



## **CROP IMPROVEMENT STUDIES IN CUSTARD APPLE CULTIVARS**

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**ABSTRACT :** The present investigations were carried out in Fruit Science Department under aegis of All India Coordinated Research Project on Arid Zone Fruits at College of Horticulture and Forestry, Jhalawar on new established orchard during 2010 to evaluate the four different custard apple cultivars collected from different horticultural institutes of the country. The fruit quality characteristics during first bearing (2016) revealed that maximum fruit weight (169.38g), pulp wt. (68.27g), pulp % (40.71) was observed in Balanagar cultivar, however maximum TSS (35.73°brix), higher yield/plant (3.81kg), less no. of seeds (24.80) and less seed weight/ fruit (6.63) was estimated in Raydurg cultivar. The quality attributes of cvs. Balanagar and Raydurg were found at par with each other and were found superior over Ramsita and APK (Ca-1) cultivars during first bearing. The evaluation of custard apple fruit quality during second bearing (2017) revealed that maximum average fruit weight (224.34g), pulp weight (100.03g), pulp % (44.54) and yield/plant (5.60kg) was recorded in Balanagar cultivar, however maximum TSS (32.88°brix), less number of seeds (27.80), less seed weight/fruit (7.35g) was estimated in Balanagar cultivar and were found higher over Ramsita and APK (Ca-1) cultivars. The genetic studies revealed high heritability values for fruit weight (148.79), pulp weight (149.29), pulp percentage (149.05), number of seeds/fruit (148.41), seed weight/fruit (149.87), TSS content (148.41) and fruit yield/plant (147.89) among custard apple cultivars. The present studies determine that Balanagar and Raydurg cultivars have shown promise under heavy black soils of Jhalawar district and holds potential for this crop in subhumid climate having good average annual rainfall (750mm).

**Keywords :** Custard apple, fruit weight, pulp weight, pulp percentage, heritability

Custard apple being a potential underutilized fruit plant naturally acclimatized in sub mountainous tracts of Udaipur, Rajsamand, Chittorgarh, Baran, Kota and Jhalawar district. Custard apple (*Annona squamosa*) belongs to family Annonaceae of the order Magnoliales. It is hardy, tolerant to drought, salinity and saline irrigation water to some extent. It grows very well in shallow soil profile. It also sheds off leaves during stress condition to evade moisture loss from the plant tissue through transpiration. This crop is known by various names like *Sitaphal*, *sharifa* and sugar apple. The acreage under custard apple in Rajasthan is meager and approximately 600 hectares is reported in Rajasthan. This fruit is gaining importance for its sweet pulp extensively used in ice-cream, milk shakes, confectionery and other delicious food dishes. The different custard apple cultivars were introduced as a part of crop improvement process under varietal

evaluation trial during 2010 and experimental block of custard apple were established under vertisols at Fruit Instructional Farm of College of Horticulture and Forestry, Jhalawar. With intent to study fruit quality and amenability, new introduction of custard apple cultivars from other parts of the country in Jhalawar district of Rajasthan state were made during 2010 and as a mandate of Plant Genetic Resource Management, the present investigations were carried out under All India Coordinated Research Project on Arid Zone Fruits at Jhalawar centre.

### **MATERIALS AND METHODS**

The study area falls under Sub humid Southern plains and Humid South Eastern plains of Rajasthan. The Jhalawar district on an average receives 1000 mm rainfall and average temperature lies in the range of 10 to 48°C. The experiment was conducted at Fruit Instructional Farm of College of Horticulture and Forestry, Jhalawar under the aegis of All India

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Coordinated Research Project on Arid Zone Fruits. The plantation of these custard apple varieties were done during July 2010 and these four custard apple varieties were procured from IIHR Bangalore, HRS Ananthapur and Horticulture College and Research Institute, Periyakulam. The plantation spacing among these custard apple cultivars were done at 5 × 5 m spacing. The fruit samples of these four custard apple cultivars were harvested during first week of November during 2016 and 2017 at horticultural maturity stage. The fruit samples were collected from all the four directions of the tree at horticultural maturity stage and five replications were done for assessment of fruit quality in the laboratory of Department of Fruit Science. Eight fruits/replication and forty fruits per cultivar and a total of 160 fruits for four cultivars were taken for analysis work. Average of fruit weight as well as pulp weight was taken using Sartorius electronic balance. The custard apple pulp was separated manually from the individual seeds and pulp weight/fruit was recorded. The number of seeds/fruit was calculated and seed weight/fruit was also recorded. Average yield/plant was recorded by taking total fruit weight of samples on electronic weighing balance of range (1-20kg). The estimation of genotypic coefficient of variation, heritability and genetic advance was worked out using the formula suggested by Burton (2).

