

Effect of Different Pollination Techniques on Fruit Set, Fruit Quality and Yield of Barhi Date Palm Cultivar

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Abstract

An experiment of Barhe date palm cultivar was conducted during three successive seasons 2015, 2016 and 2017 to compare between the different pollination techniques included traditional pollination, dusting technique and liquid spraying technique on fruit set, fruit quality and yield of Barhi date palm cultivar. The results of this study showed that all the pollination techniques induce significant differences between the treatments. The dust pollination gave high fruit set %, excellent fruit quality and high yield than traditional pollination. The poorest and lowest fruit set, quality and yield produced from the liquid spraying of pollens. Generally, dusting techniques is the cheapest and easiest and minimum cost means of pollination.

Key words: Barhi date palm cultivar, pollination techniques, traditional pollination, dusting techniques, liquid spraying of pollens.

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Introduction

Date palm is one of the oldest fruit trees which was cultivated in the world, also in the Sudan, is consider as a one of the most important fruits and distributed at large scale in different states. Barhi cultivar is consider as thebest introduced date cultivars suitable for marketing at khalal stage .Actually, it is most economically important soft cultivars grown under different agro climatic zones of Sudan and usually harvested and consumed at Khalal (Bisr) stage. This cultivar is expected to playing an important role in the economic development of the country by earning handsome amount of foreign exchange. Barhi date can be a best possible source of foreign exchange for Sudan, so endangering our national economy Hamid *et al.*, (2018). But unfortunately this cultivar suffering from pollination practices and its quality is severely affected by traditional pollination as it is ineffective in efficient fruit set and yield. The date palms are dioecious and thus require the transfer of pollen from the male palm to female one in order to obtain a considerable economically yield. The traditional pollination technique of hand pollination which includes climbing the palm has become impractical under the changing socio-economic structure in all regions where date palms are intensively grown. It requires experienced pollinators and a high labor cost (Ibrahim, 1988). Several previous researches indicated that the pollination is one of the major horticultural practices and it is a necessary operation as a mean to ensure good fruit setting and yield (Khan and Ghaffoor, 1993; Bechar *et al.*, 1999 and Soliman and Kasany, 2006). Similarly, Attalla *et al.*, (1998) observed that the effect of different pollination techniques by dusting various proportions of pollen powder significantly increased the average fruit set percentage as compared to other treatments. Hussain *et al.* (1984) reported reduction in pollen viability within half an hour in all suspension media, resulting poor fruit setting. The pollination techniques included dusting of pollens, placement of male spathe, liquid spraying of

pollens as well as natural process of pollination (control) were carried out on female flowers (Iqbal *et al.*, 2010). Their results revealed that different pollination techniques had significantly affected the fruit setting and other quality parameters. Moreover, the highest fruit set was recorded in the placement method while the lowest fruit set was observed in the control. They are unaware of the best techniques of pollination, which may be easiest and most convenient. So it is needed to find the best pollination technique for improving fruit setting percentage, also as result of socio-economic changes of date palm sector, and the high wages and scarcity of skill labors doing this work therefore it is badly needed to find new methods of pollination technique as mechanized practices, *e.g.* (Dusting or liquid spray of pollen) as. Therefore, the main aim of this study is to compare different pollination technique to select the most useful, simply, cheapest one, to improve fruit setting percentage, quality and yield

Materials and methods

The present investigation was carried out in three successive years 2015, 2016 and 2017 on Barhi date palm cultivar grown in Private orchard at Soba Southern Khartoum state. 14 years old Barhi cultivar date palm, normally in such experimental palms were chosen uniform as far as possible on the bases of their height and growth vigor and subjected to the normal schedule of cultural practices to investigate different Pollination techniques. On each Barhi date palm, yearly selected, nine spathes nearly similar in vigor, and others spathes were removed to ensure uniformity. On 21th March 2015, 28th March 2016 and 30th March 2017 between 10.00 am and 2.00 pm on a well sunny day on opening or cracking spathe by using the same pollen sources (selected male date palms) in order to avoid repetition and overlapping.

