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FUNDAMENTALS OF POLLINATION IN DATE PALM PLANTATIONS IN IRAN

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ABSTRACT

Producing of marketable and quality dates is the main goal of date production management. According to the latest FAO report in 2004, the yields of date plantation per hectare were 37.7, 9.4, 8.1, 6.7 and 5.9 tons in Egypt, Sudan, Pakistan, Oman and Saudi Arabia, respectively. Unfortunately, Iran as the second largest producing country of dates in the world has 4.8 tons per hectare yield during the same year. Optimizing application of collected pollen grains can decrease the number of required pollinator trees in a plantation so this is one of the best methods for increasing of the yield. In this way yield could be increased up to 12.5% of the current level. Also selection of higher pollinators, their location in plantation, recognizing of mature spathes, pollen grains acquisition, suitable method of pollination and determining time for pollination are the most important factors that influence on pollination efficiency in date plantations and increasing of their yield. The latest results derived from recent researches especially in southwest climatic conditions of Iran are discussed in this article.

Key words: Traditional pollination, artificial pollination, spathe cracking, pollen harvesting, fresh pollen, dry pollen, pollen storage, pollen variety, and effective pollination period.

INTRODUCTION

Date palm is the second important economic and exportable fruit crop of Iran. According to FAO reports in 2004, Iran with 184000 hectares date palm harvested areas and 875000 tons annual production has been the second world largest producer among the main producing countries (Fig. 1) (FAO, 2005). Also more than 400 cultivars have been reported from Iran (Fig. 2) (Zaid, 1999) and in this regard, it is placed first in the world. In spite of above advantages, the average yield per hectare has been 4.8 t during the past 10 years (Fig. 3) (FAO, 2005).

Date palm is a dioecious perennial plant. Sexes are borne by separate individuals so, male and female flowers being produced in clusters separately. The fruit set, growth and development of dates depend on fertilizing of females by pollen grains therefore, pollination is one of the most important practices in date industry.

POLLINATION TECHNIQUES IN IRAN

A few plantations of date palm especially in south and southeast of Iran are still pollinated by wind, bees, and insects that are called natural pollination. All these regions are characterized by their 100% seedling composition with about 50% males that lead to low efficiency of fruit production. Commercial date production necessitates artificial pollination that ensures desire fertilization and overcome disadvantages of dicogamy. Artificial pollination is practiced by traditional and mechanical methods in Iran. The most growers of Iran perform the first method as following ways:

a) Placement Method

The male strands are cut from a freshly cleaved male spathe and place 4-5 of these strands, lengthwise and in an inverted position, between the strands of the female inflorescence. It is recommended that this should be done after some pollen has been shaken over the female inflorescence. It is also recommended to tie the pollinated female clusters about 10 cm from the outer end in order to keep the male strands in place and avoid the entanglement of the female clusters' strands during their rapid growth. For long trees it is done by a tall wood without any closing the female cluster due to unavailability of them. Both of above cases are very common in Khuzestan, Kerman, and Hormozgan provinces.

b) Fine Cloth Bag Method

In this case 48-72 hours after male flowers opening dry pollen grains are poured by a fine cloth bag (like a stocking) over the female clusters. For long female trees the bag of pollen is tied to a wooden stick and shaken over the inflorescence. It is recommended that shaking practice have to be done 2-3 times, for safe pollination and good fruit setting.

Pollen-Mixed Cotton Pieces Method

This is not very common in Iran but is used by few growers. In this case dry pollen is dusted on a spherical cotton piece about the size of a golf ball and placed 1-3 pieces between the strands of female inflorescences.

The above traditional pollination methods have some disadvantages as follow:

- Inadequate skilled labor
- High risks of life due to climbing upon the tall trees
- High costs
- Long duration of pollination practices in date plantation
- Increasing consumption of pollen grains
- Dicogamy
- Low efficiency

Mechanical pollination is gaining grounds, especially in Kerman province (Jiroft, Bam and Kahnuj regions) in recent years (Pezhman, 2001). The device is similar to a knap sack sprayer (Fig. 4) that is made up of:

- Stainless steal air reservoir with volume about 20 liters
- Air pump
- Rubber connecting hose
- Metal aluminum connectable pollinator pipes
- Pollen hopper
- Safety valve
- Pressure gauge
- Handle

By repeatedly pressing the air pump, the air is condensed in the air reservior. About half of pollen hopper is filled by dry pure or mixed pollen grains and when the handle is pressed, the condensed air releases and moves through connecting hose. So the grains move from pollen hopper towards the nozzle through connectable pollinator pipes and expulse over female

inflorescence. It is recommended that mechanical pollination have to be repeated twice after 2-3 days.

