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# EFFECT OF POLLINATION TIME ON YIELD AND QUALITY OF DATE FRUIT

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## ABSTRACT

The effects of pollination at different day time in date cv. Dhakki were investigated at Date-palm Research Orchard, Gomal University Dera Ismail Khan during 2008-2009. The six spathes on the selected Dhakki trees were pollinated at one hour interval from 8 am to 4 pm. Data were recorded for fruit set (%), fruit weight (g), fruit length (cm), fruit breadth (cm), fruit drop (%) and yield (kg). Pollination at different day time had significant effect on the fruit setting and other quality parameters. The highest fruit set of 91% and 89.87%, fruit weight of 18.00 g and 18.34 g, fruit length of 4.75 cm and 4.72 cm and fruit thickness of 2.89 cm and 2.61 cm in both years were recorded when pollination was carried out at 12:00 pm. A consistent trend was observed during the two years. Pollination carried out at 12:00 pm found to be the most effective for getting better yield, fruit setting and fruit size. In addition, positive and significant correlation was observed among different parameters, which can provide basis for further improvement in yield and quality of dates.

**Key words:** Dhakki, Pollination Time, Fruit Set, Fruit Drop, Yield Traits.

## INTRODUCTION

Date palm (*Phoenix dactylefera* L.) is the third major fruit crop of Pakistan and commercially grown in many parts of the country. Many exotic and local varieties are grown in this area. Dhakki is a local variety is extensively grown due to its attractive colour, high yielding, extra large size and keeping quality. Its yield is severely affected by natural way of pollination (Khan and Ghaffoor, 1993). Manual pollination is considered essential for commercial yield (Hussain *et al.* 1984) and it helps in improving the yield and quality (Beacher *et al.* 1999). Many factors are responsible for artificial pollination success (Atalla *et al*.1998). Amongst them pollination time is considered an important factor affecting fruit production of date palm as reported by various researchers (Khalifa *et al.* 1980; Elksas *et al.* 1996; Nasir *et al.* 1997; Iqbal *et al.* 2004 and Daud and Ahmed, 2008). Efficient pollination is localized with the period when pollen could fertilize the ovule. It depends upon the ovule longevity as well as on growth speed of pollen tube. Pollen grains germination is closely related with environmental factor and stigma receptivity (Ruther and Crawford, 1964). The pollen tube germination depends upon temperature, which is highly susceptible to low and high temperature results poor germination of pollen grains (Albert, 1930; Ream and Furr, 1968). Pollination at early and late hours has some negative effects on fruit set. In this area pollination is done whole day by grower. But they are unaware of the best time of pollination at day time. The present study was designed to elucidate the best day pollination time for increasing the yield of cv. Dhakki in Dera Ismail Khan.

## MATERIALS AND METHODS

An experiment was conducted for two successive seasons (March~August) during year 2008 and 2009 at Date Palm Research Orchard, Gomal University, Dera Ismail Khan. Twenty seven date palm trees of cv. Dhakki possessing 28 years age and vigorous growth were selected for the study.

Six female spathes were randomly selected on each tree for recording of parameters. The pollination dates were 20$^{th}$ March and 22$^{nd}$ March in 2008 and 2009, respectively on whole spathes of tree. The pollination was conducted on well sunny day after two days of spathe opening. Single male mature spathes were cut soon sheath crack appeared at the top of spathe. The protective spathe sheet was removed and the inflorescence strands were separated. Male strands were excised and placed on the female flower cluster to facilitate pollination. Bagging was done to avoid contamination ( Iqbal *et al.* 2004; Asif *et al.* 1983 and Shabana *et al.* 1985).

The experiment was designed in Randomized Complete Block Design (RCBD) having 9 pollination times with 3 replications. All the standard cultural practices were done during the course of this study. The detail of the treatments is as under:

T1 = Pollination at 8:00 AM
T2 = Pollination at **09:00 AM**
T3 = Pollination at 10:00 AM
T4 = Pollination at 11:00 AM
T5 = Pollination at **12:00 PM**

T6 = Pollination at 01:00 PM
T7 = Pollination at 02:00 PM
T8 = Pollination at 03:00 PM
T9 = Pollination at 04:00 PM
Data on the following parameters were recorded

**Fruit Set Percentage:** Ten strands per spath were selected for recording of abnormal and normal fruit set. Fruit setting percentage was calculated by using the following formula:

$$\frac{\text{Total number of normal fruit set - Number of abnormal fruit set}}{\text{Total number of fruits}} \times 100$$

**Fruit Drop Percentage:** Fruit drop percentage was calculated by using the following formula:

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

**Single fruit weight (g)**: To determine single fruit weight, 20 fruits were weighed on electric balance and mean fruit weight was calculated.

