International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(5): 810-814

Received: 05-07-2018
Accepted: 10-08-2018

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Physico-chemical analysis of quality attributes in custard apple (*Annona squamosa* L.) genotypes

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Abstract
The present study was carried out at the Research Farm of College of Agriculture and Research Station, Kanker, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh). During two consecutive seasons *viz*., kharif 2013-14 and 2014-15 Experimental materials comprised 60 genotypes four replications with the objectives of estimate the post-harvest and quality attributes traits. The finding of analysis of variance revealed significant mean squares due to genotypes for all the quality attributes traits. A chemicals analysis was carried *viz* total soluble solids (°brix), total sugar (%), reducing sugar (%), non-reducing sugar (%), acidity (%), keeping days (Shelf life), pulp ratio, pulp-seed ratio, peel percentage and fruit yield per plant (kg). The highest quality parameters observed in total soluble solids (°brix), keeping days, fruit yield per plant and pulp-seed ratio present in IGCA-21 genotype, total sugar percentage (IGCA-2), reducing sugar percentage (IGCA-3), non-reducing sugar percentage (IGCA-51), acidity percentage (IGCA-15), pulp ratio (IGCA-25) and peel percentage (IGCA-36).Looking to the study of variance and Physico-chemical analysis in custard apple, this was first framework for improvements of custard apple under baste reason of Chhattisgarh and as well as India.

Keywords: custard apple (*Annona squamosa* L.), physico-chemical and genotypes

Introduction
Custard apple (*Annona squamosa* L.), also known as *Sitaphal* or *Sharifa*is an important dryland fruit crop of India and belongs to family 'Annonaceae' having chromosome number 2n = 14. The fruit tree belongs to tropical climate and is native of tropical America and surrounding regions. *Annona* means year's harvest and *squamosa* means scaly referring to the scale like structure of the fruit surface. Custard apple tree has been naturalized in the Deccan plateau due to its hardy nature and hence, it is an important dryland fruit crop. It is cultivated in Maharashtra, Gujarat, Madhya Pradesh, Andhra Pradesh, Chhattisgarh, Karnataka, Bihar, Orissa, Assam and Tamil Nadu. Besides India, it is common in China, Phillippines, Egypt and Central Africa. In India, it is presently grown in an area of about 29.87 thousand hectares with a production of 228.37 MT and the average productivity is 765 q/ha and it ranges from 673 q/ha in Andhra Pradesh to 685 q/ha in Maharashtra (2014-15). Chhattisgarh and Maharashtra occupies 55.74 per cent of the total area in the country, whereas Gujarat occupies 5.34 thousand hectare and the average productivity is 768 q/ha (Chandra, 2010) [5].
Chhattisgarh, state of India occupies an area of approximately 7.990 thousand hectare with an annual production of 39.73 metric tones having the productivity of 497.25 q/ha under custard apple. In the range of forest scattered across Jagdalpur, Beejapur, Dantewada, Kanker, Dhamtari, Rajnandgaon, Durg, Jashpur, Surguja and Bilaspur districts, only Kanker district is blessed with natural biodiversity of the custard apple. Its wild land races are found distributed all along as a natural stand over an area of about 7.20 thousand hectare with an annual production of 35.60 MT having the productivity of 494.45 q/ha (Nag *et al*., 2017 and 2018) [10, 12]. The fruit of custard apple has delicious whitish pulp, and is popular in tropical markets. The fruits composed of loosely cohering carpels forming a squamose or tuberculated surface. Aggregate and soft fruits form from the numerous and loosely united pistils of a flower which become enlarged and mature into fruits which are distinct from fruits of other species of genus and more like a giant raspberry instead. Custard apple produces single crop in a year during September to December in Central India and maturing fruits turn light-green. The inter-areole space widens, the fruit turn creamy-white. The round or heart-shaped greenish yellow, ripened aggregate fruit is pendulous on a thickened stalk, 5 cm to 10 cm in diameter with many round protuberances and covered with a powdery bloom.

