanamy akhdar	offshoots	12.58	13.43	1.40	1.24	0.10	1.29	3.10	1.27	80.82	19.17
	tissue culture techniques	12.21	12.90	1.16	1.27	0.15	1.01	3.95	5.33	85.79	14.20
Khikri adi	offshoots	15.25	15.38	1.85	1.73	0.20	1.64	2.81	5.67	88.05	11.94
	tissue culture techniques	14.03	13.25	1.44	1.56	0.15	1.29	2.52	6.83	87.48	12.51
mean of male cultivars	Ghanamy akhdar	12.40	13.16	1.28	1.26	0.12	1.15	3.52	3.30	83.31	16.68
	Khikri adi	14.64	14.31	1.65	1.65	0.18	1.46	2.66	6.25	87.77	12.22
mean of propagation methods	offshoots	13.91	14.40	1.62	1.49	0.15	1.47	2.95	3.47	84.44	15.55
	tissue culture techniques	13.12	13.07	1.30	1.42	0.16	1.15	3.23	6.08	86.64	13.35
LSD0.05 for male cultivars		0.669	0.719	0.289	0.182	0.045	0.280	0.516	1.886	3.134	3.133
LSD0.05 for methods of propagation		0.669	0.179	0.289	0.182	0.045	0.280	N.S	0.886	N.S	N.S
LSD0.05 for interaction		0.946	1.017	0.409	0.258	0.064	0.397	0.730	1.253	4.432	4.431

The results of Table (2) showed that the studied factors (male cultivar and propagation method) had a significant effect on the qualitative characteristics of the fruits. The superiority of Ghanamy akhdar in fruit parameters (fruit length, fruit diameter, fruit weight and flesh weight, fruit firmness and water content of fruit) that amounted 26.37 mm, 21.05 mm, 6.67 g, 6.38 cm³, 5.90, 7.25, 87.80% respectively. Khikri adi male cultivar gave the highest value of seed weight, TSS, dry matter percentage that reached 0.77 g, 17.17%, and 14.74% respectively.

As for the propagation method, the propagation method by offshoots was significantly superior by giving the highest values of the most studied characteristics except fruit firmness and the percentage of total soluble solids that was noticed that there were no significant differences between the propagation methods in their effect on these two characteristics. The interaction between the two factors had a significant effect on the increment of the qualitative characteristics of fruits, it is clear that Ghanamy akhdar and the propagation method by offshoots gave the highest values of the mentioned characteristics. Results were in the same line with the results of Rahnama and Rahkhodaei [4] on Medjhol cultivar pollinated with pollen grains of Ghanamy, wardi and semenemi.

Table 2. Effect of pollen source and propagation method and the interaction between them on qualitative characteristics of date palm fruits cv. Barhi at “Kimiri” growth stage

male cultivars	methods of propagation	Fruit length (mm)	fruit diameter (mm)	fruit weight (gm)	Fruit Volume (cm ³)	Seed Weight (gm)	Flesh Weight (gm)	Fruit firmness Kg/cm	TSS (%)	Water content (%)	Dry matter (%)
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Ghanamy akhdar	offshoots	27.65	21.97	7.47	7.50	0.91	6.56	7.32	6.50	86.32	13.67
	tissue culture techniques	25.09	20.13	5.86	5.25	0.60	5.25	7.19	4.83	89.28	10.72
Khikri adi	offshoots	25.02	20.42	6.03	5.75	0.73	5.30	6.92	7.00	85.27	14.72
	tissue culture techniques	25.46	20.28	6.17	6.56	0.81	5.35	6.66	7.33	85.0	14.70
mean of male cultivars	Ghanamy akhdar	26.37	21.05	6.67	6.38	0.75	5.90	7.25	5.67	87.80	12.20
	Khikri adi	25.24	20.35	6.10	6.15	0.77	5.32	6.79	7.17	85.28	14.71
mean of propagation methods	offshoots	26.34	21.20	6.75	6.62	0.82	5.93	7.12	6.75	85.80	12.71
	tissue culture techniques	25.28	20.20	6.02	5.90	0.71	5.30	6.92	6.08	87.29	14.20
LSD0.05 for male cultivars		0.707	N.S	0.501	N.S	0.063	0.441	0.226	1.530	0.569	0.570
LSD0.05 for methods of propagation		0.707	0.796	0.501	1.258	0.06	0.441	N.S	N.S	0.569	0.570
LSD0.05 for interaction		1.000	1.126	0.709	1.779	0.089	0.624	0.320	2.164	0.804	0.806