**Fruit length (cm)**: The fruit length (cm) of dates was recorded for 20 fruits using vernier caliper and then means fruit length was calculated.

**Fruit thickness (cm)**: The fruit thickness (cm) of dates was recorded for 20 fruits using vernier caliper and then means fruit thickness was calculated.

**Fruit yield tree$^{-1}$ (kg)**: All the fruit bunches from each treatment were weighed and finally mean yield per tree (kg) was computed.

**Statistical Analysis:** The data was statistically analyzed by computing Analysis of Variance as described for comparison of mean using (MSTAT) computer program.

## RESULTS AND DISCUSSION

**Fruit Set (%):** Significant differences among different pollination times were observed for fruit set (%) in dates cv. Dhakki (Table 2). In general, an increase in fruit setting was observed with the increase in pollination time from 8 am to 12 pm and then a decline in fruit set was observed upto 4 pm. It was followed by 1:00 pm and 11:00 am (90.00 & 88.67%) and (87.67 & 87.68%). The lowest fruit set percentage were observed in 8:00 am pollination in both years (72.00 & 74.00 %). Perusal of Table 1 revealed that temperature and humidity have a tremendous role on the pollen life as well as pollen tube growth that lead successfulness of fertilization process. The highest fruit set recorded was 91% (2008) and 89.67% (2009) when pollination was carried out at 12:00 pm in both years as indicated in Table 2. In a similar study, Daud and Ahmad (2008) also reported high fruit setting when pollination performed at 12.00 pm. However, Albajalani *et al*. (1989) reported that pollination at three times (morning-noon-afternoon) had no significant effect on fruit set in cv. Sukhari.

**Fruit Weight:** The single fruit weight of Dhakki was significantly affected by different pollination times during both the years (Table 2). The lowest fruit weight was observed when pollination was done at 8 am and 4 pm. They also observed pollination at 12 O' clock produced dates with higher weight. The heaviest fruit of 18 g and 18.34 g observed during 2008 and 2009, respectively, probably, various physiological process get optimum conditions which results in high fruit set and heavy dates. The study conducted by Nasir *et al.* (1997) and Rahim (1975) also supported present findings.

**Fruit Length:** The data pertaining to fruit length as affected by various pollination times has displayed significant differences during the two years (Table 2). Intermittent results were revealed against various pollination times without any specific trend. The longest fruits of 4.75 cm (2008) and 4.72cm (2009) were recorded for fruits that developed in response to pollination at 12 PM. The minimum fruit length of 3.93 cm was recorded against pollination at 4 pm in 2008 while in 2009 the lowest fruit length of 4.16 cm was noted pollination at 8 am. Attalla ***et al***. (**1998**) are also of the view that fruit length is varied as per pollination day time.

**Fruit Thickness:** Varying pollination times has significantly affected fruit thickness of cv Dhakki (Table 3). It was observed that there was irregular trend in fruit thickness upto pollination at 11:00 am, and later on a decline in fruit thickness was observed in both the years on pollination at 12:00 pm to pollination at 04:00 pm. A certain relationship, yet to explore, existed in rest of treatments that resulted in loss of fruit weight. The thickest fruit was observed at pollination at 12:00 pm when pollination was done at 12 pm during both the years. It was followed by 2 pm (2.75cm) in 2008 and 10am (2.68cm) in 2009. The fruits with minimum diameter were observed when pollination was conducted at 4 pm in both the years. In another study, Iqbal (2004) also reported a significant trend in fruit thickness and varying pollination times.

These results confirmed the finding of the Shafiq *et al.* (2011). They reported that pollination frequency had no significant effect on fruit breadth but are contrary to finding of Iqbal *et al.* (2004) and Rahim (1975). They reported that pollination time significantly affect on fruit breadth.

**Fruit Drop:** Table 3 revealed that the pollination at different day time did not significantly influence fruit drop. The maximum fruit drop (66.67 in 2008 and 65.34 in 2009) was noted when pollination was done at 8am, followed by 9 am. The minimum fruit drop of 59.34% and 59.67% was observed when the pollination done at

12 pm in 2008 and 2009, respectively. The results contrary to the previous findings of Iqbal *et al.* (2004), who reported that pollination at different time significantly affected the fruit drop.