Fruits are formed of loosely cohering or almost free carpels the ripened pistils (Morton, 1987) [9].

The pulp is white-tinged yellow, edible and sweetly aromatic. It has a thick, creamy-white layer of custard like, somewhat granular, flesh beneath the skin surrounding the concolorous moderately juicy segments. Each carpel containing a single, hard, smooth, shiny, dark-brown or black, glossy seed, oblong, smooth, less than 1.3 to 1.6 cm long (Nath *et al*., 2008). Actual seed counts have been found 55 to 60. A pointed, fibrous, central core, attached to the thick stem, extends more than halfway through the fruit and possessing pleasant flavour, custard apple fruits are utilized for ice cream making (Maurya and Singh, 2006 & Nag *et al*., 2017) [8, 10]. Once the above nutritional and medicinal qualities of dietary importance were realized, there has been considerable awareness about the consumption of custard apple in the world. The immature fruits, seeds, leaves and roots are of considerable medicinal values both in Aurvedic and Yunani systems of medicine. It is full of vitamin C anti-oxidants, which helps to combat many diseases and also enhances the immune system. Eating custard apple is helpful in curing many diseases and disorders. The fruit is good for heart, skin and bone and maintains blood pressure. Custard apple is also helpful in curing of boils, ulcers and gum related problems. The leaves of this fruit work against cancer, bark can be used in case of toothache, and gum pain. However, the most important advantages of custard apple are healthy heart, beneficial in pregnancy, improve eye vision, cure arthritis, fighting fatigue and protects against anaemia. The edible portion or pulp is creamy or custard like, granular, with a good blend of sweetness, possessing pleasant flavor and mild aroma have a universal liking, being rich in carbohydrates 23.0 g per100 g fruits. The fruit is reported to have moisture 70.5 g, protein 1.6 g, fat 0.4 g, minerals 0.9 g, fiber 3.1 g, calcium 17.0 mg, phosphorous 47.1 mg, iron 1.5 mg, thiamine 0.07 mg, riboflavin 0.17 mg, niacin 1.30 mg, Vitamin C 37.0 mg and energy 104Kcal Gopalan *et al*., (1987) [6], Singh, (1995) [17] and Nag *et al*., (2018) [12]. Shedding off leaves during stress conditions is another associated escape mechanism which offers ample scope for cultivation of custard apple in arid regions. There is no well-organized orcharding of this crop. Hence, the custard apple fruits yield is a complex character and therefore, the knowledge of association and cause and effect relationship of yield component traits with yield would help in formulation of effective selection schemes (Baskaran and Muthiah, 2007) [1]. Grouping of genotypes based on the inherent genetic diversity is also helpful to find out the linkage of association. Diverse genotypes are always used to exploit heterosis in plant breeding programme.

The evolution of custard apple through natural and human selection in diverse elevation zones and under different cropping systems with involvement of honey bees being the carrier of cross pollination has resulted in a wide variety of locally adapted landraces. These landraces have evolved over years to fit into local cropping patterns and diverse end uses and represent a wide range of patterns of crop diversity. The knowledge of patterns of genetic variation of a crop species in any given region or country is very important for planning future germplasm exploration missions and thereafter it's efficient utilization in crop improvement programme as well as quality assessment. Their component is useful to predict the extent of improvement possible for fruits yield and other important characters.

