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Assessment of morphological and biochemical characters of date palm cultivars

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Abstract

Eight date palm cultivars i.e. Khadrawy, Shamran, Zahidi, Braim, Chipchap, Sabiah, Seddami and Medjool commonly grown in Bikaner were studied for their morphological and physiochemical characters at ICAR-CIAH, Bikaner, Rajasthan, India during the year 2015-16. The results revealed that differences in vegetative characters were statistically significant except in the length of leaves. The fruit colour, size, weight, stone size and grooves in stone are useful characters for identification of date palm cultivars and the maximum plant height (5.34 m) and length of pinnae (44.79 cm) was recorded in cv. Seddami whereas, minimum height (2.16 m) and length of pinnae (33.64 cm) in cv. Khadrawy. Breadth of pinnae range from 1.96 cm in cv. Shamran to 2.85 cm in Medjool. Maximum leave length (3.25 m) was recorded in cv. Braim whereas, minimum in cv. Medjool (2.40 m). Among the varieties maximum fruit size i.e. length (4.41 cm), dia (2.92 cm), fruit weight (21.49 g), stone weight (1.97 g) and pulp: stone ration (12.93) was produced by cv. Medjool and minimum fruit size i.e. fruit length (2.91 cm), diameter (1.93 cm), fruit weight (7.62 g) and stone weight (1.09 g) in cv. Sabiah . The total soluble solid (36.55 %), total sugars (36.35%), reducing sugar (31.54%) was recorded maximum in Braim whereas, minimum total soluble solid (32.83 %) and reducing sugar (27.72%) in a Sabiah, total sugars (31.39%) in cv Shamran. Non reducing sugars were maximum (5.50%) in a Seddami and minimum in cv. Shamran (2.70%). Maximum acidity content was recorded (0.31%) in Sabiah and minimum (0.21%) in Braim, maximum ascorbic acid was recorded in Medjool (7.83 mg/100g pulp) and minimum in Shamran (4.65 mg/100 g).

Keywords: date palm, morphological and biochemical characters

Introduction

Date palm (*Phoenix dactylifera* L.) is one of oldest cultivated plant by human kind and used as food for 6000 years. It is a dioecious plant, which belongs to the family Palmaceae and has diploid chromosome number 2n=2x=36. Date palm, also known as *khajoor* or *kharek* is an ancient indigenous fruit of countries around the Persian Gulf (Al Ugaydy, 2000). The cultivation of date palm is increasing day by day because of its vast potential in arid and semi–arid parts of India. The cultivation of date palm on commercial basis in the Thar Desert will be helpful in saving of foreign exchange which is incurred on import of date fruits and products. In addition to this, it will provide best utilization of command irrigated area under Thar Desert, prosperity to the farmers of the area and employment generation opportunities in the region, as well as nutritious food to rural inhabitants of arid region. Different products like sugar, starch, vinegar, juice, toffees, wine, chutney, jam, pickles are prepared from date palm fruits. The date palm fruit have been recognized for their highly nutritive and caloric values. Date fruit provides abundant quantity of iron, potassium, calcium, nicotinic acid and small amount of protein, copper, magnesium, sulphur and vitamin A, B & B2. Date pulp contains moisture (20%), sugar (60-65%), fiber (2.5%), protein (2%) and less than 2 % fat and pectic substances (Gopalan *et al.*, 1985). Caramel colour, produced from dates, can be used in food and pharmaceuticals industries (Zaid *et al.,* 2007). The date palm leaves are also used for making temporary huts and preparation of baskets, broom, ropes and handicraft items. The seed kernel is used in making cattle feed (Srivashtav *et al.,* 2013). The varieties like Halawy, Zahidi, Khalas,

Barhee, Medjool and Khadrawy have been found suitable for production of higher yield in Western Rajasthan (Chandra *et al.*, 1992; Singh *et al.,* 2003). Morphological and biochemical assessment is very important to identify the elite cultivars having economics importance. This is of great importance to further study for crop improvement, selection, multiplication and preserving the crop product. Morphology is the bird eye view for further research work, which creates bench mark for correlating with its molecular aspects. Morphological and biochemical analysis was done at Bikaner region for making the general view on the evaluation and identification of eight date palm cultivars.

