

Effect of pollen source on productivity, maturity and fruit quality of 'Hayyani' date palm

J. Muhtaseb* and H. Ghnaim

Irrigated Research Program, National Center for Agricultural Research and Technology Transfer (NCARTT), P.O. Box: 639, Baqa'a, Jordan. *E-mail: Jalall2@hotmail.com

Abstract

To study the effect of pollen source on the productivity, maturity and fruit quality of 'Hayyani' date palm, one local and three commercial male varieties were used during 2002. Effect of pollen source on 'Hayyani' fruit-set and yield was statistically not significant, however, trees pollinated with 'Mejhool' pollen recorded the highest fruit-set and yield. The largest fruit weight, length and diameter were obtained when trees pollinated with 'Barakah' male. In addition, pollen source had no or little effects on 'Hayyani' fruit maturity, however, fruits of trees pollinated with 'Jarvis' male matured earlier while in trees pollinated with 'Barakah' showed delayed maturity. Moreover, 'Hayyani' trees pollinated with 'Barakah' pollen gave the highest fruit flesh %.

Key words: Male, pollen, Hayyani, pollination, maturity, fruit quality, date palm, *Phoenix dactylifera* L.

Introduction

Date palm (*Phoenix dactylifera* L.) plantations in Jordan have increased in the last years; however, this has not coincided with the increase in the knowledge of the appropriate cultural practices for date palm such as pollination. In addition, little information is available about date palm males used in pollination and its viability, which could mean the use of low quality males (low pollen viability) in pollinating highly valuable female trees, that will affect fruit set and thus yield and quality of date palm fruits.

Date palm is a dioecious plant with separate male and female trees in which pollination is normally done by wind. However, to ensure and improve fruit setting, pollination is done artificially in which mature male inflorescence are cut off before spathe splits, and male strands are placed in the female flower cluster so pollen will be transferred to female inflorescence (Asif *et al.*, 1983; Asif *et al.*, 1987; ElMardi *et al.*, 2002; Shabana *et al.*, 1985). In addition, pollen of date palm has effects on the resulting seed shape and size (xenia) and on the size, development, quality and ripening time of date palm fruits (metaxenia) (Nixon, 1955).

Pollen source affect ripening time and it ranged from about 10 days when fruits ripen early in hot weather, to as much as 2 month when fruits ripen late in cool weather (Nixon, 1955). In addition, pollen which produced smaller fruits and seeds, also produced earlier ripening (Monselise, 1986). Pollen from both 'Ghannami' and 'Werdi' males shortened the yellowing time of the Khalal stage of 'Zehdi' and increased the percentage of matured fruits. However, pollen from 'Rissasi' and 'Werdi' resulted in increased fruit set compared to other males. Fruits from trees pollinated with 'Werdi' had the lowest seed weight percentage (the highest edible portion), however, those pollinated with 'Ghannami' had the highest percentage of soluble solids (Delaimy, 1969).

This research aimed to study the effect of different sources of

pollen (male varieties) on the yield, quality and maturity of 'Hayyani' date palm cultivar.

Materials and methods

The study was conducted in a private farm at Aqaba area on twelve, 18 years-old uniform 'Hayyani' trees divided into three replicates during the 2002 season. A local date palm seedling male was evaluated with respect to its viability (according to germination test in a nutrient media), and named 'Barakah' male according to its location in Jordan. In addition, three commercial males ('Boyer', 'Jarvis' and 'Mejhool') collected from local date palm farms were used in this study.

At the beginning of the season, pollen germination test was done for all sources in a nutrient media consisted of 20 % sucrose and 1 % agar according to the method followed by Kwan (1969) and Asif *et al.* (1983). Pollen germination was recorded after 24 hour under microscope. Pollen having germination tube longer than pollen diameter were taken as germinated. Results were statistically analyzed according to Randomized Complete Block Design (RCBD) with three replicates.

At the time of natural opening of female spathe, each tree was pollinated with one source of pollen and the spathe was covered with a paper bag to prevent contamination with other sources. Pollen was diluted by mixing with flour in a ratio of 1:2 to insure maximum pollen distribution. Bags were removed after two weeks of pollination.

Seven female spathes were left on each tree to ensure uniformity. Fruit set percentage was calculated four weeks after pollination. At the end of the season, the following parameters were recorded: Total yield, fruit and seed weight, length and diameter, fruit total soluble solids (TSS %), maturity % (calculated as weight of fruit at Rutab stage to the total fruit weight at harvesting date), and flesh %. Data was analyzed using ANOVA with three replicates.