Materials and Methods

An experiment comprised of 60 genotype accessions (Table-2) was conducted at 10 years *In-situ* plantation at Northern Bastar, Research cum Instructional Farm College of Agriculture and Research Station, Singarbhat, Kanker, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh) during *Kharif* 2013-14 and 2014-15 Physico-chemical analysis of fruits was done in the Quality Laboratory, College of Agriculture & Research Station, Singarbhat, Kanker, (C.G.). The standard package of practices was adopted throughout the studies. The intercultural operation was done time to time at pre and post-monsoon seasons. To control the weeds of experimental site, hand weeding was done during the month of July and September. The experiment was laid out in Randomized Complete Block Design (RCBD) with four replications recommended package of practices were applied to raise the normal crop. Observations recorded on chemical composition of fruits were recorded on one randomly selected competitive plants from each genotype, in each replication on 10 characters *viz.,* total soluble solids (°brix), total sugar (%), reducing sugar (%), non-reducing sugar (%), acidity (%), keeping days (Shelf life), pulp ratio, pulp-seed ratio, peel percentage and fruit yield per plant (kg). The analysis of variance for qualitative traits of fruit yield and its components was done as per the method given by Burton (1952) and Physico-chemical analysis done by different formula and methods (Results and Discussion). As per the custard apple descriptors developed by ICAR, NBPGR.

Results and Discussion

Analysis of variance

The Analysis of variance (ANOVA) worked out for qualitative traits with respect to fruit yield and other components in custard apple indicated that the mean sum of squares due to genotypes were highly significant for all the characters. This is an indication of existence of sufficient variability for the traits (Table-1).

Physico-chemical analysis

Custard apple is no longer poor man's fruit as it fetches an even higher price than several other fruits because the fruits are very sweet, nutritious, very perishable in nature and other all parts are used as a medicine purposes mean of chemical study present in table-2.

Total Soluble Solids (°Brix)

Total soluble solids (TSS) of custard apple pulp of all the genotypes was recorded by using a Hand Refractometer at 20 ºC, which is based on the principle of total refraction and expressed in º Brix. The character Total Soluble Solids was recorded ranged from 19.26 °Brix (IGCA-48) to 28.08 °Brix (IGCA-21) with a mean value of 22.37°Brix.

Total sugar (%)

Sugar was determined by the method of Lane and Eynon as described by Ranganna (1986) [15]. The Standard invert sugar solution was prepared by dissolving 9.5 g sucrose and 5 ml concentrate HCL then volume made upto 100 ml. This solution was allowed to stand for further three days at 20-25 ºC for inversion to take place and used for several months during analysis.

For total sugars, 50 ml of filtered sample was taken in a 250 ml conical flask to which 50 ml water and 5g of citric acid was added, boiled gently for 10 minutes to complete the inversion of sucrose, transferred to 250 ml volumetric flask

and neutralized with 1N NaOH. The volume was made up-to the mark and determined the total sugars as invert sugars.Titration was done for all the genotypes.

$$\text{Total sugar as invert sugar (\%)} = \frac{\text{mg of invert sugar X Dilution X 100}}{\text{Titrate X Wt or volume of the sample X 100}}$$

% Sucrose = (% Total invert sugar - % Reducing sugar originally present) X 0.95
% Total sugar = (% Reducing sugar + % Sucrose).
The qualitative character Total Sugar was recorded ranged from 14.27 (IGCA-57) to 23.77 per cent (IGCA-2) with a mean value recorded as18.38 per cent.

Reducing sugar (%)
Reducing sugar was determined by the method of Lane and Eynon as described by Ranganna (1986) [15]. This method is based on the principle that invert sugar reduces the copper in Fehling's solution to red, insoluble cuprous oxide. The sugar content in a food sample is estimated by determining the volume of the unknown sugar solution to completely reduce a measured volume of Fehling's solution.

Apparatus: Volumetric flask 100 ml, Conical flask 250 ml, Burette 50 ml, Pipette and Water bath/heater.

Reagents
1. Fehling's solution (A)
2. Fehling's solution (B)
3. Methylene blue indicator: methylene blue 1% aqueous.
4. 45% Neutral lead acetate solution
5. 22% Potassium oxalate solution
6. Standard invert sugar solution AR sucrose 9.5 g and concentrate HCI 5 ml and volume up to 100 ml.

