

Variability Patterns in Guava (*Psidium guajava* L.) Seedlings Progenie for Growth and Leaf Parameters

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ABSTRACT

The present study was conducted to assess variation among existing guava trees of seedling origin. During 2018, a total of 60 healthy seedling guava of trees were marked for study. Marked trees were observed to be erect, spreading and drooping in growth habit, varying in tree height (4.0–10.9m), trunk girth (40.3–114.3 cm), extension growth of twigs (15.4–22.5 cm) and fruit yield (15.4–32.8 kg/tree). The variation was observed in shape of the leaf (round, ovate, obtrullate, obovate and oblong), colour of mature leaf (green to dark green), leaf area (34.42–55.22 cm²) and leaf chlorophyll index (32.30–54.80 SPAD meter). Based on overall distinguishing qualities, four of the 60 guava seedling trees tested were identified as "elite." These high-variation traits will be used in a guava breeding programme to select top types, genotypes and vegetatively replicate them on a commercial scale.

Keywords: Leaf, Breeding, Trees, Variation and Spreading.

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INTRODUCTION

Guava (*Psidium guajava* L.) is an important fruit of the tropical and sub-tropical regions of the world. Botanically, it belongs to the natural order Myrtales and family Myrtaceae. It is indigenous to Tropical America, perhaps from Mexico to Peru, where it is still found in the wild state as well as cultivated forms. It is reported to have been introduced into India by the Portuguese during the 17th Century (Menzel and Paxton, 1985). The major guava growing countries in the world are Cuba, Brazil, Mexico, Southern China, India and Malaysia. It is an important crop of the Horticultural wealth of our Nation and ranks fourth with respect to area and production after Mango, Banana and Citrus. Total guava production in the country from an area of 287 thousand hectares and yielding 4304 thousand metric tonnes (Anonymous, 2020). In India, it is cultivated in Uttar Pradesh, Bihar, Andhra Pradesh, Punjab, Madhya Pradesh, Kerala and Tamil Nadu. Uttar Pradesh leads in area under guava cultivation whereas Madhya Pradesh leads in terms of production. Trees of guava are very hardy and can be grown on a wide range of soil and climatic conditions. Guava is considered as an "Poor man's apple" or "Apple of tropics" owing to its availability for a longer duration of time in the year at very moderate price, also its nutritive value are comparable with that of apple, particularly in respect of vitamin C, minerals and pectin (Singh *et al.*, 2016). Guava was propagated through seeds during the earlier days, thereby giving rise to considerable variations in its morphological characters, such as spreading or erect growth habit of the tree. This variation has been utilized commercially and a large number of varieties have come into existence. Guava improvement programme has been directed towards evolving dwarf strains, enabling high density planting and terete branching habit for greater number of spurs and higher productivity (Patel *et al.*, 2011).

MATERIALS AND METHODS

During 2018, a total of 60 healthy and bearing guava trees of seedling provenance were marked for thorough study. The

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experimental plant material consisted of a 20-years old bearing seedling tree population of guava trees that were planted 7 metres apart and labelled. The climate at the Dhaulakuan, is humid subtropical, with the warmest months being May and the coldest months being December. Between 35.5°N latitude and 77.5°E longitude, at an elevation of 468 metres above mean sea level, roughly 80% of the annual rainfall is reported during the months of July and September.

Height of tree was measured from ground level to the top of the tree and expressed in meters (m) and girth measured 30 cm above ground level with the help of measuring tape and expressed in centimetres (cm). Ten shoots of current season's growth were randomly selected from the periphery of the trees and the length was measured in the month of September with the help of measuring tape. Tree habit was described as per standard descriptor for guava prescribed by (UPOV, 1987). Yield of each plant was recorded in kilograms on weight balance from first harvest to the last harvest of fruits and total yield of each plant was calculated by adding yield of all the harvests.

A total of 10 leaves sampled randomly from all directions from each individual tree were used for characterization and

evaluation. Shape of mature leaf was assigned as per UPOV descriptors, leaf area was recorded with Li-COR 3100 leaf area meter and Leaf venation of mature leaf was observed visually. It was classified into reticulate or parallel venation. Leaf colour was assigned as per colour chart of Royal Horticultural Society (Wilson, 1941). Leaf chlorophyll index was recorded directly on the tree using portable device SPAD 502 Plus chlorophyll meter. The mean values of data were subjected to analysis of variance as per the procedure outlined by Gomez and Gomez (1984).

