

Genetic diversity in mango (*Mangifera indica* L.) genotypes and molecular characterization

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(Received: Aug., 2011; Accepted : Sep., 2011)

Pre harvest sprays of different calcium, particularly 1.0 per cent calcium chloride, reduce physiological loss in weight as well as it increase the firmness and shelf life of fruit. While, rotting per cent and organoleptic rating was increase in calcium chloride (CaCl₂) 0.5 per cent among all the treatments when fruits were ripened.

Key words : Genetic diversity, Mango, Genotypes, Molecular characterization

Barhate, S.G., Balasubramanyan S. and Bhalerao, R. R. (2011). Genetic diversity in mango (*Mangifera indica* L.) genotypes and molecular characterization. *Asian J. Bio. Sci.*, 6 (2) : 241-245.

INTRODUCTION

Mango (*Mangifera indica* L.) is the most important fruit crop of India and it has been cultivated in India for over 4000 years. There are at least 1000 named cultivars in India (Kumar *et al.*, 2001). Mango is considered as the national fruit of India. In South India alone, over 350 varieties are being cultivated (Naik, 1963). Urbanization and industrialization paved way to large scale destruction of mango germplasm. Moreover, there was a shift in the preference of people towards new varieties and grafts. This has resulted in genetic erosion of traditional mango germplasm of state Tamil Nadu. Many of our traditional varieties have become extinct. Therefore, there is an urgent need to catalogue and conserve at least the available traditional genetic resources, which are on the verge of extinction. Proper assessment of existing genetic diversity is important in view of emerging patent rules. In this context, systematic studies to characterize the mango varieties based on morphological, floral and fruit traits were earlier attempted by Naik and Gangolly (1950), however, subsequent efforts in this regard are not appreciable. The excessive preference among the growers for collection of large number of varieties in their mixed orchards is another potent cause for the present chaotic nomenclature and classification.

This situation warrants a reliable, scientific method

to document and classify the available genotypes (varieties) in mango. RAPD is a quick, reliable and widely accepted molecular marker. It is simple to perform and is preferable to experiments where the genotypes of a large number of individuals are to be determined at a few genetic loci. The RAPD technique has high potential for the identification and management of mango germplasm (Kumar *et al.*, 2001). However, very little information is available with cultivars of Tamilnadu based on molecular characterization. So the present study was taken up to assist molecular characterization of mango cultivar of Tamil Nadu.

RESEARCH METHODOLOGY

The experiment was conducted on central block of Horticultural College and Research Institute, Periyakulam. Twelve genotypes such as Senduram, Alphonso, Himayuddin, Baneshan, Neelum, PKM 1, Panchavaranam, Swarnarekha, Mulgoa, Pottalma, Kalepad and Rumani were maintained in the germplasm collection of department of fruit crops in periyakulam with three replications and five plants per replication in randomized block design (RBD). The Genetic variability and diversity analysis for morphoeconomic traits (vegetative characters, growth habit, bearing habit, tree height, trunk girth, tree spread and number of branches per tree), leaf characters (leaf shape, leaf length, young

Table 1 : Growth habit and bearing habit of different mango genotypes

Sr.No.	Code No.	Genotypes	Erect	Spreading	Drooping	Very vigorous	Vigorous	Semi vigorous	Dwarf	Bearing habit
1.	Acc.No.1	Senduram					Vigorous			Regular
2.	Acc.No.2	Alphonso					Vigorous			Regular
3.	Acc.No.3	Himayuddin		Spreading				Semi vigorous		Regular
4.	Acc.No.4	Baneshan		Spreading			Vigorous			Regular
5.	Acc.No.5	Neelum		Spreading						Regular
6.	Acc.No.6	PKM 1						Semi vigorous		Regular
7.	Acc.No.7	Panchavarnam		Spreading						Shy bearer
8.	Acc.No.8	Swarnarekha		Spreading			Vigorous			Regular
9.	Acc.No.9	Mulgoa					Vigorous			Shy bearer
10.	Acc.No.10	Pottalma		Spreading		Very vigorous				Regular
11.	Acc.No.11	Kalepad		spreading				Semi vigorous	Dwarf	Regular
12.	Acc.No.12	Rumani		spreading				Semi vigorous		Regular

leaf, colour, leaf tip and leaf margin), inflorescence characters (position of inflorescence, shape of inflorescence, length of inflorescence and spread of inflorescence) and fruit characters (fruit length, fruit diameter, individual fruit weight and fruit volume) were studied in present investigation.

