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Evaluation of male date palm (*Phoenix dactylifera* L.) for pollen grain production under arid conditions

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Abstract

In date palm cultivation, pollen grains play an important role for fruit set, maturity, fruit yield and quality. It is a dioceous plant and pollination is essential for proper fruit set. The farmers of the arid region are facing problem of pollen grains due to lack of sufficient number and superior type of male plants. Further, it was observed that due to climatic conditions, since last 2-3 years emergence of spathe is late in males than female palm. The objective of the study was to identify superior genotype of male date palm for pollen production. Four elite male palms grown at Date palm experimental block, CIAH farm were evaluated during the year 2016-17 for emergence,, number of spathes, size of spathe and pollens yield/spathe under hot arid environment. The amount of pollen produced per spathe varied among male palms. The size of spathe was also differed significantly from one male to another male palm. The pollen production ranged from 17.2 g to 25.0 g per spathe. The study revealed that CIAH/DP/M-03 male plant produced highest amount of pollen grains (643g/tree) followed by CIAH/DP/M-01 (578g/tree) under arid conditions.

Key words: Date palm, male, spathes, pollen grains, pollination, fruit set,

Introduction

Date palm (*Phoenix dactylifera* L. Family- Arecaceae) also known as *Khajoor*, *Kharek* is an ancient fruit tree of semi-arid and arid regions of the world. It grows well under poor desertic soils due to its hardy plant characteristics and deep root system. Date palm is dioceous and cross pollinated crop. It requires dry hot climate for growth and development of fruits (Zaid, 1999). It can be grown at such places where adequate irrigation facility is available besides other climatic requirements (Chandra *et al.*, 1992). It's delicious fruits at *doka* (khalal) stage are eaten as fresh and also used for preparation of several value added products (Singh *et al.*, 2004). Moreover, all plant parts of date palm are useful since its history of cultivation (Chao and Krueger, 2007) in several ways to make handicraft items. Its seed kernel is used for animals and fish feed.

The extremely dry hot areas comprising Jaisalmer, Barmer, Bikaner and Jodhpur in Rajasthan, Bhatinda, Fazlika, Abohar in Punjab, Sirsa, Hisar, Mahendergarh, Bhiwani in Haryana and Kachchh region in Gujarat are the potential areas for date palm cultivation in India. In Rajasthan, earlier area of date palm cultivation was about 50- 60 hectare, now 850 ha area is under cultivation by planting of imported tissue culture plants in districts of Jaisalmer, Barmer, Jodhpur, Churu, Sri Ganga nagar,Hanumangarh and Bikaner by Rajasthan Horticulture Development Society. The naturally grown date palm seedling is available in costal areas of Gujarat as grove in depressions, on riverbank, *nala* and boundary of field/farms (Singh *et al.*, 2004; Murlidharan *et al*., 2008). These seedling populations include female and male plants. The estimated area under date palm cultivation is 18847 ha. with production 173997.66 MT during the year 2017 in Kachchh region,Gujarat (Bhuj, Anjar, Khedoi, Mundra, Mandavi and Jamnagar).

The male date palm is also important like female plants for production of pollen grains as well as avenue tree. Looking to its potential, new date palm plantation has done in arid region of Rajasthan, Gujarat ant other parts of the country. Being dioceous nature, male and female flowers borne on tree separately. Male and female plants are identifying only at flowering stage and about 5% male plant is required for pollination. However, availability of pollen grains is one of the emerging constraints in date palm cultivation area due to lack of sufficient male trees. Identification of elite male and further multiplication is essential to meet out present pollen demand and conservation of pollen is also desirable. About 10- 20g pollen grains are normally required for pollination of a full grown tree. Keeping in view, the present study was undertaken to identify suitable date palm male tree for early flowering and high pollen grains yield under hot arid conditions.

Material and Methods

The study was carried out on different 4 elite type male palms at CIAH, Bikaner for pollen production potential. The historical and morphological back ground of male tree under taken for study is given. The date palm seeds procured from Iran, Iraq, Mundra (Gujarat), Bikaner (Rajasthan) were sown in nursery to raise saplings .The saplings were planted in the field for evaluation. In general the 50:50 sex ratio of male and female palm have been reported in seeedlings. The full

grown tree between age of 10-12 were taken for study. These plants were maintained with common cultural practices. Looking to the importance of the male tree, it was studied for pollen production during 2016-17. The observations on emergence of spathe, time taken for opening of spathe, size of spathe, pollen grains yield per spathe as well as per tree was recorded. The number of spathe emerged per tree was counted and observations on size (length x width) were observed of three spathes. For pollen yield, spathes were cut down at opening time and kept on paper under shade condition for drying. The weight of dried pollen was measured and data was analysed statistically.

Results and Discussion

Data on spathe emergence, opening and days taken for flowering in male palm in relation to pollen grains yield is given in table 1 and 2.

Variability in male date palm: The natural seedling population of date palm is available in costal belt of Kachchh region of Gujarat in India and pollen grains are collected from male plants by farmers for pollination (Singh *et al*., 2004). In other parts of country, seedling population is very less. At CIAH, Bikaner, 4 genotypes were marked elite tree in field repository collected from different available sources (Table 1). The seedlings of date palm were evaluated for spathe size, days taken for opening of spathes and pollen production. The variation in spathe size, days taken for opening of spathes was observed in male seedlings. The variation in days taken for opening of spathes ranged from 18-29 days. The opening of spathe also depends on climatic conditions of the region. Similar findings have also reported by Shaheen (2004).