RESULTS AND DISCUSSIONS

Growth Parameters

The maximum tree height (10.90 m) was recorded in Tree No. 31 and minimum tree height (4.0 m) was found in Tree No. 45,

with mean value of 7.65 m. Coefficient of variation was recorded as 17.76 per cent (Table 1). The maximum trunk girth was found in Tree No. 37 (114.30 cm) and minimum (40.30 cm) in Tree No. 45, with a mean value of 71.13 cm. Coefficient of variation was recorded as 23.37 per cent (Table 1). Guava seedling trees exhibited spreading growth habit in 29 trees, drooping in 27 trees and erect growth habit in only 4 trees (Table 1). The nature and extent of variation in tree growth characters as observed in the present study is in confirmation with previous studies on guava (Marak and Mukunda 2007; Patel *et al.*, 2011; Shukla *et al.*, 2012) conducted in various other parts of the country. Substantial variation so observed in growth parameters can mainly be attributed to genotypic and environmental factors largely owing to heterozygous nature. The extension growth of twigs was found maximum (22.50 cm) in Tree No. 26, whereas

Table 1: Variation in tree characters of guava seedling trees

Tree No.	Plant Height (m)	Trunk girth (cm)	Tree Habit	Extension growth of twigs (cm)	Fruit yield (kg/tree)
1	8.60	55.20	Spreading	18.35	23.46
2	7.90	63.50	Spreading	16.25	21.57
3	6.70	91.80	Spreading	21.50	20.64
4	7.45	71.40	Spreading	22.25	22.34
5	6.40	100.50	Spreading	17.32	25.42
6	8.60	69.30	Drooping	18.50	22.36
7	7.70	90.50	Drooping	15.60	26.53
8	9.10	67.50	Erect	19.25	24.52
9	8.70	52.40	Drooping	16.50	32.32
10	9.70	77.40	Drooping	19.25	32.43
11	8.10	50.20	Drooping	18.50	26.37
12	8.90	46.70	Drooping	19.40	30.40
13	9.40	70.30	Spreading	17.30	32.80
14	7.90	74.50	Drooping	18.25	24.20
15	8.90	95.30	Spreading	17.50	23.45
16	8.40	99.60	Spreading	19.25	20.85
17	8.40	87.50	Spreading	20.45	32.42
18	8.20	85.60	Spreading	18.25	28.34
19	9.80	81.30	Drooping	16.50	22.50
20	10.00	48.80	Drooping	20.35	25.37
21	6.80	75.30	Erect	18.20	15.48
22	6.20	66.40	Spreading	16.25	16.50
23	6.50	67.50	Spreading	16.50	21.42
24	5.80	70.20	Spreading	18.40	24.54
25	6.20	103.50	Drooping	20.25	22.37
26	5.40	66.60	Drooping	22.50	23.50
27	5.60	70.50	Drooping	17.35	22.80
28	8.30	66.40	Drooping	20.15	24.52
29	8.60	84.50	Drooping	21.30	22.48
30	8.40	82.50	Spreading	17.50	23.46
31	10.90	83.20	Drooping	16.60	22.32

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Tree No.	Plant Height (m)	Trunk girth (cm)	Tree Habit	Extension growth of twigs (cm)	Fruit yield (kg/tree)
32	6.10	52.40	Spreading	19.40	20.50
33	8.20	89.50	Spreading	18.65	24.52
34	8.00	76.40	Drooping	15.45	30.47
35	7.60	76.50	Spreading	21.25	21.62
36	8.60	55.40	Drooping	20.30	22.50
37	9.00	114.30	Drooping	19.50	21.25
38	5.90	61.30	Drooping	21.35	23.42
39	7.10	80.40	Spreading	18.40	28.50
40	7.40	88.60	Drooping	20.70	30.42
41	8.70	80.00	Drooping	19.50	26.65
42	9.50	86.30	Drooping	17.25	25.24
43	7.70	76.50	Drooping	19.00	30.50
44	8.50	86.40	Spreading	20.60	22.50
45	4.30	40.30	Drooping	19.25	15.45
46	6.50	57.50	Drooping	19.50	28.62
47	7.60	65.30	Spreading	18.60	32.28
48	7.40	75.50	Spreading	20.35	25.50
49	7.70	68.40	Spreading	17.50	26.34
50	7.50	56.50	Spreading	20.25	24.42
51	6.40	50.40	Spreading	17.50	20.62
52	6.20	43.50	Spreading	21.30	16.25
53	6.80	58.60	Drooping	20.45	26.50
54	4.52	49.50	Erect	20.35	17.50
55	7.50	40.40	Drooping	16.25	25.50
56	6.40	45.50	Spreading	17.50	24.30
57	5.70	57.20	Drooping	18.65	20.50
58	7.20	65.60	Erect	15.50	16.25
59	7.90	81.30	Drooping	21.35	26.20
60	9.30	72.50	Spreading	20.50	22.32
Mean±SE	7.65 ± 0.18	71.13 ± 2.15	-	18.86 ± 0.23	24.24 ± 0.55
SD	1.36	16.62	-	1.78	4.28
CV (%)	17.76	23.37	-	9.42	17.67