RESULTS AND ANALYSIS

The results obtained from the present investigation are presented below:

Morphological characters:

Based on growth habit, 12 mango varieties were grouped into *viz.*, erect, spreading, drooping, very vigorous, vigorous, semi vigorous and dwarf types. Acc.No.1, Acc.No.2, Acc.No.4, Acc.No.8, Acc.No.9 were vigorous. Acc.No.4, Acc.No.5, Acc.No.7 and Acc.No.8 were spreading however, Acc.No.9 and Acc.No.12 were semi vigorous and spreading. Acc.10 (Pottalma) observed as very vigorous and Acc. no.11 (Kalepad) as semi vigorous and dwarf (Table 1). Wide variation in the growth habit of these mango varieties were expected as substantial geographical diversity were also observed in the origin of these selected varieties. For instance, Alphonso is believed to have originated from western part of Maharashtra. *Gujante and Salvi (1988)* reported that Alphonso is the only commercial variety of the Konkan region accounting more than 90 per cent of the area under mango cultivation. The other variety 'Baneshan' is from Andhra Pradesh

and the varieties like Neelum, Senduram, Panchavarnam, Mulgoa, Pottalma and Kalepad are endemic to Tamil Nadu.

The growth habit of the genotypes was also found to vary from spreading, very vigorous, vigorous, semi vigorous and dwarf types in the present investigation. Among the various growth habits, semi vigorous and dwarf types like Kalepad is much preferred for high density planting and also to plant in backyards of modern limited house sites. Further in the present study the tallest tree height was recorded in Pottalma (13.1 m) and the shortest tree was recorded in Kalepad (3.6 m) (Table 2). The maximum tree girth was recorded with Mulgoa (2.1m) followed by Rumani (2.1m) and the minimum was with PKM 1 (0.5m). Tree spread exhibited significant differences among the mango cultivars, the maximum tree spread was recorded in Panchavarnam (12.7 m) in E.W. and 11.8 m in N.-S. This reveals that substantial genetic variability existed among the cultivars. According to *Morton (1987)*, the mango tree is erect, 10 to 30 m high, with a broad, rounded canopy which may vary with age, attain 30 to 38m in width, or a more upright oval, relatively slender crown.

Mango cultivars are generally classified as regular bearer, alternate bearer or irregular and shy bearers. In the present study, all the varieties evaluated were found to be regular bearer excepting Panchavarnam and Mulgoa which came under category of shy bearer. Alphonso which was found to be an alternate bearer in Northern India is found to be regular bearer in this present study. Certain

Table 2 : Mean performance of mango genotypes for tree height (m), tree girth (cm) and Tree spread (m)

Sr.No.	Name of genotype	Tree height	Tree girth	Tree spread (m)	
				E – W	N – S
1.	Senduram	4.8	0.53	5.13	5.2
2.	Alphonso	5.46	0.6	4.86	5.1
3.	Himayuddin	4.96	0.64	4.6	4.76
4.	Baneshan	9.1	0.8	11.16	10
5.	Neelum	6.8	0.6	10	9.2
6.	PKM 1	5.1	0.5	7.3	6.7
7.	Panchavarnam	11.8	2	12.7	11.8
8.	Swarnarekha	12.1	1.8	10.5	11.1
9.	Mulgoa	8.6	2.1	9.6	10.13
10.	Pottlma	13.1	1.46	16	15
11.	Kalepad	3.6	0.7	5.9	6.2
12.	Rumani	4.46	2.1	6.86	7.36
	Grand mean	7.5472	1.1792	8.6417	8.5428
	SE(±)	0.5356	0.1107	0.3511	0.0370
	CD(0.05%)	1.1107	0.2296	0.7282	0.0767

mango varieties are known to exact certain eco-physiological adaptation. *Pandey and Kishore (1987)* reported that one of the most important factors affecting the regularity of flowering is the variety. Most varieties from Northern India flower in alternate years, while those from the south tend to flower every year but produce poor quality fruits.

