



## Effect of pollination time to improve physicochemical characteristics of 'dhakki' dates

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### Abstract

To assess the effects of different pollination times to improve physicochemical characteristics of Dhakki table dates, an experiment was conducted during 2012 and 2013 at Date Palm Research Orchard of Gomal University Dera Ismail Khan Khyber Pakhtunkhwa-Pakistan. The experiment was comprised of seven different treatments of pollination times i.e., at 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup>, 6<sup>th</sup> and 8<sup>th</sup> days after spathe cracking and carried out in RCB Design having three replications. Single pollen source was used for pollination by inserting 3 male strands into the female spathe respectively. Different variables were recorded during the experiment that included fruit set (%), days to fruit set, fruit drop (%), days to maturity, Physicochemical characteristics and fruit yield (kg/tree). The results indicated that pollination times had a significant effect on all the parameters studied. Maximum fruit set (91.15, 90.15 %) and fruit yield (86.82, 87.15 kg palm<sup>-1</sup>) for both years were recorded when pollination was carried out on the 2<sup>nd</sup> day after spathe cracking. In delaying pollination average values of these parameters decreased. However, in late pollination at 8<sup>th</sup> days of spathe cracking produced maximum fruit length (4.26, 4.27 cm), fruit weight (21.20, 20.95 gm), and total sugars (17.91, 17.94 %). Based on these findings it can be suggested that pollination on the 2<sup>nd</sup> day after spathe cracking is the most effective for getting maximum fruit set and economical yield of Dhakki date palm cultivar.

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## Introduction

Date palm (*Phoenix dactylifera* L.) is olden fruit trees and is cultivated for its commercial use throughout various countries of the World. It can be grown in Egypt, Islamic Republic of Iran, Saudi Arabia, Northern Africa, Pakistan, India and the various state of USA. Pakistan stands at the 7<sup>th</sup> position in producing date in the world (FAO, 2017). In case of failure of pollination, triplicate parthenocarpic fruits are developed that have no marketable value of commercial purpose (Atalla *et al.*, 1998). The success of artificial pollination is dependent on the stigma reception time so that pollen can easily fertilize the ovule (Daud and Ahmed, 2008). If pollination is delayed from the exact time yield is reduced up to 50% (Iqbal *et al.*, 2004).

The significance of pollination time for enhancement of yield and quality of different date palm cultivars have been investigated by various. Pollination before one to two days before spathe cracking is suitable pollination time for getting maximum fruit set and yield in 'Barhee' and 'Zahedi' date's cultivars (Marshee, 2011). Similarly, earlier spathe cracking is suggested the best time for a quality and yield enhancement in 'Madhjoor' and 'Gulistan' date palm cultivars (Rahanma and Rahkhodaeij, 2014; Iqbal *et al.*, 2017).

Similarly, 'Rothana' date increased fruit set in early pollination with an increase in fruit yield but show an adverse effect on the fruit quality (Ahmad *et al.*, 2013). Mohammadi *et al.*, (2017) determined that the best pollination time of 'Barhee' date when pollens were applied on the 2<sup>nd</sup>-day after spathe cracking. Howladar *et al.*, (2015) observed the highest yield in cvs Khalas, Sukary, Ruziez, Sheshi and Sagae when pollinated on 8<sup>th</sup> days after spathe cracking, Zaid (1999) and Hassan *et al.*, (2002) reported that pollination can influence yield at 9 days after spathe cracking (Al-bajallani *et al.*, 1989) reported that pollination can effective till 10 days after spathe cracking in Khalas date. Ahmed *et al.*, (2016) reported similar results in various other cultivars. Zirari (2012) reported that date palm 'Najda'

enhanced the number of fruit set when pollinated after 15 days of spathe cracking.

Amongst local cultivar, Dhakki ranks at the first position due to its larger size and is superior in terms of its nutritive value than all other cultivars (Iqbal *et al.*, 2011).

