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Genetic variability and bio-chemical screening of guava (*Psidium guajava* L.) hybrids

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Abstract

The study was carried out to estimate biochemical parameters from fruits of guava hybrids. In the experiment undertaken, fourteen guava (*Psidium guajava* L.) hybrids were evaluated for selected nine biochemical characters using CRD in three repetitions. Among the different hybrids of guava, the highest vitamin – C was found in hybrid Allahabad Safeda x Mishri (321.33 mg/100g), total soluble solids in Allahabad Safeda x Chittidar (13.67°B), total sugar in Allahabad Safeda x Tehsildar (12.51%), non-reducing sugar in Allahabad Safeda x Tehsildar (7.09%), reducing sugar in Allahabad Safeda x Apple Colour (7.06%) and pectin was noted Allahabad Safeda x Apple Colour (0.87%) while lowest titrable acidity in Allahabad Safeda x Dholka (0.329%). Analysis of variance suggested the existence of significant amount of variability among *Psidium* hybrids for all the characters under study. Ascorbic acid recorded significantly higher amount of genotypic variance (1247.32) and phenotypic variance (1490.06) suggesting the high magnitude of variability for these traits. Genotypic coefficient of variation and phenotypic coefficient of variation were medium (10-20) for most of the traits with highest value for non-reducing sugar (25.10% and 25.30%) indicating existence of higher magnitude of variability for these characters.

Keywords: Genetic variability, genotypic coefficient, phenotypic coefficient, biochemical screening, hybrids, fruits

Introduction

Guava (*Psidium guajava* L.) belonging to Myrtaceae family is native of America; however, was introduced to another region of the world where it is cultivated nowadays. It is an important tropical commercial fruit crop of India. It is also known as "Apple of the tropics", *amarood*, *jamphal* or *jamrukh* in Hindi in India. Guava is the fourth most important fruit crop in India after Mango, Banana and Citrus (Ray, 2002) [19]. Guava is the hardiest among tropical fruit trees and excels most of the other fruit crops in productivity and adaptability. It can resist water logged condition to a greater extent than other fruit crop. It can also withstand temperature up to 45° C.

Genus *Psidium* contains about 150 species (Hayes, 1974) [8]. All cultivated varieties of guava are either diploid $2n=2x=22$ or triploid $2n=3x=33$ (Atchinson, 1947) [3]. In guava, most of the commercial varieties are reported to be diploids, except the seedless types which are triploids. A natural triploid was reported by Kumar and Ranade (1952) [10], but most of them are shy bearers (Menzel, 1985) [14].

The food value of whole ripe guava fruit per 100 g of edible portion is calories 36 - 50 Kcal, moisture 77-86 g, crude fibre 2.8-5.5 g, protein 0.9-1.0g, fat 0.1-1.5 g, carbohydrate 9.5-10 g, ash 0.43-0.7 g, calcium 9.1-17 mg, phosphorus 17.8-30 g, riboflavin 0.03-0.04 mg, thiamine 0.046 mg, niacin 0.6-1.068 mg, vitamin - A 200-400 I.U., vitamin – B3 40 I.U., vitamin – G4 35 I. U., vitamin – C 299 mg/100 g pulp (Morton, 1987) [15]. It is a popular fruit of India due to its delightful taste, flavour and easy availability. Guava is used for preparation of jams, jellies, juices, cakes, pies, ice-cream, milk shakes, sauces, butter, cheese, marmalade, chutney, relish, pickle, puree, beverages, ethanol, wine, animal feed, baby food, soft-drinks, as source of pectin, etc.

Fisher (1918) [7] suggested that continuous variation exhibited by quantitative traits with which plant breeders' deal includes heritable and non-heritable characters. Selection is effective for variation which are heritable in nature. The heritable component is the consequence of genotypes, while the non-heritable part is mainly due to unknown environmental factors.

The proper choice of parents responsible for successful breeding programme mainly depends upon variability and correct selection.

Moreover, guava scores over other fruits in ascorbic acid, pectin and other mineral contents. Assessment of diversity has traditionally been achieved through chemical composition, and cytological studies however; they have several limitations especially in perennial crops. Despite the fact that biochemical characters are often limited in number, they have a complex inheritance pattern and are vulnerable to environmental conditions; it is easy and cheap to carry them out and can be carried out systematically.

Materials and Methods

The present findings “genetic variability and bio-chemical screening of guava (*Psidium guajava* L.) hybrids” was carried out on 14 different hybrids of guava, planted on 09-08- 2012 and maintained at Horticultural Research- cum- Demonstration Farm, Department of Horticulture, B. A. College of Agriculture, Anand during the *Rabi*-2016. The experiment was laid out in Completely Randomized Design with fourteen hybrids. Hybrids act as treatment and each plant from treatment like repetition. Five fully and freshly ripened fruits of similar size and same ripening stage were collected randomly from each repetition from all fourteen hybrids. Sample was extracted and estimation of various biochemical parameters was done in five repetition. The moisture content was determined by using method of AOAC (1980) [2]. The ascorbic acid, reducing sugar, pectin extraction, titrable acidity content in the fruit juice were determined by described method of Ranganna (1979) [18]. While total soluble solids, total sugar, non-reducing sugar were determined by using hand refractometer, Fehling solution method and subtracting the values of the reducing sugar from total sugar for each sample separately. Genotypic and phenotypic variance is calculated as per Johnson (1955) [9] whereas genotypic coefficient of variation and phenotypic coefficient of variation were computed using the formula Shivasubramanian and Menon (1973) [23].

