



ASSESSMENT OF GENETIC DIVERSITY AND DIVERSITY RELATIONSHIP IN DIFFERENT VARIETIES OF GUAVA USING MORPHOLOGICAL CHARACTERIZATION

Shalu Ran, Jeet Ram Sharma and M.S. Jakhar^{1*}

Department of Horticulture, CCS Haryana Agricultural University, Hisar (Haryana), India.

¹Haryana Farmers Commission, Panchkula (Haryana), India.

Abstract

The present study was conducted to estimate genetic relationship among thirteen genotypes of *Psidium guajava* L. and two species viz., *P. friedrichsthalianum* (Berg) Nied and *Psidium cattleianum* Sabine by morphological characterization. Out of 16 morphological characters studied, only inflorescence type did not show any variation, while the remaining traits showed variability to considerable extent. The genetic variation among genotypes was high enough to divide them into two major clusters A and B. The first major group (A) consisted of three guava genotype which further divided into two sub groups at similarity coefficient of 0.75. In the sub group (A1) consisted of two guava genotype Allahabad Safeda and Hisar Safeda at similarity coefficient of 0.816 and second sub group (A2) consisted only strawberry guava. The second major cluster B is divided into four sub- clusters, B1, B2, B3, B4. The sub group (B1) have only one guava species i.e Chinese guava at similarity coefficient of 0.74. Two genotype of guava Lalit and Shweta was clustered under sub group (B2) at similarity coefficient of 0.86. The sub group (B3) included guava genotypes Hisar Surkha and Banarasi Surkha at similarity coefficient of 0.803. The sub group (B4) comprised the remaining seven guava genotypes (L-49, Super acid, Patillo, Super Max Ruby, Hybrid Red Supreme, SP6550 and Supreme). In this sub cluster L-49 and Supreme was out grouped at similarity coefficient of 0.81 and 0.798, respectively. Patillo and Super Max Ruby showed highest (0.938) coefficient of similarity.

Key words : Guava, genetic diversity, diversity relationship and morphological characterization.

Introduction

Guava is an allogamous fruit crop, which is highly heterozygous. Amongst the various species available, Strawberry guava (*P. cattleianum* Sabine) and Chinese guava (*P. friedrichsthalianum* (Berg.) Nied.) are resistant to guava wilt and are used as dwarfing rootstocks. Several guava (*Psidium guajava* L.) cultivars have emerged as a result of seedling selection. These cultivars are commercially exploited through seed propagation by unscrupulous nurseryman that has indirectly given rise to several types which are not true to the commercial type and vary in several characters from the parent population. Guava cultivars display a greater diversity in tree size, shape, quality and ripening season. Different name have attributed to similar varieties in different zones. The characterization of the germplasm would also help to eliminate duplicacy in the germplasm collection, thus saving land, space and time.

Moreover, characterization is also required for varietal identification and preparation of data base of germplasm. Characterization of the germplasm can be carried out using morphological and molecular approach. Morphological approach is simple, easy and cost effective for characterization of germplasm. It is the first step in characterization of germplasm of any crop. Several morphological traits such as leaf shape, size and fruit colour, shape, etc. may be useful, if characterization is carried out systematically.

Materials and Methods

A total of thirteen cultivars of *Psidium guajava* L. and two other species namely *Psidium cattleianum* Sabine and *Psidium friedric hsthalianum* Berg. Nied were selected for morphological characterization from experimental orchard of Department of Horticulture Chaudhary Charan Singh Haryana Agricultural University, Hisar during 2012-2014. The following

*Author for correspondence : E-mail: monijakhar@gmail.com

morphological features were observed during winter season to study the diversity: tree habit, foliage density, leaf shape, mature leaf colour, inflorescence type. For recording fruit (fruit shape, fruit surface, fruit length, diameter, fruit weight, fruit skin colour, pulp colour) and physico-chemical characters (total soluble solids, total titrable acidity, ascorbic acid), randomly ten fruits were selected from each tree. Total soluble solids or TSS of representative fruit juice extracted from pulp was determined by using hand refractometer of 0-32 per cent range at room temperature. Values were corrected for 20°C. Total titrable acidity and Ascorbic acid (vitamin-C) were determined by method given by A.O.A.C. (1990).

