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# Study on fruit growth and bunch characteristics in Date palm cultivars

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**Abstract**

The present study on fruit growth and bunch characters in Date palm (*Phoenix dactylifera* L.) cultivars" under arid conditions was conducted at ICAR-Central Institute for Arid Horticulture, Bikaner during the year 2014. The treatments comprising of four date palm cultivars *viz.* Halawy, Khalas, Khadrawy and Shamran to assess morphological and bunch characteristics during fruit development. The study reveals that cultivar Halawy was earlier to attain *Kimri* stage after pollination whereas, Khadrawy requires maximum days. The fruit weight, length and diameter of fruit significantly increased from kimri to *doka* stage and harvesting. Fruit weight and diameter were found maximum in cv. Khalas (10.35 g and 2.28 cm, respectively) while fruit length was recorded maximum in cv. Halawy (3.45 cm).

The length of bunch varied from 44.76 cm (cv. Khadrawy) to 58.19 cm in cv. Shamran. The number of bunch/ tree was varied from 6.50 in cv. Khadrawy to 12.25 in cv. Khalas. The number of strands/ bunch was 35.50 and 79.50 for cv. Khadrawy and Halawy, respectively. The number of berries per strand varied from 16.50 in cv. Khalas to 21.50 in cv. Halawy. Length of strand was ranged from 33.50 cm and 45.75 cm in cv. Khadrawy and Shamran, respectively. A significant difference was noted in length of bunch, number of bunch,number of berries /strands and days taken to maturity of fruits. Days taken to colour turning stage, *doka* stage and harvesting of bunches were minimum in cv. Halawy (85, 103 and 110 days, respectively) while maximum days recorded in cv. Khadrawy (104, 118 and 123 days, respectively). The total soluble solids (TSS) increased significantly from initial fruit growth to *doka* stage of harvesting in date palm cultivars.

**Key words:** Date palm, *Phoenix dactylifera* , Cultivars, Fruit growth, Bunch characters

## Introduction

Date palm (*Phoenix dactylifera* L. Family: Palmaceae ) is one of most successful and extremely important subsistence fruit crop in hot arid regions of the world ( Awad, 2011). In India, maximum area of date cultivation is about 17,072 ha with production of 1,37,476 million tonne in Kachchh region of Gujarat. Further, its cultivation has great potential in western parts of Rajasthan, which falls under hot arid climate and provided with irrigation facilities. Date palm is drought hardy fruit plant and tolerates salinity. Date fruit is used for fresh consumption as well as for value added products such as wine, starch vinegar, *arak*, jam, chutney, beverages, juice and toffees. It is highly nutritious fruit and contains high calorific value (3150 calories/kg of fresh fruits), 60-65% sugar, fair amount of fibre (2.5%), protein (2.0%), fat (2.0%), vitamins (vitamin A = 220 I.U., vitamin $B_1$ = 0.35 mg, vitamin $B_2$ = 0.38 mg), minerals up to (2.0%) i.e. iron, potassium, calcium, copper, magnesium, chlorine, sulphur, phosphorus, etc. (Gopalan *et al.,* 1985).

The date fruit goes through five distinct growth and ripening stages (Shobana *et al*., 1981). These five stages are usually referred to in terms derived from Iraqi Arabic as "*Hababouk*", "*Kimri*", "*Khalal*", "Rutab" and "Tamer". "*Hababouk*" stage which starts soon after fertilization and is characterized by loss of two unfertilized carpels. The *Kimri* or *gandora* represent the pea stage and immature green colour, *doka* or *Khalal* – mature full coloured and Rutab *or dang* -soft brown, Tamer *or pind*- hard raisin like (Chandra *et al*., 1992). Under Indian conditions, maximum dates are harvested at hard ripen *doka or Khalal* stage due to early rains in July month.

The growth and development of the fruit follows a unique pattern in the date palm cultivars (Al-Qureshi and Adel, 2010). Although, work has been reported by different workers from different places which is mostly based on physical and chemical characters (Chandra *et al*., 1992; Bacha *et al*., 1987; Mertia *et al*., 2010 and Markhand *et al*., 2010). The present study was undertaken to assess the fruit growth and development patterns in date palm cultivars starting from *Kimri* to *doka* stage of maturity and bunch characteristics.

