



*Archives of Agriculture Sciences Journal*  
Print ISSN: 2535-1680  
Online ISSN: 2535-1699

## Effect of different sources of pollen and bagging bunches on yield and fruits quality of Barhee date palm under New Valley conditions, Egypt

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### Abstract

The present investigation was carried out during two successive seasons of 2021 and 2022 to study the influence of different pollen sources and bagging techniques on fruit set, yield, and fruits quality attributes of Barhee date palm trees in Farafra, New Valley conditions. Four pollen sources were compared: a local male (Balady), and three commercial varieties (Fard 4, Ghanamy, and Abdel-jabbar). Bunches pollinations were followed by immediate bagging, one-week delayed bagging, and unbagged. Results revealed that using pollen sources other than the local Balady, particularly Abdel-jabbar, improved initial and final fruit set, bunch weight, and total yield. Additionally, bagging bunches immediately after pollination with these alternative pollen sources enhanced these parameters. Fruit weight, pulp weight, and total soluble solids (TSS %) significantly influenced by using pollen sources other than Balady, with Abdel-jabbar again demonstrating the most favourable outcomes. Fruit length, diameter, and total crude fiber content remained largely unaffected. Abdel-jabbar pollen resulted in the highest total sugars and the lowest reducing sugars, while Fard 4 exhibited the highest levels of reducing sugars. Overall, the study suggests that using non-local pollen sources, particularly Abdel-jabbar, combined with immediate post-pollination bagging, can significantly enhance fruit set, yield, and fruits quality of Barhee date palms.

**Keywords:** pollen grain sources, bunch bagging, Barhee date palm.

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## 1. Introduction

The date palm (*Phoenix dactylifera* L.), a member of the Palmaceae family, is renowned as the "tree of life" in arid regions due to its exceptional resilience to high temperatures, aridity, and salinity, surpassing that of other plants (Lunde 1978). In Egypt, the date palm stands as one of the most prosperous and economically significant crops. According to Ministry of Agriculture and Land Reclamation (2022), Egypt boasts approximately 15,710,250 date palm trees yielding around 1,847,629 tons annually. This position let Egypt among the top ten producers of date palms globally. Egypt was one of the top-producing nations in the world in 2021, accounting for 1,747,714 tons of dates (FAOSTAT, 2022). Date palm pollination naturally occurs by the action of wind. But it is not sufficient for commercial production. Therefore, artificial pollination is required for commercial production. To guarantee satisfactory yielding qualities, artificial pollination techniques should be applied to female spathes. Typically, this involves keeping male strands between female strands (Gupta *et al.*, 2017; OrtizUribe *et al.*, 2019). Among the various cultivars, Barhee merges as the most economically vital date palm cultivar cultivated in Egypt. Thus, Egypt maintains its status as one of the leading date palm producers worldwide. Two critical factors influencing the quality and productivity of date palm fruits are the types of pollen and the practice of bagging bunches. It is imperative to identify the most suitable types of pollen to enhance fruiting in date palms, as pollen sources significantly

impact fruit set, yield, and fruit quality (Islam, 2017). Research on date palm cultivation highlights the necessity of selecting appropriate pollen types to improve the quantitative, qualitative, and economic aspects of date production (Abd-Elhaleem *et al.*, 2020; El-Salhy *et al.*, 2010; Hafez Omaina 2015; Iqbal *et al.*, 2010). Date palm is a dioecious plant, necessitating artificial pollination for profitable crop yields. The choice of pollen type is crucial as pollen grains from different male palms can significantly influence fruit yield and quality. In many palm-growing regions, including Egypt, male date palms are commonly utilized for pollination. These male palms exhibit considerable variability in growth, vigor, spathe characteristics, and pollen quality. Numerous studies have demonstrated that pollen grains from different male palms not only impact seed size and shape (Xenia) but also directly affect fruit set, yield, and various physical and chemical characteristics of the fruit (Metaxenia). Additionally, studies by Atawia *et al.* (2020), El-Salhy *et al.* (2010) and Shaheen *et al.* (1989) have shown that pollen sources influence fruit and seed characteristics, displaying metaxenic effects depending on the female cultivar used. Bagging bunches of date palm cultivars during flowering and fruit setting stages has been observed to have a positive impact on fruit set, yield, and enhanced fruit quality. Additionally, bunch covers provide several advantages by safeguarding fruits against damage from high humidity, rain, insects, and diseases. Various researchers have noted that both the productivity and quality of date palm fruits are influenced by the source of pollen grains (Galib *et al.*, 1988; Kassem

*et al.*, 1994; Karim, 2005). The objective of this study was to assess the impact of utilizing various pollen sources on fruit set and yield, as well as the physical and chemical properties of Barhee date palm trees cultivated in the New Valley, Egypt, specifically in the Farafra region on the Baraka Plain.