Results and discussion

Pollen germination: Pollen germination percentage ranged from 60.7% for 'Mejhool' to 76.6 % for 'Boyer' which significantly gave the highest pollen germination (Table 1).

Table 1. Pollen germination of male varieties used in the experiment

Treatment	Pollen germination (%)
Boyer	76.6 a*
Barakah	73.8 ab
Jarvis	70.6 b
Mejhool	60.7 c

* Mean separation within columns by LSD test, values that don't share the same letter are significantly different at $P=0.05$.

Fruit set percentage: No significant difference was observed among treatments when trees were pollinated with 'Mejhool' (68.1 %) and the least fruit-set was recorded when trees were pollinated with 'Barakah' (57.4 %) (Table 2).

Total yield: No significant differences was observed among treatments. However, trees pollinated with 'Mejhool' pollens gave the highest yield (78.4 kg) while trees pollinated with 'Jarvis' which was the lowest yield (57.9 kg) (Table 2).

Table 2. Effect of pollen source on fruit set (%) and total yield (kg) of Hayyani fruits

Treatment	Fruit set (%)	Total yield (kg per tree)
Boyer	67.6 a*	66.5 a
Barakah	57.4 a	69.2 a
Jarvis	59.5 a	57.9 a
Mejhool	68.1 a	78.4 a

* Mean separation within columns by LSD test, values that don't share the same letter are significantly different at $P=0.05$.

Fruit weight: Fruit weight was highest when trees were pollinated with 'Barakah' male (12.0 g). This could be due to low fruit set obtained when trees pollinated with this male. But it had no significant differences with those pollinated with 'Jarvis' and 'Boyer' (9.8 and 8.4 g, respectively). Trees pollinated with 'Mejhool' pollen gave the least fruit weight (7.4 g) (Table 3).

Fruit length and diameter: No significant difference was observed among the treatments in relation to fruit length. However, the highest fruit length was observed when pollinated with 'Barakah' male (39.5 mm) while those pollinated with 'Mejhool' pollen had the least (31.9 mm) (Table 3).

Table 3. Effect of pollen source on fruit weight, length and diameter and L/D of Hayyani fruits

Treatment	Average fruit weight (g)	Average fruit length (mm)	Average fruit diameter (mm)	L/D
Boyer	8.4 ab*	34.0 a	21.2 ab	1.6 a
Barakah	12.0 a	39.5 a	24.0 a	1.7 a
Jarvis	9.8 ab	36.0 a	21.0 ab	1.7 a
Mejhool	7.4 b	31.9 a	20.5 b	1.6 a

* Mean separation within columns by LSD test, values that don't share the same letter are significantly different at $P=0.05$.

The same was observed for fruit diameter but the differences were significant. The increase in fruit size could have contributed to the increase in fruit diameter rather than fruit length since no significant difference was observed for fruit length.

Fruit shape results showed that pollen had no effects on 'Hayyani' fruit shape (Table 3).

Seed weight, length and diameter: No significant difference was observed among treatments in relation to average seed weight and length. However, trees pollinated with 'Boyer' and 'Barakah' gave the largest seed diameter (10.3 and 10.2 mm, respectively), and those pollinated with 'Jarvis' gave the least (9.7 mm). In addition, no significant difference was observed among treatments with respect to length/diameter ratio, which meant that there was no effect of pollen source on seed shape. Consumers prefer date fruits with small seeds which could be obtained when 'Hayyani' trees were pollinated with 'Jarvis' male (Table 4).

Table 4. Effect of pollen source on seed weight, length, diameter and L/D of Hayyani fruits

Treatment	Average seed weight (g)	Average seed length (mm)	Average seed diameter (mm)	L/D
Boyer	1.7 a*	24.2 a	10.3 a	2.3 a
Barakah	1.6 a	24.5 a	10.2 a	2.4 a
Jarvis	1.5 a	24.2 a	9.7 b	2.5 a
Mejhool	1.5 a	23.6 a	10.0 ab	2.4 a

* Mean separation within columns by LSD test, values that don't share the same letter are significantly different at $P=0.05$.

Maturity percentage: With regard to maturity, no significant difference was observed among the treatments, however, trees pollinated with 'Jarvis' male had early fruit maturity while trees pollinated with 'Barakah' pollens showed delayed fruit maturity (Table 5).

