



A comparative study between mechanical and manual pollination in two premier Saudi Arabian date palm cultivars

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Abstract

The Kingdom of Saudi Arabia produces nearly a million tones of dates annually from an estimated 25 million palms. Date palm (*Phoenix dactylifera* L.) is a dioecious crop where male and female inflorescences are on separate palms. To ensure good fertilization and overcome disadvantages of dichogamy, enhance fruit set and sustain yield levels, each female inflorescence has to be artificially pollinated either manually which is time consuming and labour intensive or mechanically using pollinating devices. We therefore carried out a comparative study to assess the yield and yield attributes between manual and mechanical pollination in two premier date palm cultivars of Saudi Arabia viz. Khalas and Sheshi. Results indicate that manually pollinated palms gave the best fruit set in both the cultivars. However, with regard to yield results were cultivar specific. In Khalas, yield levels were statistically at par for both manual and mechanical pollination ranging from 10.99 to 11.54 Kg per bunch, while mechanical pollination was significantly superior to manual pollination in the cultivar Sheshi, where pollen : flour ratio of 1:15 resulted in the best yield of 8.06 Kg per bunch.

Keywords: Date palm, *Phoenix dactylifera*, Dioecious, Mechanical pollination, Manual pollination, Pollen, Female inflorescences, Yields.

Introduction

Date palm (*Phoenix dactylifera* L.) is a major crop fruit crop in the Arabian Peninsula where it is closely associated with the life of the people since pre-historic times. Date palm is a multipurpose tree providing, fibre, carbohydrates, minerals and vitamins besides having certain medicinal properties (Mohamed, 2000; Vayalil, 2002; Al-Farsi *et al.*, 2005; Ishurd & Kennedy, 2005; Baloch *et al.*, 2006; Al-Abdoulhadi *et al.*, 2011a,b;). The Kingdom of Saudi Arabia has an estimated 25 million date palms producing nearly a million tones of dates annually. More than 400 different date palm cultivars are reported to exist in Saudi Arabia (Anonymous, 2006).

With an estimated three million palms the Al-Hassa oasis in the Eastern Province is the largest in the Kingdom where Asif *et al.*, 1986 grouped date palm cultivars based on the season of production. Khalas, a mid-season cultivar is widely cultivated in the Al-Hassa oasis and considered by many as the best date in the world, with mostly medium to big sized fruits that are consumed as both fresh (*rutab*) and dry (*tamar*) dates which store well. Currently the cultivar Khalas is cultivated in more than 60 % of the area (Al -Khatib *et al.*, 2006; Al-Mahla & Hussein 2003). Sheshi is also an important date palm cultivar of the Al-Hassa oasis. Sheshi produces mostly medium to large fruits that are plump and firm in texture. Skin separation of fruits is common in this cultivar which often lowers the quality and value of the produce (Asif *et al.*, 1986; Sakr *et al.*, 2010; Al-Abbad *et al.*, 2011).

Date palm is a dioecious crop where male (pollen bearing) and female (fruit bearing) inflorescences are on

separate palms. Unisexual flowers of date palm are either pistillate (female) or staminate (male) in character where the male palm produces pollen and female palm bears fruit (Popenoe, 1992; Zaid & De Wet, 2002; Vijayalaxmi Kinhal & Parthasarathy, 2008). To ensure good fertilization and overcome disadvantages of dichogamy and also reduce the number of male palms in the field, artificial pollination is carried out in commercial plantations, where pollen harvested from staminate flowers are used for artificial pollination which is done manually as traditionally taken up by date farmers throughout the Middle East or mechanically through pollen dusters.

Bonavia (1885) first attempted mechanical pollination of date palm in India. In USA ground-level dusters have been used to mechanically pollinate date palm since the late nineteen sixties (Brown & Perkins, 1969; Brown *et al.*, 1970; Perkins & Burkner, 1973). Mechanical pollination in date palm has been investigated in the Middle East and is reported to have several advantages including high efficiency, decrease in pollen consumption, saving of time, less labour intensive etc. (Shabana *et al.*, 1986; El-Kassas, 1986; El-Mardi *et al.*, 2002; Hajian, 2005).