## RESULTS AND DISCUSSION

The results on fruit quality are present under suitable subheadings:

**Fruit weight :** The data presented in table 1 revealed that during 2016, fruit weight among custard apple varieties ranged from maximum (169.38g) in cv. Balanagar to minimum (123.79g) in cv. Ramsita and was found significant over APK (Ca-1) and Ramsita cultivars. The fruit weight of cultivars Balanagar and Raydurg were found at par with each other. The data presented in Table-2 revealed that during 2017, fruit weight ranged from maximum (224.34g) in cv. Balanagar to minimum (150.30g) in cv. Ramsita. The fruit weight of cultivar Balanagar was found statistically significant and superior to all other cultivars. The better fruit weight of cv. Balanagar observed under Jhalawar district might be attributed to better adaptability of this cultivar under sub humid edaphic-climatic conditions and self fruitfulness nature of Balanagar cultivar. The fruit weight is a genetically controlled character and varied significantly among the four cultivars. The present results are in consonance with the findings of Bhatnagar *et al.* (1) who reported variation among landraces of custard apple collected from different districts of South Eastern Rajasthan. The plate 1

depicts the fruit morphology of two promising cultivars viz. Raydurg and Balanagar in Jhalawar district.

**Pulp weight :** The data exhibited in table 1 revealed that during 2016 among different custard apple varieties, pulp weight of custard apple varieties ranged from maximum (68.27g) in cv. Balanagar to minimum (45.48g) in cv. Ramsita. Pulp weight of cultivars Balanagar and Raydurg were found at par with each other, however pulp weight of cv. Balanagar was found statistically superior over Ramsita and APK (Ca – 1) cultivars. The data elucidated in Table 2 revealed that during 2017, pulp weight ranged from maximum (100.03g) in to minimum (59.91g) in Ramsita cultivar. Pulp weight of cultivar Balanagar was found statistically significant and superior over other cultivars. The better pulp weight observed in Balanagar cultivar might be attributed to inherent genetic character of this cultivar and wider adaptability of Balanagar under different ecological niches across the country.

**Pulp percentage :** The data exhibited in Table 1 revealed that during 2016, pulp percentage among custard apple varieties varied from maximum (40.71%) in cv. Balanagar to minimum (45.48%) in cv. Ramsita. Pulp percentage of cultivars Balanagar and Raydurg were found at par with each other, however this attribute was found statistically significant and superior over Ramsita and APK (Ca-1) cultivars. The data presented in Table 2 revealed that during 2017, pulp percentage ranged from maximum (44.54%) in cv. Balanagar to minimum (39.83%) in cv. Ramsita. Pulp percentage of Balanagar and Raydurg cultivars were found at par with each other, however it was found statistically significant over Ramsita and APK (Ca-1) cultivars. The correspondingly better values of pulp percentage observed in Balanagar and Raydurg cultivars might be attributed to better pulp weight estimated in both the cultivars during 2016-17.

**Number of Seeds :** The data presented in Table 1 revealed that during 2016, number of seeds/fruit among custard apple varieties varied from maximum (75.20) in cv. Ramsita to minimum (27.80) in cv. Raydurg. The data presented in Table 2 during 2017 revealed that number of seeds/fruit varied from maximum (41.40) in cv. Balanagar to minimum (27.80) in cv. Raydurg. Lesser no. of seeds observed in Raydurg cultivar reflects the inherent genetic character of this cultivar and is an indication of good fruit quality in terms of pulp: stone ratio in comparison to other cultivars. Less seed per fruit is the most desirable characteristics for fruit quality of custard apple in terms of edible pulp.

**Table 1 : Physico-chemical characteristics of custard apple (2016).**

Variety	Fruit wt. (g)	Pulp wt. (g)	Pulp%	No. of seeds	Seed wt./fruit	TSS (°brix)	Yield plant <sup>-1</sup>
Balanagar	169.38	68.27	40.71	31.20	8.29	33.86	3.70
Raydurg	167.16	68.25	40.26	24.80	6.63	35.73	3.81
Ramsita	123.79	45.48	36.73	75.20	7.33	30.36	3.09
APK(Ca-1)	141.80	55.21	38.92	29.00	7.69	31.69	3.06
<b>CD (P=0.05)</b>	7.66	6.13	2.60	4.81	1.29	1.90	0.44

**Table 2 : Physico-chemical characteristics of custard apple (2017).**

Variety	Fruit wt.(g)	Pulp wt.(g)	Pulp%	No. of seeds	Seed wt./fruit	TSS (°brix)	Yield Plant <sup>-1</sup> (kg)
Balanagar	224.34	100.03	44.54	41.20	7.74	32.46	5.60
Raydurg	198.88	85.68	43.08	27.80	7.35	32.88	5.17
Ramsita	150.30	59.91	39.83	32.40	7.57	29.90	3.50
APK (Ca-1)	168.34	70.20	41.70	33.20	7.83	28.58	3.74
CD (P=0.05)	13.94	6.99	3.27	3.71	0.98	3.42	0.63
<b>CV %</b>	5.45	6.42	5.61	8.01	9.40	8.01	10.25