Leaf characters:

In the present study, the selected 12 mango genotypes were found to have different leaf shapes such as lanceolate, ovate, oval lanceolate and elliptic lanceolate

(Table 3). Similarly the leaf tips observed were of acuminate, sub acuminate and acute leaf tip. Whereas, young leaf colour exhibited variability, ranging from green, grape green, green with brown tinge, orange citrine, pyrite yellow, orange to brown, brown turn citrine, brown to red. The leaf length ranged from 16.4 cm to 23.7 cm. The maximum leaf length (23.7 cm) was recorded in the Acc No. 9 (Mulgoa) and the shortest leaf length (16.4 cm) was observed in Acc. No. 1 (Senduram), however, number of branches exhibited significant differences among the genotypes. It varied from 19.3 to 50.33. The maximum number of branches (50.33) was

Table 3 : Leaf shape of different mango genotypes and mean performance of mango genotypes for leaf length (cm) and number of branches/ tree

Sr.No.	Name of genotype	Leaf shape	Leaf tip	Young leaf colour	Leaf margin	Leaf length	Number of branches
1.	Senduram	Ovate lanceolate	Acute	Light green with brown tinge	Slightly reflected and folded	16.4	19.66
2.	Alphonso	Lanceolate	Acuminate	Brownish red	Slightly crinkled and folded	19.6	19.33
3.	Himayuddin	Lanceolate	Sub acuminate	Orange citrine	Flat and wavy	21.14	31.66
4.	Baneshan	Ovate lanceolate	Sub acuminate	Pyrite yellow	Slightly reflected and folded	22.19	31.33
5.	Neelum	Oval lanceolate	Acute	Orange to brown	Slightly reflected and folded	23.6	30.66
6.	PKM 1	Ovate lanceolate	Sub acuminate	Green	Flat and slightly reflected	21.75	21
7.	Panchavarnam	Oval lanceolate	Sub acuminate	Diamine brown turn citrine	folded	19.4	42.66
8.	Swarnarekha	Oval lanceolate	Sub acuminate	Brownz to browne	Slightly folded	22.3	50.33
9.	Mulgoa	Elliptic lanceolate	Sub acuminate	Brownish red	Folded and wavy	23.7	33.66
10.	Pottlma	Oval lanceolate	Acute	Dark green	Flat	22.3	33.66
11.	Kalepad	Elliptic lanceolate	Sub acuminate	Grape green	Slightly reflected and folded	19.9	48.66
12.	Rumani	Oval lanceolate	Acute	Green	Slightly reflected and folded	21.44	24
	Grand mean	--	--	--	--	21.1439	31.8611
	SE(±)	--	--	--	--	0.0795	1.9983
	CD(0.05%)	--	--	--	---	0.1648	4.1451

Table 4: Type of inflorescence of different mango genotype and Mean performance of mango genotypes for length of inflorescence (cm) and spread of inflorescence (cm)

Sr. No.	Name of genotype	Type of inflorescence	Position of inflorescence	Length of inflorescences(cm)	Spread of inflorescences(cm)
1.	Senduram	Intermediate	Terminal	22.9	21.3
2.	Alphonso	Broadly pyramidal	Terminal	28.4	30.2
3.	Himayuddin	Conical	Terminal	32.5	24.3
4.	Baneshan	Pyramidal	Terminal	21.9	21.2
5.	Neelum	Intermediate	Terminal	25.9	21.5
6.	PKM 1	Intermediate	Terminal	24.7	20.6
7.	Panchavarnam	Intermediate	Terminal	23.8	17.1
8.	Swarnarekha	conical	Terminal	31.4	24
9.	Mulgoa	Conical	Terminal	26.3	17.5
10.	Pottlma	Intermediate	Terminal	23.3	18.9
11.	Kalepad	Conical	Terminal	26.1	20.1
12.	Rumani	Intermediate	Terminal	24.9	21
	Grand mean			25.4972	21.600
	SE(±)			0.6018	0.6695
	CD(0.05%)			1.2481	1.3885

recorded in the Acc. No. 8 (Swarnarekha) and the least number of branches (19.33) was observed in Acc. No. 2 (Alphonso). The leaf shape, leaf tip and young leaf colour are also used to describe mango varieties in India. The work of *Naik and Gangolly (1950)* underlined the importance of characters such as leaf tip and folding of the leaf, shape of the leaves and colour of emerging leaves to characterize mango varieties. In many instances, the unique leaf characteristics of certain varieties are the main key for identification of the varieties in the nursery and field evaluation during non fruiting season. This significantly indicated that substantial genetic variability existed among the varieties selected in this study.