These selected and labelled spathes were subjected to the following pollination techniques during the experimental years:

- 1-Traditional pollination (control)
- 2-Dusting 10% technique
- 3-Liquid spray technique

After pollination the bagging was done with waxy paper to avoid contamination. Prior to pollination, unopened spathes in all trees were covered with waxy paper bags. Measuring 60 x 40cm. The bags were removed during the time of pollination and covered again soon after pollination to prevent natural wind or bees pollination. After pollination the spathes were re bagged immediately with (40 x 60cm) paper bags for four weeks, and a great care was carried exercised against mixing of different pollens or contamination by any means.

Regarding traditional pollination:

The pollinator climbed the palm and placed 5 inverted male strands into the female spathe cracked and then tied the distal end of it.

In dusting pollens:

The pollen grains were extracted by removing protective sheath and inflorescence was kept under sunlight on newspaper for releasing pollen grains. After one hour the flowers were opened and pollen grains released. After drying pollen grains were rubbed in foam duster. The pollens were collected and mixed with wheat flour as filler at 1 part pollen to 9 flour (1:9), respectively. Dusting was done on opened spathes by hand pollen duster.

In liquid spray technique:

The extracted pollens were mixed into the distilled water and were sprayed on the open spathes by a micro sprayer.

The following parameters were recorded:

Fruit set % was calculated four weeks after pollination. Fifty completed yellow color date fruits from each replicate were randomly harvested at the end of khalal (bisir) stage (during the first weeks of June seasonally, and used for determination of the following physical and chemical parameters of their fruits. The harvested samples fruits were immediately packed in plastic bags and kept on ice during transporting to the laboratory, and then kept in a refrigerator at $5\pm 1^{\circ}\text{C}$ for the determination of physical and chemical properties, i.e., fruit weight (g), fruit number/kg, fruit size (cm^3), Fruit length (cm), fruit diameter (cm), fruit pulp weight at maturity (g). The total sugars content was analyzed in flesh according to AOAC (1995) and the results were computed on a dry weight basis. The titratable acidity (citric acid), soluble solid content Tannins and vitamin C content ($\text{mg}/100\text{ml}$) were determined in date juice according to (Ranganna, 1979). When the fruits reach the khalal stage (fully mature, crunchy and yellow in color) in first weeks of July The average fruit yield/tree and bunch weight were recorded in kilograms

Statistical analysis:

The experiment was designed in randomized complete block design (RCBD) with 4 replications and 3 trees per plot. Means were compared with using Duncan's multiple range tests at 5% level.

Results and discussion

Some of fruit characters as acidity, total soluble solids, fruit weight at maturity and combined yield of Barhi date affected by different pollination techniques and exhibited significant effect on all parameters observed during 2015, 2016 and 2017, and the results indicated that: significantly highest acid fruit produced from liquid spray while the lowest acid fruits produced from traditional pollination. The high total soluble solids fruits produced from dusting pollination technique, while the liquid spray technique produced lowest total soluble solids fruits. However, the three methods of pollination also, have the same effect on Fruit weight at maturity (g) and followed the same trend as with total soluble solids. Also the highest fruit yield was recorded by dusting pollination method (328 kg/ palm) followed by traditional pollination (306 kg) and liquid spray (253.7kg). These findings are in harmony with the

findings of Hamood, *et al.*, (1986) and Attalla, *et al.*, (1998). They reported that fruit yields were increased by various pollination methods than control. Likewise, Hussain, *et al.* (1989) and Ibrahim and Haggag (1993) reported that dust pollination gave good yield than traditional pollination.