Results and Discussion Variance Component

All Fourteen hybrids were evaluated for various qualitative traits related to fruits. The value of genotypic and phenotypic variance was high for Ascorbic acid (1247.32 and 1490.06), Moisture content (0.30 and 4.12) and total soluble solids (0.98 and 1.16) while medium for total sugar (1.57 and 1.62), reducing sugar (0.80 and 0.82) and non-reducing sugar (1.30 and 1.32). Whereas low value of genotypic and phenotypic variance for pectin content (0.008 and 0.009) and titrable acidity (0.006) and 0.007). The high value indicates major proportion of phenotypic variance was shared by genotypic variance where as low value indicates the trait was mostly affected by environmental factors.

Coefficient of Variation

The high values of GCV and PCV for non- reducing sugar (25.10% and 25.30%) indicated the existence of high variability while moderate value for ascorbic acid (14.20% and 15.52%), total sugar (13.80% and 14.00%), reducing sugar (19.65% and 19.96%), pectin (12.91% and 13.58%) and titrable acidity (15.88% and 16.78%) indicates partial share of variation either by genotypic or environment. Low value of coefficient of variation were observed for total soluble solids (8.25% and 8.97%) and moisture content (0.68% and 2.55%) suggests variation due to environmental factor.

Biochemical screening

Variation was observed in ascorbic acid (vit. -C) (mg/100g) content in fruit of different hybrids of guava. The ranges varied from 174.67 to 321.33 mg/100g. The highest content of vitamin – C was noted in hybrid Allahabad Safeda x Mishri (321.33 mg/100g), while the lowest vitamin – C was recorded in Local Red x Dholka (174.67 mg/100g). These observations are close conformity with the reported by some earlier worker viz., Singh and Singh (2000) [22], Nambiar (2005) [16], Sharma *et al.* (2010) [20], Mahmoud and Peter (2014) [12] and Anuragi (2015) [1]. Moisture content was measured in the fruits of different guava hybrids. The moisture content was ranged from 78.39% to 82.45%. Total soluble solids content was measured in the fruit pulps of different hybrids of guava. Total soluble solids found in the range of 9.82 to 13.67 °B. Maximum amount of total soluble solids was recorded in case of Allahabad Safeda x Chittidar (13.67°B), which was at par with Allahabad Safeda x Matchless (13.33°B) and Allahabad Safeda x Local Red (13.00°B), whereas minimum amount of total soluble solids was recorded for Local Red x Mishri (9.82°B). Above result suggested that genotypes of Allahabad Safeda x Chittidar possess fruits with high content of total soluble solids. These observations are conformity with the reported by some earlier worker viz., Maiti *et al.* (2001) [13], Devi *et al.* (2002) [5], Prabhuraj *et al.* (2003) [17], Singh (2003) [21], Nambiar (2005) [16], Sharma *et al.* (2010) [20], Mahmoud and Peter (2014) [12] and Anuragi (2015) [1]. Variation in total sugar content of fruit, which ranged from 7.12 to 12.51 per cent. The highest content was observed in Allahabad Safeda x Tehsildar (12.51%), while the lowest sugar was present in Allahabad Safeda x Dholka (7.12%). Kundu *et al.* (1995) [11] also found variation among the 12 genotypes studied. These observations are conformity with the reported by some earlier worker viz., Devi *et al.* (2002) [5], Nambiar (2005) [16] and Mahmoud and Peter (2014) [12]. The reducing sugar was varied from 3.39 to 7.06 per cent. The highest reducing sugar was noted in Allahabad Safeda x Apple Colour (7.06%), while the lowest reducing sugar was present in Local Red x Banarasi Surkha (3.39%). Significant variation in reducing sugar was also reported by Singh and Singh (2000) [22] in their study on 10 genotypes of guava. The non-reducing sugar varied from 2.33 to 7.09 per cent. The highest non- reducing sugar was noted in Allahabad Safeda x Tehsildar (7.09 %), while the lowest reducing sugar was present in Allahabad Safeda x Dholka (2.33%). The range of pectin lied between 0.54 to per cent. The highest pectin per cent was noted in Allahabad Safeda x Apple Colour (0.87%), while the lowest pectin per cent was present in Local Red x Allahabad Safeda (0.54%). These observations are match with the reported by some earlier worker viz., Dingra *et al.* (1983) [6] and Deshmukh *et al.* (2013) [4]. Titrable acidity range lied between 0.329 to 0.620 per cent. Lowest acidity per cent was present in Allahabad Safeda x Dholka (0.329%), which was at par with Allahabad Safeda x Apple Colour (0.344%). The highest acidity per cent was noted in Local Red x Dholka (0.62%).

