

## Quantitative and Morphological Characters in Different Genotypes of Apple Color Guava (*Psidium guajava* L.)

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**Abstract** The study on floral biology and developmental changes in fruits of apple color of guava (*Psidium guajava* L.) was carried out during the year 2010-11 on ten year old plants to study of quantitative and morphological characters. The selection R<sub>4</sub>P<sub>3</sub>-32 showed outstanding results for fruit yield and quality, with 22.63 kg/plant having fruit of medium size (95.53 g) with apple color skin and attractive shape. This selection has good pulp thickness (0.88 cm) and pulp weight (87.77 g) with less number of seeds

(243.00). Length, breath, circumference and weight of the fruits are major components of fruit size. In general, there was a wide variation observed in these physical parameters among the seedling progenies of Apple Color guava and these differences were found statistically significant.

**Keywords** Quantitative characters, Morphological characters, Apple Color guava.

### Introduction

Guava (*Psidium guajava* L.) is an important and common fruit crop of the tropical and sub-tropical regions of the world. It is native to Tropical America. Guava gained considerable prominence in India, Uttar Pradesh ranks first in area and production followed by Bihar and Karnataka. In general, bright peel color of fruit is a highly desirable character, since it renders the fruit attractive, but most of the commercial guava cultivars do not possess any special attractive red color, one of the exceptions to this condition is the cv Apple Color which is mainly cultivated in Uttar Pradesh and has all the required traits of a commercial variety. The fruits of this cultivar have deep red with attractive pink skin color, resembling red variety of the apple with very sweet and white flesh, few numbers of seeds. However, this study have been conducted with an objective to evolve the genotypes having higher yield (quantitative character), with uniform shape, size, bright color, firm and thick pulp with

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**Table 1.** Quantitative characters in Apple Color guava, as influenced by different genotypes.

Genotype	No. of fruits/plant	Yield/plant (kg)	Fruit yield (t/ha)
R <sub>3</sub> P <sub>3</sub> -22	99.00	7.81	2.16
R <sub>3</sub> P <sub>5</sub> -24	158.00	14.64	4.07
R <sub>4</sub> P <sub>3</sub> -32	215.00	22.63	6.26
R <sub>6</sub> P <sub>1</sub> -49	150.00	12.1	3.35
R <sub>6</sub> P <sub>2</sub> -50	128.00	9.97	2.67
R <sub>8</sub> P <sub>5</sub> -72	165.00	13.16	3.7
R <sub>9</sub> P <sub>1</sub> -78	151.00	12.71	3.52
R <sub>9</sub> P <sub>2</sub> -79	102.00	9.41	2.6
R <sub>11</sub> P <sub>4</sub> -100	203.00	19.4	5.37
Mean	152.33	13.54	3.74
Range	99-215	7.81-22.63	2.16-6.26
SD (%)	39.79	4.79	1.34
SE (%)	13.26	1.60	0.45
CV (%)	26.12	35.40	35.65

good aroma, fewer and soft seeds (morphological characters).

### Materials and Methods

The studies were carried out on the selected ten years old seedling progenies of guava cv Apple Color were planted at a spacing of 6.0 m × 6.0 m at Horticulture Research Farm, GKVK, Bengaluru during the year 2000. Among them, the nine seedlings viz., R<sub>3</sub>P<sub>3</sub>-22, R<sub>3</sub>P<sub>5</sub>-24, R<sub>4</sub>P<sub>3</sub>-32, R<sub>6</sub>P<sub>1</sub>-49, R<sub>6</sub>P<sub>2</sub>-50, R<sub>8</sub>P<sub>5</sub>-72, R<sub>9</sub>P<sub>1</sub>-78, R<sub>9</sub>P<sub>2</sub>-79 and R<sub>11</sub>P<sub>4</sub>-100 were found to perform well under this Eastern dry zone. These nine seedling selections were selected and study has been conducted.

