Genetic Variability of Guava (*Psidium guajava* L.) and its Prospects for Crop Improvement

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Diverse germplasm of guava (*Psidium guajava* L.) assembled at Horticulture Farm, Maharana Pratap University of Agriculture and Technology; Udaipur was evaluated with respect to morphometric characteristics, yield attributes and quality parameters for further utilization in improvement programme. The 47 guava genotype showed range of variability in respect to plant growth, yield attributes and yield and quality parameters. The average fruit weight ranged from 65 to 281 g, seed content 1.21 to 3.26 g and seed number 125 to 450/fruit in the different genotypes. Further, TSS and ascorbic acid contents ranges from 11 to 18.2 per cent and 129 to 268 mg/100 g pulp respectively. Out of the 47 genotypes two genotypes (MPUAT/47, MPUAT/43 recently named as MPUAT S-1 & MPUAT S-2, respectively) were identified as superior in respect to yield and quality. Further, MPUAT/6 and MPUAT/41 were also observed as potential genotype for the yield. This paper discuss the performance of promising guava genotypes and status of the conservation of guava genotypes in the field repository being maintained and evaluated under sub humid southern plains and Aravalli hills of Rajasthan.

Key Words: Evaluation, *Psidium guajava*, Variability

Introduction

Guava is also known as the "Apple of the Tropics" and belongs to family Myrtaceae. Important guava growing states in the country are Uttar Pradesh, Bihar, Madhya Pradesh and Maharashtra. Allahabad district of Uttar Pradesh has the reputation of growing the best quality of guava fruits in the world (Mitra and Bose, 1990). In Rajasthan major guava growing pockets are Sawaimadhopur, Udaipur, Kota, Bundi etc. The importance of guava is due to the fact that it is the hardy fruit which can be grown in alkaline and poorly drained soil. Tropical America is supposed to be centre of origin of guava where it is found in wild as well as cultivated forms. Most of the cultivars of Indian guava belong to the genus *Psidium* and *species guajava*. Based on the shape of common guava fruits, they are classified into two groups, *i.e. Psidium pyriferum* and *Psidium pomiferum* (De Candolle, 1886). Genus *Psidium* contains about 150 species (Hayes, 1970) all cultivated guava varieties are either diploid 2n=2x=22 or triploid 2n=3x=33 (Atchinson, 1947). As per the inheritance pattern bold seed is found to be dominant over soft seed and governed monogenically, red flesh colour is dominant to white and is known to bealso governed monogenically, red fleshed cultivars are supposed to be heterozygous and there is linkage between red flesh colour and bold seed size. Further, triploidy and some other genetic factors are responsible for female sterility (Subramanyam and Iyer; 1982, Shukla *et al*., 2004).

The evaluation and improvement of guava for Rajasthan need to be intensified with superior quality and dwarf growth habit. Keeping in view the above facts present programme was launched to evaluated and utilize the existing variability of the guava for crop improvement.

Materials and Methods

Guava is mainly a self-pollinated crop but occurrence of cross pollination resulted in great variation in the seedling population. At present, 210 seedling germplasm of guava are being maintained at Horticulture Farm, of Maharana Pratap University of Agriculture and Technology, Udaipur, collected through exploration from different parts of Rajasthan particularly Sawaimadhopur, Kota, Bundi and Udaipur, and these were evaluated for plant growth characteristics, fruiting behaviour, fruit quality and fruit yield. Selective sampling method was adopted for the identification of the promising genotype. Age of the plants was ten years and planted at the spacing of the 6m x 6m. The fruit sample comprising of 15 mature fruits of each genotype from winter season (Mrig bahar) were used for the physico-chemical analysis. Total Soluble Sugars (TSS) content was recorded with help of hand refractometer and readings were corrected at 20^{o}C with the help of

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Table 1. Range of variability in plant and fruit characters of guava germplasm