Materials and Methods

The experiment was conducted at the Research Farm and the Plant Physiology Laboratory of Central Institute for Arid Horticulture (CIAH) during the year of 2015 with an altitude of 234.7 m above sea level at latitude 28° 01 N and longitude 73° 22 E. According to Agro Ecological region map brought out by National Bureau of Soil Survey and Land Use Planning, Bikaner falls under Agro ecological region No.2 (M 9 E 1) under arid ecosystem (Hot Arid Eco-region with desert and saline soils), which is characterized by deep, sandy and course loamy, desert soils with low water holding capacity, hot and arid climate. PET (Potential Evapo-transpiration) in this region ranges between 1500-2000 mm and annual average rainfall between 200-260 mm. The temperature may go as high as 48°C while in the winters it may dip down to 0°C. The palm uniform in size, vigour and bearing stage were selected from CIAH date palm research farm. Eight palm each of the cultivars Khadrawy, Shamran, Zahidi, Braim, Chipchap, Sabiah, Seddami and Medjool were selected. There were eight varieties with three replications planted at 8 x 8 m distance in square system of planting. In growth parameters, height of plant, length of leaves and size of pinnae were recorded. For the fruiting parameters, length of bunch, number of strands/bunch, number of fruit per strand, fruit size, fruit weight, pulp:stone ratio etc. were observed during the study. The ripe fruit (turning stage green to yellow i.e. doka stage) were harvested for taking the observations and biochemical analyses.

Vegetative characters

Height of the plant (m) - The height of individual tree (m) was measured with the help of long straight bamboo stick and measuring tape. Length of leaves: Randomly selected three leaves from each tree were selected for recording leaf length and mean value of each tree was taken Size of pinnae (cm) - Randomly selected five pinnae was taken and length as well as breadth of the pinnae was measured with the help of measuring scale.

Fruit characters

Length of bunch was recorded by using measuring tape, number of strand/bunch and number of fruit per strand were counted. For lengths of strand (cm) three strands were selected and the length of strands was measured and average length of strand was calculated. For numbers of berries per strand- three strands were randomly selected from a bunch and number of berries of each strand were counted at the time of harvesting and then average number of fruits per strand was worked out. For weight of berry (g) - five matured fruits were selected to quantify the weight of berry (g) at doka stage. The fruits were weighed with the help of balance and average weight of single berry was calculated. For stone weight (g) - Stones from the fruits selected for measuring size were separated out and weighed and average stone weight was calculated.

Pulp-stone ratio: The pulp-stone ratio was calculated using the following formula;

$$\text{Pulp: stone ratio} = \frac{\text{Pulp weight (g)}}{\text{Stone weight (g)}}$$

Biochemical parameters

Biochemical parameters were assessed viz. T.S.S. through hand refrectometer (0-50° Brix) (AOAC, 1990), titrable acidity using Phenophthalein as an indicator (AOAC, 1990), reducing sugar (Nelson's method), total sugar (Anthron reagent) and ascorbic acid (Colorimetric micro method, Grick *et. al*., 1953).

Statistical Analysis

The experiment was laid out in Completely Randomized Design. Data obtained on various characters were analyzed statistically according to the analysis of variance techniques as suggested by Panse and Sukhatme, (1985); Chandel, (1999). The critical difference (CD) was calculated to access the significance or non-significance of difference between treatment means.

Result and discussion

Vegetative characters

Analysis of the morphological parameters revealed that the maximum plant height (5.34 m) was recorded in cv. Seddami whereas, minimum in cv. Khadrawy (2.17 m).There was statistically significant difference in height of palm. The maximum leaf length was recorded in cv. Braim (3.25 m) and lowest in cv. Medjool (2.40 m). Significantly maximum length of pinnae was recorded in cv. Seddami (44.79 cm) and minimum in cv. Khadrawy (33.64 cm). Similarly, breadth of pinnae was significantly higher in cv. Medjool (2.85 cm) and lowest in cv. Shamran (1.96 cm) as represented in table 1.

The variation in the size of leaflet/pinnae was statistically significant. The variation in size of pinnae among the cultivars have been described by Gothwal *et. al.,* (2013).

Table 1. Vegetative characteristics of date palm cultivars

Cultivars	Height of plant(m) ±S.D.	Length of leaves(m) ±S.D.	Length of pinnae(cm) ±S.D.	Breadth of pinnae (cm) ±S.D.
Khadrawy	2.17±0.20	2.99 ±0.57	33.64 ±3.87	2.80±0.28
Shamran	3.18 ±0.25	3.21 ±0.12	40.44 ±3.48	1.96±0.08
Zahidi	3.10 ±0.52	2.71 ±0.32	34.36 ±3.43	2.64±0.15
Braim	3.32 ±0.54	3.25 ±0.75	41.47±2.79	2.08±0.03
Chipchap	3.03 ±0.25	3.15 ±0.42	41.89 ±3.47	2.36±0.30
Sabiah	3.27 ±0.90	2.91 ±0.28	36.53 ±2.11	2.63±0.28
Seddami	5.34 ±0.83	2.96 ±0.30	44.79 ±3.16	2.17±0.19
Medjool	3.38 ±0.63	2.40 ±0.18	38.92 ±6.97	2.85±0.37
SEm±	0.31	0.25	2.14	0.13
CD(P=0.05)	0.96	0.75	6.49	0.39

