



Research Article

Fruit Yield and Quality of Date Palm (*Phoenix dactylifera* L.) cv. Dhakki as Affected By Different Pollination Treatments

Muhammad Suleman Aziz¹, Muhammad Iqbal¹, Muhammad Sohail Khan¹, Imran Khan^{1*}, Muhammad Munir², Khalida Musa³ and Asim Iqbal¹

¹Department of Horticulture, Faculty of Agriculture, Gomal University, D.I. Khan, Pakistan; ²Institute of Food and nutrition, Faculty of Agriculture, Gomal University, D.I. Khan, Pakistan; ³Department of Environmental Sciences, Quaid-e-Azam University Islamabad, Pakistan.

Abstract | In order to boost up the production of Dhakki date an experiment was conducted during cropping season 2019-2020 at Research Orchard of date palm, Gomal University, Dera Ismail Khan (Pakistan). Experiment was designed in Randomized Complete Block Design (RCBD), possessing 13 (T₁ to T₁₃) pollination treatments including one control (No pollination) and repeated three times. Data for the following parameters were collected viz fruit set %age, fruit drop %age, fruit yield (kg bunch⁻¹) and physico-chemical fruit characteristics. Results indicated that except control, all the treatments improved the yield and yield components. The highest fruit set (81.68% and 82.30 %), bunch weight (15.28 and 16.20 kg), fruit weight (25.13 and 25.25 g), fruit length (5.09 and 5.19 cm), fruit width (3.06 and 3.13 cm) pulp weight (23.80 and 23.93 g), moisture content (63.11 and 62.89%) and T.S.S (33.13 and 33.35%) were recorded in T₁₂ (3 strands having 110 flowers) during both years of study as compared to other treatments. While all these parameters have shown lowest values in control (No Pollination). However, the findings of this research investigate that all the treatment consistently improved quantitative, qualitative and yield characteristics and can be suggested for obtaining of maximum yield of Dhakki date.

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***Correspondence** | Imran Khan, Department of Horticulture, Faculty of Agriculture, Gomal University, D.I. Khan, Pakistan; **Email:** imrankhan1441@gmail.com

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Introduction

Date palm (*Phoenix dactylifera* L.) origin is Arabian Gulf and also North Africa (Jonoobi *et al.*, 2019). In the World Egypt, Iran, UAE, Saudi Arabia and Pakistan are major date producing countries. Pakistan ranked at 6th position in the world and with cultivated

area of 102676 ha annually production of 532879.6 tons (FOASTAT, 2022). Pakistani dates are exported to USA, Denmark, India, UK, Italy, Japan, Bangladesh, Canada, Saudi Arab, Africa and UAE (Amin *et al.*, 2007). Date production is highly affected by natural pollination, due to its dioecious nature (Hussain *et al.*, 1984; Aashia *et al.*, 2017). To boost up yield

an artificial pollination is carried out manually or mechanically (Iqbal *et al.*, 2010; Salomon-Torres *et al.*, 2021). Most common technique of pollination are being used by date growers in the world are to cut the strands of male at maturity stage when pollen can fertilize female flowers and placed into the female spathe for pollination (Dowson, 1982). Extracted dried pollen are suspended and sprayed on open spathe (Ahmed and Jahjah, 1985). Dusting of full fresh male spathes or extracted dried pollens are dusted by mechanical duster or pollinator (Haffar *et al.*, 1997). Each pollination method has its merit and demerits. In past various scientists conducted the comparison studies on different pollination techniques and reported their effects on fruit quality and yield of various date cultivars. According to Iqbal (2010) and Abdallah *et al.* (2011) the highest fruit set and yield was recorded in the placement method as compared to other treatments in various date cultivar. Abdullah *et al.* (2014) tested the effects of two pollination methods viz pollen rubbing on sponge and dusted on open spathe and male strands placement into khalas date and they determined that in both methods the results were non-significant for fruit set, yield and fruit physical properties. Samouni *et al.* (2016) when pollinated Saidu date palm by (placing 5 strands into female spathe) and dusted pollen mixture, starch +pollen in different concentration and they found that maximum, yield, quality and fruit set, were recorded in dusting as compared to placement method. Jamro *et al.* (2020) tested the effects of manual and mechanical pollination in different six date cultivars and significantly maximum fruit weight, length, diameter and yield recorded when pollinated manually as compared to mechanical pollination. Munir *et al.* (2020) pollinated Khalas date with dusting, placement of strand and spray of suspended pollens and their results concluded that dusting method improved significantly the fruit set, fruit length, fruit weight, seed weight, pulp weight, total sugars, T.S.S and reduce fruit drop percentage.