**Yield per tree (kg):** Different pollination times have displayed a significant variation for fruit yield which ranged from 56.33 kg to 88 kg and 58 kg to 91.3 kg in 2008 and 2009 respectively (Table 3). Fruit yield against each pollination time has shown an increasing trend upto pollination at 12:00 pm, which sequentially declined with the increment in time interval upto pollination at 04:00 pm . The highest fruit yield (88.0 kg) was observed at pollination at 12:00 pm and it was at par statistically with pollination at 11:00 am, pollination at 01:00 pm and pollination at 02:00 pm. The lowest yield (56.33 kg) was observed at pollination at 08:00 am . Similar trend was observed during 2009. The past findings worked out by Nasir *et al*. (1997) were also on the analogy of present study.

Table 4 revealed cumulative mean values regarding effect of different day time pollination on fruit set, fruit weight, fruit thickness, fruit drop percentage and yield during 2008 and 2009 of Dhakki date. Maximum fruit set (90.34%) in 12pm and minimum fruit set (73.00%) at 8 am was observed. While maximum fruit weight (18.17 g) in 12pm and minimum fruit weight (13.50 g) at 4 pm was noted. Whereas lengthiest fruit (4.74 cm) in 12pm and shortest fruit (3.78 cm) at 4 pm was observed. Maximum fruit thickness (2.80 cm) in 12 pm and minimum fruit thickness (2.38 cm) at 4 pm was noted. Highest fruit drop (66.00 %) in 8 am and minimum fruit drop (59.34 %) at 10 am was recorded. While highest fruit yield (89.50 kg tree$^{-1}$) in 12pm and lowest fruit yield (57.17 kg tree$^{-1}$) at 8 am was observed. The similar study was undertaken by Iqbal *et al*. (2004).

To have a better understanding of the data set and mutual relationships, correlation coefficients were computed for different parameters investigated. A positive and significant association among fruit set, fruit weight, fruit length & width and fruit yield have been recorded (Table 5). However, fruit drop has shown a negative association with all parameters studied.

**Table 1. Cumulative Mean (2008 and 2009) of monthly temperature ($^{o}$C), humidity (%) and precipitation**

| Months | Temperature ($^{o}$C ) | | | Humidity (%) | Precipitation (mm) |
|---|---|---|---|---|---|
| | Maximum | Minimum | Mean | | |
| February | 19 | 8 | 13.5 | 69 | 7.00 |
| March | 24 | 14 | 19.0 | 63 | 4.40 |
| April | 30 | 19 | 24.5 | 59 | 36.13 |
| May | 41 | 24 | 32.5 | 58 | 20.16 |
| June | 42 | 26 | 34.0 | 52 | 12.11 |
| July | 44 | 29 | 36.5 | 57 | 32.14 |
| August | 39 | 26 | 32.5 | 58 | 35.13 |

**Table 2. Effect of different day time pollination on fruit set, fruit weight and fruit length in 2008 and 2009 of Dhakki date.**

| Treatments | Day Pollination Time | Fruit set (%) | | Fruit weight (g) | | Fruit length (cm) | |
|---|---|---|---|---|---|---|---|
| | | 2008 | 2009 | 2008 | 2009 | 2008 | 2009 |
| T 1 | 8am | 74.00d | 72.00e | 14.33bc | 14.34 | 4.00 | 4.16cd |
| T 2 | 9am | 83.67 bc | 84.33c | 14.00c | 14..00 | 4.48 | 4.64ab |
| T 3 | 10am | 85.33ab | 86.67a-c | 17.00ab | 17.68 | 4.37 | 4.30b-c |
| T 4 | 11am | 87.67ab | 87.67a-c | 17.00ab | 16.00 | 4.50 | 4.52a-c |
| T 5 | 12pm | 91.00a | 89.67a | 18.00a | 18.34 | 4.75 | 4.72a |
| T 6 | 1pm | 90.00ab | 88.67ab | 17.00ab | 17.34 | 4.70 | 4.71a |
| T 7 | 2pm | 85.33ab | 88.33ab | 17.33ab | 18.00 | 4.64 | 4.69a |
| T 8 | 3pm | 77.67cd | 85.67bc | 16.00a-c | 14.00 | 4.07 | 4.18cd |
| T 9 | 4pm | 75.33d | 79.00d | 14.00c | 13.00 | 3.93 | 4.17d |
| LSD | | 6.77 | 3.59 | 2.83 | NS | NS | 0.385 |

A common trend was found that a proportionate increase observed for fruit setting percentage and fruit yield with the increase in pollination time from 8 am to 12 pm, however, further increment in pollination time (1pm~4 pm) yielded a gradual decrease in the respective parameters.

