

Effect of Pollination Times on Fruit Characteristics and Yield of Date Palm cv. Dhakki

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ABSTRACT

Manual pollination of female whorls was carried out at different times of spathe opening *viz.* one day before spathe opening to twenty days after opening on cv. Dhakki, during 2001 and 2002. Maximum fruit setting was recorded when pollinated up to 4 days after spathe opening and it was significantly reduced with pollination beyond six days of spathe opening. Later whorl (W₃) depicted more fruit setting and less fruit drop as compared to the early whorls. Pulp weight was increased with pollination up to eight days after spathe opening. Pollination four days after spathe opening gave maximum fruit yield per bunch. It might be suggested to get the maximum yield date cultivar Dhakki shall be manually pollinated from one day before spathe opening up to 4 or 6 days after spathe opening.

Key Words: Pollination; Times; Yield; Characteristics; Dhakki

INTRODUCTION

Date palm (*Phoenix dactylifera* L.) is highly cross pollinated due to its dioecious nature. For pollinating hundred female plants about four to ten male plants are sufficient. In male, spathe opening starts from December to March while in female it starts from January to end of March. Cultivar Dhakki, being protandrous in nature faces shortage of pollen grains at the time of stigma receptivity. The success of pollination depends upon pollinizers like insects and wind. At pollination insects mostly visit mustard crop instead of date palm due to its attractive flower color. Wind pollination is not effective for longer distances due to low temperature and high moisture content of the pollen grains. Cultivar Dhakki is not giving its potential yield due to lack of pollination and fruit setting, consequently the yield is decreased up to 50 percent (Khan & Ghafoor, 1993).

Artificial pollination is carried out to increase fruit set. Most important factor is delayed stigma receptivity. If pollination is delayed yield is decreased by 70% Dammas (1998) and Moustafa (1998), pollination is manual which is very difficult and has to be repeated several times due to opening of spathe of various whorls at different times. Delay in pollination from exact time decreases the yield. Leding (1928) reported that longer the pollination delayed after opening of the spathe the poorer the fruit set and yield. Albert (1930) reported that pollination should not be delayed longer than three to four days. (Ream & Furr, 1969) stigma has a limited time of receptivity for pollen. Rahim (1975) obtained highest fruit set when pollination was performed within five days after spathe opening in cv. Zaidi. However, pollination of cvs. Barban and Khudrawi can be delayed up to twenty days. Nasir *et al.* (1994) reported that stigma of female flower remains receptive for twenty four

hours then its receptivity decreases. Maximum fruit set (74.04%) and yield (80.00 kg/tree) was obtained when individual spathes were pollinated at opening (Nasir *et al.*, 1997). Attallah *et al.* (1998) pollinated the date palm cultivar Sabbaka and Roushodia and obtained maximum fruit set in both cultivars after 4th day treatment in 1994 and the 2nd day treatment in 1995, respectively. He concluded that pollination should be carried out between the second and fourth day after the spathe cracking. The present study was designed to determine best time for pollination of spathes of various whorls and receptivity of stigma for getting maximum fruit set and yield.

MATERIAL AND METHODS

An experiment was conducted for two successive seasons (February to August) during years 2001 and 2002 at Date Palm Research Orchard, Gomal University, D.I. Khan. Eleven date palm trees of cv. Dhakki of 20 years age and vigorous growth were selected for the study. Three spathe from each first, second and third whorl were selected for pollination. The experiment was planned in split-plot design having eleven treatments as a sub-plot and three whorls as a main plot with three spathes as repeats. Before opening of each spathe bagging of whorl was done by waxy paper (60 × 23 cm). Whorl-wise spathes were pollinated at different times and then again re-bagged to avoid contamination. The detail of treatments is as presented in Table I.

Data on the following parameters were recorded:

Fruit setting percentage. Fruit setting percentage was determined according to El-Makhtoum (1981).

Fruit drop percentage.

Physical characteristics of fruit. Fruit weight (g); Fruit size (cm); Fruit pulp weight (g)

Table I. Detail of the treatments

Treatments	Date of Pollination	
	2001	2002
T ₁ Pollination one day before spathe opening	7 th March	2 nd March
T ₂ Pollination of spathe on it opening day.	8 th March	3 rd March
T ₃ Pollination one day after spathe opening.	9 th March	4 th March
T ₄ Pollination two days after spathe opening.	10 th March	5 th March
T ₅ Pollination four days after spathe opening.	12 th March	7 th March
T ₆ Pollination six days after spathe opening.	14 th March	9 th March
T ₇ Pollination eight days after spathe opening.	16 th March	11 th March
T ₈ Pollination ten days after spathe opening.	18 th March	13 th March
T ₉ Pollination twelve days after spathe opening.	20 th March	15 th March
T ₁₀ Pollination sixteen days after spathe opening.	24 th March	19 th March
T ₁₁ Pollination twenty days after spathe opening.	28 th March	23 th March

Weight of fruits bunch (kg)

Statistical Analysis. The data were analyzed statistically (Steel & Torrie, 1980) and means were separated by LSD.

