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EFFECT OF POLLEN EXTRACT AND IT CONCENTRATION ON SOME PHYSICO-CHEMICAL OF FRUIT AND YIELD CHARACTERISTICS OF DATE PALM (*PHOENIX DACTYLIFERA* L.) CV. KHADRAWI

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Abstract:

The experiment was carried out in one of the private orchards in the Ktaiban, Shatt Al-Arab region, Basral, Iraq during the growing season of 2021. Fifteen date palms were selected from the female cultivar Khadrawi at the age of 7 years. The date palm fruits of Khadrawi cultivar were sprayed with 0, 10%, 20% pollen extract of Khikri or Ghanami Ahmer. The main effect of the pollen cultivar was not significant in the characteristics of fruit length and weight, total soluble solids, carbohydrates, and titratable acidity content in fruit pulps of the date palm Khadrawi cultivar after 90 days of pollination, except for the fruit diameter in which the pollen cultivar Ghanami Ahmer excelled. As for the main effect of spraying fruits with the pollen extract, the treatment of fruit spraying with a concentration of 20% pollen extract was superior in all the above-mentioned characteristics compared to the control treatment. The results of the study indicated that the interaction treatment between the pollen cultivar Ghanami Ahmer and the fruit spray with a concentration of 20% pollen extract led to significant differences in the length, diameter, weight of the fruit, and its total carbohydrate content compared to the other interaction treatments. Whereas, the interaction treatment between the pollen cultivar Khikri and the fruit spray with a concentration of 20% pollen extract led to a significant superiority in reducing the percentage of total titratable acidity compared with the other interaction treatments.

Keywords: Carbohydrates, *Phoenix*, pollination, titratable acidity, total soluble solid

INTRODUCTION

The date palm (*Phoenix dactylifera* L.) tree belongs to the Arecaceae family and the Arecales order. It is one of the most important semi-tropical fruit trees in Iraq from an economic and nutritional (Al-Rawi and Al-Mohemdy, 2001; Mousawi et al., 2001). Date palm trees are unisexual and dioeciously plant. Therefore, female flowers need artificial pollination to ensure that the fruits are set and the crop has an economic return. The results of previous studies showed that the source of pollen used in the pollination process has a significant effect on the characteristics of date palm fruits through its effect on the physical and chemical characteristics of the fruits and their ripening time (Osman et al., 1974; Denney1992; Ibrahim, 1996). The effects of pollen source on the characteristics of date palm fruits are known metaxenia. The phenomenon of metaxenia still attracts the attention of researchers and farmers specialized in the production of date palms all over the world (Ream, 1976; Khalifa et al., 1980; Shafaat and Shabana, 1980). Khadrawi is one of the most important commercial female cultivars in Iraq. Its fruits are of good quality desired by the Iraqi consumer. The two male cultivars, Khakri and Ghanami Ahmar, are among the important males in Iraq, which pollen grains are used to pollinate female cultivars, including the Khadrawi cultivar (Al-Baker, 1972; Ibrahim and Khalif, 2003). Researchers and farmers are now interested in using plant extracts in agriculture as alternatives to plant growth regulators and growth stimulants because they are natural substances that do not leave any harmful effect on human health or the environment (Fayyad, 2005). Researches indicated that date palm pollen grains are rich in protein (31. 11%), carbohydrates (13. 41%), fats (20. 74%), ash (4.57 %), water content (28.80%), and fibers (1.37%), (Hassan, 2011; Basuny et al., 2013). The results of a study showed that spraying date palm leaves with pollen extract improved the physical and chemical characteristics and yield of the fruits cv. Alshoithi cultivar (Ebtihaj et al., 2018). Sayed et al. (2018) found that spraying with pollen extract of date palm, Zaghloul cultivar at a concentration of 800 mg L^{-1} led to an improvement in yield and fruit quality. The current study was conducted with

the aim of studying the effect of spraying fruits with pollen source type extract, its concentration and its role in improving some physical and chemical characteristics and yield of date palm fruits cv. Khadrawi.

MATERIALS AND METHODS

The experiment was carried out in one of the private orchards in the Ktaiban, Shatt Al-Arab region, Basral, Iraq during the growing season of 2021. Fifteen date palms were selected from the female cultivar Khadrawi at the age of 7 years. The female pollen appeared in the trees on February 23, and the process of hand pollination was carried out on March 14 using pollen grains of the male cultivar Ghanami Ahmer. The date palm fruits of Khadrawi cultivar were sprayed with the following treatments one month after the pollination process:-

1. Control treatment: The fruits of three female date palms cv. Khadrawi were sprayed with distill water.
2. The fruits of three female date palms cv. Khadrawi were sprayed with 10% pollen grain extract of male date palm Khikri cultivar.
3. The fruits of three female date palms cv. Khadrawi were sprayed with 20% pollen grain extract of male date palm Khikri cultivar.
4. The fruits of three female date palms cv. Khadrawi were sprayed with 10% pollen grain extract of male date palm Ghanami Ahmer cultivar.
5. The fruits of three female date palms cv. Khadrawi were sprayed with 20% pollen grain extract of male date palm Ghanami Ahmer cultivar.

