

Evaluation of Date Palm Germplasm Under Hot Arid Ecosystem

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The introduction of date palm germplasm in the arid region is essential to enrich genetic resources for crop improvement. A rich genetic diversity in date palm is available in Kachchh region of Gujarat and its exploitation is essential. The performance evaluation study indicates that cultivar Halawy is the most suitable with respect to growth, early maturing, regular bearing and fruit quality for cultivation under Indian arid ecosystem. However, the initial performance also showed that cultivars Khadrawy, Zahidi, Khuneizi, Dayari and Sabiah are better with respect to fruiting. The study reveals that introduction of date palm offshoots from warm arid and semi-arid parts of the world is useful for better establishment, growth and production.

Key words: Date palm, *Phoenix dactylifera*, Germplasm, Genetic diversity

Date palm (*Phoenix dactylifera* L. Family - Arecaceae) is an important drought hardy fruit tree of semi-arid and arid regions. Doka fruits, chuhhara (dry dates) and Pind khajoor (soft dates) are in high demand as dessert in our country. Due to meagre production in India, majority of dates are imported from Gulf countries to meet the domestic requirements (Singh *et al.* 2003).

The extremely dry areas comprising Jaisalmer, Barmer, Bikaner and Jodhpur in Rajasthan, Bhatinda, Fazilika, Abohar in Punjab Sirsa, Hisar, Mahendergarh and Bhiwani in Haryana and Kachchh region in Gujarat are the potential areas for date palm cultivation in India. However, some natural groves of date palm are found on the coastal belt extending from Anjar to Mandvi in Kachchh region of Gujarat. The selection of promising date palm genotypes from groves of Kachchh and adopting improved practices can enable a good profit per hectare annually in arid region (Pareek and Sodagar, 1986; Singh *et al.* 2004).

In order to exploit the potential of the north-western dry areas of the country for date palm production, a number of varieties have been introduced from Middle east countries, USA and Egypt and some have performed well (Chandra and Choudhary, 1990). Introduction of new varieties having better traits is a continuous process to enhance productivity of crops. Evaluation studies in date palm have been conducted at Chandan, Jaisalmer (Mertia and Vashishtha, 1985). Bhojaka, Jaisalmer (Chandra and Pareek, 1992), Bikaner (Chandra *et al.*, 1990) and Abohar, Punjab (Thatai, 1997). However, for commercial cultivation in hot-arid region, there is a need to have genotypes/cultivars, which are early to medium maturing, tolerant, capable of tolerating high temperature and salinity condition. Hence, the present study was undertaken to screen date palm germplasm

in order to identify the suitable genotypes for cultivation in hot-arid parts of western Rajasthan.

Material and Methods

The germplasm evaluation of date palm was carried out at CIAH, Bikaner (Rajasthan) which is located at 28°N and 73.18°E latitude and altitude of 234.84 m above mean sea level in north-western India. The soil of the region is sandy, poor in water holding capacity and fertility, having pH 8.3 to 8.5, EC 0.10 to 0.15 dS/m and 0.08 to 0.09 per cent organic carbon. The annual average rainfall is 240 mm, which is erratic and distributed between July and September. The mean monthly maximum temperature ranges from 42.9°C in May in summer to 23.7°C in January in winter and the minimum monthly mean temperature range from 29.6 to 7.1°C. However, the summer temperature may be as high as 49°C and the winter temperature as low as -2°C. The morning relative humidity ranges from 78% in January to 45% in April and the evening RH from 50 to 18% in these months. The wind velocity may be as high as 17km/hr and as low as 3km/hr respectively, in June and January.

Introduction and collection of date palm germplasm was initiated during the year 1997-98 from available sources to develop repository. The offshoots were collected from Regional Fruit Research Station, Abhor; Date palm Research Station, SDAU, Tundra, Kachchh, Gujarat; Date Palm Research Centre, RAU Bikaner; CAZRI, Jodhpur and Central State Farm, Jetsar. The date palm offshoots were planted at 8m x 8 m distance in well prepared pits of 1x1x1 m size and filled with soil mixtures of sand + clay + FYM (1:1:1) and methyl parathion dust 2 % (50g /pit). Three plants of each genotype were maintained in the field repository.