## 2. Materials and methods

### 2.1 Experimental site and treatments description

During the 2021 and 2022 growing seasons, this study was conducted on 10-year-old Barhee date palms in a private orchard situated in the Baraka Plain of Farafra district 3X4C+M4V, New Valley governorate, Egypt. The date palms were cultivated on sandy soil spaced 8 × 8 meters apart and managed under a drip irrigation system. Healthy palms of nearly uniform vigor were selected for the experiment and subjected to common cultural practices typical of the orchard. Four different sources of pollen grains were utilized, including a local male (Balady) obtained from Sameh Abdel Rahman's farm in the village of Al-Liwaa Sobeih, west of Farafra, which was growing in the same area under study. Additionally, three commercial male varieties Fard 4, Ghanamy, and Abdel-jabbar were employed. Before the start of the season, pollen germination tests were conducted for all pollen sources on a nutrient medium consisting of 20% sucrose and 1% agar, following the method outlined by Asif *et al.* (1983).

Pollen germination percentage was recorded after 24 hours using a light microscope at 100x magnification, focusing on those with germination tubes longer than the pollen diameter. Randomly selected 10-year-old date palm trees were allocated to twelve treatments, each consisting of three replicates with one palm per replicate. These palms' spathes were pollinated using the respective pollen grains as part of the experimental procedures. To prevent the metaxenia effect, three bunches from the same male palm were covered with paper bags immediately after pollination, while three additional bunches were covered one week later. Another set of three bunches were left uncovered. After 30 days from the pollination, all the covered bunches were released from the bags. Twelve female palms were selected for the experiment and divided into twelve treatments. The experimental palms were arranged in complete randomized block design (CRBD) in split/plot arrangement with three replications (bunches or palms) per treatment. The main and sub-plot were bagging and male sources, respectively. The main plots included three bagging treatments, whereas the sub-plots involved for male types as shown in Table (1).

### 2.2 Weather conditions in the experimental area

Values of the monthly temperatures, relative humidity, and wind speed during the two seasons of study are shown in Table (2).

Table (1): The arrangement of treatments.

No.	Factor B (Male pollen)	Factor A (Bagging types)
1	Balady variety	Unbagged
2		Bagging bunches immediately after pollination
3		Bagging bunches after 1 week
4	Fard 4 variety	Unbagged
5		Bagging bunches immediately after pollination
6		Bagging bunches after 1 week
7	Ghanamy variety	Unbagged
8		Bagging bunches immediately after pollination
9		Bagging bunches after 1 week
10	Abdel-jabbar variety	Unbagged
11		Bagging bunches immediately after pollination
12		Bagging bunches after 1 week

Table (2): The maximum and minimum air temperature, relative humidity and wind speed during 2021 and 2022 seasons at Farafra, New valley, Egypt.

Climate of Farafra – New Valley, Egypt (2021 Monthly)								
Latitude: 27.05 / Longitude:27.96 /Altitude:78								
Months	SRAD	TMAX	TMIN	RAIN	WIND	TDEW	TMean	RH
January	14.34	16.40	4.28	0.00	3.82	0.97	9.63	51.88
February	17.55	21.03	6.60	0.00	3.62	0.16	13.38	40.19
March	19.33	24.20	10.56	0.00	4.21	-0.03	16.94	31.28
April	24.23	31.54	14.68	0.00	4.12	-0.61	22.82	20.00
May	26.05	33.51	18.14	0.00	4.39	2.89	25.79	21.27
June	28.59	38.99	22.40	0.00	4.32	4.98	30.22	19.15
July	28.70	31.05	17.41	0.00	4.40	4.55	24.33	21.56
August	26.86	35.66	21.84	0.00	4.09	9.20	28.78	27.31
September	23.60	33.10	19.68	0.00	4.46	9.53	26.12	33.26
October	19.51	28.75	15.43	0.00	4.21	9.48	21.69	43.25
November	15.10	22.94	11.56	0.00	3.79	7.59	16.68	52.34
December	13.16	16.17	4.93	0.00	3.74	2.80	9.79	57.12
Average and Sum	21.42	27.70	13.96	0.00	4.10	4.29	20.51	34.86
Climate of Farafra – New Valley, Egypt (2022 Monthly)								
Months	SRAD	TMAX	TMIN	RAIN	WIND	TDEW	TMean	RH
January	13.65	15.83	3.74	0.00	3.41	-0.36	9.99	49.00
February	17.66	17.92	4.14	0.00	3.62	0.01	10.46	45.77
March	20.63	22.72	8.26	0.00	4.39	0.25	15.13	34.93
April	23.63	28.66	12.66	0.00	4.03	-0.06	20.43	24.62
May	25.73	33.00	17.47	0.00	4.20	3.63	25.31	23.48
June	28.62	36.16	20.96	0.00	4.31	5.94	28.69	22.58
July	28.55	37.17	22.55	0.00	4.18	8.25	29.97	24.17
August	26.88	36.24	22.20	0.00	4.13	9.81	29.24	27.55
September	23.79	28.92	14.65	0.00	3.97	4.23	21.44	26.58
October	19.80	27.29	13.65	0.00	3.96	6.37	20.28	38.20
November	15.85	22.08	9.06	0.00	3.19	3.47	14.84	43.89
December	12.86	18.53	7.12	0.00	3.34	4.25	12.28	55.49
Average and Sum	2147	27.04	13.04	0.00	3.89	3.83	19.71	34.86
Interpretation								
SRAD	(MJ/m <sup>2</sup> /day)							
TMAX	Maximum Air Temperature (degrees C)							
TMIN	Minimum Air Temperature (degrees C)							
RAIN	Average Precipitation (mm)							
WIND	Wind Speed (m/s)							
TDEW	Dew/Frost Point Temperature (degrees C)							
TMean	Average Air Temperature (degrees C)							
RH	Average Relative Humidity (%)							
Central Laboratory for Agricultural climate (CLAC) (2021 and 2022)								

