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## Genetic Variability in Custard Apple Landraces of Madhya Pradesh, India

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### ABSTRACT

The present investigation entitled “Diversity in Custard apple genotypes collections from Madhya Pradesh, India” was carried out during 2018-2019 at Fruit Preservation Laboratory, Department of Horticulture, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.). The experimental material for the present investigation was comprised of twenty genotypes of custard apple collected from four districts of Madhya Pradesh. Among 20 promising genotype significantly maximum length of fruit (90.55 mm), width of fruit (91.49 mm), weight of fruit (287.77 g), fruit pulp per cent (71.25%) and non reducing sugar per cent (8.60%) was observed in genotypes SEO-04 and it was recorded minimum number of seeds fruit<sup>-1</sup> (16.95), weight of seeds fruit<sup>-1</sup> (5.98 g) and peel weight fruit<sup>-1</sup> (42.13 g). Genotype DRH -04 exhibited maximum volume of fruit (266.65 cc). TSS (30.49), acidity per cent (0.22%) and TSS: acidity ratio (141.67) was registered maximum in CHH -03. Genotype DHR -05 was noted maximum total sugar per cent (24.08%) and reducing sugar per cent (18.15%).

#### Keywords

Custard apple,  
Genotype,  
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#### Article Info

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### Introduction

Custard apple (*Annona squamosa* L.), belongs to a family “Annonaceae”, and also known as *Sitaphal* or *Sharifa*. It is an important dryland fruit of India. It belongs to tropical climate and native of tropical America and surrounding regions. *Annona* means year’s harvest (Lizana and Reginato, 1990) and *Species squamosa* means scaly, referring to the scale like structure of the fruit surface. Some botanists

have considered it to be a native fruit of that country. In India, it is presently grown on 44000 ha area covering the states of Maharashtra, Gujarat, Madhya Pradesh, Andhra Pradesh, Telangana, Chhattisgarh, Karnataka, Bihar, Odisha, Assam and Tamil Nadu with the production of 367 MT (Anonymous, 2017). In MP, cultivated area is 3,590 ha with production 37.00 MT (Anonymous, 2015). Custard apple having high nutrient and medicinal value with short

span of availability of fruits. It is considered as beneficial for cardiac diseases, diabetes, hyperthyroidism, cancer etc. It is rich in carbohydrate (23.5 g), protein (16.6 g), mineral (0.9 g), fiber (3.1 g), calcium (17 mg), phosphorus (47 mg), iron (1.5 g) and Vitamin-C (37 mg), in a 100 gram fruit pulp (Gopalan *et al.*, 1997). This fruits are generally used as fresh and custard powder are prepared either mixed with other fruits or alone. It is also used for preparing ICE cream.

Custard apple is gaining commercial significance now a day and several commercial orchards are immersing in Andhra Pradesh and Maharashtra (Yadav *et al.*, 2017). A rich diversity of custard apple exist in Madhya Pradesh and major growing districts are Chhindwara, Seoni, Betul, Raisen, Sagar, Dhar, Khandwa, Khargone, Jhabua, Dindori, Sehore, Mandla and Harda (Nair and Agrawal, 2017).

It shows that wide adoptability under different location and climatic conditions. Thus, there is immense scope of genetic improvement of custard apple through selection of promising genotype from wild genetic diversity rich regions of M.P. Keeping the above points in view an extensive survey was carried out to collect superior germplasm from Kymore plateau and Satpura hills, climatic zone of Madhya Pradesh in order to evaluate them for their quantitative and qualitative traits.

### **Materials and Methods**

A Survey and characterization study entitled “Genetic Variability in land races of custard apple of Madhya Pradesh, India” was carried out during 2018-2019. The collected land races were characterized with respect to qualitative and quantitative traits in the fruit laboratory, Department of Horticulture, JNKVV Jabalpur (M.P.). The study consisted of landraces of custard apple