One sucker of each exotic date palm cultivars viz. Braim (EC 402388) and Chip chap (EC 402389) was also introduced from Iraq to CIAH, Bikaner through NBPGR, New Delhi during the year 1997. The survival and growth performance of these cultivars under arid environment was evaluated. At planting, suckers were treated with Carbendazim (0.1%) and IBA 1000 ppm for better survival and growth. The plantations were maintained with recommended cultural practices during course of evaluation. Initially plant growth in date palm was slow. A total of 55 indigenous as well as exotic collections are maintained at CIAH farm. 22 germplasm flowered after four years of planting and rest are in vegetative growth stage.

The vegetative growth parameters were studied included plant height, spread of palm in north - south, east - west directions, trunk girth and number of suckers per palm. Trunk girth was recorded from 25-30 cm above ground level. The date of spathe emergence and opening of spathe/flowering, fruiting behaviour, maturity (*doka* stage) and fruit characters were recorded during 2003 and 2004.

Results and Discussion

The data on the performance of 22 date palm germplasm with respect to vegetative growth is presented in Table 1.

Plant Growth

The plant growth basically depends upon genetic composition as well as soil and climatic features of the region. In general, 1.80 to 3.50 m height was observed after five years of planting. The palm had good foliage, vigorous growth and 4 to 15 offshoots per palm. Maximum tree height was recorded in cultivar Halawy (3.55 m) followed by Muscat, (3.35 m), Dayari (3.25 m) and Sabiah (2.90 m). Minimum tree height was recorded in cultivars Nagal (1.80 m) followed by Hayani, Medjool, Sayer, Suria and Hamara. The highest plant spread (4.50 x 4.75 m) was noted in cv. Muscat followed by Halawy, Sabiah, Sedami, Chip chap and Khadrawy, while it was minimum (2.20 x 2.50 m) in cv. Nagal followed by Zahidi. The cultivar Halawy attained maximum spread (4.15 x 3.75 m) and trunk girth (1.40 m) at an age of five years. Superior performance in Halawy has also been reported by Mertia and Vashshitha (1985) under Chandan, Jaisalmer conditions. Similar results have also been reported by Chandra *et al.*, (1990) and Thatai (1997) under Bikaner and Abohar conditions, respectively. However, cultivar Sedami was at par in trunk diameter and spread with Halawy. Out of three new introductions, Braim and Chip chap grew well and the palm height was around 3.00 m. These plants have started flowering and fruiting after four years of establishment while, offshoot of variety Shakkarak could

Table 1. Vegetative growth parameters of date palm genotypes (2004)

Cultivar/genotype	Average height of palm (m)	Trunk girth (m)	No. of suckers per palm	N-S	Spread (m)	E-W
Halawy	3.5	1.4	12.0	4.15	3.75	
Khadrawy	2.9	1.0	12.0	4.00	4.00	
Shamran	2.6	1.0	10.0	3.50	3.60	
Zahidi	3.0	1.0	9.00	2.50	2.70	
Braim	3.0	1.0	11.0	3.00	3.10	
Chip chap	3.0	1.0	8.00	4.10	4.00	
Sewi	2.6	1.2	6.00	3.00	3.10	
Khuneizi	2.8	0.9	6.00	2.60	2.70	
Medjool	2.0	0.8	10.0	2.40	2.50	
Sabiah	2.9	1.0	10.0	4.30	4.50	
Dayari	3.2	1.0	14.0	3.60	4.00	
Muscat	3.3	1.2	16.0	4.50	4.75	
Tayer	2.3	1.0	12.0	3.00	3.40	
Umshok	2.5	0.9	8.00	3.00	3.40	
Hayani	2.3	0.8	7.00	3.20	3.20	
Hamara	2.2	0.9	14.0	3.50	3.50	
Sedami	3.0	1.4	5.00	4.20	4.30	
Medini	2.5	1.1	12.0	3.80	4.00	
Sayer	2.2	0.7	8.00	3.00	2.50	
Bikaner Local	3.0	1.2	15.0	3.00	3.00	
Nagal	1.8	0.9	4.00	2.20	2.50	
Suria	2.1	1.0	8.00	3.50	3.00	
C.D. at 5%	0.12	0.25	1.73	0.15	0.51	

not survive. It may possible be due to small size or lack of roots in the suckers. The appropriate size and weight of sucker is required for better establishment (Pareek, 1984). The sucker of cultivar Sakkar was small in size and rootless while other two were appropriate in size/weight with 3-4 roots. According to Mohammad (1978), the offshoots weighing 8-10 kg gave the maximum rooting. Wellrooted medium size sucker (10 - 12 kg) are better in survival and growth under field conditions as compared to poorly rooted small sized or over sized offshoots.

