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## Study on the performance of Cape gooseberry (*Physalis peruviana* L.) genotypes in the humid zone of southeastern Rajasthan, India

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### Abstract

An investigation was conducted to assess the growth characteristics, yield characteristics, and quality characteristics of various genotypes of Cape gooseberry (*Physalis peruviana* L.). The findings showed that the highest plant height was found in Ambedkar Selection-4 (127.89 cm). The highest concentration of chlorophyll in the leaves was observed in the Ambedkar Selection-7 (3.36 mg/g). The Ambedkar Selection-3 exhibited the highest leaf length (13.51cm) and leaf breadth (11.45 cm), respectively. Among the various genotypes, the cultivar Selection-9 exhibited the shortest duration for the fruit set (37.77 Days), and first harvest (93.77 Days). However, among the different genotypes the maximum fruit set was counted under Ambedkar Selection-6 (93.10%), followed by Ambedkar Selection-3 (92.13%). Nevertheless, there was observed a minimum number of pickings per plant (3.33), and the minimum time frame for harvesting (24.66 Days) was observed in the Selection-21. Hence, the maximum horizontal fruit diameter (36.81mm), and vertical fruit diameter (34.30mm) were recorded under the Selection-7. Therefore, Ambedkar Selection-3 exhibited the highest concentrations of total sugars (5.10%), juice (66.66%), and carotene (1.73mg/100g) respectively. Despite the fact that the highest TSS: acid ratio (57.86) was determined under the Ambedkar Selection-6. Based on the findings, it was observed that among the various genotypes, the genotypes 'Selection-7' were found to possess superior production attributes, whereas the genotypes 'Ambedkar Selection-3' were found to possess superior growth and quality attributes. The findings of the investigation indicate that both varieties hold the greatest potential for commercialization in the humid region of south-eastern Rajasthan, India.

**Keywords:** Evaluation, Performance, Fruit quality, Genotype and Cape gooseberry

### Introduction

The Cape gooseberry (*Physalis peruviana* L.), is also referred to as Mokai, Rasbhari in India, Peruvian cherry in the United States, Golden berry in South Africa and Poha in Hawaii. It is indigenous to the region of South America. It is a member of the family of Solanaceae. In the Solanae family, there are seven species, including *Physalis*. There are 80 species in the genus *Physalis*, some of them are very important for the economy. Both species, *Peruviana* and *Alkekengi*, produce edible fruits that are commonly referred to as Cape gooseberry, Husk Tomato, and Winter Cherry, respectively (Singh *et al.*, 1990) [21]. It is extensively cultivated throughout India, with predominant cultivation occurring in Uttar Pradesh, Punjab, and Rajasthan. The annual herbaceous, erect-growing, self-pollinated, small crop of tropical fruits was cultivated in India. It is possible to use the crop as a nutraceutical as reported by (Ramadan and Morsel, 2007) [16].

The fruit is a small berry with smooth skin, waxy, orange-yellow skin. Fruits are covered in a papery husk, which is formed from calyxes. It has an acidic pulp with a pleasant flavour; this ingredient is capable of being consumed raw, as a dessert, as an appetizer, or as a garnish for a dish. It can be utilized for the purpose of preparing elaborate dishes, such as cakes, or to make jams (Mazumdar, 1979) [11].

The Cape gooseberry has several health advantages, but its cultivation is limited to a small area of our country. A poorly developed package of practices and a lack of suitable genotype are possible reasons. The Cape gooseberry is popular because of a major bottleneck in increasing its yield and economics. It is imperative to identify the genotypes of Cape gooseberry that exhibit higher yield and superior quality. Therefore, this study was conducted to find out better genotypes for humid south-eastern Rajasthan, India.

