

NOTE

**COMPARISON BETWEEN MECHANICAL
AND HAND POLLINATION OF SHAHANI
DATES**

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(Received August 23, 1992)

ABSTRACT

Two experiments were conducted in 1988 and 1989 to compare the effects of machine and hand pollination on fruit set, size and yield of *Phoenix dactylifera* L. cv. Shahani, and also to determine the optimum time for pollen application by a newly developed mechanical pollinator. Pollen application on days one to five after spathe opening did not affect yield per bunch significantly, although high yield was obtained on day 3 after spathe opening. Mechanical pollination increased fruit set and reduced fruit size. Overall fruit yield per bunch was better with mechanical pollination than with hand pollination when treatments were applied on separate palms but no significant difference was observed on the same palms.

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چکیده

دو آزمایش در سالهای ۱۳۶۷ و ۱۳۶۸ جهت مقایسه اثرات گرده افشانی ماشینی و دستی بر روی تشکیل میوه، اندازه و میزان محصول خرما (*Phoenix dactylifera L.*) رقم شاهانی و همچنین تعیین زمان بهینه جهت گرده افشانی با یک دستگاه گرده افشان جدید به اجرا گذاشته شد. انجام گرده افشانی ماشینی از یک تا پنج روز پس از شکافته شدن غلاف گل آذین تأثیر معنی داری بر روی محصول خالص هر خوشه نداشت، اگرچه گرده افشانی سه روز پس از شکافته شدن گل آذین محصول بیشتری را حاصل نمود. گرده افشانی ماشینی موجب افزایش تراکم میوه و کاهش اندازه آن گردید. کل میزان محصول هر خوشه گرده افشانی شده با ماشین، زمانی که تیمارهای ماشینی و دستی بر روی نخل های مجزا انجام گرفت، بطور معنی داری بیشتر از روش دستی بود، ولی در مورد تیمارهای انجام شده بر روی خوشه های نخل تفاوت معنی داری ملاحظه نگردید.

INTRODUCTION

Following the development and preliminary tests of a mechanical date pollinator designed for the conditions of Iranian date groves (6), the need for determination of the optimum time for pollen application following spathe cracking was recognized. Leding (5) and Oudejans (8) have reported that female date palm flowers are most receptive within three to four days after spathe opening. If this is true mechanical pollination should be

performed when receptivity is maximal.

The method of pollen application could also affect fruit set and quality. Brown *et al.* (1, 2) evaluated two methods of pollinating date blooms using ground-level equipment, namely a palm duster and a bloom duster. Fruit set, following use of the palm duster was poorer than that following hand pollination; whereas fruit set resulting from use of the bloom duster was equal to or better than that from hand pollination.

The objectives of this research were to determine, a) the optimum time for pollen application by the mechanical date pollinator, and b) the effect of mechanical pollination on fruit set and yield in comparison with conventional hand pollination.

MATERIALS AND METHODS

The experiments in 1988 and 1989 were conducted at Jahrom, a date growing town located 195 km south-east of Shiraz in Fars province, Iran.

A. 1988 Experiment

Twenty Shahani date palms having nearly the same age and growing conditions were selected. The experimental design was a CRD with five pollination treatments and four replications. Pollen was applied 1,2,3,4 or 5 days after spathe opening.

Complete opening of the spathes normally occurs within seven to ten days. To insure complete fertilization of the female flowers, double pollination of the inflorescences has been recommended by investigators (2), therefore a second pollination was performed five days after the first application. In the

conventional hand pollination method there is no need for double pollination, because the split spathes are removed before pollination.

The twenty selected palms were randomly divided into five equal groups. On each palm, three spathes were randomly selected and tagged, one to be pollinated mechanically according to the predetermined pollination schedule (M.P.), one hand pollinated (H.P.) by the conventional method and the other left unpollinated as control (N.P.). Thus within the CRD experiment described for timing of mechanical pollination, a second experiment using five randomized complete block design (RCBD), each block (tree) having three treatments, allowed comparison of hand and machine pollination.

In M.P. treatments a mixture of pure pollen and carrier with the ratio of one to two was applied using the mechanical pollinator developed by Loghavi (6). Dried, finely ground and screened male flower parts were used as carrier powder.

