

Effect of Pollination Time on Date Yield and Quality of Mishrig Wad Khateeb and Barakawi in Northern Sudan

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Abstract

The experiments were conducted in the Horticulture nursery and a farmer's orchard at Elgureir for two and three seasons on Mishrig Wad Khateeb (MWK) and Barakawi palms, respectively, with the objective of determining the optimum time for pollination in the two cultivars. The results showed that the best time for pollination was 4-5 days after spathe opening in Barakawi and 3-5 days after spathe opening in (MWK), which gave fruits with best characteristics of shape, size, weight, bulb/seed ratio and higher yield.

Introduction

Date palm (*Phoenix dactylifera*) is the most predominant fruit in the northern Sudan. Long, hot and dry summers with low relative humidity make northern Sudan an ideal region for date production (Appendix 1). The Sudan like most other date palm growing countries has its own indigenous cultivars. Barakawi is the most important commercial dry cultivar and Mishrig Wad Khateeb is the most important semi-dry cultivar in Merowe region. Date palm yields in the northern Sudan are still below the world standard; this is mainly due to many problems including pollination methods, pollen sources and time of pollination.

The date palm is unique in having pollination as a cultural practice. Several attempts were made to improve the traditional methods known for a long time which resulted in more yields and better quality fruits (Al Bakr 1972, Furr and Ream 1969, Rahim 1975, Al Heaty, 1975 and Osman, 1979, 1989). The palm stigmas have been found to be receptive for a limited time (Al. Heaty, 1975). Therefore, the objective of this study was to determine the optimum pollination time for improved fruit set, yield, and better quality on MWK and Barakawi.

Materials and Methods

The experiments were carried out in the Horticulture nursery and a farmer's orchard at Elgureir for two (2004 and 2005) and three (2003, 2004 and 2005) seasons for MWK and Barakawi, respectively. The selected palms planted at 8×8 m spacing, were of uniform growth pattern, size and received the same cultural treatments. They were about 30 to 15 years old, irrigated at about a month and 15 days interval for MWK and Barakawi cultivars, respectively. The experimental design was a randomized complete block replicated 3 and 4 times for MWK and Barakawi cultivars, respectively. One male date palm about 15 years old grown at Elgurair adjacent to the

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experimental area was selected as a source of pollen. The male spathes to be used for pollination were cut at spathe cover cracking or shortly before. Strands were gently removed and tied in bundles of 2-3 for hand pollination. Each female inflorescences receiving one bundle each. The female spathes were bagged immediately before cracking to prevent external pollination for (21-30) days.

Treatments:

A. For Brakawi

1. Pollinated at spathe opening.
2. Pollinated one day after spathe opening.
3. Pollinated two days after spathe opening.
4. Pollinated three days after spathe opening.
5. Pollinated four days after spathe opening.
6. Pollinated five days after spathe opening.
7. Pollinated seven days after spathe opening.
8. Pollinated ten days after spathe opening.
9. Pollinated by the farmer (three days after spathe opening)

B- For Mishrig Wad Khateeb

1. Pollinated one day after spathe opening.
2. Pollinated two days after spathe opening.
3. pollinated three days after spathe opening.
4. Pollinated four days after spathe opening.
5. Pollinated five days after spathe opening.
6. Pollinated seven days after spathe opening.
7. Pollinated ten days after spathe opening.
8. pollinated thirteen days after spathe opening.
9. pollinated fifteen days after spathe opening.
10. Pollinated by the farmer (three days after spathe opening).

Data collection:

The yield and morphological data were taken at the Tamar stage, including the total yield per bunch, number of strands per bunch, number of fruits per strand, average length of strands at the upper, middle and lower part of the bunch. Ten fruits were randomly selected for each treatment to measure the whole fruit, pulp and seed weights using a sensitive balance. A vernier was used to determine fruit length, width, and diameter of fruits, in addition to seed length and width. Seed percentage was determined based on weight of whole fruit. Total soluble solid (TSS) and sucrose percent of various treatments were determined at the Khalal stage using hand refractometer (at $40C^{\circ}$).