Growth in palm also depends on the size and weight of planting material besides environmental factor of the region and management practices. The sucker production in date palm is a genetic features of the variety coupled with growing conditions. A dat palm tree produces 10-30 suckers in the whole life. More than 10 suckers per plant were observed in cvs. Halawy, Khadrawy, Braim, Dayari, Muscat, Tayer, Hamara, Medini and Bikaner local, which show vigorous suckering habit of these cultivars.

Spathe Emergence and Opening/Flowering

The spathe emergence and opening/flowering is mainly governed by environmental factors particularly temperature. However, it also depends on the genotype. The period of spathe emergence to opening also varied from 9 (Hamara) to 21 days (Khadrawy). Early spathe emergence i.e. 15 February was observed in Halawy and Sayer. Emergence of spathe was late in cvs. Medjool, Dayari, Sedami, Tayer and Umshok during 2003. In 2004, the pattern of spathe initiation greatly varied, which may possibly be due to the environmental factors. The emergence of spathe was recorded in the last week of January in cvs Muscat, Tayer, Sayer and Nagal. Though, in most of the genotypes it was observed during mid February. The spathe initiations vary from year to year even at a particular location (Mertia and Vashishtha, 1985). During 2003, there was no spathe initiation in Nagal and Suria while in 2004, Chip chap, Sewi and Braim did not bear flower/fruit. It may possible be due to young age of plantation as well as prevailing environmental conditions. The early and late opening

Table 2. Spathe emergence/opening and fruit characters of date palm germplasm under hot arid conditions (2003)

Cultivar genotype	Spathe		Bunch per palm			No. of (cm) Stand/ bunch	No. of berry/ strand	Weight of fruit (g)	Fruit size		Fruit yield (kg/plant)	Stone weight (g)
	Date of emergence	Date of opening	No.	Length (cm.)	Av. bunch weight(g)				Length	Width		
Halawy	15.2.2003	1.3.2003	8.5	92.0	2.8	37.5	18.5	7.85	3.33	2.40	25.2	0.9
Khadrawy	18.2.2003	12.3.2003	7.0	56.6	3.0	26.7	14.3	7.42	3.23	2.15	21.0	0.76
Shamran	22.2.2003	13.3. 2003	3.0	75.3	3.0	28.5	18.3	8.30	3.33	2.10	9.0	0.74
Zahidi	1.3. 2003	15.3. 2003	1.0	35.0	3.0	21.0	20.0	7.25	3.00	2.16	3.0	0.86
Braim	2.3. 2003	19.3. 2003	4.0	45.0	1.5	21.0	15.0	7.74	3.34	2.10	6.0	1.09
Chip chap	7.3. 2003	21.3.2003	1.0	35.0	0.5	16.0	10.0	8.32	3.56	2.26	1.0	1.25
Sewi	1.3. 2003	17.32003	4.0	57.5	2.5	25.0	14.5	7.50	2.82	2.00	10.0	0.89
Khuneizi	13.32003	21.32003	6.0	33.0	1.0	16.0	10.0	7.40	2.80	1.70	6.0	0.61
Medjool	14.3. 2003	22.3. 2003	2.0	63.0	1.5	21.0	08.0	10.5	4.90	3.30	3.0	0.78
Sabiah	17.22003	12.3. 2003	2.0	70.0	2.2	35.0	14.0	8.60	3.03	1.90	4.7	0.60
Dayari	15.3. 2003	22.3. 2003	9.0	85.6	1.7	23.3	07.0	9.25	4.10	2.30	15.5	1.14
Muscat	17.2. 2003	28.2. 2003	6.0	72.6	1.0	34.0	14.0	7.30	3.23	1.57	6.0	0.75
Tayer	14.32003	24.3. 2003	3.0	44.0	0.5	27.5	11.0	7.00	2.93	1.80	1.6	0.80
Umashok	17.3. 2003	28.3. 2003	3.0	46.0	2.0	35.0	14.0	6.10	3.10	2.10	6.0	0.76
Hayani	12.3. 2003	19.3. 2003	3.0	28.0	0.6	22.0	06.5	7.50	3.00	1.67	1.7	0.56
Hamara	25.2. 2003	5.3. 2003	5.0	50.0	0.5	19.0	05.0	7.42	3.20	1.80	.6	0.79
Sedami	20.3. 2003	1.4. 2003	3.0	70.0	.5	3.5	10.0	7.00	3.00	1.60	4.5	1.10
Medini	17.2.2003	07.3.2003	2.0	51.0	2.0	26.5	11.0	8.50	3.76	2.00	4.0	0.96
Sayer	15.2.2003	07.3.2003	6.0	48.0	2.2	33.5	15.0	5.60	3.00	1.75	13.8	0.70
Bikaner	4.3. 2003	5.32003	3.0	55.0	3.0	28.0	20.3	6.40	2.83	2.10	10.0	0.86
Local												
* Nagal	-	-	-	-	-	-	-	-	-	-	-	-
* Suria	-	-	-	-	-	-	-	-	-	-	-	-
C.D. at 5% -			0.16	14.3	0.30	3.2	2.2	0.49	0.44	0.23	2.14	0.18