A. Plant phenology		Range
Plant height (m)		3.10-5.18
Canopy spread	E-W (m)	5.10-6.48
	N-S (m)	5.18-7.25
Girth (cm)		28.00-64.00
Leaf Size	Length (cm)	9.2-13.45
	Width (cm)	4.24-5.65
B. Fruit yield and quality		
Fruit weight (g)		65.00-281.00
Fruit size (cm) (L x B)		4.40 x 8.61-3.60 x 8.24
Fruit yield (kg/tree)		25.00-68.00
Seed weight (g/fruit)		1.21-3.26
Number of seeds/fruit		125.00-450.00
TSS (%)		11.00-18.20
Reducing sugar (%)		3.96-4.75
Non reducing sugar (%)		3.45-4.68
Total sugars (%)		7.41-9.43
Acidity (%)		0.5-1.01
Ascorbic acid (mg/100 g pulp)		129.00-268.00
Organoleptic score		7.00-9.00

temperature correction chart. However, titrable acidity and vitamin C contents were determined as per standard method described by AOAC (1990). Organoleptic score was obtained by a panel of five judges following zero to ten hedonic scale.

Results and Discussion

It is evident from the data presented in Table 1, 2 and variability exists with respect to plant growth characteristics, fruit yield and fruit quality in the analysed germplasm accessions. From the observations it was noticed that the plant height varied from 3.10 to 5.18 m, canopy spread 5.10 to 6.48 m (E-W), 5.18 to 7.25 m (N-S), girth of main branch 28 to 64 cm, leaf length 9.20 to 13.45 cm and width 4.24 to 5.65 cm. Further, average fruit weight varied from 65 to 281 g and fruit length and breadth showed variability range from 4.40 to 8.61 cm and 3.60 to 8.24 cm, respectively. However, seed weight/fruit varied

Table 2. General characteristics of fruits of guava germplasm

Collector No.	Fruit characters	Collector No.	Fruit characters
MPUAT/1	Smooth surface, seedy & milky white pulp	MPUAT/23	Shining surface, pear shape, sweet taste, seed big size.
MPUAT/2	Smooth surface. Inside cavity & white pulp	MPUAT/24	Oblong shape, soft and little seed , milky white pulp
MPUAT/3	Smooth surface, sweet taste, low seed but hardy	MPUAT/25	Smooth surface with line depressions , hollow cavity, seedy but soft seed, milky white pulp
MPUAT/4	Smooth surface, creamish yellow pulp, less & soft seed		
MPUAT/5	Smooth surface, creamish green pulp, hard seed	MPUAT/26	Round shape, whitish pulp, 5 locular but hard seed
MPUAT/6	Rough surface, pyriform shape, less & soft seed with white pulp	MPUAT/27	Greenish background with red colour pigmentation, low seed density.
MPUAT/7	Slight roughish surface, creamish yellow pulp small seed with soft.	MPUAT/28	Greenish white pulp, large or bold seeds
		MPUAT/29	Golden colour, acidic taste, low & soft seed
MPUAT/8	Shining smooth surface, few & soft seed, milky white pulp	MPUAT/30	Golden colour, milky white pulp, high but soft seed with 5 seed cavity locules.
MPUAT/9	Smooth surface, soft seed, good aroma & white pulp	MPUAT/31	Red colour pulp, good sugar acid blend
MPUAT/10	Rough surface, pyriform shape, creamish yellow pulp	MPUAT/32	Rough shape, low & soft seed with good taste, milky white pulp
MPUAT/11	Shining smooth surface, round shape, seed medium hardy, white milky pulp	MPUAT/33	Light green surface, milky white pulp, low but hard seed
		MPUAT/34	Ridge to smooth surface, golden colour, white pulp, low seed but hard
MPUAT/12	Pronounced ridges on surface, small & little seed but comparatively hard	MPUAT/35	Greenish fruit skin, white pulp, big size fruit, low seed but hard with 5 locules.
MPUAT/13	Smooth surface with greenish yellow colour, milky white pulp	MPUAT/36	Smooth green surface, white pulp, soft & low seed.
MPUAT/14	Smooth and golden colour surface, extra milky white pulp	MPUAT/37	Rough karela shape, little seed, good acidic blend with high pulp content
MPUAT/15	Round shape, greenish yellow colour, smooth & soft pulp with whitish colour	MPUAT/38	Golden colour, smooth surface, milky white pulp with coconut biting, low and soft seed
MPUAT/16	Smooth surface with slight ridges, low seed but soft good texture	MPUAT/39	Golden colour with apple like pigmentation, taste sweet and coconut biting but hard seed
MPUAT/17	Rough surface, ridge on it, creamish white pulp, negligible seed but hard	MPUAT/40	Pulp white, low seed but hard
		MPUAT/41	Light green fruit surface, whitish pulp with 5 locules in it.
MPUAT/18	Smooth surface with six line depressions on it, seedy but soft in nature, milky white pulp	MPUAT/42	Extra smooth surface, low but hard seed
MPUAT/19	Ridge surface with hallow cavity, greenish yellow surface colour, white pulp	MPUAT/43	Oblong shape, greenish yellow skin colour, white pulp good appealing overall with 2 locular segmentation..
MPUAT/20	Bright surface with round shape, high sweet with 4-5 locules, white pulp with soft seed	MPUAT/44	Smooth green surface, white pulp with hallow cavity& 6 locules and soft seed
MPUAT/21	Bright surface with round shape, high sweet with 6 loculer cavity, white pulp with soft seed	MPUAT/45	Rough surface, white pulp, bold and soft seed.
		MPUAT/46	Golden green colour, milky white pulp, low and soft seed
MPUAT/22	Bright & slight ridges on it, tiny hole cavity, 4 locules & soft pulp	MPUAT/47	Red Skin surface look like apple, creamish pulp, slight hard seed with good organoleptic score