The general pollination practice is to apply pollen several times after spathe cracking manually or mechanically which is a laborious and expensive job and the pollen most quantities are used especially in mechanical pollination. Because this pollination practice is repeated several times. Although some research work is conducted regarding the pollination times of date palm cultivars present in the area particularly 'Dhakki' but still there is some deficiency regarding fruit physical and chemical characteristics. Due to this reason the present study was conducted to determine the suitable pollination time and its effect on yield and yield components of date palm promising cultivar.

## Materials and methods

This experiment was conducted for two consecutive seasons of 2012-2013 (March-August) at Extension Farm of Agriculture Department, Dera Ismail Khan-Khyber Pakhtunkhwa, Pakistan. For assessments, 21 representative female cultivars of Dhakki having 20-23 years of age with vigorous growth were selected.

Male spathes from selected healthy male trees were cut and used at the time of spathe cracking. Spathe cracking is a sign of releasing pollen grain for pollination. Spathe contains strands. After removing protective spathes sheath, strands were separated, packed in an airtight glass jar and then stored in a household common refrigerator at 4°C. The process of pollination was practiced by inserting 3-4 male strands into female spathes at 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup>, 6<sup>th</sup> and 8<sup>th</sup> days after spathe cracking. The experiment was laid out in randomized complete block design with three replications. Before and after pollination spathes were bagged with waxy paper to avoid natural pollination. These bags were removed 2-3 weeks after

pollination. All the practices like fertilizer application, irrigation, and weed-control disease management were carried out according to the local practices used.

#### *Fruit set (%)*

After 4 weeks of pollination fruit set data were recorded as per the procedure described by El-Makhtun (1981). Fruit set percentage was calculated by counting (Fertilized) and (Un-fertilized) fruits of 10 strands per spathe using the following formula.

Fruit set (%) = No. of normal fruit – No. of abnormal fruit x 100/Total No. of fruits.

#### *Fruit weight (g)*

Twenty fruits randomly of each treatment were weighed (electric balance) and average fruit weight was calculated in grams.

#### *Fruit size (cm)*

The size (length and breadth) of twenty fruits randomly from each treatment was assessed using a measuring scale in centimeter and the mean size of fruit was calculated.

#### *Fruit drop (%)*

It was calculated using the formula described by (Iqbal *et al.*, 2004). Percent fruit drop was determined.

#### *Fruit drop (%)*

No of fruit drops x 100 / Total no of fruits set.

#### *Days to maturity*

The days to maturity were counted on turning of 50% fruit color as yellow in each tree and then were calculated.

#### *Moisture (%)*

It was determined as procedure adapted by AOAC (2005) with using oven drying method. The moisture content was determined using the following formula:

Moisture percentage = Loss in weight/ Weight of sample x 100.

#### *Fruit yield per tree (kg)*

Mean yield per tree (kg) was calculated by harvesting all fruit bunches from each tree and weighed.

#### *Total Soluble Solids (Brix)*

TSS was determined by hand refractometer as per AOAC (2005).

#### *Total sugars*

These were assessed by Lane and Annon method as described by AOAC (2005).

#### *Statistical analysis*

Data were statistically analyzed with the help of statistics 8.1 software. The significance of treatments was assessed with the help of ANOVA. Means were separated by following Least Significant Difference (LSD) test (Steel *et al.*, 1997).

## **Results and discussion**

#### *Fruit set (%)*

The highest fruit set (91.15, 90.15 %) was recorded when pollination was carried out at 1<sup>st</sup> day after spathe cracking. The lowest fruit set (45.14, 44.83 %) was observed at 8<sup>th</sup> days of spathe cracking (Table 2). The highest fruit set in early pollination is due to the peak time of stigma receptivity for pollen tube development to stimulate fertilization in the ovary (Nasir *et al.*, 1994).