### Quantitative parameters

The yield per plant both on count basis and weight basis (g) was recorded from each of the selected seedling progenies of Apple Color guava. The fruits harvested at maturity stage and the number of fruits per plant counted and recorded. The harvested fruits were weighed using an electronic balance and the fruit yield was expressed in kilograms (kg/plant). The estimated fruit yield was calculated by the following formula,

$$\text{Fruit yield (t/ha)} = \text{Fruit yield (kg/plant)} \times 277 \text{ plants (number of plants/ha at 6.0 m} \times \text{6.0 m spacing)}$$

**Table 2.** Length of fruit at weekly intervals in different genotypes of Apple Color guava.

Weeks	Directions			
	North	South	East	West
1 <sup>st</sup> week	2.00	2.15	2.00	1.19
2 <sup>nd</sup> week	2.40	2.51	2.74	1.84
3 <sup>rd</sup> week	2.84	2.95	2.95	2.22
4 <sup>th</sup> week	3.25	3.36	3.45	2.45
5 <sup>th</sup> week	3.59	3.74	3.94	2.99
6 <sup>th</sup> week	4.02	4.13	4.27	3.30
7 <sup>th</sup> week	4.33	4.46	4.64	3.88
8 <sup>th</sup> week	4.64	4.79	4.86	4.25
9 <sup>th</sup> week	4.95	5.11	5.24	4.70
10 <sup>th</sup> week	5.26	5.45	5.58	4.95
11 <sup>th</sup> week	5.60	5.80	5.93	5.44
12 <sup>th</sup> week	5.96	6.11	6.27	5.77
F test	*	*	*	*
SEm±	0.21	0.23	0.26	0.28
CD @ 5%	0.60	0.65	0.73	0.80

### Morphological parameters

In each of the seedling progenies of Apple Color guava, fifteen fruits were tagged in each directions at fruit set stage and the observations were recorded for the physical parameters. The length of the fruit was measured from the stalk end to calyx end at seven days interval using vernier callipers and expressed in centimeter. The breadth of the fruit was measured at the widest cheeks of the fruit at seven days interval using vernier callipers and expressed in centimeter. The circumference of the fruit was measured in centimeters at the center of the fruit by using a thread and centimeter scale.

The freshly harvested fruits were weighed using an electronic balance and it expressed in grams. The peel color of freshly harvested fruits was recorded by using the color chart. The pulp color of the fruit was recorded by visual observation after cutting the freshly harvested fruit. Thickness of the pulp was recorded by using vernier callipers after cutting the fruit and expressed in centimeters. The skin of the fruit was scrapped off by using a sharp knife, seeds were removed and only the pulp was weighed in grams using a top loading electronic balance. The seeds were cut into four halves and the seeds were extracted from the pulp and counted. The number of seeds present per fruit was calculated. The total weight of

**Table 3.** Breadth of fruit at weekly intervals in Apple Color guava, as influenced by different genotypes.

Weeks	Directions			
	North	South	East	West
1 <sup>st</sup> week	2.31	2.31	2.30	1.75
2 <sup>nd</sup> week	2.73	2.68	2.89	2.23
3 <sup>rd</sup> week	3.18	3.06	3.13	2.75
4 <sup>th</sup> week	3.61	3.74	3.62	3.15
5 <sup>th</sup> week	4.08	4.04	4.03	3.67
6 <sup>th</sup> week	4.61	4.46	4.54	4.13
7 <sup>th</sup> week	5.15	4.74	4.82	4.71
8 <sup>th</sup> week	5.61	5.22	5.24	5.27
9 <sup>th</sup> week	5.89	5.60	5.61	5.71
10 <sup>th</sup> week	6.24	5.93	5.94	5.95
11 <sup>th</sup> week	6.64	6.24	6.21	6.27
12 <sup>th</sup> week	6.86	6.47	6.48	6.52
<i>F</i> test	*	*	*	*
SEm±	0.26	0.31	0.25	0.27
CD @ 5%	0.75	0.88	0.71	0.77