## Materials and Method

This experiment was conducted at the Protected Cultivation Unit located at the College of Horticulture and Forestry in Jhalrapatan City, Jhalawar, during the academic year 2015-16. The experiment was set up in randomized block design with three replications with ten plants each. The area experiences an average annual rainfall of 954.77 mm. In the summer, the maximum temperature range is 43–48 °C, and the minimum temperature range is 1.0–2.6 °C during the winter. The seeds of the three genotypes Selection-7, Selection-9, and Selection-21 were collected from the College of Horticulture, Narsarai, Nalanda (Bihar), India, and Ambedkar Selection-1, Ambedkar Selection-2, Ambedkar Selection-3, Ambedkar Selection-4, Ambedkar Selection-5, Ambedkar Selection-6, and Ambedkar Selection-7 seeds were collected from Bhimrao Ambedkar University, Lucknow (Uttar Pradesh), India. The Cape gooseberry plants were grown at 60×30 cm spacing on raised beds. Data on various growth, production, and quality parameters were obtained between 2015- 2016. The measurement of the plant height was conducted by using a measuring scale that extends from the ground level to the apex of the longest branch of the plant subsequent to harvesting. The chlorophyll content of the leaf of the Cape gooseberry was determined using the methodology recommended by Sadasivam and Manickam (1997) [17]. The length and breadth of the leaves were measured by randomly collecting ten leaves from each marked plant from each treatment with a Vernier calliper, and the average was calculated and the value represented in centimetres. The duration of time required for the initial fruit set was recorded when the ovary underwent swelling and reached a size equivalent to the size of a fly head. It was recorded when 5-6 plants produced fruit in each set of replications. The number of fruits that exhibited swelling (such as a flower with a swollen ovary) was recorded subsequent to the initial stage of fruit development. The following formula was used to calculate the percentage of fruit:

$$\text{Fruit set (\%)} = \frac{\text{The number of set fruits}}{\text{Total number of flowers that appeared}} \times 100$$

The days taken to the first harvest should be recorded. Fruits are deemed ready for harvesting when both the persisting calyx and the fruit stem have entirely dried. The number of days taken to reach the final harvest was calculated from the date of the first harvest to the last harvest in each treatment. The harvesting time was recorded, and the average was calculated. The quantity of fruits harvested was determined by a tally of the number of times they were picked, and the average was calculated to record the data. The fruit diameter of the same 10 fruits was measured for length (mm) and breadth (mm) with the help of a Vernier calliper, and the average was calculated. The result was expressed in millimeters. Total sugars were estimated using the copper

titration method by Lane and Eynon (1984) [9]. The mature fruits of Cape gooseberry were collected in muslin cloth, and then crushed. The juice was extracted by vigorous squeeze. The juice was weighed using an electronic weighing machine, and the percentage of juice was determined based on the total weight of the fruit taken for juice extraction. The amount of total carotenoids was determined using the method described by Wettstein (1957) [23]. The TSS: acidity ratio was measured mathematically by dividing the value of TSS by titratable acidity, and the data so observed was expressed as the TSS: acidity ratio. The analysis of variance for individual characters was performed using mean values, as recommended by Panse and Sukhatme (1967) [15].