In Pakistan more than 300 date cultivars are grown in different parts of country. Amongst these cultivars 'Dhakki' is the most promising cultivar being grown in all over the country and growers of this area pollinating Dhakki date through placement method by placing 3 strands into female spathe and in other date palm countries 5-7 male strands are placed into the female spathe is a pollen wastage. In those countries where pollens are in extra amount then

there is no problem, while in those countries where pollens are in shortage and purchased by growers is a serious economic problem. After one decade there will be totally shortage of pollens and date yield will be suffered because mostly males are infested by different diseases and mostly male stems are being used as a fuel for bricks factories (Iqbal *et al.*, 2019). Exact male strands number and flowers per strand for pollination of date palm are still unknown. This study aimed to quantify the exact number of strand and with suitable number of flowers present on strand for the pollination technique to check its effects on yield, fruit setting and quality of cv. Dhakki.

Materials and Methods

An experiment was carried out during the months of Feb-August, 2019 and 2020 at Orchard of Date palm, Gomal University, D.I. Khan, Khyber Pakhtunkhwa (Pakistan). Thirteen 'Dhakki' trees having vigorous growth with age of 20 years were selected. The study was conducted in Randomized Complete Block Design, possessing 13 treatments and replicated thrice. Single pollen source was used for pollination. For this purpose, three spathes were selected from each female tree. Then the pollens strands were collected at flower maturity stage. At maturity stage male spathes were cut back and brought carefully to the laboratory, where protective sheets were removed and from inflorescence the strands were separated. After separation, strands were placed in air tight glass jar and then these strands were stored in house hold refrigerator at 4 °C. Two days after spathe opening these strands were inserted into the female spathe at 10 A.M on well sunny day. After pollination bagging was done to control natural pollination. For conducting of experiment all the usual cultural practices viz. hoeing, irrigation, weeding and fertilization were adopted.

Pomological characters

Fruit set %age: Fruit set percentage was recorded after one month according to the method described by El-Makhtoun and Abdel-Kader (1990).

Fruit drop percentage: Ten strands were randomly selected from each spathe for recording of drop as method described by Iqbal (2010).

Weight of fruits (g): Randomly ten fruits from all palms were taken at khalal stage and weighed

with electric balancing and fruit weight mean was computed.

on prism of refractometer and then TSS mean was determined.

Table 1: Treatment's detail.

T ₁	Insertion of 1 strand with 30 flowers
T ₂	Insertion of 1 strand with 60 flowers
T ₃	Insertion of 1 strand with 90 flowers
T ₄	Insertion of 1 strand with 110 flowers
T ₅	Insertion 2 strands with 30 flowers
T ₆	Insertion of 2 strand with 60 flowers
T ₇	Insertion of 2 strand with 90 flowers
T ₈	Insertion of 2 strand with 110 flowers
T ₉	Insertion of 3 strand with 30 flowers
T ₁₀	Insertion of 3 strand with 60 flowers
T ₁₁	Insertion of 3 strand with 90 flowers
T ₁₂	Insertion of 3 strand with 110 flowers
T ₁₃	Control (No pollination).

The data were recorded for following parameters.

Fruit length (cm): Randomly ten mature fruits at khalal stage were taken and fruit length was measured with measuring scale and mean length was recorded.

Fruit width (cm): Ten randomly mature fruit were taken at khalal stage and with the help of meter scale fruit width was measured.

Weight of pulp and seed (g): Randomly ten fruits pulp and seed were separated and weighed with using digital electric balance and mean pulp and seed weight was calculated.

Fruit bunch weight (Kg bunch⁻¹): Bunches of all trees were cut back at khalal stage and each bunch was weighed separately then all bunches weight was calculated.

Chemical characters

Moisture (%): According to AOAC (2005) by using oven drying method and mean moisture percentage was recorded.

