Research Article

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Varietal evaluation of date palm (*Phoenix dactylifera* L.) in Kachchh, India

Kapil Mohan Sharma*, C. M. Muralidharan, D. A. Baidiyavadra, C. N. Panchal[1] and Piyush Verma[2]

Date Palm Research Station, S. D. Agricultural University, Mundra 370421, Gujarat, India

[1]Polytechnic in Agriculture, S. D. Agricultural University, Amirgadh 385130, Gujarat, India

[2]C. P. College of Agriculture, S. D. Agricultural University, Sardarkrushinagar 385506, Gujarat, India

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Abstract

Date palm (*Phoenix dactylifera* L.) is one of the important fruit crops of semi-arid regions of the western border of India with Kachchh district of Gujarat comprising of the highest area and production. The majority of the plantations in this area are seed propagated, resulting in high variability and irregular orchards. For systematic planting, a variety of desired quality is required for which this experiment was laid out in 2007 to evaluate five promising varieties *viz.,* Barhee, Halawy, Khunezi, Khalas and Selection-3 in an RBD design, replicated four times. Evaluation of all these varieties was done during 2016-18 when all the plants came into regular bearing. Observations with respect to vegetative characters, yield attributing characters, duration of fruit harvesting and fruit characters were recorded and finally varieties were compared with a scorecard to identify the best variety for commercial cultivation. After the evaluation, it was found that Barhee performed best among the cultivars compared and is suitable for commercial cultivation in the Gujarat state of India.

Keywords: Date palm, Kachchh, *Phoenix dactylifera*, varietal evaluation

Introduction

Date palm (*Phoenix dactylifera* L.) is one of the oldest fruit crops of the world and is believed to be originated in Iraq (Zaid and Arias-Jimenez, 2002). In India, it is an important fruit crop of the North West arid region of India comprising of Gujarat, Rajasthan, and Punjab with the largest area in the Kachchh district of Gujarat having 17,600 ha area producing 165,000 tonnes of fresh fruits (Anonymous, 2016). Date palm is a dioecious plant, highly tolerant to salinity, is water-loving and bears nutritionally rich fruits. Pertaining to its nutritional quality, it is consumed around the world with the major share of consumption in India importing about 3,50,000 MT of dates valued 12 billion INR (FAO, 2017).

In India, dates fruits are harvested in the '*Khalal*' stage (matured unripe stage) unlike other parts of the world where consumption is mainly in the '*Rutab*' (partial ripen stage) or '*Tamar*' stage (full ripen stage), mainly due to climatic compulsions. In India, rainfall generally starts in July which coincides with the *Khalal* stage of maturity which results in the spoilage of fruits making it mandatory to harvest to avoid yield loss. Moreover, in India, preference is given to the non-astringent fruits at the *Khalal* stage. In Kachchh, the majority of the plantation is of seedling origin, resulting in high variability and diversity in fruit size, colour, taste, *etc.* (Muralidharan*, et al.,* 2008; Pareek, 2015). To identify suitability of commercial variety Date Palm Research Station, Mundra, Gujarat, has endorsed the varieties Barhee and Halawy for commercial cultivation in this region during 2003 after evaluation of five exotic and one local variety based on germplasm evaluation of date palm at Kachchh (Ramdevputra *et al.,* 2009; Baidiyavadra, *et al.,* 2019). Earlier, a few other varietal comparisons were also reported by Shrivastava and Dhavan (1981), Singh *et al.* (1985), Singh *et al.* (2005), Mertia *et al.* (2010) and Muralidhara *et al.* (2016) from various parts of the country, however limited studies have been undertaken in this regard

**Corresponding Author: k.m.sharma456@sdau.edu.in*

in Gujarat which is currently sharing largest area and production of date palm in India, with the major share of production in Kachchh district. To exploit the potential of the location, the present varietal evaluation of five varieties *viz.,* Barhee, Halawy, Khunezi, Khalas, and Selection-3 were done to identify the best suitable variety for this location.