## Material and Methods

The study was carried out at ICAR- Central Institute for Arid Horticulture Bikaner, Rajasthan in

Completely Randomized Design (CRD) with four replications.. The four commercial date cultivars *viz*., Halawy, Khalas, Khadrawy and Shamran were taken for fruit growth and bunch characters study. The fruit samples were collected at 15 days interval (15th April, 30th April, 15th May, 30th May, 15th June, 30th June, 15th July and at harvesting) in the month of April to July 2014 for assessment of different morphological changes in fruit and bunch parameters of date palm cultivars. Five fruits sample from each treatment were taken randomly from four replications at fifteen days interval for record of weight and size of fruit. The fruit length and diameter of the fruit was measured with the help of digital Verneer calliper.

The length of bunch was measured by measuring scale from the origin of stalk to the end where the strands started appearing by selecting randomly three bunches from each tree were measured for the length of bunch in cm and mean value of each tree was taken into consideration for statistical analysis. Three stands were selected and the length of strand was measured and average length of strand was measured with the help of scale and averaged was presented in centimetres. Three strands were randomly selected from a bunch and number of berries in each strand was counted at the time of harvesting and then average number of fruits per strand was worked out. Number of strands were counted from randomly selected three bunches from which average number of strands per bunch was calculated. Days taken to colour turning stage from green to yellow was observed by counting the days from pollination to fruit set to colour turning stage in date palm cultivars. Days taken to *doka* stage were observed by counting the days from pollination to fruit set to *doka* stage. TSS was measured by digital hand refractometer. Data obtained on various characters were analyzed statistically.

**Results and Discussion**

Periodic fruit growth data includes the weight, length and diameter of fruit is given in table-1, 2 and 3 respectively. Fruit weight, length and diameter increased from initial stage of fruit development to *doka* stage of maturity and significant variation among cultivars was observed during the study.

**Weight of fruit (g)**

The data presented in the table 1 showed the variation in fruit weight of different cultivars at fifteen days interval of fruit development. It revealed that the fruit weight was 7.33 g at harvesting stage which was 0.19 g at initial stage of fruit development in Halawy cultivars that gradually increased on 30th April to harvesting. On 30th April the magnitude of fruit weight was 1.05 g, which increased 3.29 g by 15th May. Maximum fruit weight was recorded in Khalas (10.35 g) followed by Khadrawy (7.81 g), Halawy (7.33 g) and lowest in Shamran (7.07 g). Difference among the cultivars in fruit weight was not significant at the initial stage of fruit development but significant at all other fruit development stages .Fruit weight, size, length and diameter were increased from *Kimri* stage of fruit growth to *doka* or *Khalal* stage followed by a slight decline in latter stages. The increase in size of fruit may possibly due to cell elongation and accumulation of biomass in fruits during growth and development period. The results are closely in conformity with findings of Shobana *et al.,* (1981); Bacha *et al., (*1987); Chandra *et al., (*1992) and Awad *et al.,* (2011).

Table 1. Weight of fruit (g) of different Date palm cultivars at 15 days interval

| Treatments | April | | May | | June | | July | Harvest |
|---|---|---|---|---|---|---|---|---|
| | 15 | 30 | 15 | 30 | 15 | 30 | 15 | |
| Halawy | 0.19 | 1.05 | 3.29 | 4.67 | 6.62 | 6.72 | 7.22 | 7.33 |
| Khalas | 0.14 | 0.87 | 3.61 | 5.20 | 7.99 | 9.76 | 10.29 | 10.35 |
| Khadrawy | 0.28 | 0.96 | 3.39 | 5.11 | 7.22 | 7.47 | 7.60 | 7.81 |
| Shamran | 0.23 | 0.77 | 2.55 | 3.48 | 6.18 | 6.47 | 7.02 | 7.07 |
| SEm± | 0.04 | 0.06 | 0.18 | 0.32 | 0.26 | 0.68 | 0.74 | 0.52 |
| CD (P=0.05) | NS | 0.19 | 0.55 | 0.99 | 0.82 | 2.11 | 2.31 | 1.61 |

**Length of fruit (cm)**

The data in table 2 exhibited variations in the fruit length of different cultivars at fifteen days interval of fruit development except initial stage. The highest fruit length was recorded in Halawy (3.45 cm) followed by Khalas (3.33 cm), Shamran (3.25 cm) and lowest was in Khadrawy (3.07 cm). Difference among the cultivars was not significant at the initial stage of fruit development but significant at all other fruit development stages. The findings are similar to the results of Bacha *et al., (*1987); Chandra *et al., (*1992) and Awad *et al.,* (2011) reported in date palm cultivars.