TSS (total soluble solid) %: TSS were determined with the help of hand refractor-meter. The juice of date fruit was prepared by addition of 15 ml of distilled water into 5 gm of grinded pulp for shaking of two minutes then this mixture was passed through a filter paper. After that one drop of solution was placed

Statistical analysis

Data of each parameter were analyzed statistically with using (ANOVA) technique of statistical program STATISTIX 8.1 and LSD was computed by using procedure as per Steel *et al.* (1997).

Results and Discussion

Fruit set %

Different pollination treatments significantly affected fruit set %. Maximum fruit set (81.68 and 82.30%) was recorded with T₁₂ (insertion of 3 strands possessing each 110 flowers) during both years of study (Table 2). It was followed by T₁₁ (insertion of 3 strand each possessing each 90 flowers) with 80.96 and 81.66% fruit set. Minimum fruit set (14.98 and 18.60 %) was noted in control (T₁₃). All the treatments T₁ -T₁₃ produced fruit set above the 50 % level which is considered best for commercial yield of date palm. All treatments are applicable for obtaining commercial yield. Highest fruit set in T₁₂ is due to insertion of maximum number of strands having maximum flowers, because these provides maximum fresh pollen quantity for pollination as flower persist 2 to 3 days under normal prevailing condition (Iqbal *et al.*, 2004). These results, agree with those reported by Iqbal (2010) and Abdallah *et al.* (2011) but contradictory to Munir *et al.* (2020).

Fruit drop %

Different pollination treatments significantly affected fruit drop of 'Dhakki' dates. Highest fruit drop (33.43 and 35.72%) was observed in control during both years of study and minimum fruit drop (30.37 and 30.13%) was recorded by T₁₂ (insertion of 3 strands with 110 flowers each) (Table 2). Minimum fruit drop in T₁₂ is due to highest fruit set. These findings agree with Soliman *et al.* (2017).

Fruit weight (g)

Different pollination treatments significantly affected fruit weight. Maximum fruit weight (25.13 and 25.25 g) was noticed in T₁₂ (3 strands having 110 flowers) while minimum fruit weight (22.19 and 21.23 g) was observed in T₁₃ (control) during both years of study (Figure 1). The results agree with Malaka *et al.* (2014), Hussein (2016) and Soliman *et al.* (2017) but are contradictory with the results of Iqbal (2010).

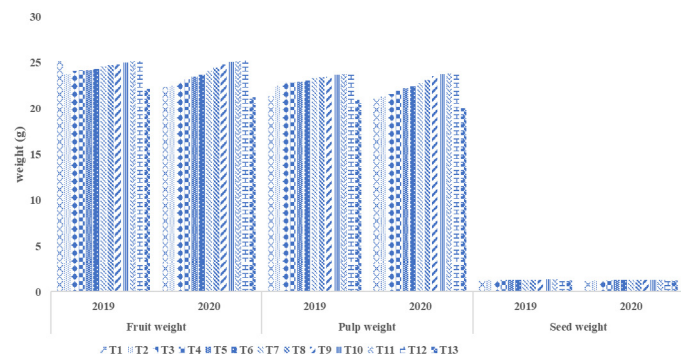


Figure 1: Effect of different pollination treatments on fruit, pulp and seed weights (g) of Dhakki fruit.

Fruit length (cm)

Different pollination treatments significantly affected fruit length. The longest fruits (5.09 and 5.19 cm) were observed in T₁₂ (3 strands having 110 flowers) while shortest fruits (4.40 and 4.38 cm) were noted in T₁₃ (control) during both years (Table 2). Shortest fruit length in control is due to least fruit set (Iqbal, 2010). Maximum fruit length in T₁₂ is due to availability of maximum pollen quantity for pollination. These findings are agreed with the results of Munir *et al.* (2020) as they reported highest fruit length in cv. Khalas with higher concentration of pollen 4 g per liter instead of 1 g per liter.

Table 2: Effect of different pollination treatments on fruit percentage %, fruit drop % and fruit length (cm) of Dhakki dates.