Material and methods

The present investigation was conducted at Date Palm Research Station, Sardarkrushinagar Dantiwada Agricultural University, Mundra-Kachchh, during 2016-2018. Offshoots of selected varieties *viz.,* Barhee, Halawy, Khunezi, Khalas, and Selection-3 were planted in the year 2007 at 8 m x 8 m spacing in an RBD design replicated four times. Each replication comprises of two plants with a total of eight plants in four replications considering the low availability and low production of offshoots of date palm for the experiment. The first production of plants started in 2014 and the evaluation of these plants was done during 2016-18. Plant vegetative characters were recorded every year in the month of July after the harvest of fruits and characters of the final year (2018) were compared. The number of bunches and yield were compared for all the three years along with their pooled analysis. Time of harvest was recorded after all the plants of that particular variety reached harvesting maturity. Fruit characters were recorded at the *Khalal* stage (Doka stage) on the same day of harvest using a vernier caliper and weighing balance. Fruit colours were compared with the RHS colour chart. All these characters along with other visible characters were compared through a scoring technique developed by authors based on importance to identify the best variety suitable for this location. Statistical analysis was done using OPSTAT by CCS HAU, Hissar (Sheoran *et al.,*1998).

Results and discussion

Vegetative characters

There were no significant differences in the vegetative characters among the different varieties after the 11 years of plant growth (Table 1). It represents that none of the varieties are either dwarfing or vigour in growth among one another.

Table1. Comparison of vegetative characters among different varieties of date palm (2018)

Variety (V)	Plant height (m)	Stem girth (m)	Number of leaves*	Length of leaves (m)
Barhee	3.37	2.18	5.58 (30.25)	3.21
Halawy	3.68	2.53	5.63 (30.75)	3.01
Khunezi	3.58	2.45	5.67 (31.62)	3.04
Khalas	3.32	2.14	5.23 (26.62)	2.85
Selection-3	3.31	2.45	6.02 (35.37)	2.92
SeM ± (V)	1.57	1.12	0.24	9.05
C.D. @5 % (V)	NS	NS	NS	NS
C. V. %	9.13	12.67	8.67	6.01

*Data shown are square-root transformed and original values are given in parenthesis

Yield attributing factors

Among the yield attributing factors, the number of bunches is one of the contributing factors (Table 2). Barhee gave significantly higher number of bunches in all the three years (2016-18) as well as in the pooled result (7.41) followed by Selection-3 (7.16). A similar pattern was also observed in the yield characters where Barhee is the highest yielder (58.67 kg), however, it was followed by Halawy (36.95 kg). The year-wise variations observed among the varieties is due to age. Similar results were also reported by Ramdevputra *et al.* (2009).

Duration of fruit harvest

All the fruits were harvested in the *Khalal* stage during 2016-18 and their duration of harvesting is presented in Table 3. Among all the cultivars, Barhee and Selection-3 were late in maturing (July-End) while Halawy, Khunezi, and Khalas are mid-season varieties (June-End to July-First). Similar information is also been documented by Zaid and Arias-Jimenez (2002) and Muralidharan *et al.* (2008).

Table 2. Comparison of yield attributing factors among different varieties of date palm (2016-18)

Variety (V)	Number of bunches*				Yield (kg palm^{-1})			
	Year 1 (2016)	Year 2 (2017)	Year 3 (2018)	Pooled (V)	Year 1 (2016)	Year 2 (2017)	Year 3 (2018)	Pooled (V)
Barhee	2.82 (7.12)	2.68 (6.25)	3.07 (8.50)	2.88 (7.41)	33.98	66.17	75.87	58.67
Halawy	2.54 (5.50)	2.25 (4.12)	2.59 (5.75)	2.57 (5.66)	19.37	40.47	51.50	36.95
Khunezi	2.25 (4.12)	2.34 (4.50)	2.61 (5.87)	2.40 (4.83)	9.63	16.75	36.37	20.91
Khalas	2.14 (3.62)	2.25 (4.13)	2.59 (5.75	2.38 (4.75)	7.53	14.62	31.50	17.88
Selection-3	2.86 (7.25)	2.80 (7.13)	2.86 (7.25)	2.85 (7.16)	31.00	33.25	46.50	36.91
Mean	2.52 (5.52)	2.46 (5.22)	2.75 (6.62)	2.62 (5.96)	20.33	4.25	48.35	34.26
	Year 1	Year 2	Year 3	Pooled	Year 1	Year 2	Year 3	Pooled
Sem ±(V)	0.15	0.13	0.07	0.06	5.23	2.69	2.75	1.57
C.D.@ 5% (V)	0.46	0.40	0.25	0.17	16.31	8.39	9.59	4.51
Sem ±(Y)				0.04				1.22
C.D.@ 5 %(Y)				0.13				3.49
Sem ± (Y x V)				0.09				2.73
C.D.@ 5 %(Y x V)				NS				7.82
C.V. %	0.14	10.37	5.76	7.71	51.57	15.78	11.40	15.60