A positive relationship between fruit set percentage and fruit yield (kg) was observed that of

course is understandable. However, rest of quality attributes like fruit size and single fruit weight have yielded varying responses against different pollination times. Perusal of the above data set provided an insight to determine/identify suitable pollination time, which in this case was around 12 pm. This study, apart from other studies, whether supportive or contradictory to our findings, provided useful information in general and to this region in particular. Though cumulative response of genotypes x environment varies for genotype to genotype, however, this study has provided a basis and time frame, which can be adopted with proper modification through experiments for other genotypes and other date palm growing regions. As an important component of such studies, the underlying phenomenon and physiological processes that affect yield and other fruit quality attributes are needed to be investigated.

**Table 3. Effect of different day time pollination on fruit thickness, fruit drop and yield in 2008 and 2009 of Dhakki date.**

| Treatments | Day Pollination Time | Fruit thickness (cm) | | Fruit drop (%) | | Yield (kg tree$^{-1}$) | |
|---|---|---|---|---|---|---|---|
| | | 2008 | 2009 | 2008 | 2009 | 2008 | 2009 |
| T 1 | 8am | 2.55 | 2.49 | 66.67 | 65.34 | 56.33d | 58.00 |
| T 2 | 9am | 2.51 | 2.48 | 65.67 | 65.34 | 64.33cd | 64.00 |
| T 3 | 10am | 2.70 | 2.68 | 60.00 | 58.67 | 70.00bc | 73.00 |
| T 4 | 11am | 2.71 | 2.63 | 64.32 | 63.34 | 83.00a | 83.68 |
| T 5 | 12pm | 2.89 | 2.71 | 59.34 | 59.67 | 88.00a | 91.34 |
| T 6 | 1pm | 2.75 | 2.62 | 63.67 | 62.34 | 86.33a | 87.00 |
| T 7 | 2pm | 2.62 | 2.53 | 64.00 | 63.67 | 86.67a | 86.67 |
| T 8 | 3pm | 2.48 | 2.44 | 63.34 | 64.67 | 79.67ab | 81.34 |
| T 9 | 4pm | 2.37 | 2.38 | 63.67 | 62.00 | 58.00d | 61.00 |
| LSD | | NS | NS | NS | NS | 10.80 | NS |

**Table 4. Effect of different day time pollination on fruit set, fruit weight, fruit thickness, fruit drop percentage and yield in kg tree-1 as cumulative mean values during 2008 and 2009 of Dhakki date.**

| Treatments | Fruit set (%) | Fruit weight (g) | Fruit length (cm) | Fruit Thickness (cm) | Fruit drop (%) | Yield (kg/tree) |
|---|---|---|---|---|---|---|
| T 1 | 73.00 | 14.34 | 4.08 | 2.52 | 66.00 | 57.17 |
| T 2 | 84.94 | 14.00 | 4.56 | 2.50 | 65.50 | 64.16 |
| T 3 | 86.00 | 17.34 | 4.34 | 2.69 | 59.34 | 73.00 |
| T 4 | 87.67 | 16.50 | 4.51 | 2.67 | 63.83 | 83.00 |
| T 5 | 90.34 | 18.17 | 4.74 | 2.80 | 59.50 | 89.50 |
| T 6 | 89.34 | 17.17 | 4.71 | 2.69 | 63.00 | 86.87 |
| T 7 | 86.83 | 17.67 | 4.67 | 2.58 | 63.83 | 86.67 |
| T 8 | 81.67 | 15.00 | 4.13 | 2.46 | 64.00 | 80.86 |
| T 9 | 77.17 | 13.50 | 3.78 | 2.38 | 62.83 | 59.50 |

**Table 5. Simple correlation among different parameters in Date cv. Dhakki**

| Parameter | Fruit set (%) | Fruit weight (g) | Fruit length (cm) | Fruit thickness (cm) | Fruit drop (%) |
|---|---|---|---|---|---|
| Fruit weight | 0.821 | - | - | - | - |
| Fruit length | 0.884 | 0.731 | - | - | - |
| Fruit thickness | 0.772 | 0.884 | 0.721 | - | - |
| Fruit drop | -0.542 | -0.647 | -0.274 | -0.629 | - |
| Yield | 0.859 | 0.838 | 0.733 | 0.677 | -0.404 |

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