Inflorescence characters:

In the present investigation all mango varieties were observed terminal bearer but the type of the inflorescence is a varietal factor. In the present study, type of inflorescence of varieties was classified into intermediate, broadly pyramidal, pyramidal and conical (Table 4). *Hartless (1913)* was the first worker to emphasize the importance of floral characters in classifying mango varieties. Floral characters included in the description of South Indian mangoes by *Naik and Gangolly (1950)* were shape, hairiness and sex ratio. Inflorescence characters were also used in describing mango varieties. These included shape, colour, hairiness and flowering intensity (*IBPGR, 1989*). The longest inflorescence (32.5cm) was recorded in the Acc. No. 3 (Himayuddin)

and the shortest inflorescence (21.9cm) was recorded in Acc. No. 4 (Baneshan). *Thimmappaiah and Suman (1987)* reported the panicle size in mango varied from 11.25 to 42.20 cm, varieties having longer panicles produced the largest number of flowers consisting of mostly male flowers. They also opined that the role of perfect flowers was only secondary and indirect on yield.

Fruit characters:

Fruit characters such as fruit length, diameter, fruit weight and fruit volume were found to differ substantially among the twelve varieties used in this study. In the present investigation, fruit length did differ significantly among the mango genotypes and it varied from 6.3 cm to 12.46 cm (Table 5). The maximum fruit length (12.46cm) was recorded in Acc. No. 4 (Baneshan) and the shortest fruit length (6.3cm) was recorded in Acc. No.12 (Rumani). In case of fruit diameter, it was observed maximum (12.5cm) in the Acc. No. 9 (Mulgoa) and the lowest fruit diameter (5.76cm) was recorded in Acc. No. 11 (Kalepad). Fruit weight varied from 151.3 g to 707.7g. The maximum weight of 707.7 g being recorded with the cultivar 'Mulgoa'. Mulgoa is a shy bearer and expected to produce less number of big sized fruits (*Naik and Gangolly 1950*). The highest fruit volume (705.3ml) was recorded in the Acc. No. 9 (Mulgoa) and the lowest fruit volume (149.6ml) was recorded in Acc. No.11 (Kalepad). In mango, among all the group of characters, fruit characters are very important in identifying a variety.

Table 5 : Mean performance of mango genotypes for fruit length (cm), fruit diameter (cm), individual fruit weight (g) and fruit volume (ml)

Sr. No.	Name of genotype	Fruit length (cm)	Fruit diameter (cm)	Individual fruit weight (g)	Fruit volume
1.	Senduram	9.36	7.73	226	224.1
2.	Alphonso	8.56	7.5	225	223.2
3.	Himayuddin	11.56	8.33	330	327.5
4.	Baneshan	12.46	8.56	343	342.3
5.	Neelum	11.5	8.6	354.6	352.1
6.	PKM 1	9.7	7.5	288	286.4
7.	Panchavarnam	9.5	8.53	268.33	265.8
8.	Swarnarekha	10.36	7.46	269.3	266.7
9.	Mulgoa	12.46	12.5	707.7	705.3
10.	Pottlma	8.6	7.43	233.3	231.1
11.	Kalepad	8.33	5.76	151.3	149.6
12.	Rumani	6.3	7.33	251	248.34
	Grand mean	9.8944	8.1083	303.6389	302.069
	SE(±)	0.2003	0.2078	52.75	52.75
	CD(0.05%)	0.4155	0.4310	109	109.4

Earlier authors gave much importance for fruit characters such as fruit shape, beak type, sinus, shoulder etc. The shape of the fruit including the presence/absence of beak is considered as the most important character of mango fruits (*Gangolly and Ranjith, 1957*). According to *Manay and Shadksharaswamy (1995)*, the mango fruit is a large drupe in varied shape, size, colour and flavour. They also reported that the shapes are normally round, oval or oblong and the size ranges from plum sized ones to giants (more than 22 cm long). In local market, choice varieties like Mulgoa or Baneshan with higher fruit weight are preferable but for export purpose medium sized fruits namely Alphonso 225 g is optimum (*APEDA, 2008*).

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