There are 15-20 male trees per hectare in traditional date plantations of Iran but conducted researches during the past 20 years showed that we can decrease it to 5 male trees per hectare if obtained pure pollens mix to inert filler substances (Table 1).

At the case of 20% pollen + 80% pollard, in general, not only the amount of pollen consumption could be decreased to one in five but also the yield could be increased to 12.5% per hectare (Fig. 5). The size of inert filler materials (such as talc powder, wheat pollard, grinded date bunch remains, etc) must be similar to the pollen grains with no harmful effect on the pollens viability, or their germination on female stigma.

Mechanical pollination has some advantages as follow:

- No need of skillful labor
- No risk of life for pollinator
- High efficiency
- Decreasing consumption of pollen grains
- Decreasing pollination costs
- Time saving
- Low cost

POLLEN HARVEST AND HANDLING

Identification of Mature Male Spathe

The position of male spathe changes from vertical to oblique during maturation. Mature male spathe leans on the neighboring leaf. A male spathe that is ready to harvest assumes a red brown, dark brown or light brown color depending on the variety. The cracking sound is heard if fingers press a mature male spathe. At maturity the male spathe cracks showing signs of small visible splits.

Drying of Pollens

Freshly opened male flowers contain a high level of moisture. If they are not to be used immediately, they must be dried in order to avoid of pollen contamination by moulds. Iranian date growers use different methods. After opening of the spathe, the inflorescence is separated to some clusters containing 2-3 strands for each one. These small clusters are hung on a wire or cord for few hours in a room. Air movement and sunlight are to be avoided in order to protect the pollens viability and to prevent dispersion of them.

Some of the other date palm growers especially in south west of Iran (Khuzestan province) decompress the inflorescence after removing the spathe cover. Then it is placed on a paper in a shaded and protected area for about 2 days.

It is recommended to put two pieces of spathe covers below of the inflorescence to prevent tearing of the paper because of the inflorescence moisture. Released pollen grains have to turn upside down 3-4 times a day. It is better to shake the inflorescence slowly each time or to inflict some strokes slowly by a 40 cm metal pipe or a ping-pong bat.

Pollen Storage

Obtained dry pollen grains have to be kept in an airtight glass vessel near-by a humectant at 4-5^{o}C. It is reported that 200g calcium chlorides as a humectant are enough for 1 kg pollen at refrigerator condition (4-5^{o}C) to prevent pollen moisten for about one year.

POLLEN VARIETY

The most female plantations of date palm are pollinated by local pollinator rootstocks in Iran. Many of male trees are unknown taxonomically but there are recommendations for pollination of some commercial cultivars of Iran (Table 2) based on researches during the past 15

years. Fortunately a 3-years research project began from early 2005 in order to identify male varieties of date palm in Khuzestan province (south – west of Iran).

EFFECTIVE POLLINATION PERIOD

The length of receptivity period of pistillate flowers could vary up to 3-4 days depending on the cultivars of Iran. Pollination period of date palm generally during March and middle of April. The most effective pollination period for some female commercial cultivars is given Table 3.

TOP RECOMMENDATIONS

- Male trees have to be cultivated in a separate area of the plantation consisting of early, mid and late season variety.
- Splitting of female spathe is a very good sign for its receptivity.
- The best hours for pollination are between 10 am to 3 pm.
- Most of the cultivars have to be pollinated during 2-4 days after spathe opening
- If rain occurs within 2-3 days after pollination it has to be repeated.
- Dicogamy of male and female flowers is too important when traditional pollination is used.
- It is emphasized that skillful labors are used for traditional pollination.
- Mechanical pollination has to be repeated 2-3 days after the first time.
- Mechanical pollination is preferred than traditional one and recommended strongly.
- Covering of pollinated inflorescences by craft paper bag could be useful if the temperature decreases. These covers must be removed after 8-10 days.
- First thinning of fruits (cutting one third of inflorescence) and pollination could be done together.
- If the pollen of previous year is to be used for pollination, their viability has to be evaluated by a germination test.
- Fresh and dry pollen is preferred than dry pollen of previous year.
- To keep dry pollen in an airtight glass vessel (near –by calcium chloride at 4-5°C) is the best condition.
- Mixture of 20% pure pollen and 80% pollard is desirable for pollination of the most cultivars.
- Although fresh pollens are preferred than dry ones due to their more efficiency, but there is no significant difference between them.
- If a female cultivar is transferred to another region, its pollinator has to be transferred with it.