Treat- ments	FS (%)		FD (%)		FL (cm)	
	2019	2020	2019	2020	2019	2020
T ₁	74.20 c*	74.93 g*	33.15 ab	35.50 ab	4.68g*	4.59i*
T ₂	75.83 bc	75.90 fg	33.09 ab	35.18 a-c	4.69fg	4.63hi
T ₃	76.76abc	76.65 efg	33.79 ab	35.01bcd	4.71eg	4.65gh
T ₄	78.11abc	76.92defg	32.70 ab	34.86 cd	4.74ef	4.69fg
T ₅	78.96abc	77.82cdef	32.66 ab	34.48 de	4.77e	4.73f
T ₆	79.10abc	78.46bcef	32.53 ab	34.07 ef	4.84d	4.80e
T ₇	79.88 ab	78.83bcde	32.20 ac	33.64 fg	4.86d	4.84e
T ₈	80.26 ab	79.63abcd	32.00 ac	33.34 g	4.89d	4.91d
T ₉	80.50 ab	80.22 abc	32.00 ac	33.34 g	4.97c	4.97c
T ₁₀	80.62 ab	80.79 ab	31.80 bd	32.45 hi	5.02bc	5.04b
T ₁₁	80.96 a	81.66 a	30.80cd*	32.16 i*	5.05ab	5.13a
T ₁₂	81.68a**	82.30 a**	30.37 d*	30.13 j*	5.09a**	5.19a**
T ₁₃	14.98 d*	18.60 h*	33.43 a**	35.72 a**	4.40 h*	4.38 j*
LSD	5.02	2.79	1.53	0.61	0.06	0.06

Means followed by the similar letter(s) are non-significantly different at $\alpha = 0.05$. Where (**) = maximum values and (*) = minimum values, FS = Fruit Set, FD = Fruit Drop and FL = Fruit Length.

Fruit width (cm)

Different pollination treatments significantly affected

fruit width. Highest fruit width of 3.06 and 3.13 cm was observed in T₁₂ (3 strands with 110 flowers) while least fruit width of (2.61 and 2.54 cm) was observed in the control during both years (Table 3). Maximum fruit width in T₁₂ is due to maximum quantity of pollens for pollination. Similar findings were reported by Awad (2010) and Abdalla *et al.* (2011).

Table 3: Effect of different pollination treatments on fruit width (cm), moisture% and total soluble solids% of Dhakki dates.

Treat- ments	FW (cm)		Moist %		TSS %	
	2019	2020	2019	2020	2019	2020
T ₁	2.66ef*	2.73i*	60.42 h*	60.55ij*	30.48 ef*	30.53h*
T ₂	2.72def	2.75hi	60.66gh	60.60hij	30.60 df	30.69g
T ₃	2.75def	2.79gh	60.92 fg	60.69hij	30.71 df	30.78g
T ₄	2.75def	2.82g	61.12 ef	60.76hi	30.88 de	31.19f
T ₅	2.81cdef	2.87f	61.11 ef	60.91gh	31.06de	31.48e
T ₆	2.84bcde	2.90ef	61.44 de	61.18fg	31.13 d	32.16d
T ₇	2.87abce	2.93e	61.73 cd	61.44ef	32.10 c	31.65c
T ₈	2.91abd	3.00d	61.91 c	61.67de	32.21 c	32.86b
T ₉	2.91abd	3.05c	62.02 c	61.96cd	32.53 bc	33.25a
T ₁₀	3.02ac	3.07bc	62.04 c	62.25bc	32.95 ab	33.27a
T ₁₁	3.05ab	3.11ab	62.41 b	62.48b	33.06 ab	33.30a
T ₁₂	3.06a**	3.13a**	63.11a**	62.89a**	33.13a**	33.35a**
T ₁₃	2.61f*	2.54j*	59.90i*	60.40j*	30.27f*	30.32i*
LSD	0.21	0.04	0.34	0.34	0.59	0.12

Means followed by the similar letter(s) are non-significantly different at $\alpha = 0.05$. Where (**) = maximum values and (*) = minimum values, Fruit width (cm), Moist = Moisture and TSS = Total Soluble solids.