**Table 4.** Circumference of fruit at weekly intervals in different genotypes of Apple Color guava.

Weeks	Directions			
	North	South	East	West
1 <sup>st</sup> week	3.09	2.69	2.80	2.66
2 <sup>nd</sup> week	4.86	4.03	4.13	4.28
3 <sup>rd</sup> week	6.68	5.95	5.50	6.08
4 <sup>th</sup> week	8.34	7.77	7.60	7.94
5 <sup>th</sup> week	10.09	9.63	9.52	10.04
6 <sup>th</sup> week	12.35	11.17	11.52	11.79
7 <sup>th</sup> week	13.71	13.34	13.46	13.37
8 <sup>th</sup> week	15.32	15.09	15.46	15.00
9 <sup>th</sup> week	16.59	16.47	16.62	16.38
10 <sup>th</sup> week	17.68	17.66	17.77	17.44
11 <sup>th</sup> week	18.70	18.08	18.78	18.56
12 <sup>th</sup> week	19.28	20.14	19.77	19.59
<i>F</i> test	*	*	*	*
SEm±	0.89	1.19	1.19	1.14
CD @ 5%	2.51	3.34	3.34	3.22

the fruit (g) was weighed using an electronic balance after separating the seeds from the pulp.

Analysis and interpretation of experimental data was done by employing the mean, range, standard deviation, standard error and coefficient of variation for field and laboratory studies as suggested by Fisher and Yates [1]. Whereas, physical parameters like length, breadth and circumference of the fruits has analyzed by one way ANOVA.

## Results and Discussion

### Morphological parameters

The genetic makeup of the plant plays a vital role in the productivity of the plant. Yield is known to be a polygenic character. Besides care and management of orchard, age of plant, season and fertilizer application are the other important factors which are responsible for the yield. In the present findings, there was a wide variation observed among the seedling progenies of guava cv Apple Color with respect to number of fruits per plant recorded in the rainy season. The seedling R<sub>4</sub>P<sub>3</sub>-32 (Table 1) recorded maximum number of fruits per plant (215.00) while, R<sub>3</sub>P<sub>3</sub>-22 recorded minimum number of fruits per plant (99.00). Iyer and Subramanyam [2] recorded that Selection-8

guava variety produced higher yield (300.00 fruits/tree), when compared to its parent variety Allahabad Safeda (250.00 fruits/tree). Similarly, Ojha et al. [3] reported that both cvs Sardar and Allahabad Safeda recorded the highest yield (670.00 and 705.00 fruits/tree, respectively) during rainy season. Among the different seedling progenies of Apple Color guava, the highest yield in terms of weight was recorded in R<sub>4</sub>P<sub>3</sub>-32 (22.63 kg/plant). Whereas, the lowest yield was recorded in R<sub>3</sub>P<sub>3</sub>-22 (7.81 kg/plant). This may be due to full utilization of the yield potential by the plants and due to genetic makeup of the individual as they are open pollinated progenies. Maximum yield in rainy season due to higher number of flowers obtained in summer flowering while, due to exhaustion of the food reserves by the rainy season crop. Less number of flowers and fruits were produced on the tree during other cropping seasons. The same trend was observed by Singh [4] in guava. Dubey et al. [5] also recorded highest yield in Allahabad Safeda (36.50 kg/plant) and lowest (32.50 kg/plant) in Kohir Safeda. Hiwala and Raturi [6] found that the maximum yield of fruits under this variety might be due to increase in yield contributing characters like number of fruits per plant and higher weight of individual fruits.

### Physical parameters of the fruit

Length, breadth, circumference and weight of the fruits

**Table 5.** Weight, pulp thickness, pulp weight, number seeds per fruit and seed weight per fruit in different genotypes of Apple Color guava.