Table 2. Length of fruit (cm) of different Date palm cultivars at 15 days interval

| Treatments | April | | May | | June | | July | Harvest |
|---|---|---|---|---|---|---|---|---|
| | 15 | 30 | 15 | 30 | 15 | 30 | 15 | |
| Halawy | 0.82 | 1.31 | 2.31 | 3.04 | 3.17 | 3.33 | 3.42 | 3.45 |
| Khalas | 0.75 | 1.15 | 2.09 | 2.67 | 3.07 | 3.17 | 3.28 | 3.33 |
| Khadrawy | 0.68 | 1.10 | 1.77 | 2.52 | 2.88 | 2.93 | 3.07 | 3.07 |
| Shamran | 0.73 | 1.14 | 1.86 | 2.73 | 3.02 | 3.03 | 3.12 | 3.25 |
| SEm± | 0.04 | 0.04 | 0.09 | 0.08 | 0.03 | 0.05 | 0.06 | 0.06 |
| CD (P=0.05) | NS | 0.11 | 0.28 | 0.24 | 0.09 | 0.14 | 0.19 | 0.18 |

**Diameter of fruit (cm)**

Perusal of data from table 3 indicated the variation in fruit diameter of different cultivars at fifteen days interval of fruit development. From the table, it is revealed that the fruit diameter in date palm cultivar Halawy was 1.94 cm at harvesting stage which was 0.61 cm at initial stage of fruit development cultivars that gradually increased on 30$^{th}$ April to harvesting. It was similar pattern in other cultivars. Highest fruit diameter was recorded in Khalas (2.28cm) followed by Khadrawy (2.22 cm), Shamran (2.10 cm) and lowest in Halawy (1.94 cm). Difference among the cultivars in diameter of fruits was found significant at all the fruit development stages. The finding is similar to the earlier report of Bacha et al,(1987) in date palm cultivars.

Table 3. Diameter of fruit (cm) of different Date palm cultivars at 15 days interval

| Treatments | April | | May | | June | | July | Harvest |
|---|---|---|---|---|---|---|---|---|
| | 15 | 30 | 15 | 30 | 15 | 30 | 15 | |
| Halawy | 0.61 | 1.15 | 1.35 | 1.57 | 1.86 | 1.91 | 1.93 | 1.94 |
| Khalas | 0.54 | 1.05 | 1.47 | 1.72 | 2.03 | 2.21 | 2.26 | 2.28 |
| Khadrawy | 0.72 | 1.16 | 1.67 | 1.86 | 2.09 | 2.11 | 2.14 | 2.22 |
| Shamran | 0.65 | 1.12 | 1.44 | 1.65 | 1.86 | 1.94 | 2.04 | 2.10 |
| SEm± | 0.03 | 0.03 | 0.03 | 0.06 | 0.04 | 0.07 | 0.07 | 0.05 |
| CD (P=0.05) | 0.10 | 0.08 | 0.09 | 0.17 | 0.11 | 0.22 | 0.23 | 0.16 |

**Bunch characteristics**

**Length of bunch (cm)**

The highest bunch length was recorded in Shamran (58.19 cm), followed by Halawy (53.79 cm), Khalas (52.06 cm) and lowest bunch length was recorded in Khadrawy (44.76 cm) cultivar at harvesting stage(table-4). A significant difference in length of bunch was found in date palm cultivars at harvesting stage. The length of bunch varied among cultivars during the study. It might be due to age of palm, genetic makeup of the variety and environmental factors. The present findings are in conformity with the results of Chandra and Choudhary, (1992); Mertia *et al., (*2010).

**Number of bunch per tree**

The maximum number of bunches were recorded in Khalas (12.25) cultivar followed by Halawy (9.0), Shamran (7.0) while minimum number of bunches recorded in Khadrawy (6.5) cultivar. Difference among the cultivars was significant at harvesting stage of bunches. The number of bunches per plant depends on the factors like age of tree, number of leaves/plant, cultural practices and growing site. The results are similar to the earlier findings of Mertia and Vashishtha (1985); Chandra and Choudhary, (1990).