Fehling's solution A: Copper sulphate 69.28 g and volume made upto one litre and Fehling's solution (B): Potassium sodium tartrate 346 g and sodium hydroxide (NaOH) 100 g and volume made upto one litre
25 ml of the standard invert solution was taken with pipette into 250 ml volumetric flask and 50 ml of water was added. Few drops of phenolphthalein indicator were added and neutralized with 20% NaOH until the solution turns pink. This was acidify with 1 N HClby adding it drop wise. Volume was made upto mark with water (1 ml= 2.5 mg of invert sugar).
25 g of filtered pulp juice was weighed and it was transferred into 250 ml volumetric flask. 100 ml of distilled water was added and this was neutralized with 1 N NaOH, then 2 ml of lead acetate solution was added. It was shacked and stand for 10 minutes. Then 2 ml of potassium oxalate solution was added. Volume made up with water, and filtered.
10 ml of the mixed Fehling's solution A and B was pipetted into a 250 ml flask. 50 ml of water was added. Burette was filled with the clarified sugar solution. Sugar solution from burette was added to the Fehling's solution which was sufficient to reduce it. It was mixed and heated. Three drops of methylene blue solution was added and titration was completed by adding the sugar solution drop wise until the indicator is completely decolorized. The volume of solution required was recorded. The end point appears with brick-red colour. The reducing sugar was expressed in per cent and calculated by the following formula:

$$\text{Reducing sugar (\%)} = \frac{\text{mg of invert sugar X Dilution X 100}}{\text{Titrate X Weight or volume of the sample X 1000}}$$

To 25g of the sample in a volumetric flask, 100ml of water was added and neutralized with 1N NaOH. Two ml of 66% lead acetate solution was added and kept for 10 minutes. Excess lead acetate was precipitated by necessary amount of 20% potassium oxalate, made upto the volume with water, filtered and taken in burette. Ten ml of mixed Fehling's solution was taken in 250ml conical flask. Little quantity of the sample was run into flask and heated to boil moderately for 2 minutes. Three drops of methylene blue solution was added and completed the titration until the indicator was completely decolourized. Brick-red colour of the solution indicates the end point. Titration was done for in all the genotypes. The qualitative trait Reducing Sugar was recorded ranged from 11.36 (IGCA-58) to 19.45 per cent (IGCA-3) with a mean value calculated as 14.57 per cent.

Non-reducing sugar (%)
The non-reducing sugar was determined by subtracting the value of reducing sugar from total sugar percentage in all the genotypes of custard apple.
% Non-reducing sugar = % Total invert sugar - % Reducing sugar originally present.
The character Non-Reducing Sugar was recorded ranged from 3.17 (IGCA-25) to 6.87 per cent (IGCA-51) with a mean value of 4.53 per cent.

Acidity (%)
The acidity of the 10 g pulp samples was determined by diluting an aliquot of the sample with distilled water and titrating with 0.1N NaOH using phenolphthalein as an indicator. The end point appeared as light-pink colour. The calculated acidity was expressed as percent anhydrous citric acid in all the genotypes, (Ranganna, 1986) [15].

$$\text{\% Total acidity} = \frac{\text{Titrate x Normality of alkali x Volume made up x Equivalent Weight of acid X 100}}{\text{Volume of sample taken for estimation X Weight or volume of Sample taken x 1000}}$$

The acidity in custard apple pulp ranged was recorded from 0.22 (IGCA-21) to 0.46 per cent (IGCA-15) with a mean value of 0.38 per cent.

Keeping days (Shelf life)
Ripened fruits were stored at room temperature and recorded the number of spoiled fruits and number of days. Mean number of keeping days of fruits was worked out in each genotype. The Keeping Days of custard apple fruits was recorded ranged from 3.0 (IGCA-42, IGCA-43, IGCA-49, IGCA-51, IGCA-52, IGCA-53, IGCA-54, IGCA-55, IGCA-56, IGCA-57, IGCA-58, IGCA-59, IGCA-60) to 6.50 (IGCA-21) with a mean value calculated as 3.82 days.

