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Effect of Pollination at Different Times on Fruit Setting, Fruit Drop, Yield and Physical Characteristics of Fruit of cultivar Dhakki under the Agro-climatic Conditions of D.I. Khan-Pakistan

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Abstract

Manual pollination of female whorls (W_1, W_2, W_3) was carried out at different times of spathe opening viz. one day before spathe opening), (on the day of spathe opening), one, two, four, six, eight, ten, twelve, sixteen, and twenty days after opening on cv. Dhakki for two successive years at the Date Palm Orchard of Gomal University, D. I. Khan. The maximum fruit setting was recorded when pollination was carried out at early stages and up to 4 days after spathe opening. Fruit setting was significantly reduced with pollination beyond six days of spathe opening. The fruit setting in later whorl W_3 was more as compared to early whorl W_1. Pollination up to six days after spathe opening reduced fruit drop significantly, Maximum reduction in fruit drop was recorded in later whorls (W_3 & W_2). The fruit weight was also significantly affected by pollination time on different whorls. Fruit size, length and breadth were not significantly affected by Pollinating female whorls at different times. However, fruit pulp weight was significantly influenced. Higher pulp weight was reported with pollination up to eight days after spathe opening. The fruit yield was significantly affected by whorls as well as pollination times. Pollination up to four days after spathe opening gave maximum fruit yield per bunch which differed significantly from all other treatments. The findings suggest that for maximum fruit setting, reducing fruit drop and highest yields, the cv. Dhakki should be manually pollinated one day before spathe opening up to 4 or 6 days after spathe opening.

Key words: Pollination, Dhakki, Agro-climatic conditions, Pakistan

Introduction

Date palm (*Phoenix dactylifera L.)* is highly cross pollinated due to its dioecious nature.

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For Pollinating hundred female plants about four to ten male plants are sufficient. In male, spathe opening starts from December to March while female spathe start opening from January up to the end of March. In case of Dhakki cultivar, its spathe opening is later than the males. Hence, at the time of opening of Dhakki spathe there is shortage of pollen grains. The success of pollination depends upon the pollen transferring agents like insects and winds. During date pollination season insects mostly visit the mustard crop instead of date palm due to attractive color of later crop. In orchards where 50% male population is present there is no need of artificial pollination. In the study area one of the most promising cultivar Dhakki is not giving its potential yield due to the problem of proper pollination and fruit setting. Consequently the yield is decreased up to 50 percent (Khan and Ghafoor. 1993). In order to overcome this problem, artificial pollination is carried out to increase the fruit set which is directly associated with yield. Many factors are responsible for fruit setting problem but the most important factor is female flower receptivity time. With pollination at proper time maximum fruit setting (74.04%) and yield (80.00) kg per palm was obtained. Nasir *et al* (1997). The spathe opening differs whorl-wise, therefore pollination is carried out many times. In cv. Dhakki early whorls spathe emerge in first week of March and open in the second week of March. The mid whorls spathe emerge during the third week of March and opening is normally observed in the last week of March while the third late whorl spathe emerge in the end of March and open in first week of April. The receptivity time of different whorls of the Dhakki had not been determined. There is no proper plantation of male palm in Dhakki orchard for natural pollination. For achieving better yield, pollination is carried out artificially which is very difficult and is repeated several times due to opening of spathe of various whorls at different times. Ream and Furr (1969) observed that palm stigma has a limited time of receptivity for pollen. Rahim (1975) conducted an experiment on six date varieties to determine their best times for pollination. Pollination was performed at different intervals after opening of spathe. Highest fruit set was obtained when pollination was performed within five days after spathe opening.

Nasir *et al* (1994) reported that stigma of female flower in date palm remains receptive for twenty four hours then its receptivity decreases with the passage of time but not later than 120 hours of spathe opening. Attalla *et al* (1998) pollinated the date palm cultivar Sabbaka and Roushodia during second, fourth, sixth and eighth day of cracking of the female spathe and found that pollination during the fourth day in 1994 and the second day in 1995 significantly increased the fruit set percentage. Delaying pollination from the proper time decreases the yield significantly. The present study was designed to determine the optimum time for pollination of spathes of various whorls and receptivity of stigma for pollens for obtaining maximum fruit setting and profitable yield of cv. Dhakki under the agro-climatic conditions of D. I. Khan.