* No flowering/fruitlet observed during the year 2003

Table 3. Spathe emergence/opening and fruit characters of date palm germplasm under hot arid conditions (2004)

Cultivar Genotype	Spathe		Bunch per palm			No. of (cm) Stand/ bunch	No. of berry/ strand	Weight of fruit (g)	Fruit size		Fruit yield (kg/plant)	Stone weight (g)
	Date of Emergence	Date of opening	No.	Length (cm.)	Av. bunch weight(g)				Length	Width		
Halawy	23.2.2004	8.32004	4.0	75.0	5.02	50.0	18.0	7.84	3.43	2.10	20.1	1.30
Khadrawy	23.2.2004	10.3. 2004	4.1	53.0	4.25	37.6	16.3	6.90	3.00	2.10	17.5	1.35
Shamran	25.2. 2004	6.3. 2004	3.2	77.0	3.25	35.0	17.0	7.31	3.30	2.00	9.80	1.23
Zahidi	23.2.2004	6.3.2004	7.1	60.0	2.50	31.0	21.0	4.36	2.30	1.80	18.0	0.90
Braim	-	-	-	-	-	-	-	-	-	-	-	-
Chip chap	-	-	-	-	-	-	-	-	-	-	-	-
Sewi	-	-	-	-	-	-	-	-	-	-	-	-
Khuneizi	26.2.2004	9.3.2004	2.0	63.5	1.00	17.0	9.0	8.33	2.93	2.00	2.3	1.00
Medjool	20.2.2004	3.3.2004	2.1	50.0	1.00	14.0	10.0	9.95	3.40	2.40	2.2	1.09
Sabiah	23.3.2004	1.3. 2004	8.2	90.3	4.00	26.0	18.0	5.71	2.80	1.90	32.5	0.96
Dayari	20.2.2004	1.3. 2004	8.0	50.5	.60	38.0	13.0	7.45	3.63	2.22	20.8	1.52
Muscat	29.1.2004	10.2.2004	5.0	75.0	1.75	42.0	11.0	4.96	2.90	1.70	8.75	1.08
Tayer	29.1.2004	16.2. 2004	5.0	48.0	2.0	30.0	9.0	4.81	3.06	.80	10.0	0.67
Umashok	20.2. 2004	3.3. 2004	3.0	32.5	1.50	23.0	6.0	7.33	3.10	1.76	4.50	1.34
Hayani	15.2. 2004	1.3. 2004	2.0	52.5	2.25	30.0	10.0	7.07	3.30	2.00	4.50	1.25
Hamara	20.2.2004	3.3. 2004	1.0	37.0	0.50	39.0	10.0	4.50	3.00	1.70	0.50	0.85
Sedami	25.2. 2004	3.3. 2004	3.0	70.6	0.60	24.0	6.0	5.10	2.51	1.70	2.00	1.17
Medini	23.2. 2004	1.3. 2004	7.0	47.0	2.75	34.0	10.0	6.55	3.26	2.00	19.30	1.23
Sayer	29.1. 2004	16.2. 2004	3.0	21.0	1.00	22.0	5.0	7.0	3.30	2.20	3.00	1.18
Bikaner	6.2.2004	10.3. 2004	4.0	88.6	1.70	27.0	13.0	4.15	2.40	1.80	6.80	1.05
Local												
* Nagal	29.1.2004	14.2. 2004	3.1	39.0	0.70	16.0	9.0	5.11	2.90	1.85	2.20	0.65
* Suria	22.2. 2004	1.3. 2004	3.0	45.0	0.50	20.0	8.0	7.31	3.20	2.00	1.60	1.11
C.D. at 5% -	-	-	1.38	3.22	0.40	1.73	2.06	0.59	0.32	0.24	2.02	0.21