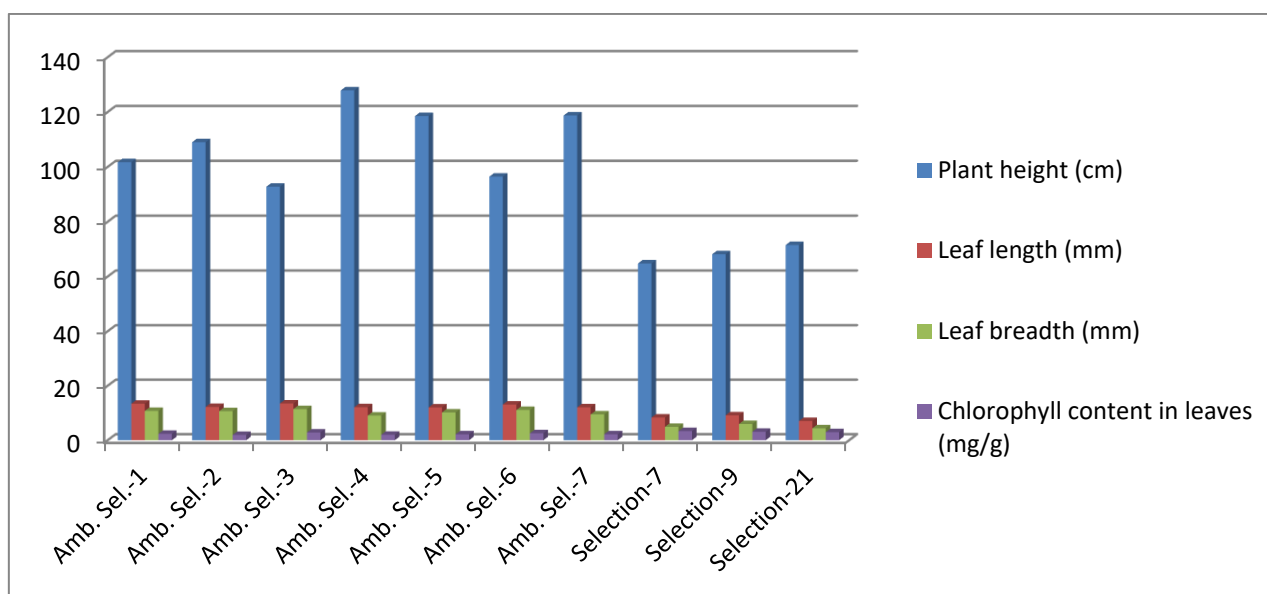
## Result and Discussion

The results of the variance analysis indicated that the genotypes showed significant differences in all the studied attributes, which indicated that there was a lot of genetic variation among the genotypes and a lot of potential for their improvement.

The results of the present investigation on growth attributes with respect to plant height (cm), the length, breadth, and amount of chlorophyll in the leaves of Cape gooseberry are shown in Table 1 and Figure 1. It was observed that the highest values of plant height was observed in Ambedkar Selection-4 (127.89cm), followed by the Ambedkar Selection-7 (118.77 cm), and the Ambedkar Selection-5 (118.55 cm), and the minimum height of the plant was recorded in the Selection-7 (64.80cm). Furthermore, the highest concentration of chlorophyll in leaves was found in Selection-7 (3.36 mg/g), followed by the Selection-9 (3.11 mg/g), Selection-21 (2.97 mg/g), and Ambedkar Selection-3 (2.86 mg/g). Whereas, the lowest amount of chlorophyll in leaves was found in genotype Ambedkar Selection-2 (1.94 mg/g). However, the highest value of leaf length (13.51cm) was documented in the Ambedkar Selection-3, followed by Ambedkar Selection-1 (13.42cm), Ambedkar Selection-6 (13.12 cm), and Ambedkar Selection-2 (12.22 cm), although the lowest value of leaf length was found in Selection-21 (7.05cm). Therefore, the highest value leaf breadth was observed in Ambedkar Selection-3 (11.45 cm), followed by Ambedkar Selection-6 (11.13 cm), Ambedkar Selection-1 (10.75 cm) and Ambedkar Selection-2 (10.70 cm), whereas the lowest value leaf breadth was observed in Selection-21 (4.37 cm). The significant variation among the various genotypes regarding the vegetative characteristics can be identified by the genetic characteristics of their individual genotypes. A similar explanation has been given by Singh *et al.*, (2011) [20] and Tulukcu (2012) [22] in Cape gooseberry, Mahour *et al.*, (2012) [10] in guava, Kumar *et al.*, (2014) [8] in aonla. The influence of temperature on numerous aspects of plant growth characteristics has been reported by Seyie *et al.*, (2015) [19] in tomato.

**Table 1:** Performance genotypes were evaluated with respect to plant height (cm), leaf length (cm), leaf breadth (cm), and total chlorophyll content (mg/g) of leaves of Cape gooseberry.