RESULTS AND DISCUSSION

Fruit setting percentage. Fruit setting %age was significantly affected by manual pollination at different times, however, fruit setting among various whorls was not significantly influenced during two successive years of experiment (Table II). Amongst whorls, maximum fruit setting percentage of 67.97 and 71.51% was recorded in W₃ during 2001 and 2002 respectively, followed by W₁ (2001) and W₂ (2002).

Highest fruit setting (95.33%) was observed in T₄ (2 days after spathe opening) followed by T₂ (spathe opening day), which showed 93.22% fruit setting during 2001. Minimum fruit setting (37.11%) was reported in T₇ (8 days after spathe opening). During 2002, maximum fruit set (93.55%) was found in T₂ followed by T₄, reported fruit set of 93.22%. The lowest fruit set (39.12%) was observed in T₆. The data suggests that maximum fruit set can be

achieved when pollination is done during the first four days of spathe opening. These results are in close agreement with the findings of Nasir *et al.* (1994). Albert (1930) found that for maximum fruit set, pollination should not be delayed longer than 3-4 days. However, flower remains receptive for 24 h only and its receptivity decreases with time but not later than 120 h.

Fruit drop percentage. Pollination of various whorls differed significantly from each other in fruit drop %age. The significantly highest fruit drop (47.09 & 48.90%) occurred in W₁ followed by W₂ and W₃ during both the years (Table III).

The significantly maximum fruit drop of 47.33% was noted in T₅, T₆ and T₁₁ during 2001. The least fruit drop (36%) was observed in T₄ and T₂. During 2002 maximum fruit drop (49%) was found in T₁ and was significantly different from all other treatments, followed by T₈ (44.66%). The T₂, T₃ and T₅ were most effective in reducing fruit drop percentage.

The interactions of female whorls and pollination at different times were significant during both years. The lowest drop fruit (30%) was noticed in W₃ pollination two days after spathe opening during 2001 while the highest fruit drop (55%) was recorded in W₁ pollinated 20 days after spathe opening. During 2002, the minimum fruit drop (30%) was identified in W₃ was pollinated 8 days after its opening and maximum fruit drop (56%) was found in W₁ pollinated 12 days after spathe opening. The results suggest that to avoid fruit drop, the spathe should be pollinated within 4 days after spathe opening. The longer the delay in pollination, the greater will be the fruit drop. Results are supported by Nasir *et al.* (1994; 1997), Albert (1930) and Al-Heaty (1975).

Physical Characteristics of Fruit

Fruit weight (g). Different whorls did not differ significantly with respect to average fruit weight during both

Table II. Effect of pollination times of various whorls of cv. Dhakki on fruit setting percentage, fruit drop percentage average fruit weight and fruit length

Treatments	Fruit setting %age		Fruit drop % age		Average Fruit weight (g)		Fruit length (cm)	
	2001	2002	2001	2002	2001	2002	2001	2002
T ₁	82.889 b	92.999 a	42.000 b	49.000 a	21.756 b	26.129 b	5.245 a	5.189
T ₂	93.222 a	93.556 a	36.333 e	38.667 e	26.267 a	25.511 bc	5.278 a	5.322
T ₃	91.667 a	92.667 a	37.667 de	38.667 e	17.978 c	12.856 e	4.644 b	4.078
T ₄	95.333 a	93.223 a	36.000 e	43.000 b-d	8.889 f	12.500e	3.667 e	4.033
T ₅	82.667 b	88.555 a	47.333 a	39.333 e	17.311c	26.778 b	4.589 b	5.211
T ₆	44.889 de	39.124 d	45.333 a	40.333 de	15.111 d	21.478 d	4.363 cd	5.022
T ₇	37.111 f	52.222 c	38.333 c-e	40.667 c-e	25.178 a	19.311 d	5.333 a	5.078
T ₈	44.111 d-f	53.333 c	39.444 cd	44.667 b	18.356 c	21.048 d	4.500 bc	4.866
T ₉	63.778 c	64.889 b	40.667 bc	43.000 b-d	14.734 e	31.689 a	3.900 d	5.743
T ₁₀	49.889 d	49.222 c	40.222 b-d	44.667 b	14.178 de	22.067 cd	4.022 d	4.922
T ₁₁	41.000 ef	40.111 d	45.000 a	44.000 bc	13.378 de	27.144 b	3.822 de	5.267
<i>F. Whorls</i>	<i>F. Whorls</i>	<i>F. Whorls</i>	<i>F. Whorls</i>	<i>F. Whorls</i>	<i>F. Whorls</i>	<i>F. Whorls</i>	<i>F. Whorls</i>	<i>F. Whorls</i>
W ₁	63.879 N.S	66.64N.S	47.091 a	48.909 a	17.358	22.758 N.S	4.485 N.S	4.991 N.S
W ₂	66.303	69.091	39.778 b	42.182 b	17.385	23.606	4.503	5.039
W ₃	67.970	71.515	35.394 c	36.000 c	17.930	20.882	4.475	4.897
LSD	7.64	8.68	2.61	3.59	1.79	3.91	2.98	-

