CHARACTERISATION OF MANGO CULTIVARS IN SUB-MONTANEOUS ZONE OF PUNJAB

Davinder Singh and Amarjeet Kaur
Department of Horticulture (Agriculture),
Khalsa College, Guru Nanak Dev University, Amritsar, 143001

ABSTRACT: ***Due to the continuous decline in the area day by day under mango(Mangifera indica L.) in Punjab due to various manmade factors and natural disasters a survey was conducted for data collection about the extent of diversity found in the native strains of mango growing in sub-montaneous zone of Punjab. For the evaluation of elite germplasm twenty five elite strains growing at farmer fields/educational institutes, road sides and government orchards were surveyed consecutively throughout the whole research period of 2017-18. The results of the study revealed that the variability existing in mango genotypes in various forms not only contributes to diversity, economical and occupational security but can also be used as a tool for breeding purposes and can be exploited for the selection of elite genotypes for conservation, evaluation and utilization as a source for crop improvement in future breeding programmes to evolve the superior varieties. The present study emphasis a great need of conservation of mango germplasm and also the protection of inhabiting areas of Punjab province.***

Keywords: Germplasm, Strains, Variability, Mangifera indica, Conservation, Elite, Breeding programme

---

INTRODUCTION

Mango (*Mangifera indica* L.) is the most popular tropical fruit in the universe that belongs to family Anacardiaceae and order Sapindales (Trivedi *et al* 2015). It is one of the most important and choicest fruit of India and has been grown in India for over 4000 years (Singh *et al* 2012). It is known as the king of fruits due to its exotic flavour, delicious taste and several other desirable characters. Mango, the national fruit of India has intimate association with cultural, religious, aesthetic and economic life of Indians since time immemorial (Parab *et al* 2014). Mango which is the ancient fruits of India was originated as alloploid and its home was suggested as eastern India extending from Assam to Burma or possibly further in Malay region. Based on recent findings the centre of origin and diversity or genus Mangifera is now firmly established in South East Asia (Kaur *et al* 2014). The English word mango probably originated from the Malayalam word maanga and the Portuguese were called it as mang (Sarker *et al* 2017). The genus Mangifera contains 41 species and all the edible cultivars of mango belong to single species indica. Over one thousand varieties have been reported belonging to this genus. Mango posseses unique nutritional and medicinal qualities apart from being rich in vitamins A, E, C and vitamin B6. Ripe fruit of mango is rich in carbohydrates, minerals like Ca, P, and iron. It is also a source of B-carotene, amino acids, antioxidants and also contain an enzyme showing stomach soothing properties. The consumption of mango is also beneficial for people suffering from constipation, diarrhoea, eye disorder, hair loss, piles, scurvy and sinusitis and spleen. It helps to increase digestive capacity enlargement (Trivedi *et al* 2015). Unripe mango fruits are acidic and commercially used for preparation of pickle, chutney and raw mango powder (amchur) whereas ripe fruits are utilized for making squash, nectar, jam, pulp, powder, baby food, mango leather, mango toffee etc. The fruits are also sliced and canned for consumption during off season. Additionally, mango peel is rich in phytonutrients, such as the pigment antioxidants like carotenoids and polyphenols, omega a and b fatty acids and dietary minerals such as Potassium and copper. Owing to other properties, several literatures reported their effectiveness in the inhibition of prostrate and skin cancer (Prasad *et al* 2008; Saleem *et al* 2004). In Punjab the area under mango fruit plantation has declined drastically due to deforestation, population pressure, shifting interests towards high remunerative cropping system, reoccurrence of cold wave with frost and urban development. There is a need and demand to conserve and protect this heritage rich fruit for the benefit of posterity (Singh *et al* 2012). Mango possesses rich genetic diversity in morphological, yield and quality characteristics, pulp, aroma and texture grown throughout the country in tropical and subtropical regions. Almost, all edible cultivars of mango belong to *Mangifera indica* Linn and have been developed through selection from the naturally cross pollinated seedlings. About 1000 varieties/ genotypes are under cultivation in different agro-climatic zones of country. However, only 40 varieties are of commercial importance. Almost all genotypes are having alternate bearing and low yield potential. The increasing internal and global demand also warrants development of varieties with export quality fruits with high yield potential (Jatav 2014). Hence, the present survey was carried out to investigate the nature and assesment of genetic variability in mango seedling progenies for physico-chemical attributes.