### 2.3 Data collection

following equation:

After four weeks of pollination, five strands from each replicate were used to calculate the initial fruit set using the

$$\text{The initial fruit set \%} = \frac{\text{Total number of fruit setting fruits per strands}}{\text{Total scapes number per bunch}} \times 100$$

Fruit set percentage was calculated one

month after pollination, while fruit retention percentage was determined just before harvest. The number of fruit set was recorded based on the method described by El-Mkhtoun (1981). Harvesting of all bunches took place during the second week of September. The fruit retention percentage was calculated using the following equation:

$$\text{Fruit retained \%} = \frac{\text{No. of retained fruits}}{\text{N. o of retained fruit} + \text{No. of flower scars}} \times 100$$

Bunch weight was approximated in kilograms (Kg). For physical and chemical characterization, samples of 10 fruits were gathered from each replicate. The parameters assessed included fruit weight (g), as well as the weight and flesh of percentage and fruit length (cm), fruit diameter (cm), fruit weight (g) Additionally, total soluble solids (%) (TSS) was measured using a handheld refractometer, total sugars, reducing sugars, acidity (%) and total crude fiber, and were determined according to A.O.A.C. (1995) guidelines.

#### 2.4 Statistical analysis

Statistical analysis was conducted to compare differences among treatments

using the least significant differences (LSD) at a 5% significance level, following the methodology outlined by Snedecor and Cochran (1980).

### 3. Results and Discussion

#### 3.1 Pollen germination

The results in Figure (1) showed that pollen germination ranged from 74.9% for Balady to 88.2% for Abdel-jabbar. Abdel-jabbar had the highest percentage of pollen germination. These variations, the overall results were considered satisfactory, indicating high pollen effectiveness. The recorded pollen germination percentage was (74.9, 77.7, 82.6 and 88.2%) for Balady, Fard 4, Ghanamy, Abdel-jabbar pollen sources, respectively. Hence the increment of pollen germination percentage attained (3.74, 10.28 and 17.76%) for Fard 4, Ghanamy, Abdel-jabbar compared to Balady pollen sources. No significant differences among due to Balady and Fard 4 pollen sources. So, in general view, it concluded that to use Abdel-jabbar or Ghanamy pollen sources for production high yield.

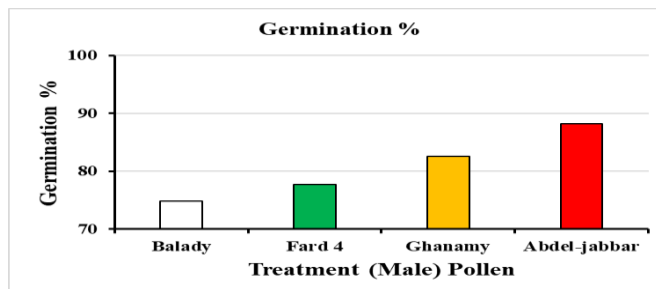


Figure (1): Pollen germination (%) for four males used in the experiment.

### 3.2 Yield components

The data presented in Tables (3, 4 and 5) indicate that initial fruit set, fruit retention (%) and bunch weight were positively influenced by using different pollen grain sources conjunction with bagging bunches immediately after pollination, compared

to the Balady male with unbagging, during the first and second seasons, respectively. It is obvious from the data that the results took similar trend during the two studied seasons. Among the different pollen grain sources, Abdel-jabbar demonstrated the highest effectiveness, followed by Ghanamy, Fard 4, and Balady, respectively.

Table (3): Effect of different types of pollen and the bagging bunches on initial fruit set (%) of date palm Barhee variety during 2021 and 2022 seasons.

Male varieties (A)	2021				2022							
	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	Mean	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	Mean				
Balady	53.3	58.1	56.5	56.0	54.1	59.0	57.3	56.8				
Fard 4	57.2	63.9	61.6	60.9	58.1	64.4	62.2	61.6				
Ghanamy	62.8	68.1	66.3	65.7	63.0	69.4	67.7	66.7				
Abdel-jabbar	67.9	73.5	71.1	70.8	68.2	74.3	72.1	71.5				
Mean	60.3	65.9	63.9	—	60.9	66.8	64.8	—				
L.S.D 0.05%	A = 1.3		B = 1.4		AB = 2.42		A = 1.4		B = 1.5		AB = 2.60	

A<sub>1</sub>: unbagged (control). A<sub>2</sub>: bagging immediately after pollination. A<sub>3</sub>: pollination, bagging after 1 week.