Genotype	Weight of the fruit (g)	Pulp thickness (cm)	Pulp weight (g)	Number of seeds/fruit	Seed weight/fruit
R <sub>3</sub> P <sub>3</sub> -22	90.47	0.80	81.75	260	2.73
R <sub>3</sub> P <sub>5</sub> -24	91.51	0.78	80.44	253	2.82
R <sub>3</sub> P <sub>3</sub> -32	95.53	0.88	87.77	243	2.68
R <sub>6</sub> P <sub>1</sub> -49	95.31	0.80	80.48	245	2.69
R <sub>6</sub> P <sub>2</sub> -50	89.61	0.76	78.81	251	3.57
R <sub>7</sub> P <sub>5</sub> -72	90.41	0.76	84.58	249	2.85
R <sub>9</sub> P <sub>1</sub> -78	95.51	0.83	82.10	252	2.63
R <sub>9</sub> P <sub>1</sub> -79	84.54	0.81	79.59	229	2.70
R <sub>11</sub> P <sub>4</sub> -100	97.41	0.84	84.94	266	2.98
Mean	92.26	0.81	82.27	249.78	2.85
Range	84.54-97.45	0.76-0.88	78.81-87.77	229-266	2.63-3.57
SD (%)	4.05	0.04	2.93	10.52	0.29
SE (%)	1.35	0.01	0.98	3.51	0.10
CV (%)	4.39	4.68	3.56	4.21	10.20

are major components of fruit size. In general, there was a wide variation observed in these physical parameters among the seedling progenies of Apple Color guava and these differences were found statistically significant.

In the present study the length of the fruit among the seedling selections of Apple Color guava in weekly intervals up to maturity was recorded (Table 2). The fruit length of (6.27 cm) attained in the East direction and followed by the South direction (6.11 cm), North direction (5.96 cm) and West direction (5.77 cm) at final stage in different seedling selections of Apple Color guava. The fruit length varied among 10 guava cvs. Apple Color was recorded 4.60 cm and cv Sardar recorded maximum length (6.32 cm) in winter season. Similarly, a length of fruit was recorded by Aulakh [7] who has reported that it was 5.00 cm in Apple Color guava. The maximum fruit length obtained in cv Surahi in winter (84.75 mm) compared to the cv Gola (56.50 mm). Aslam et al. [8] also found that fruit length was maximum in all three seasons in cv Surahi may be due to more food reserves availability in winter.

A significant variation was observed among the guava genotypes studied with regard to fruit breadth in weekly intervals up to maturity. The breadth of fruit (Table 3) in the North direction was recorded

6.86 cm and followed by the West direction (6.52 cm), East direction (6.48 cm), and South direction (6.47 cm) at maturity stage in different seedling selections of Apple Color guava. Similar kind of variations in fruit breadth was observed by Singh [9] that Apple Color guava recorded the fruit breadth of 6.30 cm and cv. Allahabad Safeda recorded 7.20 cm. Similarly, Aulakh [7] reported that the fruit breadth of 4.83 cm in Apple Color guava.

The circumference of the fruit (Table 4) among the seedling selections of Apple Color guava in weekly intervals up to maturity was recorded. The circumference of fruit recorded 20.14 cm in South direction and followed by the East direction (19.77 cm), West directions (19.59 cm) and it attained 19.28 cm in the North direction at final stage in different seedling selections of Apple Color guava. Jessica [10] observed that significant differences in circumference of fruit among the seedling progenies of Apple Color selections where, the maximum circumference of the fruit was observed in A.C. Selection 10/2 (23.01 cm) and it was recorded minimum in A.C. Selection 6/6 (18.21 cm) while, Allahabad Safeda (control) registered fruit circumference of 21.35 cm whereas, Kavitha [11] was recorded maximum circumference of fruit in ACG-9 (20.80cm) and minimum in ACG-7 (18.90 cm). However, cv Allahabad Safeda (control) recorded 20.20 cm circumference compared to seedling progenies of

### Apple Color Selections.

In the present study the length, breadth and circumference of the fruits was showed significant difference at weekly intervals because of transfer of organic metabolites from leaves to fruits during different developmental stages and these were recorded in different direction. It may be due to high light availability in those directions. These findings found similar with Kamal et al. [12] on physical parameters at different intervals during fruit development.