Materials and Methods

This experiment was conducted for two successive seasons from February to August during the 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 whorl was done by waxy paper measuring 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 under:

T_1 Pollination one day before spathe opening
T_2 Pollination of spathe on it opening day.
T_3 Pollination one day after spathe opening.
T_4 Pollination two days after spathe opening.
T_5 Pollination four days after spathe opening.
T_6 Pollination six days after spathe opening.
T_7 Pollination eight days after spathe opening.
T_8 Pollination ten days after spathe opening.
T_9 Pollination twelve days after spathe opening.
T_{10} Pollination sixteen days after spathe opening.
T_{11} Pollination twenty days after spathe opening.

Data on the following parameters were recorded:

1. Fruit Setting Percentage

Fruit setting percentage was determined according to Hamood *et al*. (1986) by the following method.

Ten strands per spathe were selected randomly and then normal fruit set and abnormal fruit set were counted and mean percentage was calculated.

$$\frac{\text{Total Normal Fruit Set - Abnormal Fruit Set}}{\text{Total Fruit Set}} \times 100$$

2. Fruit Drop Percentage

Ten strands per spathe were selected randomly and then total number of fruit at and fruits dropped were counted and percentage fruit drop was calculated on the basis of formula.

$$\frac{\text{Number of fruit dropped}}{\text{Total number of fruit set}} \times 100$$

3. Physical Characteristics of Fruit

i. Fruit Weight (gm)`

Randomly selected ten fruits were weighed in grams by digital balance and mean was calculated.

ii. Fruit Size (Length and width) (cm)

The length and width of the randomly selected ten fruits were measured in cm with the help of vernier calipers and mean was calculated.

iii. Fruit Pulp Weight (gm)

Ten fruits pulp was weighed by electronic balance and then their means were calculated.

4. Weight of Fruits .Bunch (Yield . Bunch) (Kg)

During the month of August at the time of maturity the fruits, from three bunches were picked, weighed and average fruit weight per bunch was calculated.

Statistical Analysis

The data were analyzed statistically by computing Analysis of Variance Techniques (Steel and Torrie, 1980) and separation of mean by LSD using MSTAT computer program.

Results and Discussion

1. Fruit Setting Percentage

The fruit setting %age was significantly affected by manual pollination at different times during both years of study (Table 1 & 2). However, fruit setting among various whorls was not significantly influenced during two successive years of experiment. Amongst whorls, numerically the maximum fruit setting percentage of 67.970 and 71.515% was recorded in W_3 during 2001 and 2002 respectively. It was followed by W_1 and W_2 during 2001 whereas W_2 and W_1 during 2002.

Among different treatments, the significantly highest fruit setting of 95.333% was observed in T_4 (2 days after spathe opening) followed by T_2 (spathe opening day) and T_3 (one day after spathe opening) which showed fruit setting of 93.222 and 91.667%, respectively during 2001. However all the three treatments were statistically similar. The minimum fruit setting of 37.111% was reported in T7 (8 days after spathe opening). During 2002, the significantly maximum fruit set (93.555%) was found in T_2 followed by T_4, T_1 and T_3 reported fruit set of 93.223%, 92.999% and 92.667%. All the four treatments were statistically akin. The lowest fruit set (39.124%) was observed in T_6

which differed significantly from all other treatments. The two years data suggest that maximum fruit set can be achieved when pollination is done during the first four days of spathe opening indicating the maximum receptivity of female stigma. 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 hours only and its receptivity decreases with the passage of time but not later than 120 hours. The interactive effect of female whorls and pollination at different times was not significant during both years of experiment.

2. Fruit Drop Percentage

The data regarding fruit drop percentage as influenced by manual pollination of different whorls at different times are given in Table 1 and 2. The data reveal that pollination of various whorls differ significantly from each other in terms of fruit drop %age. The significantly highest fruit drop (47.091 and 48.909%) occurred in W_1 followed by W_2 and W_3 during both the years.

The significantly maximum fruit drop of 47.333% was noted in T_5 (4 days after spathe opening) followed by T_6 (6 days after spathe opening) and T_{11} (20 days after spathe opening) during 2001. All the three treatments were statistically at par with each other. The least fruit drop of 36% was observed in T_4 (2 days after spathe opening) and T_2 (on spathe opening day). However, both treatments were statistically similar. During 2002 the maximum fruit drop of 49% was found in T_1 (one day before spathe opening) which differed significantly from all other treatments. It was followed by T_8 (10 days after spathe opening) or T_{10} (16 days after spathe opening) both showed 44.667% fruit drop. The T_2 (on opening day), and T_3 (one day after) and T_5 (4 days after) were most effective in reducing fruit drop percentage. All the three treatments were statistically identical. The interactions of female whorls and pollination at different times were significant during both years.