**Table 1.** Detail of cultivar used with different pollination times is as follows.

Cultivar used	Pollination times
	1 <sup>st</sup> day after spathe cracking
	2 <sup>nd</sup> day after spathe cracking
	3 <sup>th</sup> day after spathe cracking
Dhakki	4 <sup>th</sup> day after spathe cracking
	5 <sup>th</sup> day after spathe cracking
	6 <sup>th</sup> day after spathe cracking
	8 <sup>th</sup> day after spathe cracking

The following parameters were included in the study.

These results partially agree with the findings of Iqbal *et al.*, 2017, who recorded the highest fruit set in Gulistan date palm when pollination was carried out at spathe cracking day. These results are contradictory with the findings of Mohammadi *et al.*,

2017; they reported maximum fruit set in 'Barhee' date pollinated on the 2<sup>nd</sup> of spathe cracking. El-Salheyet *et al.*, (2011) reported the highest fruit set in 'Sewy' date palm who pollinated at 3<sup>rd</sup> day of spathe cracking.

**Table 2.** The effects of pollination time on fruit set, fruit weight and fruit length of 'Dhakki' dates during 2012 and 2013.

Treatments	Fruit set (%)		Fruit weight (g)		Fruit length (cm)		
	2012	2013	2012	2013	2012	2013	
Days after spathe cracking	1 <sup>st</sup> day	91.15a	90.12a	18.11b	18.14d	4.15b	4.15b
	2 <sup>nd</sup> day	90.15ab	90.14a	18.13b	18.15d	4.18ab	4.20ab
	3 <sup>th</sup> day	90.14ab	90.13a	18.46b	18.54cd	4.18ab	4.22ab
	4 <sup>th</sup> day	87.78b	69.94b	19.17b	19.50bd	4.24ab	4.22ab
	5 <sup>th</sup> day	69.44c	60.12c	21.14a	19.83a-c	4.24ab	4.24a
	6 <sup>th</sup> day	62.45d	44.83d	21.17a	20.82a	4.26a	4.25a
	8 <sup>th</sup> day	45.14e	1.39	21.20a	20.95a	4.26a	4.27a
	LSD	1.06	1.39	1.15	1.42		

Means followed by the similar letter(s) are non-significantly different at  $\alpha = 0.05\%$ .

#### Fruit weight (g)

Maximum fruit weight (21.20, 20.95 g) was recorded when pollination was carried out after the 8th days of spathe cracking. On the other hand, minimum fruit weight (18.11, 18.14 g) was recorded with pollination 1<sup>st</sup> day after spathe cracking (Table 2). These results might be due to decreased fruit set and maximum fruit size obtained on account of delayed pollination. This in turn has a positive impact on fruit size due to increase food supply to the growing fruit as a whole (Elhamet *et al.*, 2006. These results are online with the findings of Iqbal *et al.*, 2017; Ahmad *et al.*, 2016; and Marzouket *et al.*, 2002, they reported that fruit weight was improved when pollination was delayed and are contradictory to Mohammadi *et al.*, (2017) they recorded maximum fruit weight on spathe cracking day in 'Barhee' dates.

#### Fruit length (cm)

Maximum fruit length (4.26, 4.27 cm) was produced with pollination performed after 8th days of spathe cracking. Pollination on 1-4<sup>th</sup> day after spathe cracking produced the shortest fruit during both years of study (Table 2). The decrease in fruit length due to early pollination might be due to the highest fruit set

at the expense of reduced accumulation of carbohydrates to the individual fruit due to increased competition. These results agree with the findings of Abdel-Galil *et al.*, 2007) they reported that delaying pollination significantly improved fruit length. Similar results were reported by Iqbal *et al.*, 2017.

On the other hand, these results are contrasted to the findings of Mohammadi *et al.*, 2017, they reported the lengthiest fruit on spathe cracking day in 'Barhee' dates.