Table 3. Physico-chemical properties of fruits of guava germplasm

Collectors No.	Fruit weight (g)	Fruit width (cm)		TSS (%)	Acidity (%)	Vitamin C (mg/100 g pulp)	Seed weight (g)/fruit	Organoleptic score (0 to 10)
		Length	Breadth					
MPUAT/1	185	6.95	8.24	11.0	0.80	145	2.00	8.0
MPUAT/2	136	6.14	7.76	12.0	0.75	130	1.85	7.5
MPUAT/3	115	5.85	6.25	13.0	0.64	134	1.79	8.0
MPUAT/4	121.5	6.21	5.87	11.5	0.78	142	1.76	7.25
MPUAT/5	138	6.37	6.63	12.0	0.73	154	2.10	7.5
MPUAT/6	281	9.17	7.65	13.2	0.75	210	2.45	8.5
MPUAT/7	200	7.78	7.32	11.0	0.85	190	3.00	7.0
MPUAT/8	130	6.81	6.34	12.0	0.72	175	1.89	8.5
MPUAT/9	160	6.47	7.10	13.0	0.69	163	1.90	9.0
MPUAT/10	200	8.61	6.68	12.8	0.72	197	2.89	8.0
MPUAT/11	115	6.44	5.91	12.8	0.76	149	2.10	7.0
MPUAT/12	115	6.30	5.24	16.0	0.65	170	3.10	6.2
MPUAT/13	170	5.72	5.30	13.0	0.72	183	3.34	7.0
MPUAT/14	95	5.85	5.44	12	0.78	185	2.10	7.0
MPUAT/15	75	5.35	4.67	14	0.70	145	2.00	7.0
MPUAT/16	106	5.70	5.70	16.0	0.64	176	2.14	7.5
MPUAT/17	195	6.90	6.23	17	0.68	178	2.90	7.0
MPUAT/18	157.5	6.60	6.65	15.5	0.64	179	2.76	7.0
MPUAT/19	76	5.25	4.87	17	0.62	134	1.98	7.5
MPUAT/20	110	5.9	5.5	16	0.59	138	1.76	8
MPUAT/21	200	7.4	6.9	15	0.54	210	3.14	8
MPUAT/22	187	7.2	5.9	16	0.53	205	2.89	8
MPUAT/23	90	5.25	5.70	17	0.52	178	1.75	8.5
MPUAT/24	104	5.7	5.9	15	0.61	175	1.68	7.5
MPUAT/25	122.5	6.3	6.0	16	0.60	168	1.70	7.5
MPUAT/26	191	7.1	6.8	16	0.59	190	2.00	7.5
MPUAT/27	95.0	6.5	4.0	17	0.57	180	1.98	8.0
MPUAT/28	128	6.35	6.7	16	0.53	129	3.00	7.5
MPUAT/29	65.0	4.4	3.6	17	1.01	180	1.45	7.5
MPUAT/30	121.5	6.4	5.8	17.0	0.54	175	3.26	8.0
MPUAT/31	100	5.4	5.7	17	0.54	180	2.10	8.0
MPUAT/32	82	5.4	5.1	17	0.55	172	1.98	8.0
MPUAT/33	155	6.4	6.3	17	0.54	210	1.76	8
MPUAT/34	100	5.9	5.2	17	0.50	199	1.65	8.0
MPUAT/35	200	7.1	6.3	16	0.57	193	2.30	7.5
MPUAT/36	123	5.4	5.5	16	0.60	192	1.76	7.5
MPUAT/37	200	6.9	7.5	17	0.59	199	3.00	8.0
MPUAT/38	88	5.35	5.5	17	0.58	139	1.68	8.0
MPUAT/39	85	5.6	4.5	17.2	0.57	167	1.74	8.0
MPUAT/40	71	5.25	4.2	17	0.55	150	1.49	8.0
MPUAT/41	200	6.5	6.2	17	0.58	237	2.89	8.5
MPUAT/42	75	4.8	4.3	16	0.68	160	1.72	7.5
MPUAT/43	204	7.12	7.77	18	0.52	240	2.10	8.0
MPUAT/44	71	5.98	4.89	17	0.54	157	1.21	8.0
MPUAT/45	141	6.65	5.94	17	0.57	150	1.48	7.5
MPUAT/46	75	4.79	4.17	17	0.58	149	1.39	8.0
MPUAT/47	175	5.35	5.40	18.2	0.50	268	1.72	9.0