Fruit setting percentage:

The data regarding fruit set percentage is given in Table (2). The results show that different pollination techniques significantly affected the fruit set percentage in all experimental years. The significantly highest fruit set (87.1%, 89.3% and 88.9%) was recorded in dusting method during all experimental years. It was followed by traditional pollination method (79.1%, 80.3% and 82.0%) and the lowest significant fruit set percentage was produced from liquid spray practices (25.7%, 26.1% and 41.2%). These results are in agreement with the findings of Khan and Ghafoor (1993) who reported that maximum fruit set was obtained with adopting of dusting method for pollination of Dhakki date. Similar findings were reported by Attalla and Sharaan (1998) who worked on different pollination techniques on the Sukari and Hellawa of date palm and recorded lowest fruit set in control. Shukar, *et al.*, (1988) tested four pollination techniques on 14 female date palm of Zahidi viz. fresh pollen from male, heat killed pollen, soaking fresh pollen in distilled water and no pollen in control. They found 60-90% fruit set in three methods against 33% in control. Similar results were reported by (Aziz *et al.*, 1983 and Laghavi *et al.*, 1993).

Length of fruit:

Different pollination techniques did not show any significant effect on average length of fruit. Generally the lengthiest fruits were obtained by Dusting practices method (4.87cm, 4.93cm and 5.15 cm) then followed by traditional pollination, (4.60cm, 4.87 cm and 5.10cm) the shortest fruits were obtained from liquid spray (4.20cm, 4.60cm and 4.87cm). These results are in agreement with the findings of (Hamood *et al.*, 1986). They did not find significant difference among different methods of pollination. In spite, Attalla *et al.* (1998) stated contradictory to these results and confirmed the significant of pollination techniques effect on fruit length, and the results reported in this experiment may be due to possibly hormonal action in the ovule as a results of sharp difference in temperatures at pollination period.

Pulp weight of fruit:

The pulp weight was not significantly affected by different pollination techniques during the experimental years. The statistically maximum pulp weight was recorded in fruits developed by the dusting method while the minimum pulp weight was recorded in the liquid spray method. These results were reported by (EL Makhtoun, 1981; Aziz, *et al.*, 1983 and Laghavi, *et al.*, 1993). They stated that pulp weight was significantly affected by pollination techniques.

Seed weight:

No significant variation in seed weight was observed among the different pollination techniques i.e. followed the same pattern of length and pulp weight of fruit during the experimental years, the heaviest seeds were found in fruits developed by placement liquid spray method. While minimum

seed weight was obtained from dusting method and traditional pollination method during the experimental years.

Chemical characteristics of Barhi date:

Data in Table (3) showed the effect of various pollination techniques on chemical characteristics of Barhi date: However, the dusting pollination practices resulted in significantly increases of total sugars, reducing, non-reducing and Vitamin C contents and significantly decreases of fruit Tannins contents, these trend was pronounced during the experimental years, This result is strengthened by El-Mardi *et al.* (1998) who reported that the high total sugars, reducing, non-reducing, Vitamin C and low tannins contents produced from dusting pollination techniques may be attributable due to high concentrations of pollens in dusting pollination practices compared to other methods of pollination techniques.

Considering the abovementioned results, it could be concluded that:

Dusting techniques at 10% stimulates and accelerates germination pollen grain of date palm. Therefore, it improves the fruit set percentage, and consequently increases yield/date palm. Moreover, these pollination techniques greatly succeeded to enhance the physical and chemical characteristics of fruit qualities that include increasing weight, size, contents of total sugars and vitamin C as well as reducing acidity percentage, and tannins. The combination of mixing pollen grains with carrier useful for establishing mechanical pollination and getting an economical yield with good quality of fruits. Also, it is surely responsible for enhancing pollination efficacy. Mechanization of date production is becoming more important due to the rise of production cost and shortage of human power, particularly the difficult to find skilled labors to work during the period of peak pollination.

Table (1): Effect of different pollination techniques on some fruit characters and yield of Barhi date In 2014/2015, 2015/2016 and 2016/2017 seasons

Treatments	Acidity%			TSS%			Fruit weight at maturity (g)			Combined yield of three years (2015, 2016 and 2017)
	2015	2016	2017	2015	2016	2017	2015	2016	2017	
Traditional pollination	0.30c	0.30c	0.30c	26.2b	23.4b	26.2b	14.1b	14.5b	14.9b	306.7b
Dusting 10%	0.34b	0.32b	0.33b	23.2c	23.3c	23.7c	115.2a	15.4a	16.7a	328.0a
liquid spray	0.36a	0.37a	0.36a	29.3a	29.5a	29.2a	12.7c	13.3c	14.7c	253.7c

Values within a column with same letter are not significantly different (p-0.05).