#### Fruit width (cm)

Maximum fruit width (2.84 and 2.87 cm) was observed when pollination was carried out on the 8th day after spathe cracking. Minimum width (2.19 and 2.20 cm) was recorded when trees were pollinated on the first day of spathe cracking in both years (Table 3). In the case of late pollination fruit set significantly reduced and fruit drop increased. As the reduction in the number of fruit on the tree, positively affect the fruit size (Dejerbi, 1995) The results are in agreement with the findings of Ahmad *et al.*, 2013, who reported highest fruit width in cv Rothana date when pollination was carried out late on 6-8 day after

spathe cracking. Similarly, Ahmad *et al.*, 2016, reported the highest fruit width in 'Saidy' dates when pollinated late after the 10<sup>th</sup> day of spathe cracking.

#### Fruit drop (%)

Minimum fruit drop (33.86; 33.41 %) was observed when pollination was carried out at one day after spathe cracking while maximum fruit drop (41.28; 41.27%) was recorded when pollinated 8<sup>th</sup> days after

spathe cracking (Table 3). These results indicated that earlier pollination retained more fruit due to the highest fruit set. In delaying pollination less fruit set occurs and all unset fruit drop in maximum quantity (Iqbal *et al.*, 2004). These results partially agree with the findings of Iqbal *et al.*, (2017).

They reported a minimum fruit drop when Gulistan date pollinated one day after spathe cracking.

**Table 3.** The effects of pollination time on fruit width, fruit drop (%) and days to maturity of 'Dhakki' date during 2012 and 2013.

Treatments	Fruit width (cm)		Fruit drop (%)		Days to maturity		
	2012	2013	2012	2013	2012	2013	
Days after spathe cracking	1 <sup>st</sup> day	2.19c	2.20b	33.86d	34.64c	158.96b	158.97ab
	2 <sup>nd</sup> day	2.41bc	2.24b	34.49 d	34.65c	158.75b	158.71bc
	3 <sup>th</sup> day	2.64ab	2.66a	39.21c	36.53b	157.95bc	158.29bd
	4 <sup>th</sup> day	2.76 a	2.77a	40.14b	38.17a	160.84a	160.14a
	5 <sup>th</sup> day	2.78a	2.80a	40.14b	40.18a	157.11c	157.43cd
	6 <sup>th</sup> day	2.84a	2.81a	40.24b	40.26a	156.98c	157.31d
	8 <sup>th</sup> day	2.84a	2.87a	41.28a	40.32a	155.39d	155.74e
	LSD	0.24	0.25	0.91	1.72	1.34	1.39

Means followed by the similar letter(s) are non-significantly different at  $\alpha = 0.05\%$ .

#### Days to maturity

From the data, it is revealed that maximum days to maturity (160.84; 160.14) were noted when pollination was carried out on 4<sup>th</sup> day after spathe cracking. Minimum days of 155.39; 155.74 was recorded when pollination was carried out 8<sup>th</sup> days after spathe cracking (Table 3). Variation in days to maturity may be attributed due to climatic factors, tree health and kinds of cultural management used during the experimental period. Delaying pollination reduced fruit set and consequently reduced the number of fruits per bunch has the advantage to approach light in more quantity in bunches and hasten maturity. These results conformity with the findings of Osman *et al.*, 2010; Obeed and Soliman (2011) reported minimum days to maturity in late pollination.

#### Fruit yield (kg per tree)

Maximum fruit yield per palm (86.82, 87.51 kg palm<sup>-1</sup>) was recorded when pollination was carried out at

one day after spathe cracking and lowest yield of 48.15 and 47.47 kg per palm was recorded when trees were pollinated late on 8<sup>th</sup> day after spathe cracking (Table 4). From the results, it is revealed that yield is co-relates with maximum fruit setting and less fruit drop. As mentioned earlier, the highest fruit set percentage and lowest fruit drop was noted in early pollination. These results are following the findings of Shafqat *et al.*, (2005) obtained the highest yield from 'Hillawi', 'Khudrawi', 'Shamran' and 'Zarin' dates when pollination was carried out on spathe cracking day to 2 days after spathe cracking. Similar results were also reported by Iqbal *et al.*, 2017, they recorded the highest yield from Gulistan palm cultivar when pollinated early on spathe cracking day.