Conclusion

The character's ascorbic acid, moisture content, total soluble solids, total sugar, reducing sugar and non-reducing sugar possessed genotypic variance predominant in the expression of the phenotypic variance of study. This suggested that these characters were influenced by environment as well as genotypic factors. While moderate influence of environment factors along with genotypic factors was found in for characters viz., pectin and titrable acidity. Genotypic and

phenotypic coefficient of variation were found to be low for moisture content and TSS suggesting that hybrids were not differing much for these characters. Moderate GCV and PCV

were recorded for ascorbic acid, total sugar, reducing sugar, pectin and acidity suggesting that hybrids.

Table 1: Estimates of genotypic (σ^2) and phenotypic (σ^2) variances and coefficient of variation (genotypic and phenotypic) for various biochemical parameters of guava hybrids

Sr. No.	Characters/Parameters	Mean	Min.	Max.	2 (σ_g)	2 (σ_p)	Genotypic	Phenotypic
1.	Ascorbic acid (mg/100g)	248.64	174.67	321.33	1247.32	1490.06	14.20	15.52
2.	Moisture content (%)	79.57	78.22	82.45	0.30	4.12	0.68	2.55
3.	TSS ($^{\circ}$ B)	12.00	9.82	13.67	0.98	1.16	8.25	8.97
4.	Total sugar (%)	9.08	7.12	12.51	1.57	1.62	13.80	14.00
5.	Reducing sugar (%)	4.54	3.39	7.06	0.80	0.82	19.65	19.96
6.	Non-reducing sugar (%)	4.53	2.33	7.09	1.30	1.32	25.10	25.30
7.	Pectin (%)	0.71	0.54	0.87	0.008	0.009	12.91	13.58
8.	Acidity (%)	0.490	0.329	0.620	0.006	0.007	15.88	16.78

Table 2: Value of various biochemical parameters of guava hybrids

S. No	Hybrids	Ascorbic acid (mg/100g)	Moisture (%)	TSS ($^{\circ}$ B)	Total sugar (%)	Reducing sugar (%)	Non-reducing sugar (%)	Pectin (%)	Acidity (%)
1.	Allahabad Safeda x Local Red	240.33	78.66	13.00	9.41	4.04	5.37	0.55	0.481
2.	Local Red x Allahabad Safeda	236.33	81.26	11.33	8.31	3.96	4.35	0.54	0.491
3.	Allahabad Safeda x Apple Colour	213.67	78.39	11.98	9.71	7.06	2.65	0.87	0.344
4.	Allahabad Safeda x Chittidar	267.67	78.57	13.67	9.24	4.40	4.84	0.74	0.473
5.	Local Red x Chittidar	262.33	82.45	11.93	9.78	4.82	4.97	0.72	0.456
6.	Local Red x Dholka	174.67	79.97	12.32	9.23	4.46	4.77	0.72	0.620
7.	Allahabad Safeda x Dholka	294.67	79.72	12.17	7.12	4.79	2.33	0.81	0.329
8.	Local Red x Banarasi Surkha	229.33	78.71	11.17	8.01	3.39	4.62	0.69	0.553
9.	Local Red x Mishri	224.33	78.22	9.82	9.14	4.28	4.87	0.62	0.523
10.	Local Red x Matchless	231.33	79.37	11.33	9.38	4.69	4.68	0.64	0.527
11.	Allahabad Safeda x Exotica	244.67	78.78	12.50	7.69	3.74	3.95	0.75	0.523
12.	Allahabad Safeda x Matchless	260.33	78.81	13.33	8.77	4.74	4.04	0.73	0.523
13.	Allahabad Safeda x Mishri	321.33	80.74	11.00	8.82	3.84	4.98	0.76	0.562
14.	Allahabad Safeda x Tehsildar	280.00	80.39	12.50	12.51	5.43	7.09	0.78	0.443
	S.Em. \pm	8.99	1.13	0.24	0.12	0.09	0.08	0.02	0.016
	C.D. @ 5%	25.99	NS	0.70	0.35	0.27	0.24	0.05	0.046
	C.V. %	6.26	2.45	3.50	2.32	3.53	2.74	4.17	5.59

were moderate differing for these characters. Whereas high GCV and PCV were observed for non-reducing sugar suggesting that presence of variability within the hybrids. Maximum total soluble solid content was observed in hybrid Allahabad Safeda x Chittidar followed by Allahabad Safeda x Matchless and Allahabad Safeda x Local Red. The hybrid Allahabad Safeda x Apple Colour exhibited the highest pectin followed by Allahabad Safeda x Dholka and Allahabad Safeda x Tehsildar. Hybrids Allahabad Safeda x Chittidar, Allahabad Safeda x Apple Colour and Allahabad Safeda x Tehsildar emerged as good performing hybrids for total soluble solids and pectin content.

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