In commercial plantations the female flowers are usually pollinated by hand cutting the strands of male flowers and inserting them between female flower clusters during the first few days of its opening when the female flowers are receptive (Sawaya, 1986). This ensures good fertilization and overcomes disadvantages of dichogamy besides enhancing fruit set and sustaining yield levels. Manual pollination is time consuming and



also a labour intensive operation. Efficiency of pollen has been reported to be enhanced by mixing date palm pollen with wheat flour or a solution of 10% sucrose (Carpenter, 1981). Mechanical pollination of palms using ground level pollen dusters has been reported since the late nineteen sixties (Brown & Perkins, 1969; Nixon & Carpenter, 1978). Mechanical pollen dusters with lances of different lengths are now

available that facilitate pollination in date palm at higher levels. We therefore carried out a comparative study to assess the yield and yield attributes between manual and mechanical pollination in two premier date palm cultivars of Saudi Arabia *viz.* Khalas and Sheshi.

Materials and methods

The study was carried out during the following seasons: 2008, 2009 and 2010 at the experimental site of the National Date Palm Research Center (NDPRC) at Al Hassa, Saudi Arabia. Al-Hassa (25°19' 60"N latitude and 49°37' 60" E longitude) is the largest date palm oasis of Saudi Arabia situated in the Eastern Province of the Kingdom having an estimated three million date palms.

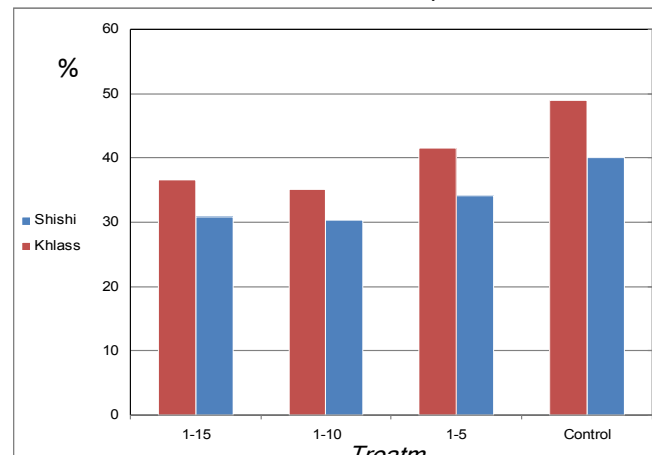
Staminate inflorescences were harvested from a single male palm in the date plantation at NDPRC, Al-Hassa which were transferred to the laboratory and air dried for 24-48 hours. These staminate inflorescences were then put in a bag and pollen was extracted manually. Part of the pollen was set aside for taking up pollination mechanically where in the extracted pollen was mixed with flour in pollen: flour ratio of 1:5(I), 1:10(II) and 1:15(III). The fourth treatment of manual pollination served as a control. The three mechanical pollination treatments and one manual pollination treatment were taken up in Khalas and Sheshi date palm cultivars planted at NDPRC. Pollination was carried in the above cultivars from 3-5 days of opening of the female inflorescences. Mechanical pollination was done using a portable pollen duster which had a 10m long telescopic tube that carried the pollen to the crown of the palm and dusted the pollen on the selected female inflorescences, while manual pollination was carried out as per the traditional practice by inserting 5 strands of the male inflorescence in the female inflorescence. Each of the four treatments was replicated thrice. In all there were 12 treated female inflorescences per palm.

All treated inflorescence were covered with craft paper to avoid contamination of the treated inflorescences by other pollen. The cover was removed after five weeks and fruit set rate was determined in five randomly selected strands per treated bunch. Subsequently, each bunch was inserted into a plastic mesh were fruits that dropped got collected. At fruit maturity the bunch weight per treatment was recorded. Further, the physical characteristics of the treated dates (fruit length and breadth) were noted besides recording the fruit drop per treated bunch at fortnightly intervals. The experiment was carried out using the completely randomized block design and data was subjected to ANOVA where treatment

means were differentiated at $p=0.05$. The results are presented and discussed below.