Preparation method

The ethanolic extract of pollen in two concentrations of 10% and 20% is prepared by taking 10 or 20 g of pollen of each male cultivar and mixing it with 200 ml of methanol alcohol at a concentration of 70% with continuous stirring by the shaker device for 24 hours at room temperature. Then the extract was prepared according to the method described by Atwan et al. (2005). After completing the preparation of pollen extracts, palm trees were sprayed with them after adding 4-5 drops of Tween 20 solution per liter of pollen grain extract, using a 2-liter hand pump in the early morning. Each treatment was repeated three times (3 date palms). The data was recorded three months after the treatment, that is, on June 15, 2021.

Studied characteristics:

1. Fruit length (cm)
2. Fruit diameter (cm)
3. Fruit weight (g)
4. Pulp weight (g)
5. Seed weight (g)
6. Total soluble solid TSS (%), described by Horwitz (2010).
7. Total titratable acidity (%), described by Horwitz (2010).
8. Total carbohydrate (%), described by Dubios et al. (1956).

Experimental design and statistical analysis

The experiment was designed by randomized complete block design. The type of experiment is factorial with two factors. The first factor represented the extracts of the two male cultivars, namely Khikri and Ghanami Ahmer, and the second factor was three concentrations of pollen extract for all of the two male cultivars (0, 10%, and 20%). The data were statistically analyzed by analysis of variance using the statistical program GenStat version 14th. The comparison between the means of the treatments was done using the least significant difference test at the 5% probability level (Al-Rawi and Khalaf Allah, 2000).

RESULTS

Fruit length (cm)

The data from Table 1 indicate that there were no significant differences between the two pollen cultivars Khikri and Ghanami Ahmer in the length of the khalal fruit after 90 days of pollination. The results of the experiment showed that spraying the fruits with pollen extract at a concentration of 20% led to a significant increase in the length of the fruit, which recorded the highest value of 3.38 cm compared to the control treatment and the concentration of 10%. But the control treatment was recorded the lowest length of the khalal fruit, which was 3.00 cm.

Two treatments of interaction between pollen extract at the concentration of 20% and pollen cultivar Khikri or Ghanami Ahmer showed a significant increase in fruit length of 3.37 and 3.40 cm, respectively. As for the treatment of the interaction without spraying with pollen extract and the Ghanami Ahmer cultivar, the lowest mean length of the Khalal fruit was recorded at 2.93 cm.

Table 1: Effect of cultivar and concentration of pollen extract, and the interaction between them on fruit length of date palm cv. Khadrawi after 90 days of pollination

	Pollen extract concentration			
Male cultivar (A)	Control	10%	20%	Main effect (B)
Khikri	3.00	2.97	3.37	3.11
Ghanami Ahmer	2.93	3.17	3.40	3.17
Main effect (A)	2.97	3.07	3.38	
	Male cultivar (A)	Extract concentration (B)	A × B	

L.S.D. p≥0.05	0.20	0.24	0.34

Fruit diameter (cm)

The data in Table 2 indicate that there were significant differences between the two pollen cultivars in the fruit diameter of the date palm Khadrawi cultivar after 90 days of pollination. Fruits sprayed with pollen extract of Ghanami Ahmer cultivar were significantly superior in mean fruit diameter compared to fruits sprayed with pollen extract of cultivar Khikri. The fruits that were sprayed with pollen extract with 20% concentration were significantly superior to the mean fruit diameter, which recorded the highest value of 2.33 cm compared to the control treatment and 10% concentration. The control treatment recorded the lowest mean fruit diameter of 2.02 cm.

The results from the same table show that there are significant differences between the interaction treatments between pollen cultivar and pollen extract concentration in the mean fruit diameter. The treatment of the interaction between the Ghanami Ahmer pollen cultivar and the concentration of pollen extract of 20% was significantly superior in the mean fruit diameter compared to the other interactions except for the interaction between the cultivar of Ghanami Ahmer and pollen extract concentration of 10% or 20%, which recorded the highest value of 2.43 cm. As for the interaction treatment of pollen cultivar Khikri without spraying with the pollen extract, the lowest mean fruit diameter was recorded at 1.97 cm.