MATERIALS AND METHODS

The present investigation entitled "Characterization of mango germplasm in sub-montaneous zone of Punjab" was conducted during the year 2017-18. The experiment was carried out in Roopnagar and Nawanshahr districts and the physico-chemical analysis was done in laboratory of the Department of Horticulture, Khalsa College Amritsar. The elite twenty five genotypes of mango were selected on the basis of information provided by tree owners, local inhabitants and officials from Department of Horticulture, Punjab. The selected genotypes were evaluated for various vegetative, floral, fruit maturity, disorders and quality characters etc. Fifty fruits/sample at the ripened stage were randomly collected from all the sides of the tree. Average fruit length, breadth, weight, pulp and seed weight, pulp / stone ratio, fruit shape, shape of fruit apex, depth of fruit stalk cavity, fruit colour, taste, pulp colour, texture and seed shape were determined using standard methods. The juice was extracted from the pulp by straining through a muslin cloth and the total soluble solids (TSS) of the berry juice were determined with the help of Erma hand refractrometer. The values were corrected at 20°C. Juice acidity was determined by titrating 10ml juice against N/10 NaOH using phenolphthalein as an indicator. The total sugars, reducing sugars and non reducing sugars were determined by volumetric method.

RESULTS AND DISCUSSION

Maximum fruit length (13.80 cm) and breadth (8.90 cm) in the genotypes NPW-2 while minimum fruit length (7.67 cm) and breadth (4.25 cm) was noted in the genotype NA-1.The present results are in conformation with the findings of Singh *et al* (2012), Kaur *et al* (2014) ,Himabindu *et al* (2016) and Bora *et al* (2017) in mango germplasm.

The data focussed the maximum fruit weight (197.41 g) in the genotype NKP-3and the minimum fruit weight (54.11 g) recorded in the genotype RG-1.The results of the present study are partially in agreement with the previous reports as the different fruit weight range has been observed in the evaluated germplasm which might be owed to climatic conditions and genetic behaviour of genotypes. The research findings of Singh *et al* (2012),Singh *et al* (2013), Kaur *et al* (2014) and Bora *et al* (2017) are also in support with the present findings.

A striking variability was noticed in the pulp percentage of the various genotypes which were evaluated during the whole study with the highest pulp: stone ratio of 7.21 in the genotype RNPB-1 while the lowest pulp: stone ratio (1.51) was recorded in genotype RA-2. Singh (2013) also opinied the same through his studies in mango genotypes.

The maximum stone weight of 23.39 g in the genotype NPW-5 closely followed by the genotype NKP-4 with 22.15 g. Minimum stone weight (5.82 g) was recorded in the genotype RBS-1.The results of the present study are in line with the findings of Singh *et al* (2013) who worked on mango strains and reported that stone weight vary considerably in mango trees .Singh *et al(*2012) also reported the same variation in mango genotypes.

Some variability in the fruit shape amongst different evaluated seedling mango germplasm was observed throughout the study. The fruits of genotypes NPW-2 and NKP-2 registered elliptic shaped fruits, whereas fruits of some genotypes NA-3, NKP-3 and RAPS-1was obovoid in shape. Genotypes RG-3, RAPS-2, RBS-1, NCPR-2 and NA-2 having roundish shaped fruits. While the rest of genotypes had oblong shaped fruits. The present results are in agreement with the previous research findings of Singh *et al* (2013) who reported that fruit shape in mango varied from round to oblong. Singh *et al* (2012) also observed a variation in the shape of the mango fruits and reported oblong, oval, cylindrical and pear-shaped fruits while evaluating local mango types respectively. Stephen (2012) also registered the fruit shape varying from oblong to ovoid among various mango genotypes tried for evaluation which are quite in agreement with the present findings.