Results and Discussion

Vegetative and floral characters

The data presented in Table 1 with respect to tree habit implied that genotypes *viz.*, Hisar Surkha, Hybrid Red Supreme and Strawberry had drooping growth habit, whereas, the well-known cultivars like Allahabad Safeda, Hisar Safeda, Banarasi Surkha, SP 6550, Super Acid, Lalit and Chinese guava have upright growth. The remaining genotypes Patillo, Supreme, Super Max Ruby, Shweta and Lucknow-49 showed spreading nature of growth. Spreading growth habit of Lucknow-49 has also been reported by Daulta *et al.* (1998). Guava propagation through seeds reduces the distinctive characteristics of a variety in commercial cultivation Allahabad Safeda and distinct with semi-dwarf tree, high yielder and Banarasi Surkha variety, its local selection from red fleshed variety but it is distinct with heavy bearing (Mahmoud and Peter, 2014; Ray, 2002). The observation with respect to upright growth habit of Hisar Safeda and Allahabad Safeda is in confirmation with that reported by Singh *et al.* (1976), Daulta *et al.* (1998) and Sharma *et al.* (2010).

In all the genotypes, the leaves were oppositely arranged. However, a further study of phyllotaxy revealed that genotypes *viz.*, Patillo, Super Acid, Lucknow-49, Allahabad Safeda, Hisar Safeda, Banarsi Surkha, Lalit, Shweta and Strawberry have superimposed leaves, while the rest of the genotypes showed decussate pattern of arrangement confirmation with the earlier work conducted by Sharma *et al.* (2010).

The perusal of table 1 reveals that majority of genotypes showed considerable variation in foliage colour. The genotypes Super Max Ruby, Supreme and Allahabad Safeda showed green shade of foliage colour while, genotypes Patillo, Shweta, Hybrid Red Supreme, SP 6550, Hisar Safeda and Chinese guava showed pale green

shade of foliage colour. In the remaining genotypes typical dark green foliage was observed.

Foliage density was highest in case of Chinese guava (35.8 per 20 cm length of shoot) followed by SP 6550 (24.2 per 20 cm length of shoot) and least foliage density was observed in case of Strawberry guava (11.5 per 20 cm length of shoot). The morphological variability with respect to leaf shape and size is depicted in Figure 1 and 2. Genotypes Super Acid, Lucknow-49 had oblong lanceolate leaves, whereas, Chinese guava had lanceolate leaves. An oblong leaf was a character of Super Max Ruby, Allahabad Safeda and Hisar Safeda and ovate of Strawberry guava, Shweta while, the rest of the genotypes possessed elliptical leaves. Similar variation in leaf shape has also been reported by many workers (Singh *et al.*, 1976; Mitra and Bose, 1990 and Sharma *et al.*, 2010). The variation among the genotypes for different morphological characters may be due to the differences in the genetic make-up of these genotypes. The *P. friedrichsthalianum* has waxy leaf and leaf edge is pointed which are the most distinguishable characteristics of this species.

The data pertaining to inflorescence depicted that all the genotypes of guava produce solitary as well flowers in cymes of two or three in the leaf axel on current season growth. Similar inflorescence character has also been reported by Shukla *et al.* (2004) and Ray (2002).

Fruit characters

The perusal of data presented in table 2 reveals pronounced variability in case of fruit shape. The genotype Patillo and Chinese guava had obovate fruits. Oblate fruits were a character of Super Max Ruby whereas Super Acid had Pear shaped fruits, Banarasi Surkha had Oblong fruit shape, Supreme and Shweta had Globose fruit shape, whereas in the remaining 8 genotypes, Round fruit shape was observed. Rough surface of fruits was noted in Super Max Ruby, Super Acid and Chinese guava, whereas rough fruit surface along with ridges was a character of SP6550, Lucknow-49 and Banarasi Surkha. Patillo and Supreme had smooth and ridged fruit surface, while the rest of the genotypes had smooth surface.

The data pertaining to fruit length in table 2 reveals that fruit length ranged from 2.9 to 7.6 cm. Maximum fruit length was observed in genotype Lucknow-49 (7.6 cm) followed by Super Max Ruby (6.6cm), Supreme (6.2 cm) and Superacid, Supreme, Patillo (6.2cm). The minimum fruit length was observed in genotype Strawberry guava (2.9 cm) followed by Chinese guava (3.04 cm). The fruit diameter ranged from 2.4 to 7.1 cm. The maximum fruit diameter was observed in case of

Table 1 : Vegetative and floral characteristics of guava genotypes.