Results and Discussion

During the two growing seasons flowering commenced during the first 15 days of February and pollination was carried at the end of February to early March. The influence of different times of pollination on bunch characteristic is shown in Tables (1 and 2) for MKW and Tables (3 and 4) for Barakawi. The data revealed that there were no significant differences in the strands length, but there were highly significant

differences in the number of fruits per strand and yield per bunch for the two cultivars. For MWK, the results showed that pollination time caused highly significant differences in fruit length, width, flesh thickness, pulp weight and seed physical characteristics (Tables 5 and 6). For Barakawi, on the other hand, pollination time had significant effect on fruit physical characteristics, but had no significant effect on seed physical characteristics (Tables 7, 8 and 9).

According to available data the increase in whole fruit weight was probably attributed to increase in pulp weight and the increase in seed size was closely associated with the fruit size. The data presented in Table 10 and 11 illustrate the effect of pollination time on sucrose and total soluble solids (TSS). It was clear that there was a significant differences in sucrose and TSS between all treatments for MWK and Barakawi cultivars. Pollination after 5 days for MWK and 4 days for Barakawi significantly improved sucrose percent and TSS compared to other treatments.

Conclusions

From this study it would be suggested that the best results were obtained when bunches were pollinated during 3–5 days after spathe opening in MWK cultivar and 4-5 days in Barakawi cultivar, which gave best quality and yield.

Recommendations

Based on the above mentioned results we request the Crop Husbandry Committee to pass the following recommendations:

- The best time of pollination for Mishrig Wad Khateeb is during 3-5 days after spathe opening.
- The best time of pollination for Barakawi is during 4 -5 days after spathe opening.

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Table 1. Effect of time of pollination on the morphological characteristics of MWK bunch at Elgureir (Merowe Province in season 2004).

Treatment	Length of strand (cm)	No. of strands/bunch	No. of dates/ strand	Yield/bunch (kg)
Pollinated one day after spathe opening	40.33 a	106.67 a	31.00 a	5.92de
Pollinated two days after spathe opening	40.00 a	104.33 a	32.33 a	7.33cd
Pollinated three days after spathe opening	39.67 a	103.00 a	31.00 ab	7.83c
Pollinated four days after spathe opening	41.00 a	106.33 a	32.00 a	10.08b
Pollinated five days after spathe opening	40.00 a	104.33 a	31.67 ab	11.92c
Pollinated seven days after spathe opening	39.67 a	104.33 a	29.33 b	8.33e
Pollinated 10 days. after spathe opening	41.67 a	107.00 a	23.00 c	5.33f
Pollinated 13 days. after spathe opening	41.67 a	105.33 a	20.33 d	3.42f
Pollinated 15 days. after spathe opening	40.67 a	106.33 a	18.33 d	2.25
10 – Control(pollinated by farmer).	40.67 a	105.67 a	31.00 ab	8.22
S.E.±	0.80	1.15	0.78	0.51
Significance level	n.s	n.s	***	***

Table 2. Effect of time of pollination on morphology and yield of MWK bunches at Elgureir (Merowe Province in season 2005).

Treatment	Length of strand (cm)	No. of strands/bunch	No. of dates/ strand	Yield/bunch (kg)
Pollinated one day after spathe opening	39.33 a	104.67 ab	25.00a	10.50 e
Pollinated two days after spathe opening	40.00 a	105.00 ab	28.00 a	11.09 d
Pollinated three days after spathe opening	41.33 a	105.00 ab	28.67 a	12.02 c
Pollinated four days after spathe opening	41.33 a	105.67 ab	25.33 a	13.05 b
Pollinated five days after spathe opening	42.67 a	106.00 a	25.67 a	14.50 a
Pollinated seven days after spathe opening	39.67 a	105.67 a	10.00 b	8.42 f
Pollinated 10 days. after spathe opening	39.00 a	108.00 a	8.00 b	7.50g
Pollinated 13 days. after spathe opening	39.33 a	107.33 a	6.67 b	6.25 h
Pollinated 15 days. after spathe opening	42.33 a	100.00 b	5.33 b	5.58 i
10 – Control(pollinated by farmer).	41.67 a	103.67 ab	30.33 a	12.67b
S.E.±	1.10	1.53	1.74	0.17
Significance level	n.s	*	***	***

Table 3. Effect of time of pollination on morphological characteristics of Barkawi bunches at Elgureir (Merowe Province in season 2004).