3. Physical Characteristics of Fruit

i. Fruit Weight (g)

Different whorls did not differ significantly with respect to average weight fruit during both the years of study Table 1 & 2. However, numerically the heaviest fruits were produced in W_3 (17.930 g) during 2001 followed by W_2 (17.385 g) and W_1 (17.358 g) whereas during 2002, the heaviest fruits were produced in W_2 (23.606 g) followed by W_1 (22.758 g) and W_3 (20.882 g). The results of 2001 are supported by the findings of Nasir *et al*. (1997) are in agreement with the result of 2002.

Amongst the treatments, T_2 (spathe opening day) produced fruits of maximum weight (26.267 g) during 2001 and by T_9 (12 days after spathe opening) during 2002 which possessed average fruit weight of 31.689 g. These treatments differed significantly from all other treatments. The data varied 9.83% in 2001 and 16.61% in 2001 & 2002 respectively. The interactive effect of whorl × pollination times was significant during 2001 and non-significant in 2002. The fruits of maximum weight (27.000 g) were achieved when W_3 was pollinated at spathe opening days (T_2) during 2001 and by W_2 pollinated 12 days after spathe opening (T_9) in 2002.

ii. Fruit Length (cm)

Manual pollination on different whorls of cv. Dhakki did not influence the length of fruits significantly during both years of experiment Table 1 & 2. However, W_2 in both years contained fruits of maximum length (4.503 cm and 5.039 cm respectively) followed by fruits of W_1 (4.485 cm and 4.991 cm). The W_3 carried fruits of the minimum length (4.475 cm and 4.897 cm). Pollination at different times significantly affected fruit length during 2001 but did not exhibit significant affect during 2002. The fruits of significantly greatest length (5.333 cm) were produced when pollination was done 8 days after spathe opening (T_7) followed by T_2 (5.278 cm) when pollination was carried out at the day of spathe opening and T_1 (5.245 cm) viz. pollination one day before spathe opening during 2001. All the three treatments bore fruits of statistically similar length which differed significantly from other treatments. During 2002 the longest fruits of 5.743 cm produced when female whorls were pollinated 12 days after spathe opening (T_9). It was followed by T_2 and T_{11}. The interactive effect of whorls and pollination times was significant in 2001 but non-significant in 2002.

iii. Fruit Breadth (cm)

The perusal of Table 1 and 2 indicates that fruits produced by manual pollination of different whorls did not differ significantly with respect to breadth of fruits during both years of study. However, fruits of greater breadth were obtained from W_3 (2.525 cm) during 2001 and W_1 (2.848 cm) during 2002.

Pollination at different times did not affect the breadth of fruit during 2001 while the affect was significant during 2002. The fruits of maximum breadth (2.911 cm) were achieved from T_2 (pollination on spathe opening day) followed by T_7 (8 days after opening of spathe) and T_1 (one day before spathe opening) which contained fruits of 2.867 and 2.767 cm breadth respectively during 2001. The fruits of minimum breadth (2.067 cm) were observed in T_4 (2 days after spathe opening). The significantly greatest fruit breadth (3.122 cm) was found in T_2 followed by T_9, T_5 and T_8 respectively during 2002. All the four treatments were statistically alike with regard to fruit breadth. The fruits of smallest breadth (2.245 cm) were reported in T_4 which was statistically similar to T_3.

The interactive effect of pollination times × whorls was significant during both years of experiment. These results were contrary to the findings of Rahim (1975), Albert (1930) and Leding (1928) who reported maximum fruit set and size when pollination was not delayed longer than 3-4 days. The coefficient of variation of data was found as 6.05% and 4.52% during 2001 and 2002 respectively.

iv. Fruit Pulp Weight (g)

The fruits pulp weight was not significantly affected when different whorls (W_1, W_2, W_3) were pollinated at different stages of spathe opening during the study period of 2001 and 2002 (Tables 1 and 2). Numerically the maximum pulp weight of 16.227 and 22.664 g was recorded in W_2 during 2001 and 2002 respectively. It was followed by W_1 and W_3 both the years.