Genotypes	Plant height (cm)	Leaf length (mm)	Leaf breadth (mm)	Chlorophyll content in the leaves (mg/g)
Ambedkar Selection-1	101.72	13.42	10.75	2.34
Ambedkar Selection-2	109.00	12.22	10.70	1.94
Ambedkar Selection-3	92.78	13.51	11.45	2.86
Ambedkar Selection-4	127.89	12.12	9.05	2.02
Ambedkar Selection-5	118.55	12.06	10.21	2.18
Ambedkar Selection-6	96.44	13.12	11.13	2.58
Ambedkar Selection-7	118.77	12.10	9.48	2.18
Selection-7	64.80	8.33	4.90	3.36
Selection-9	68.15	9.16	5.98	3.11
Selection-21	71.52	7.05	4.37	2.97
Mean	96.96	11.31	8.80	2.55
CD at 5%	11.43	1.48	1.11	0.41
SEm ±	3.85	0.50	0.37	0.14

**Fig 1:** Performance genotypes were evaluated with respect to plant height (cm), leaf length (cm), leaf breadth (cm), and total chlorophyll content (mg/g) of leaves of Cape gooseberry.

The outcomes of the current investigation on the yield characteristics are based on the number of days required for the initial harvest, days taken to fruit set, duration of harvesting, fruit set (%), number of pickings, fruit diameter vertical and horizontal (mm) of the Cape gooseberry was recorded during the course of the study are exhibited in Table 2 and Fig 2a and Fig 2b. Based on the results of the experiment, it was found that the minimum duration of days taken to fruit set was observed in the Selection-9 (37.77 days), followed by Selection-7 (39.61 days), and the Selection-21 (40.66 days), and the genotype Ambedkar Selection-2 (70.59) took days to fruit set, this genotype was the longest of all genotypes. None the less, among the diverse genotypes, the highest fruit set percentage was observed in Ambedkar Selection-6 (93.10%), followed by Ambedkar Selection-3 (93.13%), Ambedkar Selection-5 (91.10%), and Ambedkar Selection-7 (91.02%). However, it should be noted that Selection-7 exhibited the lowest fruit set percentage of (68.84 %). The variance observed among the genotypes in terms of yield characteristics may be attributed to genetic variability, inherent characteristics, and climate adaptability within a specific region, as demonstrated by Kumar *et al.*, (2014) [8], Mahour *et al.*, (2012) [10], and Meena *et al.*, (2012) [12].