**Table 3 : Estimation of genetic variability parameters among custard apple varieties.**

Traits	GCV%	PCV%	H	H%	σ <sub>p</sub>	GG
Fruit weight(g)	101.78	83.44	1.48	148.79	117.90	255.76
Pulp wt. (g)	103.42	84.64	1.49	149.29	50.96	260.31
Pulp %	99.33	81.36	1.49	149.05	26.21	249.82
No. of seeds/fruit	101.44	83.27	1.48	148.41	21.30	254.58
Seed wt./fruit	99.27	81.08	1.49	149.87	4.70	250.36
TSS(°brix)	99.44	81.63	1.48	148.41	19.13	249.57
Yield/plant	100.18	82.38	1.47	147.89	2.09	250.99

Plate 1: Fruiting in two promising cultivars of *Annona squamosa* at Jhalawar

**Total Soluble Solids :** The data elucidated in table 1 revealed that during 2016, total soluble solids content among different custard apple varieties at full maturity stage ranged from maximum (35.86°brix) in cv. Balanagar to minimum (30.36°brix) in cv. Ramsita. Total soluble solids content of Balanagar and Raydurg cultivars were found at par with each other, however, it was found superior over Ramsita and APK (Ca-1) cultivars. The data elucidated in Table 2 revealed that during 2017, total soluble solids content ranged from

maximum (32.88°brix) in cv. Raydurg to minimum (28.58°brix) in cv. APK (Ca-1), however total soluble solids content of Balanagar, Raydurg and Ramsita cultivars were found at par with each other and was found superior over APK (Ca-1) cultivar.

**Yield per plant :** The data presented in table 1 exhibited that during 2016 (first bearing), the yield/plant among custard apple varieties ranged from maximum (3.81kg) in cv. Raydurg to minimum (3.06 kg) in cv. APK (Ca-1). Yield/plant of Balanagar and Raydurg cultivars

were found at par with each other, however it was found statistically significant over Ramsita and APK (Ca-1) cultivars. The data presented in Table 2 revealed that yield/plant varied from maximum (5.60kg) in cv. Balanagar to minimum (3.50kg) in cv. Ramsita. Yield/plant of Balanagar and Raydurg cultivars were found at par with each other and were found superior over Ramsita and APK (Ca-1) cultivars.

**Estimation of genetic variability parameters among custard apple varieties :** The data presented in Table 3 revealed the extent of genetic variation in different traits of four custard apple cultivars. The genotypic and phenotypic components are the measure of variability among the cultivars under study (Singh and Jalikop, 5). The genotypic coefficient of variation was found higher than phenotypic coefficient of variation for all the characters studied and this indicates that the apparent variation is strongly genetic being lesser under influence of environment. The genotypic coefficient of variation was very high for fruit weight, pulp weight, pulp percentage, no. of seeds/fruit, average seed weight/fruit, TSS content and yield/plant. For, fruit quality characters, the higher GCV values were found for fruit weight (101.78), pulp weight (103.42), number of seeds/fruit (101.44), seed weight/fruit (99.27) and fruit yield/plant (100.18). Correspondingly, the higher PCV values were obtained for fruit weight (83.44), pulp weight (84.64), pulp% (81.36), number of seeds/fruit (83.27), seed weight/fruit (81.08), TSS content (81.63) and fruit yield/plant (82.38). Higher GCV values than PCV values for fruit quality characters indicate that these were less influenced by environment and are strongly inherited characters. The higher GCV can be further utilized for crop improvement by selection and is more amenable for further improvement.

From data in Table 3, high heritability values for fruit weight (148.79), pulp weight (149.29), pulp percentage (149.05), number of seeds/fruit (148.41), seed weight/fruit (149.87), TSS content (148.41) and fruit yield/plant (147.89) among custard apple cultivars

revealed that these characters were lesser affected by environment indicating that these were simply inherited characters governed by a few major genes or have additive effect and therefore selection for these traits would be more effective for crop improvement. According to Johnson *et al.* (3) high heritability along with considerable genetic gain is more useful than heritability alone in predicting the resultant effect of selection. Similar findings have been reported by Manohar *et al.* (4). High heritability coupled with high genetic gain was estimated for all the characters studied.

## CONCLUSION

The present studies on crop improvement in custard apple cultivars indicates ample scope of Balanagar and Raydurg cultivars in terms of good fruit weight, better edible mass as pulp percentage and rich total soluble solids content of custard apple fruits at horticultural maturity stage under sub humid zone of Jhalawar district.

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