Regarding the highest values for these traits, Abdel-jabbar pollen grain gave the highest value of initial fruit set, fruit retention% and bunch weight (70.8 and 71.5%), (62.2 and 63.1%) and (22.0 and 22.9 Kg) for initial fruit set, compared to least value that (56.0 and 56.8%), (43.4

and 44.5%) and (12.4 and 13.4 Kg) for the Balady male source. The recorded fruit retention was (43.4, 52.6, 59.3 and 62.2) and (44.5, 53.7, 60.2 and 63.8%) for Balady, Fard 4, Ghanamy, Abdel-jabbar pollen sources during the two studied seasons, respectively.

Table (4): Effect of different types of pollen and the bagging bunches on fruit retention (%) of date palm Barhee variety during 2021 and 2022 seasons.

Male varieties (A)	2021				2022							
	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	Mean	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	Mean				
Balady	40.3	47.5	42.5	43.4	41.2	48.9	43.3	44.5				
Fard 4	49.1	56.8	51.9	52.6	50.4	57.7	53.0	53.7				
Ghanamy	56.5	62.9	58.4	59.3	57.7	63.6	59.4	60.2				
Abdel-jabbar	59.2	65.7	61.6	62.2	60.8	67.5	63.1	63.8				
Mean	51.3	58.2	53.6	—	52.5	59.4	54.7	—				
L.S.D 0.05%	A = 1.6		B = 1.8		AB = 3.11		A = 1.7		B = 1.9		AB = 3.29	

A<sub>1</sub>: unbagged (control). A<sub>2</sub>: bagging immediately after pollination. A<sub>3</sub>: pollination, bagging after 1 week.

Similarly, for bunch weight, Abdel-jabbar pollen grain gave the heaviest (22.0 and 22.9 kg), while the Balady male source had the least one that (12.4 and 13.4 kg) in

the first and second seasons, respectively. The recorded bunch weight was (12.4, 16.1, 20.6 and 22.0) and (13.4, 17.0, 21.5 and 22.9 kg) for Balady, Fard 4,

Ghanamy, Abdel-jabbar pollen sources during the two studied seasons, respectively. Then, the increment percentage of bunch weight was (29.83, 66.13 and 77.43) and (26.87, 60.45 and 70.90%) for Fard 4, Ghanamy, Abdel-jabbar compared to Balady pollen sources during the two studied seasons, respectively. No significant differences among due to and Abdel-jabbar and Ghanamy pollen sources. So, in general economic view, it could be concluded that to use Abdel-jabbar or Ghanamy pollen sources for production heaviest bunches. These findings align with previous studies conducted by El-Hammady (1977); Abdel-Hamid (2000); Al-Hamoudi *et al.* (2006); El-salhy *et al.* (2007); Hafez *et al.* (2014); Atawia *et al.* (2020); EL-kosary *et al.* (2023). concerning bagging bunch treatments, data in Table (3, 4 and 5) cleared that bagging bunches immediately after pollination and one week later, along with the use of different pollen grain sources, led to increases all of the

mentioned attributes across both seasons compared to unbagged bunches. The obtained fruit retention was (51.3, 58.3 and 53.6) and (52.5, 59.4 and 54.7%) and bunch weight was (15.9, 20.6 and 18.2) and (17.0, 20.8 and 19.0 kg) for unbagged, bagging immediately pollination and one week after during two the studied seasons, respectively. Hence the increment percentage for bunch weight was (29.56 and 14.47) and (22.35 and 11.76) for bagging immediately pollination and one week after compared to unbagged one during two the studied seasons, respectively. These findings align with previous studies conducted by Galib *et al.* (1988), Kassem *et al.* (1994) and El-Salhy (2000). In addition, data in Tables (3, 4 and 5) indicated that the yield components significantly responded to the interaction between the bagging bunches and pollen grain sources. The highest values were observed when bagging bunches immediately after pollination with Abdel-jabbar pollen grain.

Table (5): Effect of different types of pollen and bagging bunches on bunch weight (kg) of the date palm Barhee variety during 2021 and 2022 seasons.

Male varieties (A)	2021				2022							
	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	Mean	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	Mean				
Balady	10.5	13.9	12.9	12.4	11.6	14.7	13.8	13.4				
Fard 4	14.4	17.5	16.3	16.1	15.5	18.3	17.2	17.0				
Ghanamy	18.6	22.0	21.1	20.6	19.7	22.8	21.9	21.5				
Abdel-jabbar	20.2	23.5	22.3	22.0	21.3	24.3	23.2	22.9				
Mean	15.9	20.6	18.2	—	17.0	20.8	19.0	—				
L.S.D 0.05%	A = 6.4		B = 7.5		AB = 12.98		A = 6.5		B = 7.6		AB = 13.15	

A<sub>1</sub>: unbagged (control). A<sub>2</sub>: bagging immediately after pollination. A<sub>3</sub>: pollination, bagging after 1 week.