Besides, the lowest duration of harvesting was documented in

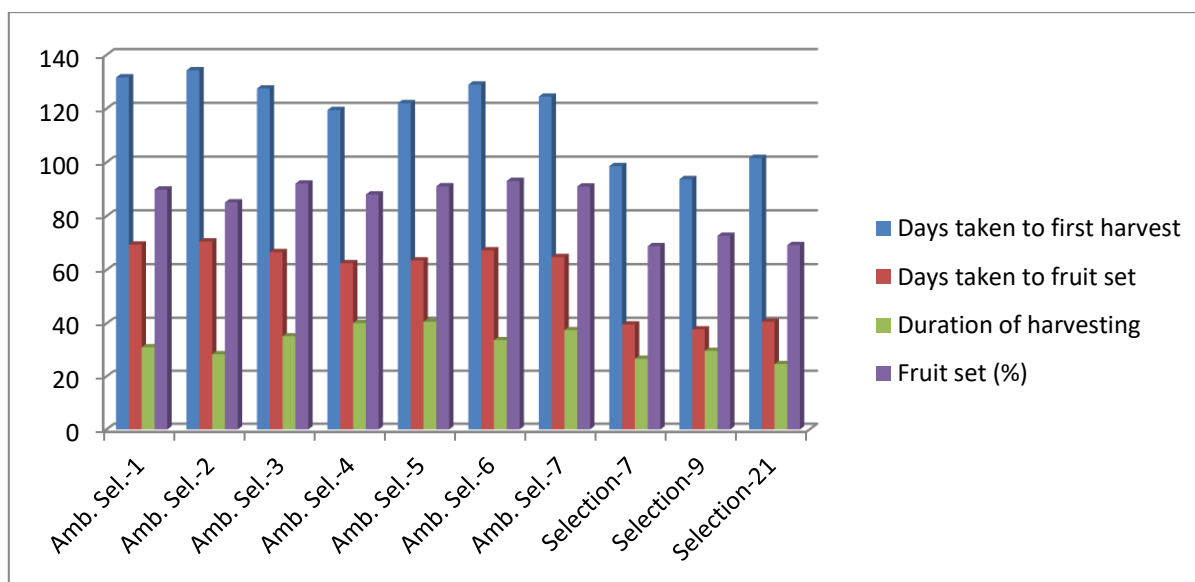
the Selection-21 (24.66 days), followed by Selection-7 (26.66 days), Selection-9 (29.66 days), and Ambedkar Selection-2 (28.37 days) even though, the highest duration of harvesting was noted down in Ambedkar Selection-5 (40.64 days). Nonetheless, the highest number of pickings was recorded in the Ambedkar Selection-5 (7.45), followed by Ambedkar Selection-6 (7.10), Ambedkar Selection-3 (6.55), and Ambedkar Selection-1 (6.22) and the minimum number of pickings were noted in the Selection-21 (3.33). The variance observed among the genotypes in terms of production characteristics may be attributed to genetic variation, inherent characteristics, and climate adaptability within a specific region (Mahour *et al.*, 2012) [10], (Meena *et al.*, 2012) [12], and (Kumar *et al.*, 2014) [8]. Furthermore, the highest value of vertical fruit diameter was measured in the Selection-7 (34.30 mm), followed by Selection-9 (30.78 mm), Selection-21 (23.74 mm), and Ambedkar Selection-1 (21.39 mm), whereas the lowest value of vertical fruit diameter was found in Ambedkar Selection-6 (15.62mm). Moreover, the highest value of horizontal fruit diameter was estimated in the Selection-7 (36.81mm), followed by Selection-9 (33.12mm), Selection-21 (26.04mm), and Ambedkar Selection-2 (22.75mm). Therefore, the smallest horizontal diameter of the fruit was seen in the Ambedkar Selection-5 (14.78 mm). The

varying fruit diameters of different genotypes of Cape gooseberry have been substantiated by numerous studies, including Pal (1991) [13] and Chandi (2000) [2], and Singh *et al.*, (2011) [20].

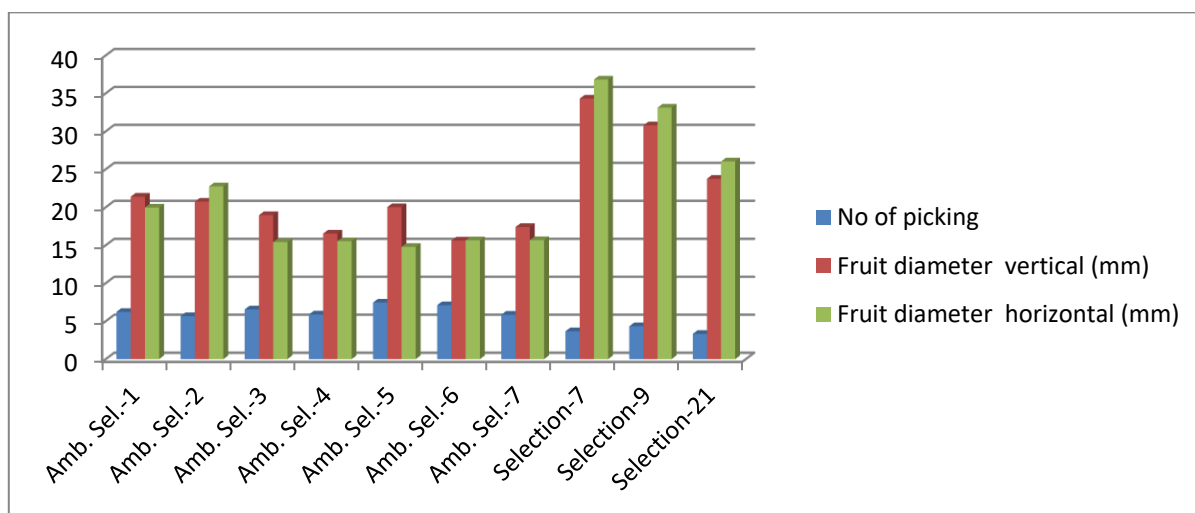
Kumar *et al.* (2011) [7] reported that environment traits had little influence on some traits, such as fruit diameter vertical and horizontal.