Results and discussion

Fig. 1. Effect of type of pollination on fruit set in Khalas and Sheshi cultivars of date palm



From Fig.1 it is evident that manual pollination resulted in better fruit set as compared to the mechanically pollinated bunches in both Khalas and Sheshi cultivars. In bunches that were mechanically pollinated the best fruit set was obtained when pollen: flour ratio of 1:5 was maintained. Attalla *et al.* 1998 reported that dusting the spathe with 5, 10 or 15% pollen powder significantly increased the fruit set in the cultivars Sukari and Helwa Qassim, while El-Mardi *et al.* (2002) reported that motorized duster produced lower fruit set than hand duster. El-Kassas (1986) recorded no significant differences in fruit set and yield either by mechanical or manual pollination methods.

With regard to fruit length mechanically pollinated Khalas palms produced significantly longer fruits (32.07mm) when a pollen: flour ratio of 1:15 was used which was superior to the other mechanical pollination treatments and also the manually pollinated bunches.

Table 1. Effect of pollination on the length and breadth of dates

Cultivar	Pollination type	Fruit length (mm)	Fruit breadth (mm)
Khalas	Mechanical		
	I	30.64b	18.92a
	II	30.94b	19.32a
	III	32.07a	19.48a
	Manual	31.16b	19.10a
Sheshi	Mechanical		
	I	29.95b	19.50b
	II	31.27ab	20.04b
	III	29.78b	18.20c
	Manual	32.00a	21.36a

- Pollen: Flour ratio (I- 1:5, II - 1:10, III - 1:15).
- Figures followed by the same letter are not significantly different ($p=0.05$).

With regard to the cultivar Sheshi manual pollination resulted in production of significantly longer fruits (32.00mm). Further, type of pollination did not influence fruit breadth in the cultivar Khalas while in the cultivar Sheshi significantly superior fruit breadth (21.36mm) was obtained in bunches that were manually pollinated (Table 1).

Table 2. Effect of pollination on drop of mature dates (Tamar stage) in date palm cultivars

Cultivar	#Mean fruit drop per bunch			
	Mechanical pollination*			Manual pollination
	I	II	III	
Khalas	39.10	40.80	44.50	30.70a
Sheshi	40.10	31.80	43.20	28.10a

*Pollen: Flour ratio (I - 1:5, II - 1:10, III - 1:15).

Treatment means are statistically not significantly different (p=0.05)

From Table 2 it is evident that pollination type did not significantly influence fruit drop in both Khalas and Sheshi. However, in both the cultivars least fruit drop was noticed in manually pollinated bunches (Table 2). Although treatment means with regard to yield (Table 3) in the cultivar Khalas were similar for both the methods of pollination, the best yield was recorded in manually pollinated bunches (11.54 kg/ bunch). El- Mardi *et al.* (2002) reported no significant effect of pollination method on yield while, Haffar *et al.* (1997) reported that mechanical pollination had a significant influence on fruit yield and quality in the cultivar Khalas. In the cultivar Sheshi mechanical pollination was significantly superior to manual pollination with pollen: flour ratio of 1:15 giving the best yield (8.06 Kg/bunch). El-Kassas & Mahmoud, 1986 compared mechanical pollination to hand pollination in date palm and found that the former gave good results in terms of yield besides reducing labour to an extent of 50 % as compared to manual pollination. Reports from Egypt suggest that delaying pollination beyond the seventh day of spathe cracking resulted in significant reduction in initial fruit set and bunch weight (El-Salhy *et al.*, 2011).

Table 3. Effect of pollination on the yield of date palm cultivars

Cultivar	Yield (Kg per bunch)			
	Mechanical Pollination*			Manual pollination
	I	II	III	
Khalas	10.99a	11.32a	11.31a	11.54a
Sheshi	7.04ab	7.84ab	8.06a	6.3b

*Pollen: Flour ratio (I - 1:5, II - 1:10, III - 1:15). Figures followed by the same letter are not significantly different (p=0.05)

Conclusion

In view of our findings and previous reports on the subject we propose that mechanical pollination of date palm may be encouraged in the region in view of its efficiency, increasing labour cost associated with manual pollination which is time consuming that results in enhanced cost of production.

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