Table III. Effect of pollination times of various whorls of cv. Dhakki on fruit breadth, fruit pulp weight and fruit yield per bunch at maturity stage

Treatments	Fruit breadth (cm)		Fruit pulp weight (g)		Fruit yield per bunch (Kg)	
	2001	2002	2001	2002	2001	2002
T ₁	2.767	2.944 bc	20.444 bc	24.978 b	5.222 a	4.944
T ₂	2.911	3.122 a	24.956 a	29.900 a	5.222 a	6.104
T ₃	2.477	2.299 e	16.078 c	11.822 e	5.222 a	4.741
T ₄	2.067	2.245 e	7.889 f	11.667 e	5.000 ab	4.622
T ₅	2.555	3.033 ab	16.289c	25.778 b	3.556 cd	3.783
T ₆	2.445	2.867 c	14.089 d	20.078 cd	3.902 b-d	3.651
T ₇	2.867	2.733 d	23.845 a	18.156 d	4.778 a-c	3.781
T ₈	2.489	3.033 ab	17.376 c	21.289 c	3.333 d	2.522
T ₉	2.222	3.133 a	11.845 e	27.066 b	3.222 d	3.364
T ₁₀	2.311	2.533 d	13.111 de	23.333 c	3.667 b-d	2.989
T ₁₁	2.379	2.933 bc	12.389 de	24.034 b	3.445 d	3.813
F. Whorls	F. Whorls	F. Whorls	F. Whorls	F. Whorls	F. Whorls	F. Whorls
W ₁	2.485 N.S.	2.848 N.S	16.212 N.S	21.603 N.S	3.939 N.S	3.634 N.S.
W ₂	2.488	2.830	16.227	22.664	4.579	3.972
W ₃	2.525	2.742	16.191	20.676	4.273	4.404
LSD	0.58	0.13	1.17	2.37	1.22	-

years of study (Table II). The results are supported by findings of Nasir *et al.* (1997), Albert (1930) and Al-Heaty (1975).

Amongst treatments, T₂ produced fruits of maximum weight (26.26 g) during 2001 and by T₉ possessed average fruit weight of 31.689 g. These treatments differed significantly from all others.

The interactive effect of whorl × pollination times was significant during 2001 and non-significant in 2002. The fruit of maximum weight (27.00 g) was achieved when W₃ was pollinated at spathe opening days (T₂) during 2001.

Fruit length. Manual pollination on different whorls of cv. Dhakki did not influence the length of fruits significantly during both years of experiment. However, W₂ in both years contained fruits of maximum length (4.50 cm & 5.03 cm respectively).

Pollination at different times significantly affected fruit length during 2001 but did not exhibit significant affect during 2002. The fruits of significantly greatest length (5.33 cm) were produced when pollination was done 8 days after spathe opening (T₇) followed by T₂ (5.27 cm) during 2001 (Table II).

The cumulative effect of whorls and pollination times was significant in 2001 but non-significant in 2002. The fruits of maximum length (5.40 cm) were recorded when W₃ was pollinated at the day of spathe opening during 2001.

Fruit breadth. Fruits produced by manual pollination of different whorls did not differ significantly with respect to breadth of fruits during both years of study.

Pollination at different times did not affect the breadth of fruit during 2001 while the affect was significant during 2002. Significantly greatest fruit breadth (3.12 cm) was found in T₂ followed by T₉ during 2002. Fruit of smallest breadth (2.24 cm) was reported in T₄ and T₃ (Table III).

The interactive effect of pollination times × whorls was significant during both years. Significantly maximum fruit breadth (3.00 cm & 3.36 cm) was obtained when W₂

was pollinated eight and twelve days after spathe opening (T₇ & T₉, respectively) during 2001. These results were contrary to the findings of Albert (1930) and Leding (1928) who reported maximum fruit set and size when pollination was not delayed longer than 3-4 days.

Fruit pulp weight (g). The fruits pulp weight was not significantly affected when different whorls (W₁, W₂, W₃) were pollinated at different stages of spathe opening during the study period of 2001 and 2002 (Table III).

Different pollination timings significantly affected the fruit pulp weight both the years. During 2001, the maximum fruit pulp (24.95 g) was recorded in fruits obtained from T₂ and T₇. The minimum pulp weight (11.84 g) was observed in fruits obtained from T₉. Similarly during 2002, the highest pulp weight (28.90 g) was achieved from fruits picked from T₂ followed by T₉. The lowest pulp weight (11.67 g) was found in fruits of T₄.