The different seedling selections of Apple Color guava studied had a different fruit weight (Table 5). It was recorded maximum in  $R_{11}P_4-100$  (97.41 g) and minimum in  $R_9P_2-79$  (84.54 g). This may be due fruits received more organic metabolites and thus gained more weight because of higher leaf to fruit ratio and better exposure to sun light. Similar observations were recorded by Singh [9] and Dwivedi et al. [13] in guava. Reddy et al. [14] also recorded maximum average fruit weight in L-49 (187.60 g) and lowest in ArkaMridula (98.00 g). It may be due to availability of better or bright sun light during fruiting season. These results are also in conformity with those of Kumar [15], Dubey et al. [5] and Aulakh [7].

The characteristic pinkish color of the fruits of Apple Color guava is due to lycopene content. In the present study, the skin color of fruit varies from light pink to pinkish red color in different genotypes of Apple Color guava. However, there is no literature available regarding lycopene content of the fruit Skin of Apple Color guava. Jagtiani et al. [16] was reported that pink coloration in guava has been attributed to the presence of lycopene pigment. Similarly, Singh and Singh [17] reported that the skin color Apple Color (reddish). In the present investigation, the pulp color of the fruits in Apple Color seedling selections was cream in color. There was no variation observed among the different seedling selections of the Apple Color guava. Singh and Singh [17] also observed the flesh color of Apple Color (white).

The good pulp thickness and pulp weight is may be due to good fruit weight gained by the fruits during developmental stages. Among the different Apple Color selections studied,  $R_4P_3-32$  showed the maxi-

mum pulp thickness (0.88 cm) and the minimum pulp thickness was observed in  $R_6P_2-50$  (0.76 cm). This may be due to maximum fruit weight. Similarly, Singh [18] recorded the thickness of pulp of Apple Color variety (1.80 cm). Kavitha [11] recorded maximum pulp thickness (0.96 cm) in Apple Color selection ACG-10 and the minimum thickness was observed in ACG-7 (0.64 cm).

Maximum weight of pulp was observed in  $R_4P_3-32$  (87.77 g) while, the minimum pulp weight was in  $R_6P_2-50$  (78.81 g) in different Apple Color guava selections. Mitra et al. [19] observed that among two seasons, the pulp weight of the Apple Color guava in the rainy season was 63.20 g and 86.40 g in winter season. Pandey and Singh [20] reported that pulp weight was maximum in cv Allahabad Safeda (94.10%) followed by Apple Color (91.82%).

The seed characters of the fruit depend upon season and cultivars. There was a wide variation observed among different genotypes with respect to number of seeds per fruit. The least number of seeds per fruit was observed in Apple Color progeny  $R_9P_2-79$  (229.00). The highest number of seeds per fruit was recorded in  $R_{11}P_4-100$  (266.00). Similarly, Phadnis [21] reported the less number of seeds in cv Seedless (19.00 seeds/fruit) while cv Sardar guava had more number of seeds (218.00 seeds/fruit). Among the different varieties Chittidar, Red Fleshed, Allahabad Safeda, Behat Coconut and Baruipur varieties had more seeds per fruit, whereas in cv L-49 had less seeds per fruit by Mitra et al. [19] while, layer and Subramanyam [2] observed the number of seeds per fruit was low in Selection-8 (196.00) compared to the cv Allahabad Safeda (260.50).

The weight of seeds per fruit was lowest in  $R_9P_1-78$  (2.63 g), while highest seed weight was recorded in  $R_6P_2-50$  (3.57 g). Similarly, Phadnis [21] recorded the higher seed weight of 5.70 g per fruit cv L-49 while, it was least in cv Seedless (0.26 g). Pandey and Singh [20] reported that the seed content of the guava cultivars Allahabad Safeda and Sangam varied from 2.31 to 3.58% respectively. Whereas, Singh and Singh [17] stated that the total weight of the seeds per fruit was 2.10 g in cv Apple Color. The number and weight of seeds varies with cultivars as it is determined by ge-

netic makeup of the individual.

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