For pollen extraction, mature male inflorescences with split or cracked spathes were cut at the base of the stalks and transported to the laboratory. The spathe sheaths were first removed and bloom clusters were gently shaken over a large tray to collect that part of the pollen already released from the open flowers. The collected pollen was air dried at room temperature for about 24 hours on absorbing paper. The inflorescences were air dried for 48 hours, then gently shaken and beaten with a stick to extract the pollen. The pollen was then screened to remove other flower parts.

During the pollination period the extracted pollen was kept in an air-tight container in a refrigerator. A small linen bag containing anhydrous calcium chloride was inserted in the

container and another in the pollen hopper of the mechanical pollinator to keep the pollen dry during storage and application. Dry date pollen can be kept at moderate temperature for two to three months without significant reduction in its viability (7). The viability of the pollen used for mechanical and hand pollination was determined weekly during the pollination experiment by germination in modified Brewbaker and Kwack (MBK) medium as reported by Furr and Enriquez (3).

The selected palms were inspected daily to record cracking dates of the M.P. tagged spathes for scheduling pollination. Mechanical pollination of the M.P. tagged spathes started on April 18 and continued through May 2. During pollination all of the cracked or opened spathes except the one under M.P. treatment were covered with paper bags to prevent them from being pollinated.

During the same interval that M.P. was conducted, hand pollination was performed by removing the split spathe, inserting a few strands of male flowers and tying the flower cluster with slip knot. Male flowers used for hand pollination and mechanical pollination were picked from the same or similar male palms.

All of the experimental palms received identical irrigation and cultivation treatments during the time interval between pollination and harvesting.

On May 6, signs of rhinoceros beetle attack were observed on several palms adjacent to the experimental plot. All experimental as well as adjacent palms were, therefore, treated with 25% lindane.

The tagged fruit bunches were harvested individually on October 15.

B. 1989 Experiment

The objective of this investigation was to compare mechanical pollination vs. hand pollination. The following parameters were chosen as the indices of evaluation and comparison:

1. Pollinated fruit set (no. of pollinated fruit/unit length of strand).
2. Percent of pollinated fruits.
3. Mean weight of ten pollinated fruits.
4. Mean weight of ripe fruit per bunch.

Fifteen Shahani date palms were selected from the same palms used in 1988 and randomly divided into three groups of five each. Among these three groups, one group was randomly assigned to be pollinated mechanically, one hand pollinated and one was pollinated by a combination of the both methods. In fact, one spathe from each palm of the third group was randomly selected and tagged to be pollinated mechanically, while the other spathes were hand pollinated.

With this arrangement the ten palms of groups 1 and 2 formed a CRD experiment with two pollination treatments and five replications (trees), while the other five palms formed a RCBD experiment with two treatments and five replications (trees).

About six weeks after completion of mechanical pollination, fruit set on M.P. and H.P. bunches was determined by counting the number of pollinated and unpollinated fruits formed on four randomly selected strands on each bunch, measuring the total length of the fruiting strands and then dividing the total number of pollinated fruits by the total fruiting length of the four strands. These data, expressed as pollinated fruits/cm of strand, were later used as an index of fruit density in statistical

analysis. The inverse of this expression (inches of strand/pollinated fruit) was used by Brown *et al.* (2) as an index of fruit density.

RESULTS AND DISCUSSION

1988 Experiment

Pollen viability. The viability of pollen used with the M.P. and H.P. treatments averaged 89% and ranged from 79 to 99%. Furr and Enriquez (3) and Khosh-Khui *et al.* (4), by germination and staining methods, respectively, have reported lower viability percentages for date pollen.

Time of pollen application. Analysis of variance indicated no significant effect on fruit yield due to the five pollination treatments, even though the highest yield was obtained by pollination on days 3 after spathe opening. Comparisons of treatment means using DMRT indicated no significant differences except for day 3 which was greater than day 1 or 5.

Mechanical vs. hand and no pollination. Values of the mean net fruit yields of the five M.P. treatments along with those of the H.P. and N.P. treatments are shown in Table 1. Comparisons of the M.P. and H.P. treatment means using DMRT indicated significant differences in 3 out of 5 cases. While mean differences between the M.P. or H.P. and the N.P. treatments were highly significant in all cases.

Partitioning of treatment sum of squares indicated a highly significant difference between pollination and no pollination as well as mechanical vs. hand pollination.

Table 1. Effect of mechanical pollination (at various stages of spathe opening), hand pollination and no pollination on mean fruit yield (kg) per bunch of Shahani dates.