In contrast, the unbagged bunches with Balady male source produced the least values. The highest recorded fruit set, fruit retention and bunch weight were (73.5

and 74.3) and (68.1 and 69.4%), (65.7 and 67.5) and (62.9 and 63.9%) and (23.5 and 24.3) and (22.0 and 22.8 kg) for pollination with Abdel-jabbar pollen grain

and immediately bagging bunch (A2B4) and pollination with Ghanamy pollen grain and immediately bagging bunch(A2B3) during the two studied seasons, respectively. On another hand the least fruit set was (53.3 and 54.1%), fruit retention (40.3 and 41.2%) and bunch weight (10.5 and 11.6 kg) due to unbagged bunches with Balady male source (A1B1) during the two studied seasons, respectively. Hence, the increment percentage of bunch weight was (123.80 and 109.48) and (109.52 and 96.55%) due to (A2B4) and (A2B3) compared (A1B1) during the two studied

seasons, respectively.

### 3.3 Physical fruit properties

The data presented in Tables (6 to 9) indicate that fruit weight, flesh percentage and fruit dimension were positively influenced by using different pollen grain sources conjunction with bagging bunches immediately after pollination, compared to the Balady male with unbagging, during the first and second seasons, respectively. It is obvious from the data that the results took similar trend during the two studied seasons.

Table (6): Effect of different types of pollen and bagging bunches on fruit weight (g) of the date palm Barhee variety during 2021 and 2022 seasons.

Male varieties (A)	Treat (B)		2021				2022					
	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	Mean	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	Mean				
Balady	10.5	12.1	11.5	11.4	11.3	12.4	12.1	11.9				
Fard 4	13.4	15.5	14.6	14.5	14.4	15.8	15.1	15.1				
Ghanamy	16.2	17.9	17.1	17.1	17.1	18.2	17.7	17.7				
Abdel-jabbar	20.4	22.3	21.6	21.4	21.5	22.6	22.2	22.1				
Mean	15.1	17.0	16.2	—	16.1	17.3	16.8	—				
L.S.D 0.05%	A = 0.4		B = 0.5		AB = 0.87		A = 0.5		B = 0.6		AB = 1.04	

A<sub>1</sub>: unbagged (control). A<sub>2</sub>: bagging immediately after pollination. A<sub>3</sub>: pollination, bagging after 1 week.

Table (7): Effect of different types of pollen and bagging bunches on flesh percentage of the date palm Barhee variety during 2021 and 2022 seasons.

Male varieties (A)	Treat (B)		2021				2022					
	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	Mean	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	Mean				
Balady	87.24	88.02	87.83	87.70	87.79	88.15	88.35	88.10				
Fard 4	91.34	91.94	91.78	91.69	91.67	91.96	91.99	19.87				
Ghanamy	93.64	93.74	93.63	93.67	93.75	93.74	93.78	93.76				
Abdel-jabbar	95.69	95.56	95.69	95.66	95.72	95.69	95.77	95.70				
Mean	19.98	92.34	92.83	—	92.23	92.37	92.47	—				
L.S.D 0.05%	A = N.S		B = 4.26		AB = N.S		A = N.S		B = 5.43		AB = N.S	

A<sub>1</sub>: unbagged (control). A<sub>2</sub>: bagging immediately after pollination. A<sub>3</sub>: pollination, bagging after 1 week.

Among the different pollen grain sources, Abdel-jabbar demonstrated the highest effectiveness, followed by Ghanamy, Fard 4, and Balady, respectively. Regarding the highest values for these traits, Abdel-jabbar pollen grain gave the highest value of fruit weight, flesh (%) as well as fruit

length and fruit diameter. The recorded fruit weight (11.4, 14.5, 17.1 and 21.4) and (11.9, 15.1, 17.7 and 22.1 g) and flesh% (78.70, 91.69, 93.67 and 95.66) and (88.10, 91.87, 93.76 and 95.70%) for Balady, Fard 4, Ghanamy, Abdel-jabbar pollen sources during the two studied



seasons, respectively. The corresponding fruit length (2.94, 3.19, 3.56 and 4.26) and (2.95, 3.21, 3.58 and 4.29 cm) and fruit diameter (1.86, 2.14, 2.49 and 3.29) and (1.87, 2.15, 2.51 and 3.32 cm), respectively. Then, the increment percentage of fruit weight was (27.19, 50.00 and 87.72) and (26.89, 48.74 and 85.71%) and flesh (%) was (4.55, 6.81 and 9.08) and (4.28, 6.42 and 8.63) for Fard 4, Ghanamy, Abdel-jabbar compared to Balady pollen sources during the two studied seasons, respectively. No significant differences among due to and Abdel-jabbar and Ghanamy pollen sources. So, in general economic view, it could be concluded that to use Abdel-jabbar or Ghanamy pollen sources for production heaviest fruit weight with highest flesh %. These findings align with previous studies conducted by Al-Hamoudi *et al.* (2006), El-salhy *et al.* (2007), Hafez *et al.* (2014), Islam (2017), Abdel-Rauof and dawoud (2022) and EL-kosary *et al.* (2023). Concerning bagging bunch treatments, data in Table (6 to 9) showed that bagging bunches immediately after pollination and one week later, along with the use of different pollen grain sources, led to increases all of the aforementioned attributes during two studied seasons compared to unbagged bunches. The obtained fruit weight was (15.1, 17.0 and 16.2) and (16.1, 17.3 and 16.81 g) and flesh % was (91.98, 92.34 and 92.83) and (92.23, 92.37 and 92.47%) for unbagged, bagging immediately pollination and one week after during two the studied seasons, respectively. Hence the increment percentage