Table (2): Effect of different pollination techniques on fruit set and physical characters of Barhi date in 2014/2015, 2015/2016 and 2016/2017 seasons

Treatments	Total sugars (%)			Reducing sugars (%)			Non-reducing sugars (%)			Tannins %			Vitamin C. mg./100ml juice		
	2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017
TP *	31.4b	32.1b	30.4b	27.5 b	22.6 b	27.3 b	5.6b	5.2b	5.8b	0.31b	0.32b	0.27b	12.30b	12.27b	12.28b
DP**	34.2a	36.7a	35.3a	30.2 a	28.4a	30.0 a	6.5a	6.9a	6.7a	0.28c	0.26c	0.27c	12.87a	12.85a	12.88a
LS***	27.5c	29.4c	26.5c	22.4c	22.5 b	22.2c	5.0c	4.0c	5.2c	0.42a	0.44a	0.36a	7.9c	8.2c	8.1c

Values within a column with same letter are not significantly different (p-0.05)

Table (3): Effect of different pollination techniques on fruit chemical characters of Barhi date in 2014/2015, 2015/2016 and 2016/2017 seasons

Treatments	Fruit set%			Fruit length at maturity (cm)			Fruit pulp weight at maturity (g)			Dry Matter%			Seed weight at maturity		
	2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017
Traditional pollination	79.1b	80.3b	82.0b	4.60ab	4.87ab	5.10ab	11.6ab	11.8ab	14.1ab	38.8a	35.6a	34.2a	1.85a	2.02a	1.80a
Dusting	87.1a	89.3a	88.9a	4.87a	4.93a	5.15a	12.2a	13.4a	14.9a	29.7b	32.6b	32.5b	1.87a	2.20a	1.81a
liquid spray	25.7c	26.1c	41.2c	4.20b	4.60b	4.87b	11.3b	11.2b	13.4b	25.8c	25.7c	24.6c	1.31c	1.62c	1.30c

Values within a column with same letter are not significantly different (p-0.05)

TP: Traditional pollination*

DP: Dusting pollination **

LS: liquid spray***

Conclusion

Date palm a dioecious species therefore manual or mechanical pollination must be carried out to obtain fruit. In this study, The dust pollination gave high fruit set %, excellent fruit quality and high yield than traditional pollination. The poorest and lowest fruit set, quality and yield produced from the liquid spraying of pollens. Generally, dusting techniques is the cheapest and easiest and minimum cost means of pollination.

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تأثير تقنيات التلقيح المختلفة على العقد و المحصول وجودة ثمار نخيل صنف البرحي

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الخلاصة

أجريت هذه التجربة على صنف نخيل البرحي خلال ثلاثة مواسم متتالية ٢٠١٥ و ٢٠١٦ و ٢٠١٧ للمقارنة بين تقنيات التلقيح المختلفة التي تضمنت التلقيح التقليدي وتقنية التعفير وتقنية الرش السائل على جودة وإنتاجية الثمار صنف نخيل البرحي. أظهرت نتائج هذه الدراسة أن جميع تقنيات التلقيح تحدث اختلافات معنوية بين المعاملات. أعطى التلقيح بالتعفير نسبة عالية من الثمار ونوعية ممتازة للجودة وإنتاجية أعلى من التلقيح التقليدي. حيث أعطى رش حبوب اللقاح بالطريقة السائلة أقل إنتاجية وجودة للثمار. بشكل عام ، تعتبر تقنيات الرش لحبوب اللقاح بالتعفير هي أرخص وأسهل وأقل تكلفة للتلقيح.

الكلمات الدالة: نخيل البلح صنف البرحي، تقنيات التلقيح، التلقيح التقليدي، تقنيات التعفير، الرش السائل لحبوب اللقاح.