Different pollination timings significantly affected the fruit pulp weight both the years. During 2001, the maximum fruit pulp (24.956 g) was recorded in fruits obtained from T_2 (spathe opening day) which was at par with the pulp weight of fruits collected from T_7 (8 days after spathe opening). The minimum pulp weight (11.845 g) was observed in fruits obtained from T_9 (12 days after spathe opening). Similarly during 2002, the highest pulp weight of 28.900 g was achieved from fruits picked from T_2 followed by T_9 (on the day & spathe opening 12 after spathe opening) and T_1 (one day before spathe opening). The later two treatments differed significantly from T_2 but were statistically similar with each other. The lowest pulp weight of 11.677 g was found in fruits of T_4 (2 days after spathe opening. The collective effect of whorls and different times of pollination significantly influenced fruit pulp weight during both years. The variability in data was 10.08% and 10.43% during 2001 and 2002 respectively.

4. Fruit Yield/Bunch (Kg)

The data regarding fruit yield per bunch as affected by pollination at different times of spathe opening on first three whorls of CV Dhakki are reported in Table 1 and 2. The perusal of data show that fruit yield of different whorls was not significantly affected by pollination at different times during both the years of study. However, numerically the maximum fruit yield of 4.579 kg bunch was recorded in W_2 followed by W_3 (4.273 kg bunch) and W_1 (3.939 kg bunch) during 2001. During 2002, the highest fruit yield of 4.404 kg bunch was obtained from W_3 which was succeeded by W_2 and W_1 producing 3.972 and 3.634 kg bunch fruit respectively. The minimum yield was achieved by W_1 during both years of experiment.

Table 1: Effect of Pollination Times of various whorls of cv. Dhakki on fruit setting percentage, fruit drop percentage, physical characters and yield during 2001.

Treatment Means	Fruit setting %age	Fruit drop %age	Weight of fruit (g)	Length of fruit (cm)	Breadth of fruit (cm)	Weight of pulp (g)	Fruit yield per bunch (Kg)
T_1	82.889 b	42.000 b	21.756 b	5.245 a	2.767	20.444 bc	5.222 a
T_2	93.222 a	36.333 e	26.267 a	5.278 a	2.911	24.956 a	5.222 a
T_3	91.667 a	37.667 de	17.978 c	4.644 b	2.477	16.078 c	5.222 a
T_4	95.333 a	36.000 e	8.889 f	3.667 e	2.067	7.889 f	5.000 ab
T_5	82.667 b	47.333 a	17.311c	4.589 b	2.555	16.289c	3.556 cd
T_6	44.889 de	45.333 a	15.111 d	4.363 cd	2.445	14.089 d	3.902 b-d
T_7	37.111 f	38.333 c-e	25.178 a	5.333 a	2.867	23.845 a	4.778 a-c
T_8	44.111 d-f	39.444 cd	18.356 c	4.500 bc	2.489	17.376 c	3.333 d
T_9	63.778 c	40.667 bc	14.734 e	3.900 d	2.222	11.845 e	3.222 d
T_{10}	49.889 d	40.222 b-d	14.178 de	4.022 d	2.311	13.111 de	3.667 b-d
T_{11}	41.000 ef	45.000 a	13.378 de	3.822 de	2.379	12.389 de	3.445 d
Whorl Means							
W_1	63.879	47.091 a	17.358	4.485	2.485	16.212	3.939
W_2	66.303	39.788 b	17.385	4.503	2.488	16.227	4.579
W_3	67.970	35.394 c	17.930	4.475	2.525	16.191	4.273
CV %age	11.03	5.51	9.83	4.63	6.05	10.08	17.32
LSD for treatment	7.649	2.362	1.794	0.210		1.7170	1.2230
LSD for whorl		2.616	0.776	0.2178			
LSD for interaction		3.83	2.908	0.3522	0.5830	2.784	

Table 2: Effect of Pollination Times of various whorls of cv. Dhakki on fruit setting percentage, fruit drop percentage, physical characters and yield during 2002.