**Number of strands per bunch**

The length of strands and number of berry are yield attributing characters in date palm crop. The maximum length of strand was recorded in Shamran (45.75 cm) cultivar followed by Khalas (41.00 cm), Halawy (38.75 cm) and minimum length of strand was recorded in Khadrawy (33.50 cm) cultivar The observation recorded at harvesting shows that the maximum number of strands recorded in Halawy (79.50) cultivar followed by Khalas (61.75), Shamran (40.50) and minimum number of strands recorded in Khadrawy (35.50) cultivar. There was significant difference among cultivar in number of strands per bunch. The variation in number of strands per bunch was possibly due to genetic makeup of the cultivars and climatic conditions. The present finding is in conformity with the results of Chandra and Choudhary, (1992).

**Number of berries per strand**

The observation showed (table-4) that the maximum number of berries per strand recorded in cultivar Halawy (21.50) and at par in cultivars Khadrawy and Shamran (18.75), minimum in cv. Khalas (16.50). Difference among the cultivars in relation to berries per strand was significant at harvesting stages in date palm. The higher number of berries per strand might be due to length

of strand, high rate of fruit set and retention of fruit in a particular variety. Further, minimum number of berries /strand in cultivar Khalas may be due to poor fruit setting and drop of immature fruits. The result is similar to the earlier findings of Mertia *et al.*, (2010) while working on evaluation of date palm cultivars in Thar desert.

**Days taken to colour turning stage**

The maximum number of days in attaining the colour turning stage after pollination was counted in Khadrawy (104 days) followed by Shamran (99.00 days), Khalas (91.00 days) and minimum in case of Halawy (85.00 days) cultivar. Difference among the cultivars in relation to days to colour turning stage was significant at fruit development stages. The change in colour of fruits from green to yellow or reddish or dark red probably due to synthesis of pigments and degradation of chlorophylls. Bacha *et al.,* (1987) reported that pigments content being high at *Kimri* stage, were greatly reduced in other stages of fruit growth.

**Days taken to *doka* stage of maturity and harvesting**

The maximum number of days in attaining the *doka* stage of maturity after pollination was counted in Khadrawy (118.00 days) followed by Shamran (115.00 days), Khalas (108.00 days) and minimum in case of Halawy (103.00 days) cultivar (table 4). Difference in days taken for maturity among the cultivars was significant at *doka* stage. The difference in days taken for *doka* stage of maturity in date palm is possibly due to genetic features of the variety and climatic conditions. Similar findings have been reported by Mertia and Vashishtha, (1985) on the maturity of date fruits.

The maximum number of days in attaining the harvesting of bunches after pollination was counted in Khadrawy (123.00 days) followed by Shamran (120.00 days) and Khalas (115.00 days), while minimum days required in case of Halawy (110.00 days) cultivar. Difference among the cultivars was significant for days taken to harvest of bunch.

**Total Soluble Solids (TSS ° Brix)**

Perusal of data in table 5 shows an increase in TSS from *Kimri* stage to *doka* stage of harvesting. TSS slightly increased from 30$^{th}$ April to15th June which rapidly increased from 30$^{th}$ June to full *doka* stage of harvesting possibly due to attaining full maturity and ripening. TSS of fruits in date palm cv. Halawy was 41.28 °Brix at harvesting stage which was 13.85 °Brix at initial stage of fruit development that gradually increased on 15$^{th}$ May to harvesting stage. The highest TSS content was recorded in Halawy (41.28 °Brix) followed by Khalas (39.17°Brix), Shamran (39.13°Brix) and lowest in Khadrawy (37.39 °Brix). A significant difference in TSS of fruits was recorded at fruit growth and harvesting stages. The findings are in agreement to the results reported by Bacha et al, 1987; Chandra *et al,*199.