Treatment	Length of strand (cm)	No. of strands/bunch	No. of dates/ strand	Yield/bunch (Kg)
pollinated at spathe opening	42.00a	50.33a	35.00 a	8.33 bc
pollinated one day after spathe opening	41.33 a	52.00 a	35.00 a	8.84 abc
Pollinated two days after spathe opening	39.67 a	50.67 a	36.67 a	9.83 ab
Pollinated three days. After spathe opening	40.33 a	52.33 a	34.33 a	10.75 ab
Pollinated four days. After spathe opening	40.00 a	52.67 a	35.33 a	12.58 a
Pollinated five days. after spathe opening	41.33 a	53.33 a	34.67 a	11.33 ab
Pollinated after spathe opening seven days	41.00a	53.00 a	20.67 b	5.50 cd
Pollinated ten days. after spathe opening	40.00 a	52.67 a	17.00 c	4.00 d
Control (pollinated by farmer).	40.67 a	51.00 a	35.00 a	10.00ab
SE±	1.50	1.22	0.73	0.32
Sig. Level	n.s	n.s	***	***

Table 4. Effect of time of pollination on morphology and yield of Brakawi bunches at Elgureir (Merowe Province in season 2005)

Treatment	Length of strand (cm)	No. of strands/bunch	No. of dates/ strand	Yield/bunch (kg)
pollinated at spathe opening	42.00a	48.00b	35.00 a	9.79 d
pollinated one day after spathe opening	40.00 a	51.00 ab	36.67 a	10.49 cd
Pollinated two days after spathe opening	39.33 a	48.67 b	33.33 a	11.70 c
Pollinated three days. After spathe opening	40.00 a	49.67 ab	33.67 a	13.82 b
Pollinated four days. After spathe opening	39.33 a	53.33 ab	34.33 a	16.49a
Pollinated five days. after spathe opening	40.67 a	54.67 ab	34.33 a	15.07 ab
Pollinated after spathe opening seven days	32.00 a	51.67 ab	19.33 b	7.93 e
Pollinated ten days. after spathe opening	38.67 a	49.00 b	13.67 b	6.50 e
Control (pollinated by farmer).	39.33 a	57.67 a	32.67 a	11.57 c
SE±	3.59 a	2.53	1.96	0.50
Sig. Level	n.s	n.s	***	***

Table 5. Effect of different time of pollination on fruit & seed physical characteristics of MWK at Elgureir (Merowe Province in season 2004).

Treatment	Fruit length (mm)	Fruit width (mm)	Flesh thickness (mm)	Fruit weight (g)	pulp weight (g)	Seed length (mm)	Seed width (mm)	Seed weight (g)
pollinated one day from spathe opening	2.44g	1.70 c	0.33e	4.60d	3.79 d	1.73 b	0.8 2bcd	0.81cd
pollinated two days after spathe opening	2.65ef	1.75 c	0.33 e	5.18cd	4.44cd	1.76 b	0.81cd	0.74d
pollinated three days after spathe opening	2.82de	2.03 b	0.43 d	5.8 c	4.90 c	1.80 b	0.85abc	0.91abc
pollinated four days. after spathe opening	3.26b	2.32 a	0.68 a	7.8 ab	6.89ab	2.01 a	0.84abc	0.92abc
pollinated five days after spathe opening	3.5 a	2.27 a	0.60 b	8.65 a	7.64 a	2.07 a	0.83bc	1.02ab
pollinated seven days after spathe opening	3.24b	2.24 a	0.61b	7.53 b	6.6 b	2.00 a	0.87ab	0.93abc
pollinated ten days after spathe opening	3.01cd	2.03 b	0.51 c	7.40 b	6.45 b	1.80 b	0.90a	0.95abc
pollinated 13 days after spathe opening	3.31ab	2.26 a	0.62 b	8.61a	7.56 a	2.01 a	0.82bcd	1.05a
pollinated fifteen days after spathe opening	3.15bc	2.16ab	0.68 a	7.8 ab	6.90ab	1.98 a	0.83bc	0.98ab
Control (pollinated by farmer).	2.23fg	1.78 c	0.38 e	5.5 cd	4.62cd	1.82 b	0.77d	0.89abc
SE±	0.07	0.05	0.02	0.30	0.28	0.04	0.02	0.04
Sig.level	***	***	***	***	***	***	***	**