Based on varietal performance under Indian conditions, the varieties have been recommended for cultivation for different regions. It has been noted that frequency of pollination and fruit set differed from variety to variety. In case of Medjool pollination is easy and required less pollen for better fruit set. The problem of fruit set and fruit drop also observed in tissue culture plantations according to feed back information of the growers in western Rajasthan. It may possibly be due to flowers opening time, receptivity of stigma, viability and germination of pollen grains besides environmental factors.

Spathe emergence and opening: Flowering takes place from January to March months depending upon agro-climatic conditions of the region and varieties. It is dioecious in nature and the identification of sex (male or female) of seedling palm trees is possible only after the trees start flowering and thus there remains equal possibility of male and female sex of seedling palm trees. In North India, flowering starts after winter season *i. e.* with the start of spring season. Flowering is preceded by spathe initiation. The spathe initiation is governed by various factors such as cultivar, place of cultivation, temperature, management practices and other climatic conditions prior to spathe initiation. The floral characteristics in male date palm have studied by Mohammad *et al*. (2009) and reported their effect on fruiting. Under Bikaner conditions, spathe emergence starts from last week of January and completed at the end of February and beginning of March. It has been observed since last two- three years that prolonged winter delays 10-15 days the spathe emergence. The spathe initiation commenced early in male then female plants. However, the duration of emergence of spathe and flowering varied in different varieties. A palm tree usually bears 2-14 spathe/tree depend on age of plant and cultural practices

Table 1. Evaluation of male date palm genotypes under hot arid conditions

S.N	Male date palm genotype	Age of tree (years)	Date of spathe emergence	Date of opening of spathes	Days taken for opening
1	CIAH/DP/M-01	13	11.1.17	10.2.17	29
2.	CIAH/DP/M- 02	10	12.2.17.	04.3.17	19
3.	CIAH/DP/M -03	12	06 .2.17	01.3.17	23
4.	CIAH/DP/M -04	12	10.2.17	28.2.17	18

Table 2. Evaluation of male date palm genotypes for pollen production.

S. No.	Male date palm genotype	Length of spathe (cm)	Width of spathe (cm)	No of spathe /plant	Weight of pollen/ spathe (g)	Pollen grains yield /plant (g)
1	CIAH/DP/M- 01	45.00	16.60	27.20	21.00	578.6.0
2.	CIAH/D/PM -02	36.60	15.62	18.60	20.20	443.00
3.	CIAH/DP/M -03	34.80	15.60	25.00	25.00	643.60
4.	CIAH/DP/M-04	41.00	19.00	22.00	17.20	379.80
SEm+		0.77	0.56	0.44	0.38	3.36
CD at 5%		**2.34**	**1.71**	**1.35**	**1.15**	**10.18**

employed.

Production of Pollens: The production of pollen grains greatly varied from one plant to another male plant and varieties. It also depend on age of tree and number of spathes emerged out. The size of spathe also influenced the amount of pollen grains. It has been observed on farmer's field in western Rajasthan that Ghanami male produced more pollen grains in comparison to Al Ain City (Madsari) male variety. The data on spathe size, number of spathe per plant and yield of pollen grains varied significantly among male genotypes studied (Table-2). The number of spathe per plants was significantly higher in CIAH/DP/M-01 followed by CIAH/DP/M-03. The significantly higher yield of pollens per plant was recorded in CIAH/DP/M-03 (643g/tree). The morphological variation in male palm has observed which may possibly due to plants originated from seeds. The morphological differences in male palms were observed during evaluation of pollen grains germination, viability and chemical composition by Aly (2018). The variation of number of spathe /plant and production of pollen per spathe varied from 17-25g. The finding is similar with the results obtained by Shaheen (2004) in male date palm plants.

Pollination and storage of pollens: Pollination in female palm trees is done manually as it is a dioecious plant and for that strands of freshly opened male inflorescence is cut from the tree. Male strands kept on female palm inverted for pollination. It is necessary to tie the pollinated inflorescence with up knot to hold male strand in pollination. Another method of pollinating female clusters consists of dusting of pollens on it within 2 days of anthesis. It should be done in morning hours for obtaining better fruit set. If pollens are in short supply, it may be mixed with talc powder. Few Farmers covers the female spathe after doing pollination with brown paper bags for better fruit set. Fruit set depends on viability and germination of pollen grains. Pollen can be stored at under refrigerated conditions at 4 ^{0}C and deep freez (-20 $^{\circ}$C) for next season use (Ateeyeh, 2012). Due to environmental factors, some time spathe in male palm opens late than female and problem arise about availability of pollen for pollination in time. The pollen grains can be stored under proper storage temperature conditions to maintain its viability for pollination. The difference in viability of pollen stored under different temperature was observed by Maryam *et al,* (2015). It can be concluded that elite male should planted in proper ratio for pollination and better fruiting in date palm. Surplus pollen grains may be stored under refrigerator or deep freeze conditions for next season use. The variation in male palm is due to the fact that the majority of male date palms are originated from seeds. An elite male palm (CIAH/DP/M-03) was found superior in respect of pollen production than other genotypes. The viability of pollen grains should also be tested before the use for pollination. The study reveals that elite male should be identified and multiplied to meet out pollen grains requirement.

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