Bunch and Fruit characters

The maximum length of bunch was recorded in cv. Zahidi (82.70 cm), which was significantly higher and the minimum length of bunch was recorded in cv. Khadrawy (53.86 cm).The maximum number of strands/bunch was observed in cv. Sabiah (55.66), which was significantly higher over other cultivars and lowest was recorded in cv. Braim (34.66) as represented in table 2. Singh et al., (2006) found significantly higher number of strand in Halaway followed by Sabiah, Seddami, Khadrawy, Shamran, Braim and Chipchap. Fruit characters were statistically significant given in table 2 and table 3. Significantly higher number of berries per strand recorded in cv. Zahidi (24.03) and lowest was in cv. Seddami (13.03). The maximum length of berry was observed in the cultivar Medjool (4.41cm) and minimum in cv. Sabiah (2.92 cm). Similarly, maximum breadth of berry was noted in cultivar Medjool (2.92 cm) and minimum in cv. Sabiah (1.93 cm). Fruit weight is an important economic index for date palm fruits yield and it was recorded maximum in cv. Medjool (21.49 g), while minimum in cv. Sabiah (7.62g).Significantly higher pulp:stone ratio was observed in cv. Medjool (12.92) and lowest in Seddami (5.52). From the table 4 the maximum length of stone was observed in cultivar Chipchap (2.49 cm) and it was lowest in sabiah (1.99 cm). Similarly, maximum breadth of stone was recorded in Seddami (0.83cm) and lowest in cv. Braim (0.62cm). Weight of stone was recorded highest in cv. Seedami (1.67g) and lowest in cv. Sabiah (1.09 g).Among the eight cultivars studied, Zahidi, Braim, Chipchap, Seddami and Khadrawy were yellow in colour whereas, Shamran was Yellow-red-tinge. The berry of cv. Medjool was orange while cv. Sabiah was red in colour at doka stage of harvest. Stone groove of date palm cultivars were recorded and classified as broad, deep, medium and narrow.

Table 2.Bunch parameters and pulp: stone ratio of date palm cultivars

Cultivars	Length of bunch(m) ±S.D.	No. of strand bunch^{-1} ±S.D.	No. of berries strand^{-1}±S.D.	Pulp :Stone ratio ±S.D.
Khadrawy	53.86±3.25	40.33±4.93	19.00±1.40	6.47±0.61
Shamran	59.13±7.86	40.00±4.35	19.26±1.80	7.24±0.52
Zahidi	82.70 ±6.57	36.33±3.21	24.03±0.55	7.07±0.30
Braim	58.00 ±4.00	34.66±3.05	16.05±2.20	6.69±0.52
Chipchap	74.83±14.21	39.66±5.68	15.73±1.79	8.21±1.03
Sabiah	65.66±7.76	55.66±3.05	16.05±2.31	6.03±1.29
Seddami	55.20±3.36	40.16±2.02	13.03±1.15	5.52±0.63
Medjool	67.66±6.52	42.00±4.00	13.38±2.93	12.92±1.14
SEm±	4.26	2.38	1.07	0.49
CD(P=0.05)	12.93	7.24	3.25	1.50

Table 3.Fruit characteristics of date palm cultivars

Cultivars	Fruit wt. (g) ±S.D.	length of berry (cm) ±S.D.	Breadth of berry(cm) ±S.D.
Khadrawy	8.93±0.12	3.25±0.02	2.13±0.02
Shamran	10.31±0.31	3.62±0.20	2.24±0.18
Zahidi	9.19±1.08	3.32±0.24	2.49±0.62
Braim	9.14±0.23	3.59±0.08	2.07±0.03
Chipchap	11.98±0.96	3.90±0.14	2.25±0.08
Sabiah	7.62±1.003	2.92±0.18	1.93±0.12
Seddami	10.84±0.09	3.61±0.01	2.30±0.08
Medjool	21.49±1.75	4.41±0.13	2.92±0.12
SEm±	0.54	0.08	0.14
CD(P=0.05)	1.66	0.24	0.44