from three agro climatic zones of Madhya Pradesh. Collection belongs to Kymore plateau and Satpura hills, Satpura plateau and Malwa plateau. These land races were distinguished based on plant type, (Tall, Semi Tall and Dwarf), plant canopy (Spreading semi spreading and upright), and size (Length, width, weight and volume) as well as shape (cordate broadly cordate, and round) of fruits. These collected data were statistically analyzed under Complete Randomized Design (C.R.D.) considering the three locations as replication. The survey of predominant growing areas was done during the *rabi* 2018. Twenty diverse landraces of custard apple were collected from each agro climatic zone Taken under study. Observations were recorded on the basis of randomly selected three competitive plants with respect to type, canopy, fruit shape and size of each landrace, separately, for studying the morphological, physical and chemical traits. The evaluation was done by following the standard procedure. Data pertaining to fruits quantitate (number of seeds fruit<sup>-1</sup>, Weight of seeds fruit<sup>-1</sup>(g), Fruit pulp (%), Peel weight fruit<sup>-1</sup>(g), and qualitative traits (Total soluble solids (<sup>0</sup>Brix), Acidity (%), TSS: Acid ratio as per given by AOAC, 1995 and total sugars (%)) (Ranganna, 1991) were recorded and subjected to statistical analysis.

### **Results and Discussion**

The data is presented in Table 1 with respect to plant type, shape of canopy, fruit shape and fruit colour. The mean performance of the genotypes revealed a wide range of variability for all these traits. Among the 20 genotypes, plant types of landraces genotypes CHH-03, JBP-03, SEO-01 and DHR-02 were having tall plant and remaining genotypes were exhibited semi tall nature. It indicates that the expression of plant characters was not uniform (Hazarika *et al.*, 2013).

The growth habit of different genotype was visually observed as upright and spreading. Upright shape of canopy was observed in genotype CHH-01 and CHH-03, JBP-03 and JBP-05, SEO-01, SEO-03 and DHR-02 which were collected from Chhindwara, Jabalpur, Seoni and Dhar, respectively, and remaining genotypes had spreading canopy. The fruits of different genotype also showed variations in their shape and colour. Genotypes CHH-01, CHH-02, CHH-03 collected from Chhindwara, JBP-04, from Jabalpur, SEO-03, SEO-04 and SEO-05 from Seoni and DHR-02 and DHR-05 from Dhar district of M.P. possessed cordate fruit shape. Whereas, genotypes JBP-02 collected from Jabalpur had broadly cordate fruit shape. Based on the fruit colour genotypes SEO-04 and SEO-05 from Seoni were recorded light brown colour. While, genotypes CHH-01 and CHH-05 from Chhindwara, JBP-03 and JBP-04 from Jabalpur, SEO-01, SEO-04 and SEO-05 from Seoni, DHR-02 and DHR-02 from Dhar district were exhibited light green fruit colour while remaining all the fruits genotypes were green.

The fruits of different genotypes varied considerably with respect to some quantitative traits viz., length of fruit, width of fruit, weight of fruit, volume of fruit, are presented in table 2. It is apparent from the data that the lowest fruit length 90.55mm of genotype SEO-03 was noted which was at par with DHR-02 (84.60mm) and DHR-04 (83.66mm), while, minimum length of fruit (51.80mm) was recorded under CHH 01 and fruit width ranging from 59.01mm to 91.49mm and highest fruit width of 91.49mm was recorded in SEO-03, followed by DHR-02(86.62mm) and DHR-01(86.32mm).

These findings are in agreement with that of Kolekar and Tagad (2012), Diwan *et al.*, (2014) and Kad *et al.*, (2016). The maximum fruit weight of 287.77g was observed in SEO-

03 which registered its superiority over rest of the genotypes under study. While, minimum fruit weight of 99.99(g) was recorded under CHH-01. The variation in fruit weight is correlated with the variation in fruit length and width. These results are in conformity with those of Hashmi and Pawar (2012) and Raina *et al.*, (2014). Fruit weight is genetically controlled character, hence significant variation was recorded in different land races (Bhatnagar *et al.*, 2012). The volume of fruit ranged from 59.40 cc to 266.65cc, being wide range of variations in genotypes. The maximum 266.65 cc and minimum 59.40 cc fruit volume was recorded in genotypes DHR-04 and CHH – 01 respectively.