**Table 2:** The performance genotypes were evaluated in relation to days taken to first harvest, days taken to fruit set, duration of harvesting, fruit set (%), number of pickings, fruit diameter-vertical (mm) and fruit diameter-horizontal (mm) of Cape gooseberry

Genotypes	Days taken to first harvest	Days taken to fruit set	Duration of harvesting	Fruit set (%)	No of pickings	Fruit diameter (mm)	
						Vertical	Horizontal
Ambedkar Selection-1	131.63	69.43	31.03	89.90	6.22	21.39	19.96
Ambedkar Selection-2	134.29	70.59	28.37	85.10	5.66	20.74	22.75
Ambedkar Selection-3	127.50	66.60	35.16	92.13	6.55	18.96	15.41
Ambedkar Selection-4	119.49	62.49	40.14	88.05	5.88	16.53	15.53
Ambedkar Selection-5	122.02	63.52	40.64	91.10	7.45	20.01	14.78
Ambedkar Selection-6	128.97	67.27	33.69	93.10	7.10	15.62	15.65
Ambedkar Selection-7	124.47	64.77	37.47	91.02	5.85	17.40	15.67
Selection-7	98.61	39.61	26.66	68.84	3.67	34.30	36.81
Selection-9	93.77	37.77	29.66	72.69	4.33	30.78	33.12
Selection-21	101.66	40.66	24.66	69.24	3.33	23.74	26.04
Mean	118.24	58.27	32.75	84.12	5.61	21.95	21.57
CD at 5%	1.99	2.00	1.53	1.78	0.85	5.62	3.09
SEm±	0.67	0.67	0.51	0.60	0.29	1.89	1.04



**Fig 2a:** The performance genotypes were evaluated in relation to days taken to first harvest, days taken to fruit set, duration of harvesting and fruit set (%) of Cape gooseberry.



**Fig 2b:** The performance genotypes were evaluated in relation to number of pickings, fruit diameter-vertical (mm) and fruit diameter-horizontal (mm) of Cape gooseberry.