*Data are square-root transformed and original values are given in parenthesis

Table 3. Duration of fruit harvest (*Khalal* stage) in different varieties of date palm (2016-18)

Variety	Duration of fruit harvest (Khalal Stage						Peak of harvest	Cultivar class (Early, Mid-season, Late)
	Year 1 (2016)		Year 2 (2017)		Year 3 (2018)			
	From	To	From	To	From	To		
Barhee	20/07/16	04/08/16	12/07/17	26/07/17	04/07/18	25/07/18	July-End	Late
Halawy	07/07/16	27/07/16	21/06/17	07/07/17	15/06/18	05/07/18	June-End	Mid-Season
Khunezi	03/07/16	25/07/16	01/07/17	06/07/17	25/06/18	08/07/18	July-First	Mid-Season
Khalas	30/06/16	10/07/16	04/07/17	20/07/17	25/06/18	04/07/18	June-End	Mid-Season
Sel-3	03/07/16	20/07/16	15/07/17	26/07/17	04/07/18	10/07/18	July-Mid	Late

Fruit characters

Among the five cultivars, Halawy has the longest fruits (3.70 cm) which is at par with Khalas (3.64 cm), while Selection-3 (2.71 cm) has the shortest fruit. However, Khalas had the highest fruit width (2.61 cm) and the lowest was in Selection-3 (1.76 cm). Khalas also had the highest fruit weight (12.34 g) followed by Khunezi (10.28 g), while the smallest seed was that of Khunezi (0.80 g) followed by Barhee (0.87 g). Pulp: stone ratio was highest in Khunezi (11.73) which is at par with Khalas (11.71). Highest TSS was found in Khunezi (42.75° Brix). Barhee, Halawy, and Khalas are yellow coloured fruits, while Khunezi and Selection-3 are red coloured fruits. Among the sensory evaluation for astringency, it was noted that apart from Barhee, all the other varieties bear slight astringency at *Khalal* stage which is one the most important character for evaluation of a variety responsible for marketing.

Table 4. Fruit characters of different varieties of date palm

Variety	Fruit length (cm)	Fruit width (cm)	Fruit weight (g)	Seed weight (g)	Pulp stone ratio	TSS (°Brix)	Colour of fruit	Astringency at Khalal (Doka) Stage
Barhee	2.96	2.26	8.34	0.87	8.51	34.58	Yellow Orange 15-A	Absent
Halawy	3.70	1.97	8.76	1.29	5.80	30.25	Yellow 13 A	Slightly present
Khunezi	3.42	2.19	10.28	0.80	11.73	42.75	Grayed Purple 185-A	Slightly present
Khalas	3.64	2.61	12.34	0.97	11.71	33.91	Yellow Orange 17-A	Slightly present
Selection-3	2.71	1.76	5.17	0.91	4.66	30.33	Red 53-A	Slightly present
Sem ±	0.03	0.03	0.04	0.01	0.08	0.45		
C.D. @5 %	0.08	0.11	0.12	0.03	0.24	1.29	-	-
C. V. %	2.96	6.09	1.62	3.19	3.30	4.86		