Pulp ratio
The total pulp ratio was calculated by dividing the total fruits weight of pulp by weight of seed. The character Pulp ratio was recorded ranged from 41.69 (IGCA-57 and IGCA-58) to 55.01 (IGCA-25) with a mean value of 48.33.

Pulp: seed ratio
The pulp: seed ratio was calculated by dividing the weight of pulp by weight of seed. The character Pulp-Seed Ratio was recorded ranged from 2.08 (IGCA-60) to 12.65 (IGCA-21) with a mean value recorded as 3.77.

Peel per cent

Peel per cent was calculated by dividing the weight of peel by total weight of fruit multiplied by 100. The character Peel Percentage was recorded ranged from 26.26 (IGCA-57) to 38.70 (IGCA-36) with a mean value of 33.17.

Fruit yield per plant (kg)

Total weight of fruits collected from each tree during the entire season was recorded and mean weight was expressed as fruit yield per tree in kilograms. The character fruit yield per plant was recorded ranged from 101.25kg (IGCA-37) to 152.25 kg (IGCA-21) and mean value was calculated as 113.89kg.

The measurement of existing variance in genetic material has been the basic requirement of a breeding programme (Nag *et al.* 2017) [10]. In the present investigation, a wide range of variability was observed for nearly all the traits *viz.*, fruit yield per plant, pulp ratio, peel percentage, reducing sugar, total sugar, total soluble solids. These findings are in general agreement with the findings of Carvalho *et al.* (2000) [4], Wang *et al.* (2001) [18], Saulo *et al.* (2006) [16], Keny and Paulo (2010) [7], Paulo *et al*. (2009) [14] and Bhatnagar *et al.* (2012) [2].

The measurement of existing variance in genetic material has been the basic requirement of a breeding programme. In the present investigation, a wide range of variability was observed for nearly all the characters indicating the existence of sufficient variability among the genotypes for the qualitative traits. Were found to be excellent in quality with pleasant aroma, smooth pulp texture with less seed, good sugar acid blend and shelf life of custard apple.

Table 1: Analysis of variance for qualitative traits of fruit yield and its components in custard apple during the year 2013-14 and 2014-15

Source of Variation	d.f.	Mean Sum of Squares									
		1	2	3	4	5	6	7	8	9	10
		Total Soluble Solids (°Brix)	Total Sugar (%)	Reducing Sugar (%)	Non-reducing Sugar (%)	Acidity (%)	Keeping Days (Shelf life)	Pulp Ratio	Pulp -Seed Ratio	Peel Percentage	Fruit Yield Per Plant
Replication	3	4.80	1.73	0.92	0.01	0.01	0.35	49.33	0.16	15.80	37.31
Treatment	59	19.73**	31.42**	21.95**	2.81**	0.01**	3.31**	42.62**	26.26**	24.54**	1388.69**
Error	177	2.74	0.88	0.77	0.02	0.01	0.21	29.14	0.06	15.94	39.31
Total	239										

**Significant at 5% probability level

Table 2: Mean performance of Custard Apple Genotypes in Northern Bastar of Chhattisgarh for qualitative traits of fruit yield and its components (pooled data) year 2013-14and 2014-15