Table 2: Effect of cultivar and concentration of pollen extract, and the interaction between them on fruit diameter of date palm cv. Khadrawi after 90 days of pollination

	Pollen extract concentration			
Male cultivar (A)	Control	10%	20%	Main effect (B)
Khikri	1.97	2.10	2.23	2.10
Ghanami Ahmer	2.07	2.30	2.43	2.27
Main effect (A)	2.02	2.20	2.33	
	Male cultivar (A)	Extract concentration (B)	A × B	
L.S.D. p≥0.05	0.13	0.16	0.23	

Fruit weight (g)

The data from Table 3 shows that there were no significant differences between the two pollen cultivars in the fruit weight of the date palm Khadrawi cultivar after 90 days of pollination. The two spraying treatments with pollen extract concentrations of 10% and 20% were significantly superior to the control treatment in fruit weight. Spraying treatment with pollen extract at a concentration of 20% recorded the highest mean weight of the fruit, which was 7.30 g. As for the control treatment, the lowest mean fruit weight was recorded, which was 6.83 g.

The data from the same table shows that there are significant differences between the interaction treatments between the pollen cultivar and the concentration of pollen extract in the mean fruit weight after 90 days of pollination. The interactions between the two pollen cultivars and spraying with pollen extract were 10% and 20% on the interaction treatments between the Khikri or Ghanami Ahmer pollen cultivar and the spraying with distilled water. The interaction treatment between the Ghanami Ahmer cultivar and the concentration of 20% of pollen extract recorded the highest mean fruit weight, which was 7.34 g. Whereas, the interaction treatment with the Ghanami Ahmer cultivar and the extract concentration of 0% recorded the lowest mean weight of fruits, which reached 6.81 g.

Table 3: Effect of cultivar and concentration of pollen extract, and the interaction between them on fruit weight of date palm cv. Khadrawi after 90 days of pollination

	Pollen extract concentration			
Male cultivar (A)	Control	10%	20%	Main effect (B)
Khikri	6.85	7.28	7.25	7.13
Ghanami Ahmer	6.81	7.26	7.34	7.14
Main effect (A)	6.83	7.27	7.30	
	Male cultivar (A)	Extract concentration (B)	A × B	
L.S.D. p≥0.05	0.15	0.18	0.25	

Total soluble solid (TSS)

The results in Table 4 indicate that there were no significant differences between the two pollen cultivars in the percentage of total soluble solids in the fruits of the date palm Khadrawi cultivar after 90 days of pollination. The spraying treatment with Khikri cultivar pollen extract at a concentration of 20% was significantly affected compared to the two treatments with a concentration of 10% and the control, which recorded the highest percentage of total soluble solids, which amounted to 48.0%. There were no significant differences between the two treatments with 10% pollen extract and the control. The control treatment recorded the lowest percentage of total soluble solids, which amounted to 39.3% (Table 4).

The interaction between the pollen cultivar used and the pollen extract concentration had a significant effect on the percentage of total soluble solids in the fruits of the date palm Khadrawi cultivar. The interaction treatments between Khikri and Ghanamy Ahmer pollen cultivars with concentrations of 10% and 20% of pollen extract were significantly superior to the two interaction treatments without spraying with pollen extract and the pollen cultivar Khikri or Ghanami Ahmer. The interaction treatment between Ghanami Ahmer and the concentration of 20% of pollen extract

recorded the highest percentage of total soluble solids, which amounted to 48.7%. While the interaction treatment between the pollen cultivar Ghanami Ahmer and without spraying (control) recorded the lowest percentage of total soluble solids, which amounted to 39.0% (Table 4).

Table 4: Effect of cultivar and concentration of pollen extract, and the interaction between them on total soluble solids (%) in fruits of date palm cv. Khadrawi after 90 days of pollination

Male cultivar (A)	Pollen extract concentration			Main effect (B)
	Control	10%	20%	
Khikri	39.7	41.7	47.3	42.9
Ghanami Ahmer	39.0	45.0	48.7	44.2
Main effect (A)	39.3	43.3	48.0	
L.S.D. p≥0.05	Male cultivar (A)	Extract concentration (B)	A × B	
	5.30	6.49	9.17	

Total carbohydrates (%)

The results from Table 5 show that there was no significant difference between the two pollen cultivars Khikri and Ghanami Ahmer in the total carbohydrates content of date palm fruits of a Khadrawi cultivar after 90 days of pollination. The treatment of spraying with pollen extract significantly affected the total carbohydrate content of fruits. The treatment of fruit spraying with pollen extract at a concentration of 20% was significantly superior in the total carbohydrate content of fruits compared to the control treatment, which recorded 50.3%. The control treatment recorded the lowest total carbohydrate content of fruits amounting to 43.9%, which did not differ significantly from the spraying with pollen extract at 10% concentration.