Highest pulp weight (25.66 g) was recorded in fruits belonging to W₃ pollinated on the day spathe opening during 2001. In 2002, the maximum pulp weight (33.73 & 31.88 g) was observed in W₂ and W₃ pollinated on spathe opening day (T₂).

Fruit bunch weight (kg). Fruit yield of different whorls was not significantly affected by pollination at different times during both the years of study (Table III). Pollination at different times significantly affected fruit yield during 2001 but no significant differences were observed during 2002. Maximum fruit yield of 5.22 kg/bunch was obtained at T₁, T₂ and T₃ during 2001. Similarly during 2002, the highest fruit yield of 6.10 kg/bunch was reported at T₂ followed by T₁ (4.94 kg fruit/bunch).

The interactive effect of pollination times and whorls was non-significant during both years of experiment. However, these findings suggest that for achieving maximum yields, the pollination should be conducted on the day of spathe opening or in early period of spathe opening. This supports the finding of Nasir *et al.* (1994) who reported

that the stigma of the female flower remains receptive for 24 hours. Likewise Albert (1930) and Leding (1928) recommended pollination between 3-4 days after spathe opening. Ream and Furr (1969) also reported that palm stigma has a limited receptivity for pollen. However, Al-Heaty (1975) found that the stigmas of Zahidi cultivar remain receptive for 10 days. Similarly, Rashid and Ali (1972) reported that the stigma of female flower remains receptive for several days. Likewise Marzouk *et al.* (2002) reported that receptivity time of Zaghoul and Samany date is till 7 days after spathe opening.

CONCLUSION

It can be concluded from the results that for getting maximum fruit set and yield, the pollination should be done one day before spathe opening up to 4 or 6 days after spathe opening of the Dhakki cultivar of date palm.

REFERENCES

- Albert, D.W., 1930. Viability of pollens and receptivity of pistillate flowers. *Date Growers Inst. Annu. Report*, 7: 5
- Attalla, A.M., M.O. Warring and I.A. Sharaan, 1998. Suitable time of two Saudi date palm cultivars. *Alexandria J. Agric. Res.*, 43: 203
- Duncan, D.B., 1955. Multiple range and multiple F. *Test Biometrics*. 11: 1-42
- Damas, M.O., 1998. Fruit growth and receptivity of pistillate flowers to pollination in two date palm cultivars (*Phoenix dactylifera* L.) *MSc Thesis*, Faculty of Meteorology, Environment and Arid Land Agriculture, King Abdul Aziz University, Riyadh, Saudi Arabia
- El-Makhtoun, F.M.B., 1981. Effect of different pollen types on fruiting and fruit quality in some date varieties. *MSc. Thesis*, Department of Horticulture, Faculty of Agriculture, Al-Azhar University, Egypt
- Khan, H. and A. Ghaffoor, 1993. Improvement and development of date palm production in D.I. Khan. In: *Proc. of Third Symp. on Date Palm in Saudi Arabia*. King Faisal Univ. Alhassa, Saudi Arabia
- Leding, A.R., 1928. Determination of length of time during which flower of the date palm remain receptive to fertilization. *J. Agric. Res.*, 36: 129
- Moustafa, A.A., 1998. Studying on the pollination of the date palms. *The 1st Int. Conf. on Date Palm*. pp: 39-48. Al-Ain, United Arab Emirates. March 8-10: 1998
- Marzouk, H.M.M., A.M. El-Salhy and R.A. Hassan, 2002. Effect of male type and receptivity of pistillate flowers on fruit set and some physical fruit properties. *Proc. Minia 1st Conf. for Agric. and Environmental Sci.*, Minia, Egypt. March 25-28: 2002
- Nasir, M.A., M.I.U. Haq and M.A. Bashir, 1994. How to differentiate male and female spathes and their characters in date palm. *Pb. Fr. J.*, 47: 67
- Nasir, M.A., M.I.U. Haq and M.A. Saeed, 1997. Effect of pollination intervals on yield, fruit setting and other characteristics of Asseel date cultivar. *Sarhad J. Agric.*, 13: 351
- Rahim, A.L. 1975. Studies on pollination of date palm trees in Iraq. The pollination intervals of dates. *Proc of 3rd Int. Date Palm Conf., Baghdad*. 30 Nov. to 4 December, 1975
- Ream, C.L. and J.R. Furr, 1969. The period of receptivity of pistillate flowers and other factors effecting fruit set of date fruit. *Date Growers Institute Report*, 46: 28
- Steel, R.G.D and J.H. Torrie, 1980. *Principles and Procedures of Statistics. A Biometrical Approach*. McGraw Hill Book Co. Inc. New York

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