from 1.21 to 3.26 g and seed number 125 to 450. Seed content was considered to be a most important fruit character for determining the quality of the guava fruits, lower seed content was a desirable trait for judging the palatability of the fruits (Khehra and Bal, 2006). The genotypes MPUAT S-1 (MPUAT/47) and MPUAT S-2 (MPUAT/43) have the lower and soft seed content and can be used for the donor parent in hybridization programme. The range of the TSS was 11.00 to 18.20% and highest TSS content was noticed in MPUAT S-1(MPUAT/47) 18.2% followed by MPUAT S-2 (MPUAT/43) 18% and minimum in MPUAT/01(11%) and MPUAT/07 (11%).

The acidity content varied from 0.5 to 1.01% and ascorbic acid content range from 129 to 268 mg/100 g pulp.

Further, total sugar, reducing sugars and non reducing sugars also ranged from 7.41 to 9.43%, 3.96 to 4.75% and 3.45 to 4.68%, respectively. Variation in fruit yield was also noticed and fruit yield ranged from 25 to 68 kg/tree. The pulp colour of the fruit varied from white, creamy white to red. Further, skin colour at the time of ripening also varied from red, yellowish green and straw yellow to greenish yellow. On the basis of organoleptic scoring TSS and ascorbic acid content MPUAT S-1 and MPUAT S-2 were most promising. The fruit skin colour is red in MPUAT S-1 and greenish yellow in MPUAT S-2 (Shukla *et al.*, 2008). MPUAT/6 and MPUAT/41 were also observed as potential genotypes for yield.

References

AOAC (1990) Methods of Analysis 15th ed., Association of the Official Analytical Chemists, Washington D.C.

Atchinson E (1947) Chromosome number in the Myrtaceae. *Amer. J. Bot.*, **34:** 159-164.

De Candolle A (1886) *Origin of Cultivated Plants.* Bibliotheque Scientifique Internationale, **43:** Paris.

Hayes WB (1970) *Fruit Growing in India.* Kitabistan Allahabad.

Khehra KS and JS Bal (2006) Studies on collecting the genetic resources of guava for Punjab. *Harayana J. Horti. Sci.*, **35:** 228-229.

Mitra SK and TK Bose (1990) Guava. In T.K. Bose and S.K. Mitra (eds.) : Fruits Tropical and Subtropical , Naya Prokash Calcutta, pp.278-303.

Shukla AK, RA Kaushik, D Pandey and DK Sarolia (2008) *Guava:* Technical Bulletin. Published by MPUAT, Udaipur, 32p.

Shukla Anil K, Arun K Shukla and BB Vashishtha (2004) Fruit breeding approaches and achievements. IBDC Lucknow, pp 203-216.

Subramanyam MD and CPA Iyer (1982) *Report.* Fruit Research Workshop, Nagpur, pp 117-118.