Pulp weight (g)

Different pollination treatments significantly affected pulp weight. Maximum weight of pulp (23.81 and 23.93 g) was also produced with treatment T₁₂ (3 strands possessing 110 flowers) (Figure 1). Control (T₁₃) produced minimum pulp weight of 21.00 and 20.01g. The results are supported by the findings of Munir (2019) who reported minimum pulp weight (Khalas date) in control as compared to other pollination methods. Similarly, Samouni *et al.* (2016) reported maximum pulp weight with maximum quantity of pollens in saidy date as compared to control.

Seed weight (g)

Different pollination treatments significantly affected seed weight. Maximum weight of seed (1.36 and

1.31 g) was recorded in T_{12} (3 strands possessing 110 flowers) during both years of study (Figure 1). Minimum seed weight (1.21 and 122 g) was found in T_{13} (control). Similar findings were reported by Munir (2019) who recorded minimum seed weight in control or in natural pollination.

Bunch weight ($kg\ bunch^{-1}$)

Different pollination treatments significantly affected bunch weight. Maximum weight of bunch (15.29 and 16.20 $kg\ bunch^{-1}$) was recorded in T_{12} (insertion of 3 strands with 110 flowers) while minimum fruit weight bunch⁻¹ (4.74 and 5.01 $kg\ bunch^{-1}$) was recorded in T_{13} (control) (Figure 2). Maximum bunch weight in T_{12} might be due to maximum fruit set, fruit size and less fruit drop. The findings match with the findings of Iqbal (2010) and Abdallah *et al.* (2014).

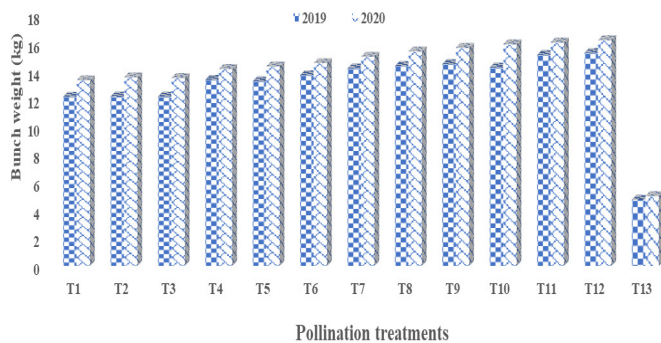


Figure 2: Effect of different pollination treatments on the bunch weight (kg) of Dhakki dates.

Moisture (%)

Different pollination treatments significantly affected moisture %. Highest moisture content (63.11-62.89%) was recorded in T_{12} and lowest rate of moisture (59.90 and 60.40%) was recorded in control (T_{13}) during both years (Table 3). Maximum moisture was found in those treatments where fruit size and weight were maximum. These results match to the findings of Samouni *et al.* (2016) and Soliman *et al.* (2017) who detected highest moisture in placement method by inserting 5-10 strand per spathe.

Total soluble solids (TSS%)

Different pollination treatments significantly affected TSS%. Maximum TSS (33.13 and 33.35%) were determined in T_{12} (3 strands possessing 110 flowers) during both years of study (Table 3). The findings are in agreement with Harhash and Abdul Naseer (2010) and Soliman *et al.* (2017) who noticed maximum TSS in date by placement method but are contrary to Samouni *et al.* (2016) and Munir (2019) who reported

maximum TSS content in pollen dusting method in different date palm cultivars.

Conclusions and Recommendations

This study results showed that pollination with insertion of 3 strands having 110 flowers (T_{12}) each given better results for obtaining maximum fruit set (%), highest fruit retention (%), weight of bunch and yield of 'Dhakki' date and also high-quality fruit (physio-chemical characteristics). However, all the treatments consistently improved all parameters of Dhakki dates and can be suggested for obtaining maximum fruit set and yield.

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Novelty Statement

In this study pollination with insertion of 3 strands having 110 flowers (T_{12}) was found to be the best method for higher yield and quality of Dhakki date fruit.

Author's Contribution

Muhammad Iqbal: Supervised the research.

Muhammad Suleman Aziz: Conducted field research and collected data.

Muhammad Sohail: Helped in designing the experiment.

Imran Khan: Helped in field work and data analysis.

Muhammad Munir: Helped in lab work.

Khalida Musa: Helped in paper setting and final shape.

Asim Iqbal: Helped in cultural practices for conducting of research etc.

Conflict of interest

The authors have declared no conflict of interest.

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