Flesh percentage: 'Hayyani' trees pollinated with 'Barakah' pollens gave the highest fruit flesh % (86.1 %), but with no significant difference with 'Jarvis' male (83.7 %). Trees pollinated with 'Mejhool' pollens significantly gave the least flesh percentage (78.4 %) (Table 5).

Total soluble solids (TSS): No significant difference was observed among treatments with respect to total soluble solids (TSS), however, trees pollinated with 'Boyer' male gave the highest fruit TSS (32.8 %) while trees pollinated with 'Barakah' pollens gave the least fruit TSS (29.6 %) (Table 5).

Table 5. Effect of pollen source on maturity, flesh percentage and total soluble solids (TSS %) of Hayyani fruits

Treatment	Maturity (%)	Flesh (%)	TSS (%)
Boyer	12.7 a*	79.3 bc	32.8 a
Barakah	6.4 a	86.1 a	28.4 a
Jarvis	12.8 a	83.7 ab	31.9 a
Mejhool	7.8 a	78.4 c	29.6 a

* Mean separation within columns by LSD test, values that don't share the same letter are significantly different at $P=0.05$.

Studying these results, we can conclude that to improve fruit weight and quality, 'Hayyani' trees should be pollinated with 'Barakah' male which increased fruit size by 35-60 % and fruit flesh % by 8-10 % compared to other males. But if high productivity is desired, 'Mejhool' will be the best option.

In addition, if early maturity is desired, 'Hayyani' trees should be pollinated with 'Jarvis' or 'Boyer' males. Moreover, if delayed maturity is desired 'Hayyani' trees should be pollinated with 'Barakah' and 'Mejhool' pollen.

Four date palm varieties used as pollen source influenced fruit size, pulp percentage, quality and ripening time of Hayyani fruits with varying degree and thus indicating that these parameters are influenced at genotypic level also. Such varietal response were also reported by Nixon (1955). Both xenia and metaxenia effects of pollen source were apparent in the present study. Influence of pollen source has been reported in date palm by Monselise (1986). Pollen from both 'Ghannami' and 'Werdi' shortened the yellowing time of the Khalal stage of 'Zehdi' and increased the percentage of matured fruits. However, pollen from 'Rissasi' and 'Werdi' resulted in increased fruit set. Fruits resulting from the trees pollinated with 'Werdi' had the highest edible portion, however, those pollinated with 'Ghannami' had the highest percentage of soluble solids (Delaimy, 1969). Our results indicate that 'Hayyani' also responds differently to various pollen sources and thus there is a scope for selection of pollen source for better and quality production.

Based on the results of the present study, it can be conclude that to improve fruit weight and quality, 'Hayyani' trees should be pollinated with 'Barakah' male which increased fruit size by 35-60 % and fruit flesh percentage by 8-10 %, compared to other males. But if high productivity is desired, 'Mejhool' will be the best option.

References

- Asif, M.I., O.A. Tahir and A.F. Farah, 1983. The effect of some chemicals and growth substances on pollen germination and tube growth of date palm. *HortScience*, 18(3): 479-80.
- Asif, M.I., O.A. Tahir and A.S. Ghamdi, 1987. Variation in date palm pollen grain size. *HortScience*, 22(4): 658.
- Delaimy, K.S. and S.H. Ali, 1969. The effect of different date pollen on the maturation and quality of "Zehdi" date fruit. *J. Amer. Soc. Hort. Sci.*, 94(6): 638-39.
- ElMardi, M.O., H. Esechie, L.M. Al-Kharousi and K.M. Abdelbasit, 2002. Effect of pollination method on changes in physical and chemical characteristics of date palm during development. *Agric. Sciences*, 7(1): 21-27.
- Kwan, S.C., A.R. Hamson and W.F. Campbell, 1969. The effect of different chemicals on pollen germination and tube growth in *Allium cepa* L. *J. Amer. Soc. Hort. Sci.*, 94: 561-62.
- Monselise, P. S. 1986. Date, In: *Handbook of fruit set and development*. CRC Press, Inc. Boca Raton, FL, USA. pp. 119-144.
- Nixon, R.Y. 1955. Effect of metaxenia and fruit thinning on size and checking of Deglet Noor dates. *Proc. Amer. Soc. Hort. Sci.*, 67: 258-64.
- Shabana, H.R., B.A. Mawlood, T.K. Ibraheem, M. Shafaat and H.M. Aziz, 1985. Pollen viability and favorable storage conditions for seven commercial male cultivars of date palms. *J. Agric. Water. Reso. Res.*, 4(3): 169-79.