The interaction treatments between pollen cultivar and pollen extract concentration were significantly different in the total carbohydrates content of date palm fruits of Khadrawi cultivar after 90 days of pollination. The interaction treatment between the Ghanami Ahmer pollen cultivar and the fruit spraying with pollen extract of 20% was significantly superior in the total carbohydrate content of fruits amounting to 52.3% compared to all the interaction treatments except for two interaction treatments with a Ghanami Ahmer pollen cultivar + concentration of 10% of the pollen extract, and Khikri pollen cultivar + concentration of 20% of the pollen extract. The treatment of the interaction between the pollen cultivar Khikri or Ghanami Ahmer + without spraying with the extract of the pollen recorded the lowest content of the fruits of total carbohydrates, which amounted to 43.9% in each of them.

Total titratable acidity (%)

The data from Table 6 indicate that there was no significant difference between the two pollen cultivars Khikri and Ghanami Ahmer in the total titratable acidity of the fruits of the date palm cultivar after 90 days of pollination. The treatment of fruit spraying with pollen extract was significantly superior to 20% compared to the control treatment, which recorded the lowest total titratable acidity rate of 0.048 %. The control treatment recorded the highest total titratable acidity rate in the fruit, which was 0.054 %, which did not differ significantly from the spraying treatment with a concentration of 10% of pollen extract.

The results from Table 6 also indicate that there are significant differences between the interaction treatments between pollen cultivar and pollen extract concentration in the total titratable acidity rate of date palm fruits of the Khadrawi cultivar. The interaction treatment of pollen cultivar Khikri + 20% pollen extract recorded the lowest total titratable acidity rate of 0.047 % in fruits. As for the treatment of the interaction between Ghanami Ahmer pollen cultivar + without spraying with the pollen extract was recorded the highest total titratable acidity rate in the fruits was 0.054 %.

DISCUSSION

The absence of significant differences between the two pollen cultivars Khikri and Ghannami Ahmer in most of the physical and chemical characteristics in the pulp of the fruits of the date palm Khadrawi cultivar is attributed to the fact that these two pollen cultivars are compatible with pollination with the female Khadrawi cultivar.

Table 5: Effect of cultivar and concentration of pollen extract, and the interaction between them on total carbohydrates (%) in fruits of date palm cv. Khadrawi after 90 days of pollination

Male cultivar (A)	Pollen extract concentration			Main effect (B)
	Control	10%	20%	
Khikri	43.9	44.8	48.3	45.7
Ghanami Ahmer	43.9	48.9	52.3	48.3
Main effect (A)	43.9	46.9	50.3	
L.S.D. p≥0.05	Male cultivar (A)	Extract concentration (B)	A × B	
	3.67	4.50	6.36	

Table 6: Effect of cultivar and concentration of pollen extract, and the interaction between them on total titratable acidity (%) in fruits of date palm cv. Khadrawi after 90 days of pollination

Male cultivar (A)	Pollen extract concentration			Main effect (B)
	Control	10%	20%	

Khikri	0.053	0.049	0.047	0.050
Ghanami Ahmer	0.054	0.049	0.048	0.050
Main effect (A)	0.054	0.049	0.048	
L.S.D. p≥0.05	Male cultivar (A)	Extract concentration (B)	A × B	
	Non-significant	0.005	0.007	

The significant superiority of the treatment of spraying the fruits of date palm fruits of the Khadrawi cultivar with a concentration of 20% of pollen extract in most of the studied physical and chemical characteristics after 90 days of pollination is because pollen extract contains high levels of endogenous hormones that interfere with the hormones present in the carpels of female flowers after the two processes of pollination and fertilization, which led to the improvement of the physical and chemical properties of the date palm fruits of Khadrawi cultivar (Abbas et al., 1995; Abdul-Wahed, 2011). The pollen extract also contains carbohydrates, proteins, nutrients, bioactive compounds, and vitamins that have an essential role in stimulating the growth and development of fruits, which is positively reflected in the physical and chemical characteristics of the fruits (Abed et al., 2011; Hassan, 2011; Basuny et al., 2013; Graystock et al., 2013; Ebtihaj et al., 2018; Sayed et al., 2018; Byan, 2020). The results of the current study are in coincidence with the results of the study carried out by Ibtihaj et al. (2018) which was conducted by spraying the female date palm trees of Shoithi cultivar with date palm pollen extract Ghanami Akhder cultivar. Also, these results are in agreement with the results found by Sayed et al. (2018) on the female cultivar Khalas.

CONCLUSION

Spraying the fruits of the date palm cultivar with a concentration of 20% of pollen extract of the Ghanami Ahmer cultivar one month after pollination leads to improvement of some of their physical and chemical properties after 90 days of pollination.

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