Evaluated seedling mango germplasm exhibited variability in terms of shape of fruit apex which was roundish in some genotypes while obtuse and acute shaped fruit apex were also found in some germplasm. The present results are in agreement with the previous research findings of Singh (2013) who also reported the same in mango.

The genotypes under study showed medium and shallow depth of fruit stalk cavity whereas it was absent in some of the genotypes .The present results are in agreement with the previous research findings of Singh (2013) in mango.

It is clear that fruit neck is of two types in the evaluated germplasm i.e. slightly prominent or absent. The genotypes RG-2, RA-2, NPW-2, NA-2 and NA-3 having non-prominent fruit neck i.e. fruit neck absent. Rest of genotypes had slightly prominent fruit neck. Singh (2013) also reported the same in mango.

The data regarding attractiveness of fruits of evaluated germplasm showed that the genotypes RG-1, RG-2, RG-3, RNPB-1, RA-6, RBS-1, RBS-2, NCPR-2, NKP-1, NA-2 and NA-3 were having fruits with excellent attractiveness value. Whereas, genotypes RNPB-2, RAPS-2, RA-2, NPW-1, NKP-3, NKP-4 and NA-1were having fruits with very good attractiveness.

From the data on fruit taste it is clear that the genotypes RG-2, RG-3, RAPS-5, RA-6, registered fruits with sub-acidic taste. While rest of the genotypes had fruits with sweet taste at the ripened stage. These results are in support with the research findings of Kapoor (2000) who stated that the fruits of mango are sweet to sub-acidic in taste depending on the various genotypes. According to Ivan (2006) the taste of mango fruits was sweetish sour which is in line with the present study.

Genotypes RG-1, RG-2, RG-3, RNPB-1, RAPS-1, RAPS-3, RAPS-5, RA-2, RBS-1, RBS-2, NPW-2, NCPR-1, NCPR-2, NPW-5, NKP-3, NKP-4, NA-1 and NA-3 had fruits with green colour, while rest of genotypes RNPB-2, RAPS-2, RA-6, NPW-1, NKP-1, NKP-2 and NA-2 had fruits with greenish yellow colour at maturity. Present findings are in conformity with the previous research work of Singh (2013) and Singh *et al* (2012) who reported yellowish to light yellow, deep chrome and dark green in selected mango strains.

Variability in pulp colour of ripe fruits was noted in the evaluated seedling mango germplasm which varied from light orange coloured to yellow coloured pulp. Present findings are in conformity with the findings of Dhillon (2013), Singh (2013) and Singh *et al* (2012) and who also noted variation in pulp colour from yellow to orange respectively.

The data regarding the pulp texture of ripe fruits of evaluated germplasm depicted that there was no variation in the texture of fruit pulp. All the genotypes were having the fruits with soft textured pulp. These results are in line with the findings of Singh (2013) who also reported the soft textured pulp of mango genotypes.

Evaluated seedling mango germplasm showed variability in stone shape . The genotypes RNPB-2, RBS-1, NCPR-1, NKP-1 and NA-1 having reniform stone shape. Rest of genotypes RG-1, RG-2, RG-3, RNPB-1, RAPS-1, RAPS-2, RAPS-3, RAPS-5, RA-2, RA-6, RBS-2, NPW-1, NPW-2, NCPR-2, NPW-5, NKP-2, NKP-3, NKP-4, NA-2 and NA-3 had oblong stone shape. The present findings are in line with the study of Singh (2013) who also reported the mango genotypes with oblong shape.

The data did not show any variation regarding the presence of stone in the fruits of various mango genotypes. All the genotypes registered fruits with a stone in it. These research parameters are in line with the findings of Dhillon (2013) , Singh (2013) and Singh *et al* (2012) who reported the presence of stone in the fruits of mango genotypes under study.