#### Fruit moisture content (%)

Maximum moisture content (68.16, 69.14%) with late pollination on 8<sup>th</sup> days after spathe cracking. The minimum moisture content (66.04; 66.02%) was observed when pollination was carried out one day

after spathe cracking (Table 4). The highest moisture content is closely associated with maximum fruit size and weight which was observed in late pollination. These results agree with the findings of Ahmad *et al.*,

2013, who found significantly maximum moisture content with late pollination. Similar results were also reported by Iqbal *et al.*, 2017 while working on cultivar Dhakki date cultivar.

**Table 4.** The effects of pollination time on fruit yield, moisture (%), TSS and total sugar (%) of 'Dhakki' date during 2012 and 2013.

	Treatments	Fruit yield (kg)		Moisture (%)		TSS (°Brix)		Total sugar (%)	
		2012	2013	2012	2013	2012	2013	2012	2013
Days after spathe cracking	1 <sup>st</sup> day	86.45a	85.87a	66.04c	66.02c	36.11d	36.14c	17.19f	17.22d
	2 <sup>nd</sup> day	86.82a	87.51a	66.15c	66.22c	36.36cd	36.27bc	17.21ef	17.23d
	3 <sup>th</sup> day	86.52a	85.55a	66.16c	66.24c	36.60c	36.57b	17.25de	17.27d
	4 <sup>th</sup> day	84.44a	83.46a	67.15b	67.84b	36.69c	36.64b	17.25d	17.29d
	5 <sup>th</sup> day	65.17b	63.14b	67.15b	67.58b	37.13b	37.10ab	17.77c	17.76c
	6 <sup>th</sup> day	53.45c	51.15c	67.16b	68.19b	37.80a	37.49ab	17.82b	17.85b
	8 <sup>th</sup> day	48.15c	47.47c	68.38a	69.14a	38.18a	38.17a	17.91a	17.94a
	LSD	5.55	4.78	0.27	0.89	0.38	1.25	0.04	0.08

Means followed by the similar letter(s) are non-significantly different at  $\alpha = 0.05\%$ .

#### Total soluble solids (TSS)

Maximum TSS of 38.18; 38.19% was recorded when trees were pollinated on 8<sup>th</sup> day after spathe cracking whereas minimum TSS of 36.10 and 36.11% was recorded when pollinated 1 day after spathe cracking (Table 3). Maximum TSS in late pollination is due to the highest dry matter and weight of pollinated fruits. These results confirm the findings of Shafique *et al.*, 2011, who reported that different pollination frequency has significantly improved fruit TSS. Al-Wasfy (2005), who mentioned that fruit chemical constituents were significantly improved in late pollination. Contradictory to Nasir *et al.*, 1997, who reported a non-significant effect of pollination time on fruit TSS content in Aseel date cultivar.

#### Total sugars (%)

Maximum total sugars (17.91; 17.94 %) were noticed with late pollination i.e., 8 days after spathe cracking. Whereas minimum total sugars (17.19; 17.22 %) were observed with pollination at one day after spathe cracking (Table 4). Highest total sugars in late pollination may be greater fruit size due to less fruit set and high drop-page (Iqbal *et al.*, 2014) Similar findings were reported by Abdalla and Abou Sayed-Ahmad (1993) and Moustafa (1998), who found that

total sugars content in fruit was significantly affected with pollination time.

#### Conclusion

It was concluded that pollination at 1<sup>st</sup> day after spathe cracking is most effective and may be recommended to get optimum fruit set, economical yield with the improvement of physicochemical characteristics of 'Dhakki' dates under the socio-economic conditions of Dera Ismail Khan.

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