minimum (15.45 cm) in Tree No. 34, with mean extension growth of 18.86 cm. Coefficient of variation was recorded as 9.42%. The variation in terms of fruit yield ranged from (15.40 kg/tree) in Tree No. 45 to (32.80 kg/tree) in Tree No. 13, with a mean value of 24.24 kg per tree. Coefficient of variation was recorded as 17.67 per cent (Table 1). Several other researchers have reported similar kind of variation in fruit yield per tree (Marak and Mukunda 2007; Ulemale and Tambe 2015; Anupa *et al.*, 2017). However, the low levels of fruit yield observed here may be due to inherent seedling nature compared to grafted trees (Shukla *et al.*, 2012).

Leaf parameters

Leaf shape in guava seedling trees was found to be obtrullate in 51 trees, obovate in 4 trees, round in 3 trees and oblong and ovate in one tree each. The leaf area was recorded maximum (55.22 cm²) in Tree No. 55 and minimum (34.42 cm²) in Tree No.

56 with mean leaf area of 45.79 cm². Coefficient of variation was recorded 11.95 per cent. The leaf venation was observed pinnate in all the trees. There was absolutely no variation in leaf venation. Colour of mature leaves was observed as green in 44 guava trees whereas, it was dark green in rest of the 16 guava trees. The results of present investigation find adequate support from the findings of various researchers (Lakade *et al.*, 2011; El-Sisy, 2013; Nasution and Haditai 2014; Ulemale and Tambe 2015) who also reported variation in leaf characters among different genotypes of guava. There was no variation observed for colour of young leaf in the guava trees under study which exhibited only light green colour. The leaf chlorophyll index was recorded maximum (54.80) in Tree No. 44 and minimum (32.30) in Tree No. 34 with a mean value of 44.07. Coefficient of variation was recorded 11.79% (Table 2). Similar kind of variation for leaf chlorophyll index was also observed by (Dubey *et al.*, 2016 and Singh *et al.*, 2016) and it