Scorecard of different varieties

After characterizing various varieties, a scorecard was prepared to compare the different varieties and is presented in Table 5. Additional characters like rain tolerance, compactness of strand, uniformity of ripening, fruit pulp type, bunch stalk length and number of offshoots at ground level were also visually noted. Among all the varieties, Barhee was found to bear the best quality fruits for the Khalal Stage of consumption. Earlier, Shrivastava and Dhavan (1981) reported that Hillawi is best suitable for cultivation in Haryana. On the other hand, Pareek (1984) highlighted that Barhee and Halawy are suitable for consumption of fresh fruits which was confirmed by Singh *et al.* (1985) in their comparison to cultivars *viz.,* Halawy, Barhee, Zahidi, Khadrawy, Shamran and Medjool done at Abohar, Punjab. Ramdevputra *et al.* (2009) also confirmed that Barhee and Halawy are suitable for fresh consumption based on germplasm evaluation. While, Mertia *et al.* (2010), on their comparison of cultivars Medzool, Shamran, Barhee, Dayani, Khadrawy and Umshock at Jodhpur, Rajasthan, found that Barhee being a very late variety does not attend Tamar stage and needs to be consumed at Khalal stage itself while the other varieties attain the Tamar stage and among them Medjool perform well. However, the current study compares the overall performance of the cultivars at their Khalal stage only and found Barhee out performing other cultivars.

Table 5. Scorecard of different varieties

Sl. No.	Character	Score split					Score obtained				
							Barhee	Halawy	Khunezi	Khalas	Selection-3
1.	Astringency at Khalal Stage	Non-Astringent 20	Slight Astringent 10	Astringent 5			20	10	10	10	10
2.	Earliness	Early Before 15th June 7	Mid 16th June to 15th July 5	Late 15th July Onward 3			3	5	5	5	3
3.	Rain tolerant	Highly Rain Tolerant 10	Moderately Rain Tolerant 7	Rain Susceptible 3			3	3	7	1	0
4.	TSS	⩾35° Brix 10	25-35 °Brix 7	15-25° Brix 5	<15° Brix 3		7	7	10	77	
5.	Yield per palm after 10 years age	High Yielding ⩾100 kg 10	Moderately High Yielding 75-100 kg 7	50-75 kg 5	Moderately Low Yielding 3	Low yielding <50 kg	7	5	3	3	3
6.	Fruit length	⩾5.0 cm 10	3.5-5.0 cm 7	2.5-3.5 cm 5	1.5-2.5 cm 3	<1.5 cm 1	5	7	5	7	5
7.	Fruit width	⩾2.5 cm 10	2.0-2.5 cm 7	1.5-2.0 cm 5	<1.5 cm 3		7	5	7	10	5
8.	Fruit weight	15.0 –20.0 g 10	10.0-15.0 g 7	5.0-10.0 g 5	<5.0 g 3		5	5	7	7	5
9.	Seed weight	<0.5 g 10	0.5-0.7 g 7	0.7-1.0 g 5	⩾1.0 3		5	3	5	5	5
10.	Pulp stone ratio	⩾12 10	10-12 7	7-10 5	<7 3		5	3	7	7	3

11.	Compactness of strand	Very Compact 10	Compact 7	Loose 5	Very Loose 3	10	5	7	57
12.	Uniformity of ripening		Uniform 10		Un-uniform 5	10	10	10	1010
13.	Fruit pulp	Soft and Juicy 10	Semi-Soft 7	Hard 5	10	7	5	7	5
14.	Bunch stalk	Long 7	Medium 10	Short 7	Very Short 3	7	10	10	1010
15.	Number of offshoots at ground level	High (10 ⩾ in 3 years) 10	Moderate (5-10 in 3 years) 7	Low (<5 in 3 years) 5	7	7	7	7	10
				Total	111	92	105	103	93

Conclusions

In line with the earlier experiment, it was found that Barhee is one of the best varieties suitable for commercial cultivation in the Gujarat state of India. Further, it has also been noted that based on the earlier recommendation of Barhee in 2003 more than 1.5 lakh plants of cv. Barhee has already been planted in the various part of Gujarat and in the recent years, it is also explored in other non-traditional states of India *viz.,* Maharashtra, Tamil Nadu, Andhra Pradesh, Telengana and Karnataka which represents the adoptability of this particular cultivar.

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