Table 6. Effect of different time of pollination on fruit & seed physical characteristics of MWK at Elgureir (Merowe Province in season 2005).

Treatment	Fruit length (mm)	Fruit width (mm)	Flesh thickness (mm)	Fruit weight (g)	Pulp weight (g)	Seed length (mm)	Seed width (mm)	Seed weight (g)
pollinated one day from spathe opening	2.57 e	1.84 d	0.39 f	4.27 f	3.40 f	1.78 d	0.78 c	0.87 b
pollinated two days after spathe opening	2.73 d	1.99 c	0.48 e	4.76 ef	3.89 ef	1.75 d	0.82 dc	0.86 b
pollinated three days after spathe opening	2.92 c	2.14 b	0.61 d	6.31d	5.40 d	1.92 bc	0.88 a	0.91 b
pollinated four days. after spathe opening	3.07 b	2.20 b	0.67 bc	7.21 c	6.23 c	1.97 ab	0.90 a	0.98 b
pollinated five days after spathe opening	3.37 a	2.41 a	0.81 a	8.85 a	7.77 a	2.10 a	0.90 a	1.08 b
pollinated 7 days after spathe opening	3.22 b	2.12 d	0.68 bc	7.70 bc	6.69 bc	1.98 ab	0.89 a	1.01 b
pollinated ten days after spathe opening	3.19 b	2.17 b	0.69 bc	7.96 bc	6.95 bc	2.00 ab	0.88 a	1.01 ab
pollinated 13 days after spathe opening	3.16 b	2.20 b	0.71 b	8.37 ab	7.39 ab	2.00 ab	0.88 a	0.98 ab
pollinated 15 days after spathe opening	3.12 de	2.18 b	0.65 cd	8.32 ab	7.25 ab	1.95 e	0.87 ab	1.07 a
Control (pollinated by farmer).	2.61	1.73 d	0.37 f	5.18 e	4.31 e	1.80 cd	0.82 bc	0.84 a
SE±	0.05	0.04	0.02	0.26	0.25	0.04	0.02	0.04
Sig.level	***	***	***	***	***	***	***	***

Table 7. Effect of different time of pollination on fruit and seed characteristics of Barakawi at Elgureir (Merowe Province, season 2003).

Treatment	Fruit length (mm)	Fruit width (mm)	Flesh thickness (mm)	Fruit weight (g)	Pulp weight (g)	Seed length (mm)	Seed width (mm)	Seed weight (g)
pollinated at spathe opening	3.15c	1.50d	0.33b	3.71e	3.11f	2.25c	0.65a	0.60b
pollinated one day after spathe opening	3.25	1.61cd	0.35b	4.30c	3.70d	2.24c	0.63a	0.60b
pollinated two days after spathe opening	3.56b	1.63cd	0.33b	4.30c	3.70d	2.43bc	0.63a	0.60b
pollinated three days after spathe opening	4.05a	1.68ab	0.35b	4.83bc	4.25b	2.53b	0.65a	0.58b
pollinated four days after spathe opening	4.15a	1.83a	0.43a	6.15a	5.45a	2.45bc	0.70a	0.70a
pollinated five days after spathe opening	4.2a	1.65bcd	0.42a	4.93b	4.25b	2.70a	0.65a	0.68a
pollinated seven days after spathe opening	3.93a	1.53cd	0.38ab	4.65d	4.62c	2.53b	0.65a	0.53c
pollinated ten days after spathe opening	3.58b	1.50d	0.33b	3.78e	3.28e	2.25c	0.63a	0.50c
Control(pollinated by farmer).	3.25c	1.62cd	0.30b	3.88f	3.38e	2.28bc	0.63a	0.50c
SE±	0.09	0.05	0.03	0.04	0.06	0.06	0.03	0.02
Sig. Level	***	***	*	***	***	***	n.s	*