Table 2: Variation in leaf characters of guava seedling trees

<i>Tree No.</i>	<i>Leaf shape</i>	<i>Leaf area (cm²)</i>	<i>Leaf venation</i>	<i>Colour of mature leaf</i>	<i>Colour of young leaf</i>	<i>Leaf chlorophyll index (SPAD) meter</i>
1	Obtrullate	38.72	Pinnate	Dark green 139 C	Light green	40.40
2	Obtrullate	50.12	Pinnate	Dark green 139 A	Light green	41.80
3	Obtrullate	51.23	Pinnate	Dark green 139 C	Light green	40.20
4	Obtrullate	50.36	Pinnate	Green 137 A	Light green	45.60
5	Obtrullate	40.25	Pinnate	Dark green 139 C	Light green	46.80
6	Obtrullate	41.12	Pinnate	Dark green 139 C	Light green	50.30
7	Obtrullate	44.36	Pinnate	Dark green 139 C	Light green	44.60
8	Obovate	54.23	Pinnate	Green 137 A	Light green	38.50
9	Obtrullate	51.26	Pinnate	Green 137C	Light green	42.60
10	Obtrullate	49.21	Pinnate	Green 137C	Light green	45.70
11	Round	50.12	Pinnate	Green 137 C	Light green	35.80
12	Obtrullate	54.35	Pinnate	Green 137 A	Light green	43.40
13	Obovate	42.27	Pinnate	Green 137 C	Light green	38.80
14	Obtrullate	45.14	Pinnate	Green 137 C	Light green	37.70
15	Obtrullate	46.26	Pinnate	Dark green 139 C	Light green	48.20
16	Obtrullate	48.51	Pinnate	Dark green 139 C	Light green	43.70
17	Obtrullate	43.24	Pinnate	Green 138 C	Light green	49.50
18	Obtrullate	45.13	Pinnate	Green 137 A	Light green	34.50
19	Obtrullate	40.65	Pinnate	Green 137 A	Light green	36.40
20	Obtrullate	44.31	Pinnate	Green 137 A	Light green	45.40
21	Obovate	51.22	Pinnate	Green138 B	Light green	46.80
22	Round	47.26	Pinnate	Green137 C	Light green	42.80
23	Obtrullate	42.14	Pinnate	Green 137 C	Light green	46.30
24	Obtrullate	43.16	Pinnate	Dark green 139 C	Light green	46.70
25	Obtrullate	54.32	Pinnate	Green 138 A	Light green	43.70
26	Obovate	50.41	Pinnate	Green 138 A	Light green	46.70
27	Round	35.86	Pinnate	Green 137 D	Light green	51.10
28	Ovate	40.43	Pinnate	Green 137 A	Light green	47.80
29	Obtrullate	45.62	Pinnate	Green 137 A	Light green	48.70
30	Obtrullate	42.17	Pinnate	Green 137 A	Light green	48.60
31	Obtrullate	40.26	Pinnate	Green 137 C	Light green	42.40
32	Obtrullate	50.38	Pinnate	Green 138 A	Light green	40.20
33	Obtrullate	42.23	Pinnate	Green 138 A	Light green	48.70
34	Obtrullate	48.25	Pinnate	Green 137 C	Light green	32.30
35	Obtrullate	42.23	Pinnate	Green 137 A	Light green	52.30
36	Obtrullate	40.37	Pinnate	Dark green 139 B	Light green	44.80
37	Obtrullate	36.29	Pinnate	Dark green 139 B	Light green	48.70
38	Obtrullate	42.54	Pinnate	Dark green 139 C	Light green	43.20
39	Obtrullate	42.12	Pinnate	Green 137 C	Light green	49.80
40	Obtrullate	47.28	Pinnate	Green 138 C	Light green	37.70
41	Obtrullate	47.26	Pinnate	Green 138 A	Light green	52.70
42	Obtrullate	35.14	Pinnate	Dark green 139 C	Light green	38.40
43	Obtrullate	42.34	Pinnate	Green 137 A	Light green	40.60
44	Obtrullate	45.22	Pinnate	Green 138 A	Light green	54.80

Tree No.	Leaf shape	Leaf area (cm ²)	Leaf venation	Colour of mature leaf	Colour of young leaf	Leaf chlorophyll index (SPAD) meter)
45	Oblong	51.34	Pinnate	Green 138 A	Light green	38.50
46	Obtrullate	47.34	Pinnate	Green 137 C	Light green	34.30
47	Obtrullate	50.14	Pinnate	Green 137 C	Light green	50.80
48	Obtrullate	54.36	Pinnate	Green 138 A	Light green	48.70
49	Obtrullate	51.35	Pinnate	Dark green 139 D	Light green	32.40
50	Obtrullate	48.32	Pinnate	Green 137 C	Light green	45.40
51	Obtrullate	55.16	Pinnate	Green 137 A	Light green	40.60
52	Obtrullate	40.62	Pinnate	Green 137 A	Light green	46.70
53	Obtrullate	40.28	Pinnate	Green 137 A	Light green	40.80
54	Obtrullate	51.33	Pinnate	Green 137 D	Light green	46.30
55	Obtrullate	55.22	Pinnate	Green 137 A	Light green	52.80
56	Obtrullate	34.42	Pinnate	Green 138 C	Light green	44.80
57	Obtrullate	36.15	Pinnate	Dark green 139 D	Light green	44.60
58	Obtrullate	43.32	Pinnate	Dark green 139 D	Light green	43.40
59	Obtrullate	50.24	Pinnate	Green 137 C	Light green	41.80
60	Obtrullate	52.34	Pinnate	Green 137 A	Light green	46.80
Mean ± SE	-	45.79±0.71	-	-	-	44.07±0.67
SD	-	5.47	-	-	-	5.19
CV (%)	-	11.95	-	-	-	11.79

can be attributed to varied photosynthetic efficiency of seedling trees having heterozygous nature.

CONCLUSION

In conclusion, it is clear that there exists a high degree of morphological variation in guava seedling trees as evident from observations recorded on most of the horticulturally important characters. The identification of 4 genotypes having desirable horticultural traits, appear promising therefore, selection of these genotypes might play a significant role for future guava improvement program.

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