Table 4.Stone characters of date palm cultivars

Cultivars	Stone wt. (g) ±S.D.	Length of stone (cm) ±S.D.	Breadth of Stone (cm) ±S.D.
Khadrawy	1.2±0.08	2.10±0.01	0.69±0.047
Shamran	1.25±0.05	2.24±0.04	0.69±0.011
Zahidi	1.13±0.09	2.17±0.13	0.69±0.005
Braim	1.19±0.10	2.35±0.05	0.62±0.032
Chipchap	1.30±0.06	2.49±0.12	0.63±0.023
Sabiah	1.09±0.06	1.99±0.13	0.63±0.011
Seddami	1.67±0.16	2.40±0.03	0.83±0.043
Medjool	1.54±0.015	2.47±0.02	0.78±0.005
SEm±	0.05	0.048	0.016
CD(P=0.05)	0.15	0.14	0.049

Biochemical characters

The highest total soluble solids (TSS) were recorded in cultivar Braim (36.65%) and lowest in cv. Sabiah (32.83%). Gothwal et al. (2013) reported that total soluble solid in date palm range from 32 0brix-39 0brix. The maximum titratable acidity (%) was recorded in cv. Sabiah (0.31%) and the lowest acidity was observed in cv. Braim (0.21%). The highest ascorbic acid content was recorded in cv. Medjool (7.83 mg/100g pulp) and lowest in cv. Shamran (4.65 mg/100g pulp). Meena et al. (2013) reported that the maximum ascorbic acid content was found in Halawy (3.59 mg/100g) and minimum in Zahidi (2.37 mg/100 g) fruit pulp. Similar finding had been reported by Alizai et al. (2005). Total sugars in fruits of eight date palm cultivars were observed at doka stage and the highest total sugars content was found in cv. Braim (36.35%) and it was lowest in cv. Shamran (31.39%). The highest reducing sugar content was recorded in the cultivar Braim (31.54%) and the lowest reducing sugar in Sabiah (27.72%). The highest non reducing sugar content was recorded in the cultivar Seddami (5.50%) and lowest in cultivar Shamran (2.70%). Gothwal et al. (2013) reported that total sugars content of fruit ranged between 31.09 % (Dayari) to 36.05% (Halawy). Nehra et al. (1988) reported the non reducing sugar content in different cultivars such as Khadrawy (3.67%), Hillawi (2.1%), Medjool (10.10%), and Zagloul (7.17 %).

Table 5. Total soluble Solid (0Brix), Acidity (%) and Ascorbic Acid (mg/100 g pulp) in date palm fruits

Cultivars	Total Soluble Solid $(TSS)^0$ Brix ±SD	Acidity (%) ±SD	Ascorbic Acid (mg/100g) ± SD
Khadrawy	34.03±1.58	0.28±0.06	4.72±0.91
Shamran	34.08±0.45	0.30±0.02	4.65±0.23
Zahidi	33.05±1.05	0.29±0.03	5.94±0.83
Braim	36.65±1.43	0.21±0.02	7.01±0.93
Chipchap	36.43±2.22	0.23±0.02	7.46±1.33
Sabiah	32.83±1.47	0.31±0.01	6.18±0.45
Seddami	33.56±0.61	0.30±0.02	4.74±0.27
Medjool	33.38±0.86	0.30±0.04	7.83±1.22
SEm±	0.76	0.019	0.5
CD(P=0.05)	2.30	0.058	1.50

Table 6.Total sugars (%), Reducing sugars (%) and Non Reducing sugars (%)

Cultivars	Total Sugar (%) ±SD	Reducing Sugar (%) ±SD	Non Reducing Sugar (%) ±SD
Khadrawy	33.60±1.42	30.93±1.15	2.72±0.38
Shamran	31.39±0.98	28.69±0.94	2.70±0.42
Zahidi	32.50±0.93	28.43±0.48	4.07±1.37
Braim	36.35±1.68	31.54±0.95	4.81±0.76
Chipchap	35.20±1.14	30.19±1.73	5.01±1.47
Sabiah	31.71±3.00	27.72±2.15	3.98±0.99
Seddami	33.42±2.07	27.91±1.03	5.50±1.45
Medjool	33.20±1.69	29.93±1.05	4.65±1.12
SEm±	1.004	0.74	0.62
CD(P=0.05)	3.01	2.22	1.87

Conclusion

Morphological characters such as height of plant, size of leaf, pinnae, bunch and fruit characters were assessed for identification of date palm cultivars. It was observed that differences in vegetative characters of different cultivars were statistically significant except in length of leaves. The fruit colour, size, weight, stone size etc are useful characters for identification of date palm cultivars.

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