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TABLES

Table 1: Recommended pollen density for pollination of some commercial date plantations

Female cultivars	Region (Province)	Recommended Pollen Density	Ref.
Sayer	Ahwaz (Khuzestan)	20% pollen + 80% pollard	(5)
Kabkab	Kazeroon (Fars)	20% pollen + 80% pollard	(15)
Shahani	Jahrom (Fars)	20% pollen + 80% pollard	(10)
Mozafti	Jiroft (Kerman)	10% pollen + 90% pollard	(3)

Table 2: Recommended variety of pollinator for pollination of some commercial female cultivars

Female cultivars	Region (Province)	Recommended Variety of Pollinator	Ref.
Sayer	Ahwaz (Khuzestan)	Khekri, Ghannami, Verdi, Samesmavi	(6)
Kabkab	Kazeroon (Fars)	Zahidi	(10)
Shahani	Jahrom (Fars)	Shahani	(10)
Zahidi	Jahrom (Fars)	Towarz, Zahidi (of Jahrom region)	(14)
Mozafti	Bam (Kerman)	(Local variety of Jiroft region)	(8)
Halilaei	Jiroft (Kerman)	Khekri, Samesmavi, Sabz Parak, Sorkh Parak, Zard Parak	(1)
Halili	Minab (Hormozgan)	Rootstock no. 1002	(11)

Table 3: The best effective pollination period for some commercial female cultivars

Female cultivars	Region (Province)	Recommended Effective Pollination Period	Ref.
Sayer	Ahwaz (Khuzestan)	From spathe cracking to next 4 days	(12)
Mozafti	Jiroft (Kerman)	1-3 days after spathe cracking	(2)
Kabkab	Borazjan (Bushehr)	2 days after spathe cracking	(9)
Shahani	Jahrom (Fars)	2-4 days after spathe cracking	(13)

FIGURES

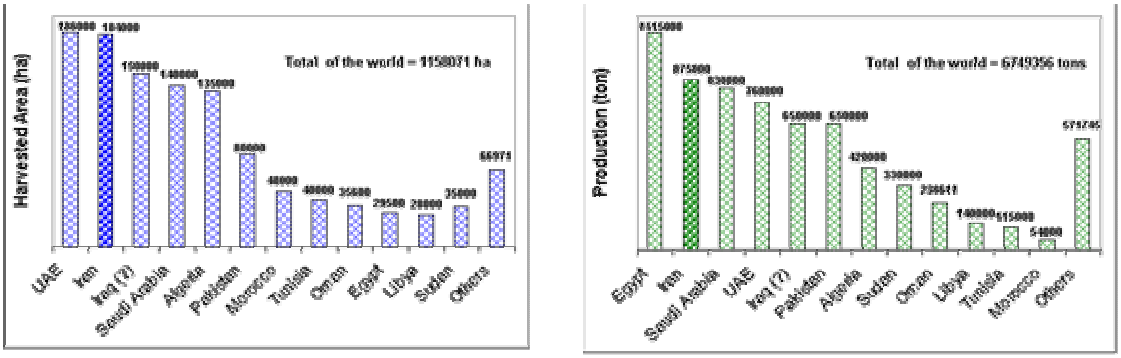

Figure 1: Harvested area (left) and production (right) of the major date producing countries in 2004