Table 8. Effect of different time of pollination on fruit and seed characteristics of Barakawi Elgureir (Merowe Province, season 2004).

Treatment	Fruit length (mm)	Fruit width (mm)	Flesh thickness (mm)	Fruit weight (g)	Pulp weight (g)	Seed length (mm)	Seed width (mm)	Seed weight (g)
pollinated at spathe opening	4.19 d	1.82 de	0.39 f	5.14 d	4.21	2.60	0.69	0.93
pollinated one day after spathe opening	4.23 d	1.74 e	0.44 ef	6.42 c	5.48	2.78	0.70	0.95
pollinated 2 days after spathe opening	4.5 dc	1.86 e	0.46 def	6.88	4.89	2.84	0.71	0.99
pollinated three days after spathe opening	4.58 bc	1.86 cde	0.53 bcd	7.31	6.33	2.71	0.70	0.98
pollinated four days after spathe opening	5.08 a	2.13 a	0.62 a	9.16	8.26	3.00	0.69	1.16
pollinated five days after spathe opening	4.71 b	1.99 abc	0.54 bc	7.94	6.60	2.87	0.72	1.09
pollinated seven days after spathe opening	4.61 dc	1.93 bcd	0.47 cde	7.39	6.37	2.86	0.75	1.09
pollinated ten days after spathe opening	5.09 a	2.04 ab	0.58 ab	9.59	8.44	3.05	0.79	1.16
Control(pollinated by farmer).	4.36 cd	1.80 d	0.45 ef	6.52	5.57	2.76	0.69	0.59
SE±	0.11	0.05	0.02	0.34	0.29	0.08	0.02	0.05
Sig. Level	*	***	**	***	***	*	**	**

Table 9. Effects of time of pollination on fruit seed physical characteristics of Barakawi at Elgureir (Merowe Province in season 2005).

Treatment	Fruit length (mm)	Fruit width (mm)	Flesh thickness (mm)	Fruit weight (g)	Pulp weight (g)	Seed length (mm)	Seed width (mm)	Seed weight (g)
pollinated at spathe opening	5.28 e	2.16 c	0.58 d	12.36 cd	11.00 cd	3.31a	0.77 a	1.37 a
pollinated one day after spathe opening	5.34 de	2.21 bc	0.62 d	13.15 c	11.85 c	3.36 a	0.78 a	1.30 a
pollinated two days after spathe opening	5.39 cde	2.32 abc	0.69 c	13.52 c	12.20 c	3.36 a	0.78 a	1.33 a
pollinated three days after spathe opening	5.53 bcd	2.34 abc	0.75 bc	14.81 b	13.45 b	3.38 a	0.80 a	1.36 a
pollinated four days after spathe opening	5.71 ab	2.48 a	0.85 a	15.65 ab	14.26 ab	3.34 a	0.79 a	1.39 a
pollinated five days after spathe opening	5.57 ab	2.35 ab	0.72 c	14.94 b	13.55 b	3.36 a	0.81 a	1.40 a
pollinated seven days after spathe opening	5.77 a	2.39 ab	0.76 bc	16.52 a	15.10 a	3.37 a	0.81 a	1.42 a
pollinated ten days after spathe opening	5.80 a	2.35 ab	0.81 ab	16.80 a	15.40 a	3.32 a	0.81 a	1.40 a
Control(pollinated by farmer).	4.91 f	1.94 d	0.59 d	11.31d	10.01 d	3.44 a	0.78 a	1.30 a
SE±	0.06	0.06	0.02	0.40	0.38	0.11	0.01	0.05
Sig. Level	***	***	***	***	***	NO.Sig	*	NO.Sig

Table 10. Effect of time of pollination on sucrose and total soluble solid (T.S.S) of MWK at Elgureir, 2005 and 2004 .