As regards to the seed counts in fruits it was noted that the minimum number of seeds fruit<sup>-1</sup> (16.95) was observed in genotype SEO-04 followed by SEO-1(19.39), DHR-03 (20.33), SEO-05 (23.01) and DHR-04(23.12), these genotype were at par with each other. However, maximum 60.41 was recorded in JBP-01. The genotypes with very less number of seeds could be utilized in the breeding programme for development of seedless varieties of custard apple. These results are similar to findings as reported by Yadav *et.al*, 2017 in custard apple collected from semi-arid regions of Gujarat.

The minimum weight of seeds fruit<sup>-1</sup> (16.95g) was noted under genotypes SEO-04 and was at par with SEO-01, DHR-03 and SEO-05 with 19.39g, 26.33g and 23.01g seed weight per fruit, respectively. While it was maximum (53.48g) under the JBP-05. The findings are in agreement with the result of Bhatnagar *et al.*, (2012). Regards to the fruit pulp per cent were noted for the genotype SEO-03(71.25%) followed by DHR-02(70.23%), DHR-03(69.02%). While, it was recorded minimum in the genotype CHH-01(23.32 %). Higher percentage of pulp is considered as desirable traits in custard apple selection. High pulp %

verities are good for processing purpose. The minimum peel weight fruit<sup>-1</sup> (42.13g) was noted under the genotype SEO-04 which is at par with CHH-05(48.72g) and DHR-03(49.71g) while maximum (70.87g) was observed in SEO-03 (Table 3).

### Quality of custard apple

The qualitative parameters with respect to TSS, acidity %, total sugar, reducing sugar, non-reducing sugar, and TSS: acidity ratio was analyzed and recorded data are presented

in table 4. It is evident from the data that there were some significant variations among the land races were collected from different agro climatic zones of M.P.

Among the various zones Satpuraplatue consisted of Chhindwara and Seoni possessed the higher value of TSS in fruits ranging from 19.81 to 30.49 and 23.96 to 30.15 °Brix respectively, moreover Malva Plateau having the similar value of TSS ranging from 22.10 to 30.19 °Brix.

**Table.1** Morphological plant characteristics of various land races of custard apple

Genotypes	Plant type	Canopy shape	Fruit shape	Fruit colour
CHH-01	Semi tall	Upright	Cordate	Light green
CHH-02	Semi tall	Spreading	Cordate	Green
CHH-03	Tall	Upright	Cordate	Green
CHH-04	Semi tall	Spreading	Round	Green
CHH-05	Semi tall	Spreading	Round	Light green
JBP-01	Semi tall	Spreading	Round	Green
JBP-02	Semi tall	Spreading	Broadly cordate	Green
JBP-03	Tall	Upright	Round	Light green
JBP-04	Semi tall	Spreading	Cordate	Light green
JBP-05	Semi tall	Upright	Round	Green
SEO-01	Tall	Upright	Round	Light green
SEO-02	Semi tall	Spreading	Round	Green
SEO-03	Semi tall	Upright	Cordate	Green
SEO-04	Semi tall	Semi Spreading	Cordate	Light brown
SEO-05	Semi tall	Semi Spreading	Cordate	Light brown
DHR-01	Semi tall	Spreading	Round	Green
DHR-02	Tall	Upright	Cordate	Light green
DHR-03	Semi tall	Spreading	Round	Light green
DHR-04	Semi tall	Upright	Round	Green
DHR-05	Semi tall	Spreading	Cordate	Green