for fruit weight was (12.58 and 7.28) and (7.45 and 4.35) for bagging immediately pollination and one week after compared to unbagged one during two the studied seasons, respectively. Similarity the recorded fruit length was (3.42, 3.57 and 3.47) and (3.44, 3.60 and 3.50 cm) and fruit diameter (2.38, 2.50 and 2.46) and (2.40, 2.52 and 2.47 cm), respectively. These findings align with previous studies conducted by Galib *et al.* (1988), Kassem *et al.* (1994), El-Salhy (2000). In addition, data in Tables (6 to 9) indicated that the physical fruit properties significantly responded to the interaction between the bagging bunches and pollen grain sources. The highest values were observed when bagging bunches immediately after pollination with Abdel-jabbar pollen grain. In contrast, the unbagged bunches with Balady male source produced the least values. The highest recorded fruit weight (23.3 and 22.6) and (17.9 and 18.2) and flesh (%) (95.59 and 93.74) and (95.62 and 93.74) as well as fruit length (4.47 and 4.50) and (3.61 and 3.64 cm) and fruit diameter (3.39 and 3.42) and (2.57 and 2.60 cm) for pollination with Abdel-jabbar pollen grain and immediately bagging bunch (A<sub>2</sub>B<sub>4</sub>) and pollination with Ghanamy pollen grain and immediately bagging bunch (A<sub>2</sub>B<sub>3</sub>) during the two studied seasons, respectively. On another hand the least fruit weight was (10.5 and 11.3 g), flesh % (87.24.3 and 87.79%), fruit length (2.90 and 2.91 cm) and fruit diameter (1.84 and 1.85 cm) due to unbagged bunches with Balady male source (A<sub>1</sub>B<sub>1</sub>) during the two studied seasons, respectively. Hence, the

increment percentage of fruit weight was and (9.64 and 8.92%) due to (A<sub>2</sub>B<sub>4</sub>) and (112.38 and 100.00%) and (70.48 and 61.06%) as well as flesh % (7.45 and 6.78) (A<sub>2</sub>B<sub>3</sub>) compared (A<sub>1</sub>B<sub>1</sub>) during the two studied seasons, respectively.

Table (8): Effect of different types of pollen and bagging bunches on fruit length (cm) of the date palm Barhee variety during 2021 and 2022 seasons.

Male varieties (A)	2021				2022			
	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	Mean	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	Mean
Balady	2.90	2.97	2.94	2.94	2.91	2.99	2.96	2.95
Fard 4	3.15	3.24	3.18	3.19	3.17	3.25	3.20	3.21
Ghanamy	3.50	3.61	3.57	3.56	3.52	3.64	3.58	3.58
Abdel-jabbar	4.14	4.47	4.18	4.26	4.16	4.50	4.21	4.29
Mean	3.42	3.57	3.47	—	3.44	3.60	3.50	—
L.S.D 0.05%	A = 0.04	B = 0.05	AB = 0.09		A = 0.04	B = 0.05	AB = 0.1	

A<sub>1</sub>: unbagged (control). A<sub>2</sub>: bagging immediately after pollination. A<sub>3</sub>: pollination, bagging after 1 week.

Table (9): Effect of different types of pollen and bagging bunches on fruit diameter (cm) of the date palm Barhee variety during 2021 and 2022 seasons.

Male varieties (A)	2021				2022			
	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	Mean	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	Mean
Balady	1.84	1.87	1.86	1.86	1.85	1.89	1.88	1.87
Fard 4	2.10	2.18	2.13	2.14	2.12	2.19	2.15	2.15
Ghanamy	2.39	2.57	2.52	2.49	2.41	2.60	2.53	2.51
Abdel-jabbar	3.17	3.39	3.31	3.29	3.20	3.42	3.33	3.32
Mean	2.38	2.50	2.46	—	2.40	2.52	2.47	—
L.S.D 0.05%	A = 0.03	B = 0.03	AB = 0.05		A = 0.03	B = 0.03	AB = 0.06	

A<sub>1</sub>: unbagged (control). A<sub>2</sub>: bagging immediately after pollination. A<sub>3</sub>: pollination, bagging after 1 week.