The results of Table (3) showed that the male cultivar had a significant effect on the qualitative characteristics of the fruits. The superiority of Ghanamy akhdar in fruit parameters by giving the highest values of fruit length, fruit weight, flesh weight, fruit firmness, TSS, water content, dry matter that amounted 9.68 g, 8.75 g, 5.75, 37.42%, 71.07% and 28.71% respectively compared to the Khikri adi male cultivar. The results of the same table showed that there were no significant differences between the two male cultivars in fruit diameter, fruit volume and seed weight. As for the propagation method, the effect of the propagated by tissue culture techniques was significantly higher than the method of propagation by offshoots in the length of the fruit recorded the highest value of 3.00 cm, while the method of propagation by offshoots recorded the highest percentage of dry matter (31.15%).

The interaction between the two factors of the study had a significant effect on fruit length, fruit weight, flesh weight, TSS and water content of Barhi fruits.

As mentioned earlier, the effect of the pollen on the parts of the seed and fruit lying outside the embryo and endosperm was called "metaxenia" by Swingle [7] and this effect is evident through differences in the weight and volume of the fruit and chemical composition as well as the date of maturity and Swingle mentioned that the reason for these differences may be due to differences in the concentration of plant hormones, then Denny [8] explained that these hormones include Auxins, Gibberellins and Cytokinins. This phenomenon has been studied to include many cultivars of date palm males and their metaxenic effect on the female cultivars [3, 5, 9, 10, 11, 12].

Table 3. Effect of pollen source and propagation method and the interaction between them on qualitative characteristics of date palm fruits cv. Barhi at " Khalal" growth stage

male cultivars	methods of propagation	Fruit length (mm)	fruit diameter (mm)	fruit weight (gm)	Fruit Volume (cm ³)	Seed Weight (gm)	Flesh Weight (gm)	Fruit firmness Kg/cm	TSS (%)	Water content (%)	Dry mater (%)
Ghanamy akhdar	offshoots	3.08	2.11	9.89	10.38	0.91	8.98	5.85	37.15	67.97	32.02
	tissue culture techniques	3.26	2.13	9.46	9.66	0.94	8.52	5.61	37.70	74.18	25.40
Khikri adi	offshoots	2.64	1.93	8.40	9.55	1.02	7.38	4.90	36.55	69.72	30.27
	tissue culture techniques	2.74	2.08	8.65	9.69	0.91	7.73	4.69	36.62	67.47	32.52
mean of male cultivars	Ghanamy akhdar	3.17	2.12	9.68	10.02	0.93	8.75	5.74	37.42	71.07	28.71
	Khikri adi	2.69	2.00	8.53	9.62	0.97	7.55	4.79	36.58	68.60	31.40
mean of propagation methods	offshoots	2.86	2.02	9.15	9.96	0.97	8.18	5.38	36.85	68.85	31.15
	tissue culture techniques	3.00	2.10	9.06	9.67	0.93	8.12	5.15	37.16	70.82	28.96
LSD0.05 for male cultivars		0.096	N.S	0.556	N.S	N.S	0.541	0.305	0.487	2.114	2.174
LSD0.05 for methods of propagation		0.096	N.S	N.S	N.S	N.S	N.S	N.S	N.S	N.S	2.174
LSD0.05 for interaction		0.136	N.S	0.787	N.S	N.S	0.765	0.432	0.689	2.990	3.074

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