**Table.2** Fruit Size, Length, width (mm) weight (g) and volume (cc), of various land races of custard apple

<b>Genotypes</b>	<b>Length of fruit (mm)</b>	<b>Width of fruit (mm)</b>	<b>Weight of fruit (g)</b>	<b>Volume of fruit (cc)</b>
<b>CHH-01</b>	51.80	59.10	99.99	59.40
<b>CHH-02</b>	59.31	63.57	118.91	66.07
<b>CHH-03</b>	59.68	67.71	120.72	126.81
<b>CHH-04</b>	58.79	62.40	158.35	116.73
<b>CHH-05</b>	53.59	65.55	109.37	125.27
<b>Mean</b>	56.63	63.67	121.47	98.86
<b>JBP-01</b>	66.20	70.49	179.25	153.50
<b>JBP-02</b>	70.03	77.47	226.67	192.17
<b>JBP-03</b>	61.60	70.59	199.43	184.66
<b>JBP-04</b>	70.28	71.39	204.40	177.96
<b>JBP-05</b>	71.56	61.31	264.35	237.11
<b>Mean</b>	67.93	70.25	214.82	189.08
<b>SEO-01</b>	69.52	72.48	161.21	132.64
<b>SEO-02</b>	76.85	77.44	207.42	169.52
<b>SEO-03</b>	90.55	91.49	287.77	162.61
<b>SEO-04</b>	70.46	68.72	141.60	104.70
<b>SEO-05</b>	60.69	64.51	120.06	115.06
<b>Mean</b>	73.61	74.93	183.61	136.91
<b>DHR-01</b>	78.31	86.32	191.70	210.77
<b>DHR-02</b>	84.60	86.62	253.78	218.24
<b>DHR-03</b>	79.81	76.38	183.96	198.19
<b>DHR-04</b>	83.66	83.61	219.36	266.65
<b>DHR-05</b>	72.40	72.57	148.25	153.43
<b>S.Em±</b>	2.47	2.40	9.80	9.15
<b>C.D.5% level</b>	7.06	6.85	28.00	26.16

**Table.3** Characterization of fruit with respect to no. of seed, seed weight, peel weight per fruit and pulp percentage in different landraces

Genotypes	No. of seedsfruit <sup>-1</sup>	Weight of seeds fruit <sup>-1</sup> (g)	Fruit pulp (%)	Peel weight fruit <sup>-1</sup> (g)
<b>CHH-01</b>	55.44	12.87	23.32	63.66
<b>CHH-02</b>	52.85	13.21	38.04	59.93
<b>CHH-03</b>	50.73	12.68	38.48	60.87
<b>CHH-04</b>	56.84	13.70	48.41	67.99
<b>CHH-05</b>	57.67	14.42	42.27	48.72
<b>Mean</b>	54.71	13.38	38.10	60.23
<b>JBP-01</b>	60.41	15.85	54.83	65.11
<b>JBP-02</b>	33.51	9.85	68.44	61.69
<b>JBP-03</b>	35.87	10.55	62.51	64.21
<b>JBP-04</b>	45.76	14.24	64.57	58.18
<b>JBP-05</b>	53.48	16.14	67.37	70.12
<b>Mean</b>	45.81	13.33	63.54	63.86
<b>SEO-01</b>	19.39	6.12	55.35	65.86
<b>SEO-02</b>	41.88	13.96	67.39	53.69
<b>SEO-03</b>	43.37	11.83	71.25	70.87
<b>SEO-04</b>	16.95	5.98	66.08	42.13
<b>SEO-05</b>	23.01	8.00	39.19	65.04
<b>Mean</b>	28.92	9.18	59.85	59.52
<b>DHR-01</b>	42.15	13.05	60.08	62.79
<b>DHR-02</b>	36.54	10.15	70.23	65.31
<b>DHR-03</b>	20.33	7.11	69.02	49.41
<b>DHR-04</b>	23.14	9.06	64.44	68.31
<b>DHR-05</b>	25.92	11.40	48.27	65.24
<b>S.Em±</b>	2.21	0.89	2.53	3.37
<b>C.D.5% level</b>	6.33	2.53	7.24	9.63