### 3.4 Chemical properties

The data presented in Tables (10 to 14) indicate that TSS, total sugars and reducing sugars as well as total acidity and total fiber crude percentages were positively influenced by using different pollen grain sources conjunction with bagging bunches immediately after pollination, compared to the Balady male with unbagging, during the first and second seasons, respectively. It is obvious from the data that the results took similar trend during the two studied seasons. Among the different pollen grain sources, Abdel-jabbar demonstrated the highest effectiveness, followed by Ghanamy, Fard 4, and Balady, respectively. Regarding the

highest values for these traits, Abdel-jabbar pollen grain gave the highest value of TSS and total sugars. The recorded TSS (32.2, 35.4, 37.1 and 38.9) and (32.4, 35.6, 37.3 and 39.1%) and total sugars (27.2, 30.5, 32.1 and 33.8) and (27.4, 30.7, 32.3 and 34.1%) for Balady, Fard 4, Ghanamy, Abdel-jabbar pollen sources during the two studied seasons, respectively. The corresponding reducing sugar (21.8, 23.7, 22.8 and 19.7) and (22.0, 22.9, 23.0 and 19.9%), respectively. Then, the increment percentage of TSS was (9.94, 25.22 and 20.09) and (9.88, 15.12 and 20.68) for Fard 4, Ghanamy, Abdel-jabbar compared to Balady pollen sources during the two studied seasons, respectively. On other hand, the recorded total acidity (0.258,

0.194, 0.168 and 0.150) and (0.256, 0.192, 12.9 and 10.6%) for Balady, Fard 4, 0.166 and 0.148%) and total fiber crude Ghanamy, Abdel-jabbar pollen sources (8.7, 9.9, 12.7 and 10.4) and (8.9, 10.1, during the two studied seasons, respectively.

Table (10): Effect of different types of pollen and bagging bunches on TSS (%) of the date palm Barhee variety during 2021 and 2022 seasons.

Male varieties (A) \ Treat (B)	2021				2022							
	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	Mean	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	Mean				
Balady	32.3	33.0	32.9	32.2	32.5	33.1	32.9	32.4				
Fard 4	34.7	35.9	35.6	35.4	34.9	36.2	35.7	35.6				
Ghanamy	36.2	38.4	36.8	37.1	36.3	38.6	37.1	37.3				
Abdel-jabbar	37.8	40.0	38.8	38.9	38.0	40.1	39.1	39.1				
Mean	34.9	36.8	36.0	—	35.1	37.0	36.2	—				
L.S.D 0.05%	A = 0.91		B = 0.09		AB = 1.16		A = 0.92		B = 0.95		AB = 1.64	

A<sub>1</sub>: unbagged (control). A<sub>2</sub>: bagging immediately after pollination. A<sub>3</sub>: pollination, bagging after 1 week.

Table (11): Effect of different types of pollen and bagging bunches on total sugar (%) of the date palm Barhee variety during 2021 and 2022 seasons.

Male varieties (A) \ Treat (B)	2021				2022							
	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	Mean	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	Mean				
Balady	25.9	28.1	27.7	27.2	26.2	28.2	27.9	27.4				
Fard 4	29.8	31.0	30.7	30.5	30.0	31.3	30.8	30.7				
Ghanamy	31.4	33.2	31.8	32.1	31.5	33.4	32.1	32.3				
Abdel-jabbar	32.9	34.9	33.7	33.8	33.1	35.0	34.1	34.1				
Mean	30.0	31.8	31.0	—	30.2	32.0	31.2	—				
L.S.D 0.05%	A = 0.97		B = 1.22		AB = 2.11		A = 0.98		B = 1.22		AB = 2.11	

A<sub>1</sub>: unbagged (control). A<sub>2</sub>: bagging immediately after pollination. A<sub>3</sub>: pollination, bagging after 1 week.

Table (12): Effect of different types of pollen and bagging bunches on reducing sugar (%) of the date palm Barhee variety during 2021 and 2022 seasons.

Male varieties (A) \ Treat (B)	2021				2022							
	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	Mean	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	Mean				
Balady	21.4	22.1	22.0	21.8	21.6	22.3	22.1	22.0				
Fard 4	23.4	24.2	23.6	23.7	23.6	24.3	23.9	23.9				
Ghanamy	22.5	23.2	22.8	22.8	22.6	23.4	23.1	23.0				
Abdel-jabbar	18.8	20.3	19.9	19.7	19.1	20.4	20.1	19.9				
Mean	21.5	22.5	22.1	—	21.7	22.6	22.3	—				
L.S.D 0.05%	A = 0.52		B = 0.55		AB = 0.95		A = 0.53		B = 0.57		AB = 0.99	

A<sub>1</sub>: unbagged (control). A<sub>2</sub>: bagging immediately after pollination. A<sub>3</sub>: pollination, bagging after 1 week.

Hence, the decrement percentage of total acidity was (24.81, 34.88 and 41.86) and (25.00, 35.16 and 42.19%) for Fard 4, Ghanamy, Abdel-jabbar compared to Balady pollen sources during the two studied seasons, respectively it could be concluded that to use Abdel-jabbar pollen sources for production the good fruit chemical properties. These findings align

with previous studies conducted by Al-Hamoudi *et al.* (2006), El-salhy *et al.* (2007), Hafez *et al.* (2014), Islam (2017), El-Rauof (2022) and EL-kosary *et al.* (2023). Concerning bagging bunch treatments, data in Table (10 to 14) showed that bagging bunches immediately after pollination and one week later, along with the use of different pollen grain

sources, led to increases all of the studied seasons compared to unbagged aforementioned attributes during two bunches.