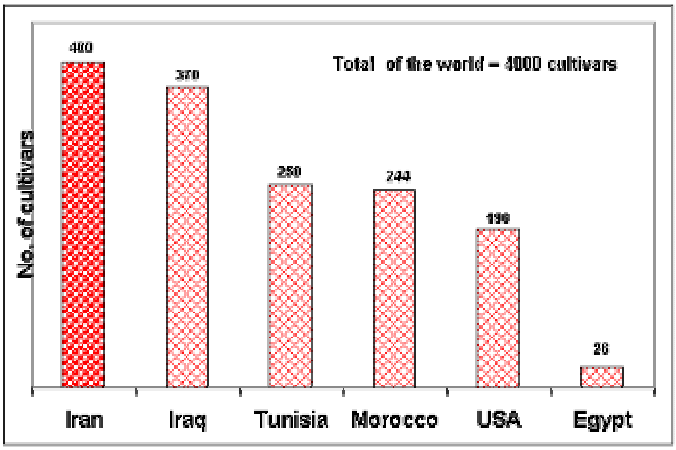

Figure 2: Number of cultivars in the major date producing countries

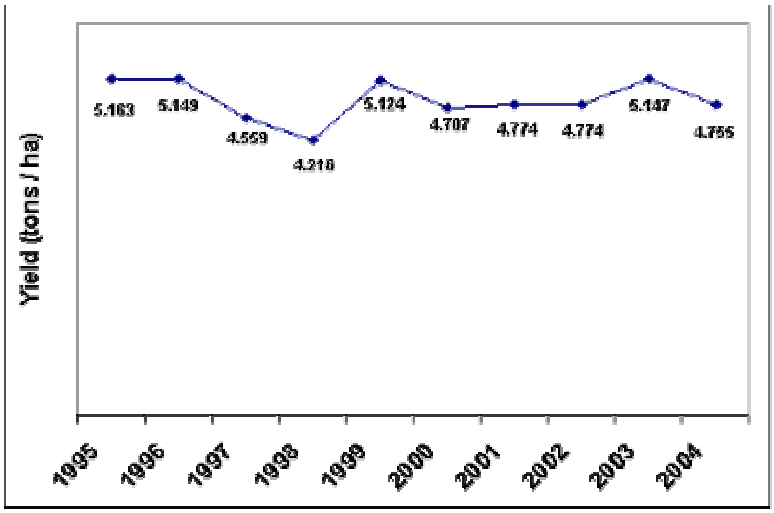

Figure 3: Date yield of Iran plantations during 1995-2004

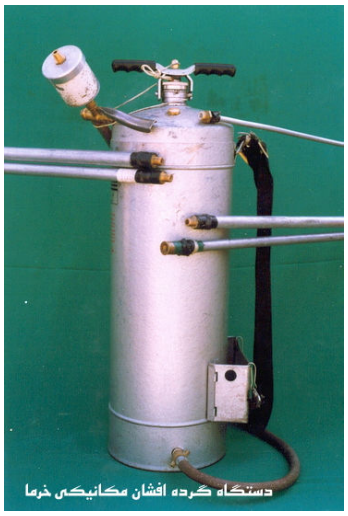

Figure 4: Mechanical pollinator for date palm

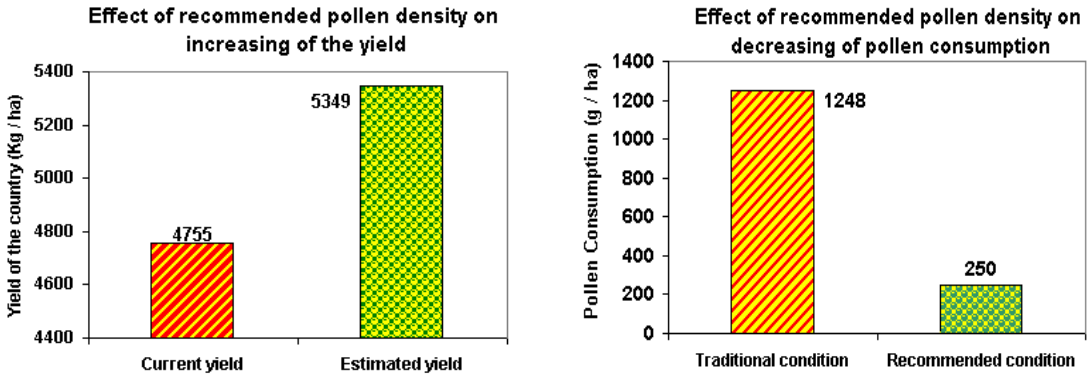

Figure 5: Effect of recommended pollen density on increasing of the yield (left) and pollen consumption (right) if 156 female trees per hectare exist