S. no.	Genotype	Tree habit	Foliage density (leaves/20 cm of shoot length)	Phyllotaxy	Leaf shape	Mature leaf colour	Inflorescence type
1.	Hisar Surkha	Drooping	22.8	Decussate	Oblong lanceolate	Green	Cymose/Solitary
2.	Hisar Safeda	Upright	20.0	Superimposed	Oblong	Pale green	Cymose/Solitary
3.	Strawberry	Drooping	11.5	Superimposed	Ovate	Dark green	Cymose/Solitary
4.	Chinese	Upright	35.8	Decussate	Lanceolate	Pale green	Cymose/Solitary
5.	Supreme	Spreading	18.0	Decussate	Elliptical	Green	Cymose/Solitary
6.	Lalit	Upright	20.1	Superimposed	Elliptical	Dark Green	Cymose/Solitary
7.	Banarasi Surkha	Upright	19.3	Superimposed	Elliptical	Pale green	Cymose/Solitary
8.	Lucknow-49	Spreading	24.0	Superimposed	Oblong lanceolate	Dark green	Cymose/Solitary
9.	Shweta	Spreading	19.8	Superimposed	Ovate	Green	Cymose/Solitary
10.	Allahabad Safeda	Upright	20.4	Superimposed	Oblong	Green	Cymose/Solitary
11.	Super Acid	Upright	12.9	Superimposed	Oblong lanceolate	Dark green	Cymose/Solitary
12.	SP6550	Upright	24.2	Decussate	Elliptical	Pale green	Cymose/Solitary
13.	Patillo	Spreading	13.6	Superimposed	Elliptical	Pale green	Cymose/Solitary
14.	Hybrid Red Supreme	Drooping	16.8	Decussate	Elliptical	Pale green	Cymose/Solitary
15.	Super Max Ruby	Spreading	22.0	Decussate	Oblong	Green	Cymose/Solitary
	CD at 5%		2.8				

Lucknow-49 (7.1cm), followed by Lalit (6.6 cm) and Shweta (6.4cm). The minimum fruit width was recorded in Strawberry guava (2.4 cm), followed by Chinese guava (2.5 cm). The fruit weight ranged from 11.9 to 195.1 gram. The fruit weight was maximum in Shweta (195.1 g), followed by L-49 (190.2 g), Lalit (180.1g) whereas it was minimum in Chinese guava (11.9 g) followed by Strawberry guava (12.9 g). Considerable variability was observed in skin colour. Skin colour was yellowish green in Lucknow-49 and Banarasi Surkha and Hisar Surkha, whereas it was greenish yellow in Hybrid Red Supreme, Supreme and Allahabad Safeda while saffron yellow skin colour with reddish blush was recorded in Lalit and in Shweta creamy epicarp with red spots was observed. The rest of the genotypes in the study had typical green coloured fruit skin; Variability with respect to pulp colour was also recorded. Super Max Ruby, Super Acid, Shweta and Hisar Safeda had creamy white pulp. Pink pulp colour was observed in Patillo, Hybrid Red Supreme, Lalit and Banarasi Surkha, whereas the rest of the cultivars of *Psidium guajava* L. taken in the study had white pulp. The two other species in the study viz. *P. cattleianum* Sabine and *P. friedrichsthalianum* (Berg) Nied have

yellowish white and yellowish pink pulp colour, respectively.

The observations recorded in the present investigation suggested that the different genotypes varied markedly with respect to fruit length, weight and shape, obviously due to their differential genetical behaviour. Fruit quality is a complex trait which depends, upon a no. of other parameters and their interaction. Round fruits of Hisar Safeda and Allahabad Safeda with smooth surface have also been reported by Daulta *et al.* (1998). Similarity in the fruit characters of Hisar Safeda with Allahabad Safeda may be because Allahabad Safeda is one of the parent of Hisar Safeda. The similar variations in the fruit characters were also observed by Singh *et al.* (1976); Dinesh and Reddy (2001). Considerable variation is found in fruit length and diameter. Lucknow-49 had maximum fruit length and fruit diameter than other genotypes. Fruit diameter was a positively correlated with fruit length. Size of the fruits is a varietal character it may be in some extent influenced by the total number of fruits born on the tree, soil moisture and source sink relationship (Singh *et al.*, 2014). Skin colour of ripe fruits showed considerable variation as green, greenish yellow, yellowish

Table 2 : Fruit characters of guava genotypes during winter season.