Treatment Means	Fruit setting %age	Fruit drop %age	Weight of fruit (g)	Length of fruit (cm)	Breadth of fruit (cm)	Weight of pulp (g)	Fruit yield per bunch (Kg)
T_1	92.999 a	49.000 a	26.189 b	5.189	2.944 bc	24.978 b	4.944
T_2	93.556 a	38.667 e	25.511 bc	5.322	3.122 a	29.900 a	6.104
T_3	92.667 a	38.667 e	12.856 e	4.078	2.299 e	11.822 e	4.741
T_4	93.223 a	43.000 b-d	12.500 e	4.033	2.245 e	11.667 e	4.622
T_5	88.555 a	39.333 e	26.778 b	5.211	3.033 ab	25.778 b	3.783
T_6	39.124 d	40.333 de	21.478 d	5.022	2.867 c	20.078 cd	3.651
T_7	52.222 c	40.667 c-e	19.311 d	5.078	2.733 d	18.156 d	3.781
T_8	53.333 c	44.667 b	21.048 d	4.866	3.033 ab	21.289 c	2.522
T_9	64.889 b	43.000 b-d	31.689 a	5.743	3.133 a	27.066 b	3.364
T_{10}	49.222 c	44.667 b	22.067 cd	4.922	2.533 d	23.333 c	2.989
T_{11}	40.111 d	44.000 bc	27.144 b	5.267	2.933 bc	24.034 b	3.813
Whorl Means							
W_1	66.640	48.909 a	22.758	4.991	2.848	21.603	3.634
W_2	69.091	42.182 b	23.606	5.039	2.830	22.664	3.972
W_3	71.515	36.000 c	20.882	4.897	2.742	20.676	4.273
CV %age	11.97	8.08	16.61	19.53	4.52	10.43	15.51
LSD for treatment	8.687	3.595	3.912		0.133	2.3710	
LSD for whorl		8.687					
LSD for interaction		5.830			0.215	3.845	

Pollination at different times significantly affected fruit yield during 2001 but no significant differences were observed among the treatments during 2002. The maximum fruit yield of 5.222 kg bunch was obtained when pollination was done one day before spathe opening (T_1), pollination on spathe opening day (T_2) as well as one day after spathe opening (T_3) during 2001. All the treatments were statistically alike but differed significantly from all other treatments except T_4 (2 days after spathe opening) and T_7 (8 days after spathe opening), which yielded 5.000 and 4.778 kg fruit bunch respectively. Similarly during 2002, the highest fruit yield of 6.104 kg bunch was reported when pollination was carried out on spathe opening day (T_2) followed by T_1 (one day before spathe opening) and T_3 (one day after spathe opening) which yielded 4.944 and 4.471 kg fruit bunch. The interactive effect of pollination times and whorls was non-significant during both years of experiment. 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 has also been supported by the finding of Nasir *et al.* (1994) who reported that the stigma of the female flower remains receptive for within 24 hours. Attalla *et al.* (1998) recommended pollination between 3-4 days after spathe opening.

References

Attalla, A.M., Warring, M.O. and Sharaan, I.A. Suitable time of two Saudi date palm cultivars. Alexandria J. Agri. Res., 1998. 43(3):203-208.

Duncan, D.B. Multiple range and multiple F-Test. Biometrics, 1955. 11:1-42.

Hamood, H.H., Mawlood, E.A. and Khafaji, M.A. The effect of mechanical pollination on fruit set, yield and fruit characteristics of date palm Zahidi cultivar. Date Palm Journal, 1986. 4(2):175-186.

Khan, H. and Ghaffoor, A. Improvement and development of date palm production in D. I. Khan. Proc. of Third Symp. on Date palm in Saudi Arabia. King Faisal Univ. Alhassa, Saudi Arabia, 1993. (1):349-359.

Nasir, M.A., Haq, M.I.U. and Bashir, M.A. How to differentiate male and female spathes and their characters in date palm. Pb. Fr. J., 1994. 47(1-4):67-71.

Nasir, M.A., Haq, M.I.U. and Saeed, M.A. Effect of pollination intervals on yield, fruit setting and other characteristics of Asseel date cultivar. Sarhad J. Agric., 1997. 13(4):351-355.

Rahim, A.L. Studies on pollination of date palm trees in Iraq. The pollination intervals of dates. Proc of third International Date Palm Conference, Baghdad. 1975. 30 November-4 December.

Ream, C.L. and Furr J.R. The period of receptivity of pistillate flowers and other factors effecting fruit set of date fruit. Date growers institute Report (1969). (46):28-29.

Steel, R.G.D and Torrie. J.H. Principles and procedures of statistics. McGraw Hill Book Co. Inc. New York. 1980.