Table (13): Effect of different types of pollen and bagging bunches on acidity (%) of the date palm Barhee variety during 2021 and 2022 seasons.

Male varieties (A) \ Treat (B)	2021				2022							
	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	Mean	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	Mean				
Balady	0.269	0.250	0.255	0.258	0.266	0.249	0.253	0.256				
Fard 4	0.208	0.181	0.192	0.194	0.206	0.178	0.191	0.192				
Ghanamy	0.177	0.158	0.169	0.168	0.176	0.156	0.166	0.166				
Abdel-jabbar	0.158	0.142	0.149	0.150	0.156	0.141	0.146	0.148				
Mean	0.203	0.183	0.191	—	0.201	0.181	0.189	—				
L.S.D 0.05%	A = 0.02		B = 0.03		AB = 0.05		A = 0.01		B = 0.02		AB = 0.04	

A<sub>1</sub>: unbagged (control). A<sub>2</sub>: bagging immediately after pollination. A<sub>3</sub>: pollination, bagging after 1 week.

Table (14): Effect of different types of pollen and bagging bunches on total fiber crude (%) of the date palm Barhee variety during 2021 and 2022 seasons.

Male varieties (A) \ Treat (B)	2021				2022							
	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	Mean	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	Mean				
Balady	8.6	9.2	8.4	8.7	8.9	9.3	8.6	8.9				
Fard 4	9.4	10.3	10.0	9.9	9.5	10.5	10.3	10.1				
Ghanamy	12.4	13.7	12.1	12.7	12.5	14.0	12.3	12.9				
Abdel-jabbar	10.6	10.2	10.4	10.4	10.8	10.4	10.5	10.6				
Mean	10.2	10.9	10.2	—	10.4	11.1	10.4	—				
L.S.D 0.05%	A = 0.22		B = 0.24		AB = 0.47		A = 0.22		B = 0.24		AB = 0.48	

A<sub>1</sub>: unbagged (control). A<sub>2</sub>: bagging immediately after pollination. A<sub>3</sub>: pollination, bagging after 1 week.

The obtained TSS was (34.9, 36.8 and 36.0) and (35.1, 37.0 and 36.2 g), total sugar was (30.0, 31.8 and 31.0) and (30.2, 32.0 and 31.2%) and reducing sugar (21.5, 22.5 and 22.1) and (21.7, 22.6 and 22.3%) for unbagged, bagging immediately pollination and one week after during two the studied seasons, respectively. Hence the increment percentage for TSS was (5.44 and 3.15) and (5.41 and 3.13) for bagging immediately pollination and one week after compared to unbagged one during two the studied seasons, respectively. On other side, the recorded total acidity was (0.203, 0.183 and 0.191) and (0.201, 0.181 and 0.189 %) and total fiber crude (10.2, 10.9 and 10.2) and (10.4, 11.1 and 10.4%), respectively.

These findings align with previous studies conducted by Galib *et al.* (1988), Kassem *et al.* (1994) and El-Salhy (2000). In addition, data in tables (10 to 14) indicated that the chemical fruit properties significantly responded to the interaction between the bagging bunches and pollen grain sources. The highest values were observed when bagging bunches immediately after pollination with Abdel-jabbar pollen grain. In contrast, the unbagged bunches with Balady male source produced the least values. The highest recorded TSS (40.0 and 40.1) and (38.4 and 38.6%) and total sugar (34.9 and 35.0) and (33.2 and 33.4%) for pollination with Abdel-jabbar pollen grain and immediately bagging bunch (A<sub>2</sub>B<sub>4</sub>) and

pollination with Ghanamy pollen grain and immediately bagging bunch(A<sub>2</sub>B<sub>3</sub>) during the two studied seasons, respectively. On another hand the least TSS was (32.3 and 32.5 %), total sugar (25.9 and 26.2%), due to unbagged bunches with Balady male source (A<sub>1</sub>B<sub>1</sub>) during the two studied seasons, respectively. Hence, the increment percentage of fruit TSS was (23.84 and 23.38%) and (18.88 and 18.77%) as well as total sugar (34.75 and 33.95) and (28.19 and 27.48%) due to (A<sub>2</sub>B<sub>4</sub>) and (A<sub>2</sub>B<sub>3</sub>) compared (A<sub>1</sub>B<sub>1</sub>) during the two studied seasons, respectively. As an overview, the results showed that the combination effect significantly increased the yield and fruit quality increment of individual affected either used pollen grain sources and bunch bagging. These findings are consistent with previous studies by Shaheen *et al.* (1989), Hussein *et al.* (1999), Galib *et al.* (1988), Zaid and De Wet (2002), Shafique *et al.* (2011), Hafez Omaima (2015), and Shahsavari and Shahhosseini (2002).

#### 4. Conclusion

It could be concluded that incorporation Abdel-jabber or Ghanamy pollen grain sources and immediate post-pollination bagging to get the high yield with good fruit quality of Barhee date palm.

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