**Table.4** Qualitative performance of custard fruit of various landraces

Genotypes	TSS ( <sup>0</sup> Brix)	Acidity (%)	Total sugar (%)	Reducing sugar (%)	Non reducing sugar (%)	TSS: acidity ratio
CHH-01	19.81	0.74	18.05	13.33	4.72	26.71
CHH-02	26.83	0.56	18.90	14.89	4.01	47.92
CHH-03	30.49	0.22	23.76	16.79	6.97	141.67
CHH-04	25.48	0.53	17.38	15.35	2.03	48.07
CHH-05	26.99	0.45	19.11	15.51	3.60	60.41
JBP-01	24.99	0.71	17.38	14.61	2.77	35.02
JBP-02	12.99	1.18	14.90	13.30	1.60	11.01
JBP-03	19.21	0.89	17.57	14.51	3.06	21.67
JBP-04	27.68	0.46	20.59	14.57	6.02	60.24
JBP-05	25.53	0.59	19.72	13.57	6.15	43.50
SEO-01	29.72	0.36	22.88	16.84	6.04	83.33
SEO-02	27.93	0.44	20.59	14.77	5.82	63.48
SEO-03	23.69	0.62	21.80	13.21	8.60	38.36
SEO-04	27.03	0.54	21.47	15.70	5.77	50.36
SEO-05	30.15	0.35	22.45	15.85	6.60	85.73
DHR-01	22.10	0.87	18.49	14.38	4.11	25.51
DHR-02	24.82	0.67	19.84	13.96	5.89	37.05
DHR-03	28.76	0.49	21.09	16.06	5.03	59.24
DHR-04	26.62	0.57	20.93	14.74	6.19	46.41
DHR-05	30.19	0.35	24.08	18.15	5.94	86.25
S.Em±	1.36	0.04	0.71	0.43	0.50	4.36
C.D.5% level	3.89	0.11	2.02	1.23	1.42	12.48

While Kymore plateau and Satapura hill zone i.e. Jabalpur recorded the lowest average value of 22.08 <sup>0</sup>Brix and ranges from 12.94 to 27.68 <sup>0</sup>Brix. Thus critically it was noted that genotype belongs to Chhindwara, Seoni and Dhar possessed the higher content of TSS i.e. 30.49, 30.15 and 30.19 <sup>0</sup>Brix was recorded with JBP – 02 which was significantly lowest over all the genotypes collected under study.

The variation in TSS in 30 genotypes collected globally was reported by Kumar *et al.*, (2018). However the ranges between genotypes were narrow. As regards to the acidity percentage it was noted that there is a reciprocal relationship with the TSS.

The highest TSS recorded the lowest acidity percent in almost all the zones. The lowest percentages of acidity (22 %) were recorded with CHH – 03 which was significantly lowest over all the other group of genotypes.

The highest acidity percentage of 1.18 % was recorded under JBP – 02 which have the lowest (12.99 <sup>0</sup>Brix)TSS. Recorded the ratio of TSS and acidity was maximum under CHH – 03 (1.18) while minimum (0.11) was noted with JBP – 02. The similar trend in variability in terms of acidity was recorded in genotypes of GC – 7 and GC – 13 collected from Gujarat by Yadav *et al.*, (2017).

The maximum total sugar was recorded in DHR-05(24.08) followed by CHH-03(23.7), SEO-01(22.88) and SEO-05(22.45) and minimum was under JBP-02(14.90).

Whereas the maximum reducing sugar 18.15 % was observed in DHR-05 which showed significantly superior over all the genotypes.

Minimum reducing sugar ( 13.21 %) was recorded in SEO-03. These results are in agreement with Othman *et al.*, ( 2014) and Nagar *et al.*, (2017).

The maximum non-reducing sugar was observed in SEO-03 (8.60%) followed by CHH-03 (6.97%) and SEO-05 (6.60%) as compared to other genotypes, while, it was observed minimum under JBP-02(1.60%). Pandey *et al.*, 2016 also reported the variation in physical parameters (yield attributes) and chemical parameters (quality) and standard that it was due to the inherent genetic makeup of the genotypes, which is some way influenced the morphological characters and expression expressed through the activity of endogenous growth regulators.

From the above findings it could be concluded that there was a significant variation in morphological characters, fruit yield and quality characters of custard apple genotypes.

The genotype SEO-04 was found most promising genotype among the 20 accessions for maximum length (90.55 mm), width (91.49 mm), weight (287.77 g), fruit pulp per cent (71.25%) and non-reducing sugar per cent (8.60%). Genotypes SEO-04 was also noted minimum number of seeds fruit<sup>-1</sup> (16.95), weight of seeds fruit<sup>-1</sup> (5.98 g) and peel weight fruit<sup>-1</sup> (42.13 g).

Landraces DRH -04 exhibited maximum volume of fruit (266.65 cc), TSS (30.49),

acidity per cent (0.22%) and TSS: acidity ratio (141.67) was registered maximum in CHH-03. Landraces DHR-05 was noted maximum total sugar per cent (24.08%) and reducing sugar per cent (18.15%). This genotype can be used for table as well for processing purposes.

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