S. No.	Name of Genotypes	1	2	3	4	5	6	7	8	9	10
1	IGCA-1	25.200	23.250	19.425	3.825	0.3175	5.250	53.260	8.835	36.000	149.500
2	IGCA-2	26.300	23.775	19.400	4.375	0.3275	6.000	53.000	8.273	36.000	148.250
3	IGCA-3	25.425	23.375	19.450	3.925	0.3175	4.500	53.000	7.770	36.000	151.500
4	IGCA-4	24.850	22.175	18.800	3.375	0.3325	5.500	53.000	8.770	36.000	148.500
5	IGCA-5	21.910	20.743	16.225	5.000	0.3475	3.500	49.690	3.610	34.000	104.500
6	IGCA-6	21.865	20.785	16.450	5.775	0.3550	3.500	48.000	2.737	34.000	105.500
7	IGCA-7	21.840	20.215	15.450	5.800	0.3450	4.250	48.000	2.820	34.000	105.000
8	IGCA-8	21.233	18.300	14.300	4.000	0.4125	3.750	48.000	2.763	34.000	105.500
9	IGCA-9	21.557	20.150	15.200	4.950	0.3375	5.000	48.000	2.690	34.000	146.750
10	IGCA-10	26.475	22.825	18.175	4.650	0.3150	5.750	53.000	8.573	36.000	148.750
11	IGCA-11	25.450	22.825	17.775	5.050	0.3100	5.250	53.000	8.740	36.000	150.250
12	IGCA-12	25.500	23.150	17.675	5.475	0.3150	4.250	53.000	8.097	36.000	145.500
13	IGCA-13	26.200	23.150	18.175	4.975	0.2900	4.250	53.000	7.762	36.000	145.250
14	IGCA-14	22.275	19.225	15.225	4.000	0.4450	3.750	48.665	2.750	33.567	104.000
15	IGCA-15	21.275	18.225	14.225	4.000	0.4575	3.500	46.497	2.637	34.000	104.000
16	IGCA-16	21.350	18.750	13.575	5.175	0.4475	4.000	48.000	2.565	34.000	102.750
17	IGCA-17	20.175	17.825	14.175	3.650	0.4225	3.500	48.000	2.593	34.000	101.500
18	IGCA-18	20.275	18.175	14.225	3.950	0.4450	4.000	48.000	2.750	34.000	101.750
19	IGCA-19	24.525	22.175	18.225	3.950	0.3175	4.750	53.000	7.940	36.000	148.750
20	IGCA-20	25.950	23.225	19.450	3.775	0.3150	4.000	53.090	8.635	36.000	150.420
21	IGCA-21	28.075	23.450	19.300	4.150	0.2150	6.500	55.013	12.65	36.000	152.250
22	IGCA-22	26.125	23.250	19.225	4.025	0.2375	6.250	53.000	8.423	36.000	146.750
23	IGCA-23	22.225	18.225	13.200	5.025	0.2975	4.250	48.000	2.603	34.000	112.250
24	IGCA-24	20.175	17.775	13.725	4.050	0.4500	3.250	48.000	2.197	34.000	102.000
25	IGCA-25	26.250	17.493	14.317	3.175	0.3700	3.500	47.013	2.570	34.000	109.000
26	IGCA-26	26.325	18.250	14.125	4.125	0.3725	3.250	49.357	2.327	34.000	112.250
27	IGCA-27	25.200	16.000	13.757	4.950	0.3675	3.500	48.000	2.205	34.000	102.250
28	IGCA-28	21.425	17.175	13.275	3.900	0.3675	3.500	48.000	2.385	34.000	107.250
29	IGCA-29	20.250	17.715	13.533	4.000	0.4500	3.000	48.317	2.373	34.883	102.500
30	IGCA-30	22.250	18.275	13.125	5.150	0.3500	4.250	48.000	2.757	32.635	102.250
31	IGCA-31	21.543	18.275	14.450	3.825	0.3325	4.250	48.000	2.595	33.005	112.250

Contd…

S. No.	Name of Genotypes	1	2	3	4	5	6	7	8	9	10
32	IGCA-32	22.23	17.43	14.15	3.27	0.41	5.00	48.00	2.53	33.14	101.50
33	IGCA-33	23.23	16.78	13.64	3.23	0.42	3.75	48.00	2.55	32.88	102.00