From the study, Halawy was found best in respect to fast fruit growth to attain early maturity, better fruiting and quality attributes. Halawy cultivar was superior over other cultivars in respect to minimum days taken to harvest, maximum fruit length, number of strands/bunch and number of berries per strand. However, cultivar Khalas was also found better than two other cultivars in respect to fruit growth, mid season maturity, more number of bunch/tree and higher fruit weight

Table 4. Bunch characteristics of different Date palm cultivars

| Treatments | Length of bunch (cm) | No. of bunch/tree | No. of strands per bunch | Number of berries per strand | Days taken to colour turning stage | Days taken to *doka* stage of maturity | Days taken to harvesting of bunches |
|---|---|---|---|---|---|---|---|
| Halawy | 53.79 | 9.00 | 79.50 | 21.50 | 85.00 | 103.00 | 110.00 |
| Khalas | 52.06 | 12.25 | 61.75 | 16.50 | 91.00 | 108.00 | 115.00 |
| Khadrawy | 44.76 | 6.50 | 35.50 | 18.75 | 104.00 | 118.00 | 123.00 |
| Shamran | 58.19 | 7.50 | 40.50 | 18.75 | 99.00 | 115.00 | 120.00 |
| SEm± | 0.53 | 0.43 | 2.02 | 0.57 | 0.65 | 0.68 | 1.04 |
| CD (P=0.05) | 1.65 | 1.33 | 6.29 | 1.77 | 2.01 | 2.11 | 3.24 |

Table 5. Changes in TSS (°Brix) of fruits in Date palm cultivars during fruit growth

| Treatments | April | May | | June | | July | Harvest |
|---|---|---|---|---|---|---|---|
| | 30 | 15 | 30 | 15 | 30 | 15 | |
| Halawy | 13.85 | 15.26 | 16.68 | 19.72 | 30.41 | 39.00 | 41.28 |
| Khalas | 11.45 | 13.84 | 14.06 | 17.33 | 24.06 | 36.04 | 39.17 |
| Khadrawy | 11.23 | 12.51 | 13.67 | 15.90 | 23.43 | 33.75 | 37.39 |
| Shamran | 12.45 | 13.17 | 13.75 | 16.09 | 19.86 | 34.03 | 39.13 |
| SEm± | 0.49 | 0.34 | 0.29 | 0.38 | 0.72 | 0.58 | 0.48 |
| CD (P=0.05) | 1.51 | 1.05 | 0.91 | 1.18 | 2.23 | 1.81 | 1.49 |

**References**


Al-Qurashi, Adel D. 2010. Physico- chemical changes during development and ripening of "Helali" date palm fruit. *Food Agriculture & Environment*, 8(2): 404-408.

Awad, M.A., Al-Qurashi, A.D. and Mohamed, A.S. 2011. Biochemical changes in fruit of an early and a late date palm cultivar during development and ripening. *International Journal of Fruit Science*, 11: 167-183.

Bacha, M.A. Nasr, T.A. and Shaheen, M.A. 1987. .Changes in Physical and chemical characteristics of the fruits of four date palm cultivars. *Proc. Saudi Biol. Soc*., 10:285-295.

Chandra, A., Chandra, Anju and Gupta, I. C. 1992. Date palm Research in Thar Desert, Scientific Publisher, Jodhpur, 116 p.

Chandra, A. and Choudhary, N.L. 1992. Bunch characteristics and their co-relation in date palm cultivars at Bikaner, *Curr. Agric*., 16(1-2): 79-83.

Gopalan, C. Ramasastri, B.V. and Balasubramanium, S.C. 1985. Nutritive Value of Indian Foods, National Institute of Nutrition, ICMR, Hyderabad, 87pp.

Markhand, G. S., Abal-Soad, A. A., Mirbohar, A. A. and Karhaz, N. A. 2010. 2010. Fruit characterization of Pakistani dates. *Pak. J. Bot*., 42(6): 3715-3722.

Mertia, R.S., Birbal and Kumawat, R.N. 2010. Performance and field management of six prominent cultivars of date palm (*Phoenix dactylifera* L.) in extreme arid regions of Thar Desert, India .*Acta Hort*., 882: 65-68.

Mertia, R.S. and Vashishtha, B.B. 1985. A note on the performance of date palm (*P. dactylifera* L) cultivars Halawy at Chandan (Jaisalmer). *Ann. Arid Zone,* 24: 263-264.

Shabana, H.R., Benjamin, N.D. and Mohammad, S. 1981. Pattern of growth and development in date palm fruit. *Date palm J*., 1**:** 31-42.