Treatment	Sucrose% (2005)	T.S.S (2005)	Sucrose% (2004)	T.S.S (2004)
pollinated one day from spathe opening	18.47 d	59.53 d	18.80 e	60.00 e
pollinated two days after spathe opening	20.58 cd	66.47 cd	20.67 cd	67.00 cd
pollinated three days after spathe opening	21.47 bc	70.20 bc	21.07 c	68.27 c
pollinated four days. after spathe opening	22.53 abc	73.47 abc	22.13 b	74.73 b
pollinated five days after spathe opening	24.80 a	81.53a	25.00 a	82.00 a
pollinated seven days after spathe opening	23.73 ab	77.27 ab	23.40 b	76.60 b
pollinated ten days after spathe opening	21.87 bc	71.13 bc	21.00 c	67.67 c
pollinated thirteen days after spathe opening	20.87 bcd	67.47 bcd	19.60 de	62.73 de
pollinated fifteen days after spathe opening	21.00 bcd	68.33 bcd	20.47 cd	64.80 cd
Control (pollinated by farmer).	20.13 cd	64.87 cd	22.60 b	73.40 b
SE±	0.87	3.1	0.39	1.44
Sig. level	**	**	***	***

Table 11. Effects of time of pollination on sucrose and total soluble solid (T.S.S) of Brakawi at Elgrureir (Merowe Province, 2005 and 2004).

Treatment	Sucrose % (2005)	T.S.S (2005)	sucrose%(2004)	T.SS (2004)
pollinated at spathe opening	21.76 ab	70.99 ab	20.75 b	66.93 b
pollinated one day after spathe opening	22.00 ab	71.50 ab	21.08 b	66.93 b
pollinated two days after spathe opening	20.92 abc	67.33 abc	21.12 b	68.33 b
pollinated three days after spathe opening	20.25 bc	64.76 bc	21.42 b	69.13 b
pollinated four days after spathe opening	22.42 a	72.84 a	22.43 a	72.93 a
pollinated five days after spathe opening	21.42 abc	69.58 abc	21.08 b	68.33 b
pollinated seven days after spathe opening	21.08 abc	68.17 abc	21.62 b	69.67 b
pollinated ten days after spathe opening	20.95 abc	67.55 abc	21.55 b	69.47 b
Control(pollinated by farmer).	19.83 c	62.92 c	20.96 b	67.73 b
SE±	0.54	2.01	0.22	0.94
Sig. Level	*	*	**	*

Appendix 1. Metrological Data for Merowi area 2004-2005.

Month	2004				2005			
	Mean temperature		Relative Humidity %	Total Rainfall (mm)	Mean temperature		Relative Humidity %	Total Rainfall (mm)
	Max	Min			Max	Min		
January	28.9	13.0	24	0	27.2	11.3	26	0
February	30.5	13.6	21	0	34.9	17.3	19	0
March	36.1	18.2	14	0	36.1	17.6	13	0
April	40.1	21.	12	0	40.6	22.9	14	0
May	45.2	26.5	11	0	41.8	25.7	14	0.7
June	43.6	26.5	14	TR	44.4	28.1	13	0
July	43.9	21.8	16	1.0	43.1	28.8	27	0.2
August	43.4	28.8	21	TR	43.2	29.2	26	0.4
September	43.4	27.7	17	0	43.1	27.8	18	0
October	40.7	25.2	21	0	40.1	24.9	21	0
November	34.7	19.3	25	0	-	-	-	-
December	29.5	13.7	29	0	-	-	-	-