34	IGCA-34	20.20	17.43	13.65	3.77	0.42	4.50	48.00	2.67	32.46	101.75
35	IGCA-35	20.23	17.17	13.45	3.73	0.37	3.50	46.03	2.61	32.72	103.75
36	IGCA-36	21.45	17.49	13.24	4.00	0.42	3.75	51.42	2.35	38.70	101.75
37	IGCA-37	21.25	18.25	13.57	4.67	0.42	3.00	48.00	2.66	34.51	101.25
38	IGCA-38	21.50	17.24	13.54	3.47	0.45	3.50	48.00	2.58	34.99	103.25
39	IGCA-39	22.50	18.33	14.53	3.80	0.42	3.50	48.00	2.58	34.80	101.25
40	IGCA-40	21.84	18.49	14.03	4.73	0.38	3.50	44.17	2.50	34.15	104.00
41	IGCA-41	20.99	18.78	13.96	5.07	0.39	3.25	43.97	2.52	31.41	106.50
42	IGCA-42	22.15	18.79	12.85	6.23	0.41	3.00	42.94	2.53	30.72	102.25
44	IGCA-43	20.20	16.19	13.07	3.83	0.45	3.00	47.02	2.78	29.85	105.75
44	IGCA-44	20.86	15.66	12.93	3.97	0.42	3.25	42.98	2.51	30.14	102.50
45	IGCA-45	21.93	16.43	12.90	5.75	0.41	3.00	42.84	2.50	29.99	104.50
46	IGCA-46	23.20	16.21	13.07	6.13	0.42	3.25	47.37	2.51	29.59	103.00
47	IGCA-47	22.27	15.77	13.46	4.30	0.42	3.25	48.02	2.48	29.69	102.00
48	IGCA-48	19.26	15.38	12.37	4.93	0.41	3.25	46.88	2.51	29.47	103.00
49	IGCA-49	20.18	14.42	12.40	3.90	0.43	3.00	44.16	2.38	30.85	104.50
50	IGCA-50	21.047	17.71	13.09	4.70	0.40	3.25	48.17	2.61	31.82	107.25
51	IGCA-51	21.14	15.78	12.51	6.87	0.42	3.00	43.94	2.36	31.21	101.50
52	IGCA-52	20.38	15.13	12.75	5.75	0.45	3.00	48.64	2.53	32.81	104.75
53	IGCA-53	20.56	15.65	12.94	5.10	0.43	3.00	47.76	2.40	32.00	103.00
54	IGCA-54	21.01	15.05	12.86	6.05	0.42	3.00	48.61	2.39	30.38	102.75
55	IGCA-55	20.94	14.89	12.39	4.00	0.41	3.00	48.27	2.36	31.83	103.25
56	IGCA-56	20.98	15.51	11.78	4.30	0.42	3.00	47.39	2.27	30.68	103.25
57	IGCA-57	20.13	14.27	11.45	5.23	0.41	3.00	41.69	2.29	26.26	108.50
58	IGCA-58	19.48	14.41	11.36	4.95	0.45	3.00	41.69	2.15	27.93	104.00
59	IGCA-59	21.26	15.08	12.70	5.20	0.42	3.00	47.88	2.30	31.47	105.00
60	IGCA-60	20.14	15.15	11.82	5.00	0.44	3.00	41.98	2.08	27.93	106.50
	SEm ±	0.54	0.40	0.33	0.17	0.01	0.17	1.82	0.16	1.33	2.42
	CD at 5%	1.49	1.12	0.93	0.47	0.03	0.46	5.05	0.45	3.70	6.74
	CV	6.69	6.09	6.45	10.56	6.83	12.39	10.72	12.13	11.18	6.05

1. Total Soluble Solids (° Brix) 2. Total Sugar (%) 3. Reducing Sugar (%) 4. Non-reducing Sugar (%) 5. Acidity (%) 6. Keeping Days (Shelf life) 7. Pulp Ratio 8. Pulp-Seed Ratio 9. Peel percentage 10.Fruit Yield Per Plant (kg)

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