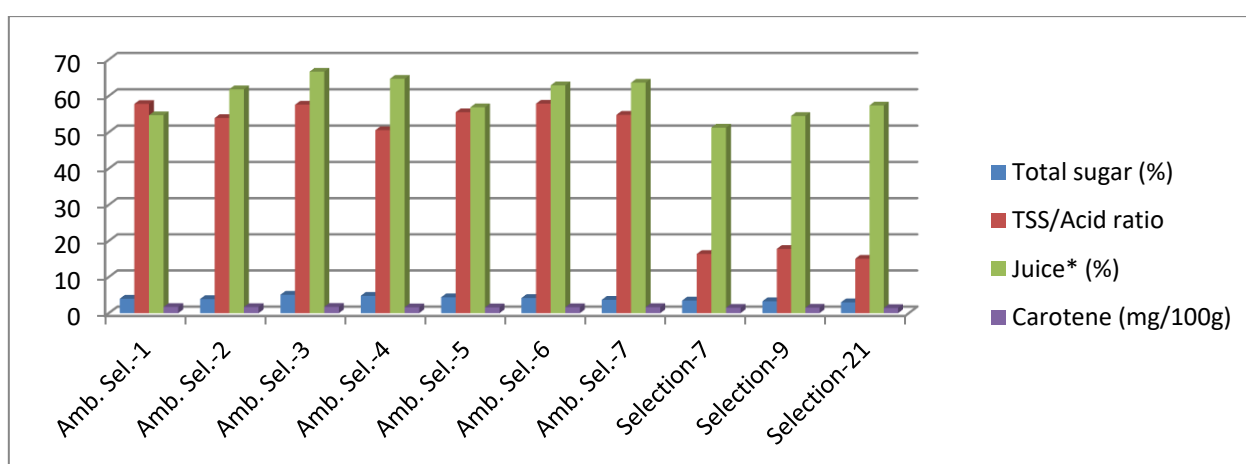


The results of the current investigation regarding quality characteristics such as total sugars (%), TSS: acid ratio, juice (%), and carotene (mg/100g) of Cape gooseberry measured during the investigation period are presented in Table 3 and Fig 3. Based on the outcomes of the experimentation, it was found that the highest concentration of total sugars was observed in Ambedkar Selection-3 (15.73%), followed by Ambedkar Selection-4 (15.60%), Ambedkar Selection-5 (15.36%), and Ambedkar Selection-1 (14.02%). However, the highest value of TSS: acid ratio was observed in the Ambedkar Selection-6 (57.86), followed by Ambedkar Selection-1 (57.78), Ambedkar Selection-3 (57.58), and Ambedkar Selection-5 (55.50), while the lowest value of TSS: acid ratio was documented in Selection-21 (15.06). This variation may be due to the environmental conditions encountered during peak growth and development of fruits, or it may be due to the distinct characteristics of the fruit varieties, as reported by Karer and Kahlon (2005) [6], Gutierrez *et al.*, (2007) [5], and Singh *et al.*, (2011) [20]. Additionally, the maximum value of juice content was

measured in Ambedkar Selection-3 (66.66 %), followed by Ambedkar Selection-4 (64.70 %), Ambedkar Selection-7 (63.64%) and Ambedkar Selection-6 (62.90%), whereas the minimum value of juice content was recorded in Selection-7 (51.25 %). Therefore, the highest value of carotene content in fruits of Cape gooseberry was determined in Ambedkar Selection-3 (1.73 mg/100g), followed by Ambedkar Selection-1 (1.71 mg/100 g), Ambedkar Selection-2 (1.69 mg/100g), and Ambedkar Selection-6 (1.66 mg/100g), whereas the lowest value of carotene content in fruits of Cape gooseberry was found in Selection-21 (1.43 mg/100 g). Wolff (1991) [24] maintains that such differences may be influenced by environmental conditions, predominantly during the peak growth and development of the fruit, or by genetic variations among different cultivars of the Cape gooseberry. This attribute has been confirmed by Meena *et al.*, (2012) [12], Pandey *et al.*, (2013) [14] and Sahu (2013) [18]. The present investigation also revealed that the presence of a significant amount of genetic variability presents promising prospects for its enhancement in the near future.

**Table 3:** The performance genotypes were evaluated in relation to total sugars, TSS: acid ratio, juice (%) and carotene (mg/100g) of Cape gooseberry

Genotypes	Total sugars (%)	TSS: acid ratio	Juice (%)	Carotene (mg/100g)
Ambedkar Selection-1	4.00	57.78	54.68	1.71
Ambedkar Selection-2	3.90	53.92	61.81	1.69
Ambedkar Selection-3	5.10	57.58	66.66	1.73
Ambedkar Selection-4	4.80	50.58	64.70	1.62
Ambedkar Selection-5	4.40	55.50	56.86	1.60
Ambedkar Selection-6	4.20	57.86	62.90	1.66
Ambedkar Selection-7	3.70	54.79	63.64	1.67
Selection-7	3.50	16.40	51.25	1.49
Selection-9	3.30	17.77	54.46	1.52
Selection-21	3.00	15.06	57.36	1.43
Mean	3.99	43.72	59.43	1.61
CD at 5%	0.43	12.03	3.77	0.03
SEm±	0.15	4.04	1.27	0.01



**Fig 3:** The performance genotypes were evaluated in relation to total sugars, TSS: acid ratio, juice (%) and carotene (mg/100g) of Cape gooseberry

## Conclusion

The conclusion can be drawn from the findings of the experiment that the genotype 'Selection-7' performed better in terms of yield characteristics, while 'Ambedkar Selection-3' performed better in terms of growth and quality characteristics, and both genotypes hold great possibilities for commercialization in the humid region of south-eastern Rajasthan, India.

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