S. no.	Genotype	Fruit shape	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (g)	Fruit skin colour	Pulp colour
1.	Hisar Surkha	RoundSmooth	5.2	5.1	91.3	Yellowish Green	Pink
2.	Hisar Safeda	RoundSmooth	5.3	5.2	90.2	Greenish yellow	Creamy white
3.	Strawberry	RoundSmooth	2.9	2.5	12.9	Green	Yellowish white
4.	Chinese	ObovateRough	3.0	2.4	11.9	Green	Yellowish white
5.	Supreme	GloboseSmooth and ridged	6.2	5.0	148.7	Greenish yellow	White
6.	Lalit	RoundSmooth and ridged	5.5	5.6	180.1	Saffron yellow with blush	Pink
7.	Banarasi Surkha	OblongRough and ridged	5.4	5.1	121.5	yellowish green	Pink
8.	Lucknow-49	RoundRough and ridged	7.6	7.1	190.2	Yellowish green	White
9.	Shweta	GloboseSmooth	5.3	5.8	195.1	Green with red spots	White
10.	Allahabad Safeda	RoundSmooth	5.7	5.1	110.2	Greenish yellow	White
11.	Super Acid	Pear Rough shaped	6.2	5.3	130.0	Green	Creamy white
12.	SP6550	RoundRough and ridged	5.4	5.7	94.2	Green	White
13.	Patillo	ObovateSmooth and ridged	6.2	3.3	61.40	Green	Pink
14.	Hybrid Red Supreme	RoundSmooth	5.4	4.6	80.4	Greenish yellow	Pink
15.	Super Max Ruby	Oblate Rough	6.6	5.0	85.4	Green	Creamy white
CD at 5%			0.4	0.8	3.4		

Table 3 : Physico-chemical characteristics of guava genotypes during winter season.

S. no.	Genotype	TSS (Úbrix)	Acidity (%)	Ascorbic acid (mg/100mg of fruit pulp)
1.	Hisar Surkha	13.1	0.46	157.9
2.	Hisar Safeda	13.5	0.35	182.2
3.	Strawberry	10.9	0.90	76.8
4.	Chinese	9.3	0.96	70.1
5.	Supreme	11.9	0.59	104.2
6.	Lalit	12.0	0.49	180.2
7.	Banarasi Surkha	11.7	0.49	154.9
8.	Lucknow-49	12.2	0.40	178.1
9.	Shweta	11.5	0.82	210.1
10.	Allahabad Safeda	10.9	0.47	155.1
11.	Super Acid	10.5	0.89	67.2
12.	SP6550	12.1	0.79	70.3
13.	Patillo	12.9	0.42	93.4
14.	Hybrid Red Supreme	13.7	0.56	140.4
15.	Super Max Ruby	10.3	0.60	162.3
CD at 5%		0.9	0.4	10.4

green and green with reddish blush. Pulp colour showed considerable variability from white, creamy white, yellowish white, yellowish pink to pink. Morton (1984) also observed variation in the pulp colour of two different species *viz.*, *P. cattleianum* and *P. friedrichsthalianum*.

Creamy white pulp colour of Hisar Safeda, Allahabad Safeda and pink pulp colour of Banarasi Surkha has also been reported by Daulta *et al.* (1998).

Physico-chemical characters

The data presented in table 3 reveals the physio-

chemical characters of the genotypes. The total soluble solids ranged from 9.3° brix to 13.7° brix. The maximum total soluble solids was recorded in Hybrid Red Supreme (13.7°brix) followed by Hisar Safeda (13.5°brix), Hisar Surkha (13.1°brix), Patillo (12.9°brix) and SP6550 (12.0°brix), while minimum total soluble solids was recorded in Chinese guava (9.3°brix) followed by Super Max Ruby (10.3°brix), Super Acid (10.5°brix). The acidity ranged between 0.35 per cent and 0.96 per cent for the different genotypes. Maximum acidity was recorded in Chinese guava (0.96%), followed by Super Acid (0.89%). The minimum acidity was noted in Hisar Safeda (0.35%), followed by Lucknow-49(0.40%) and Patillo (0.42%). Ascorbic acid, the major constituent of guava ranged from 67.2 to 210.1 mg/100 g of fruit pulp. Maximum amount of ascorbic acid was recorded in Shweta (210.1) followed by Hisar Safeda (182.2 mg/100 g fruit pulp) and Lalit (180.2 mg/100g fruit pulp). The minimum amount of ascorbic acid was observed in Super Acid (67.2 mg/100 g fruit pulp), followed by Chinese guava (70.1 mg/100g fruit pulp). The variation in the quality characteristics of guava fruits may be due to environmental factors and cultural practices adopted. High acid content in Chinese guava has also been reported by Subramanyam and Iyer (1993) and Shukla *et al.* (2004), Sharma *et al.* (2010). Ascorbic acid content was reported to increase during ripening in ber (Singh *et al.*, 1981; Kadam *et al.*, 1993) and in banana (Lodh *et al.*, 1971; Dhua *et al.*, 1988; Mustaffa *et al.*, 1998), while it has been observed to decrease during ripening in fruits of Sapodilla (Lakshminarayana and Subramanyam, 1966; Selvaraj and Pal, 1984) and in pineapple (Chadha *et al.*, 1972).

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