Method of pollination	Days after spathe opening				
	1	2	3	4	5
Mechanical pollination (M.P.)	7.49*	8.16ab	9.08a	8.23ab	7.45b
Hand pollination (H.P.)	6.70bc	6.56c	7.20C	7.33bc	6.28C
No pollination (N.P.)	2.87D	3.73D	3.70D	2.89D	2.64D

* Mean in each group of data (columns and rows) different letters are statistically different at 5% level (lower case letters) or 1% level (upper case letters) according to DMRT.

1989 Experiment

Mean values of fruit density, fruit weight, pollinated fruit percent and fruit yield per bunch when mechanical and hand pollinations were applied on spathes of separate and/or same palms are shown in Tables 2 and 3, respectively.

Fruit density. There were significant differences when M.P. and H.P. treatments were applied on separate palms, while no significant difference was observed when applied on spathes of the same palms.

Higher fruit-set on M.P. spathes could be attributed mainly to the more uniform distribution of pollen over the female flowers by M.P. Lack of significant difference when M.P. and H.P. were applied on spathes of the same palms could be due to the pollen drift from M.P. spathes to their proximate H.P. spathes.

Fruit weight. Mean weight of 10 pollinated fruits six weeks after

pollination and at harvest for both M.P. and H.P. fruit bunches are shown in Tables 2 and 3. Even though the mean weight of the M.P. fruits was slightly lower than the H.P. ones, the difference was not significant at 5% level of probability.

Percent of pollinated fruits. Ratios of pollinated fruits to the total fruits formed (pollinated + unpollinated) were very high (0.95-0.99) on both M.P. and H.P. fruit bunches, with no significant difference between machine and hand pollination.

Fruit yield per bunch. Analysis of variance for the effect of pollination methods on mean fruit yield per bunch indicated that M.P. bunches had higher fruit yield than H.P. ones when treatments were applied on separate palms. No significant difference was observed on the same palms.

Table 2. Mean values of fruit density, fruit weight, pollinated fruit percent and fruit yield per bunch when mechanical and hand pollinations were applied on spathes of separate palms.

Pollination method	Fruit density (No. of fruits/cm of strand)		Fruit weight (Wt. of 10 fruits, g)		Pollinated fruit fruit (%)	Fruit yield per bunch (kg)
	6 wks.	Harvest	6 wks.	Harvest	6 wks.	Harvest
	Mechanical	1.34a [†]	0.96a	5.17a	79.58A	99.06a
Hand	1.13b	0.79b	5.93a	83.67B	95.18a	8.43b

[†] Mean in each column with different letters are statistically different at 5% level (lower case letters) or 1% level (upper case letters).

Table 3. Mean values of fruit density, fruit weight, pollinated fruit percent and fruit yield per bunch when mechanical and hand pollinations were applied on spathes of the same palms.

Pollination method	Fruit density (No. of fruits/cm of strand)		Fruit weight (Wt. of 10 fruits, g)		Pollinated fruit (%)	Fruit yield per bunch (kg)
	6 wks.	Harvest	6 wks.	Harvest	6 wks.	Harvest
	Mechanical	1.27a [†]	0.91a	5.84a	81.16a	99.17a
Hand	1.13a	0.77a	6.98a	83.22a	96.14a	8.36a

† Mean in each column followed the same letter are not significantly different at 1% probability level.

CONCLUSION

Results of this study indicate that receptivity of Shahani date palms does not change significantly during the first five days after the opening of the spathes, but three days after spathe opening seems to be the optimum time for pollen application by the mechanical pollinator.

Artificial pollination is necessary to obtain acceptable fruit yield, and mechanical pollination gives comparable or better fruit set and fruit yield than the conventional hand pollination.

Mechanical pollination results in smaller fruits than hand pollination due to the higher fruit set, but the overall net fruit yields are not different for the two pollination methods.

In addition to the possible advantage of gaining a slightly higher yield by adopting mechanical pollination, the major advantage which favors M.P.

over H.P. is the greater speed and ease of operation of the mechanical pollinator which reduces the hardship and hazard of traditional hand pollination.

ACKNOWLEDGMENT

The author is grateful to Dr. M. Khosh-Khui of the Department of Horticulture for his assistance and valuable suggestions during the course of this study. Thanks are expressed to Mrs. Sorouri for conducting pollen germination tests and Mr. Sedighi for conducting the pollination tests in the field.

This research was supported by a grant (66-AG-448-234) from the Research Council of Shiraz University.

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