* No flowering/fruitlet observed during the year 2004.

of spathe/flowering was recorded according to emergence. The period required for opening of spathe ranged from 11-21 days in the above germplasm.

Bunch Characters

The bunch characters *viz.* Size, compactness, weight, number of strand are an important factors in date palm. Bunch formation is governed by age of palm, genetic make up of the variety and environmental factors. The fruit yield directly depends upon size of bunch and berry, number of bunches/palm and number of fruits per strand. Both loose and compact bunches were observed in date palm genotype. Variation in number of bunches was 01 to 09 per tree (Table 2 and 3). Variation in number of bunches, size and berry number might be due to genotype, age of trees and management practices employed. The bunch weights also vary from 1.0 to 5.0 kg depending on size of berries and number of strands per bunch. The variation in number of berries per strand depends upon length of strand and per cent fruit set. In date palm, pollination also hampered the

fruit set. The significant variation in fruit yield per plant was also observed during the year of evaluation, though, the yield was low in all genotypes due to young age of plants. Variation in number of bunches and fruit yield in date palm is also reported by Pareek and Sodagar (1986). At initial stage dropping of immature berries was also observed in Muscat, Tayer, Hamara, Sedami, Sayer, which may possibly be due to improper pollination, moisture stress, high wind velocity besides physiological activities. It is one of most important factor related to the fruit yield. The compact type bunch were observed in Zahidi, Halawy, Braim, Chip chap, Sabiah, Khadrawy and Khuneizi. The significantly higher number of berry per strand was in Zahidi (21.0) during both the years of study. However, fruit production in date palm vary according to the variety, age of tree and growing conditions (Zaid, 1999).

Fruit Characters

The variations in shape and colour of fruits were observed at *doka* stage, which is very useful for accepting date

fruits for fresh consumption, though, the colour of berry is a varietal character. Fruit characters *viz.* size, shape, pulp, taste, etc. vary tremendously depending on variety and environmental conditions. However, the palm bearing dark red and yellow colour big size, sweet fruits were considered promising. Early *doka* stage was recorded in Halawy and Muscat during both the years of evaluation. Similar results have been reported by Chandra *et al.* (1990). The taste and quality of *doka* fruits varied greatly because of maturity, ripening and genetic characters of the variety. For fresh consumption of *doka* fruits, astringency should be less. At *doka* stage, the colour of berry was attractive in Halawy, Zahidi, Khuneizi, Braim, Chip chap, Sewi, Nagal and Bikaner local while the appearance was poor in Muscat and Tayer.

Maximum size of berry was observed in cultivar Medjool (4.90 x 3.30 and 3.40 x 2.40 cm) during 2003 and 2004, respectively (Table 2 and 3). Variation in fruit size, colour, berry yield have also been described by Chandra and Choudhary (1990), Chandra and Pareek (1992). As far as fruit weight is concerned cultivar Medjool produced biggest size during both the years. These findings are in concurrence with the results reported by Thatai (1997); Chandra and Choudhary (1990). The size of stone also differed significantly within the genotypes. It may possibly be due to genetic characters. The small size of stone was observed in varieties of Hayani, Sabiah and Khuneizi during 2003,

while in Nagal, Tayer, Hamara and Sabiah during 2004. Pareek and Sodagar (1986) expressed that better date selection can improved the production and quality of fruits.

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