The data regarding total soluble solids revealed a marked variability in all the genotypes which was within the range of 13.10 to 20.20 ^{0}Brix. The maximum TSS (20.20^{0}Brix) were registered in mango fruits harvested from RBS-1 strain, closely followed by RNPB-1 and RAPS-2 genotypes with 19.60 and 19.10 ^{0}Brix. Minimum TSS (13.00^{0}Brix) was recorded in the genotype NA-1 .High variability with respect to TSS content in different genotypes are in accordance with previous work done on mango germplasm evaluations. Range for variability is in the agreement of Kaur *et al* (2014), Reddy *et al* (2000) and Mitra *et al* (2001) reported TSS in the range of 15.05 – 20.46 ^{0}Brix in various mango genotypes which are in agreement with the present studies. These results are also in line with the findings of Singh (2001) and Yadav *et al* (2010) in mango genotypes. Rufini *et al* (2011) and Singh *et al* (2011) also reported the same variation in mango strains. Bora *et al* (2017), Desai and Dhandor (2000) also stated a wide variation in TSS in exotic mango germplasm in accordance with the present findings.

It is evident from the data that the level of acidity in fruit pulp varied from 0.45 to 0.82 per cent in different evaluated mango genotypes with the highest content (0.82%) recorded in the genotype RAPS-2 closely followed by NKP-3 with (0.80%) with the lowest acidity (0.44%) in the genotype NKP-2 respectively. The fruit acidity highly depends upon the genotype and climatic conditions where genotype generally play a great role in maintaining the quality of fruits. The present studies are partially in agreement with the previous work of Kumar (2004) who observed the range of acidity from 0.14% to 0.34% in different mango varieties. The present studies are in consonance with the findings of Kaur *et al* (2014), Singh *et al* (2012), Reddy *et al* (2000) and Mitra *et al* (2001) mango germplasm.

A glance over the data divulged a wide variation with the highest TSS: acid ratio (52.31) which was recorded in the genotype RBS-1 while the minimum TSS: acid ratio (16.84) was recorded in the genotype NA-2. Variation in TSS: acid ratio might be attributed to inherent genetic variation .The present results are in contrary to the findings of Singh (2001) and Singh (2013) in mango cultivars. Uddin *et al* (2007) also showed wide variation in TSS: acid ratio ranging from 24.19 to 81.57.

Significant differences has been found in reducing sugar content in the evaluated genotypes of mango varying from 1.42 to 5.14 per cent with maximum of 5.14 per cent in the genotype RG-3. Minimum reducing sugars (1.42%) were recorded in genotype RBS-1. These findings are confirmed by Singh (2013), Rathor *et al* (2009), Uddin *et al* (2007) in mango evaluation . Kaur *et al* (2014) also recorded the same in germplasm of mango respectively. The findings of Singh *et al* (2012) in mango strains are also in agreement with the present studies.

The data regarding total sugars presented indicated that the genotype RG-3 contained the highest level of total sugars (21.34%). The genotype RG-1 registered the minimum (16.64%) total sugars respectively. This might be due to the climatic and varietal difference among the various strains of mango. The higher and lower values for this character showed inheritance, which is quite helpful in finding the suitable elite types as per requirements. Singh (2013), Rathor *et al* (2009), Uddin *et al* (2007) in mango might be due to genetic makeup which got favourable microclimate in montaneous region to express the characteristics. These results are agreement with the findings of Singh (2003),Bhowmick and Banik (2008), Yadav *et al* (2010), Singh *et al* (2010) and Singh *et al* (2013) in mango germplasm.

According to the data regarding ascorbic acid a wide range of variability among all the evaluated mango genotypes existed which showed a range from 26.53 to 50.46 mg/100g fruit pulp respectively. The maximum ascorbic acid 50.46 mg/100g pulp was found in the NKP-4 genotype. The genotype RG-1 registered the minimum (26.53 mg/100g pulp) ascorbic acid respectively. Results of these findings are confirmed by Singh *et al* (2012), Singh (2013), Jatav (2014) and Kaur *et al* (2014) who reported ascorbic acid content of 30.0 to 43.0 mg/100g pulp in mango respectively. Himabindhu *et al* (2016) also supported the present findings.

REFERENCES

[1] Bhowmick N and Banik B C (2008) Genetic variability and correlation studies for fruit physico-chemical properties of some mango cultivars grown under new alluvial zone of West Bengal. Asian J Hort 3: 346-49.

[2] Bora L, Singh A K and Singh C P (2017) Characterization of mango (Mangifera indica L.) genotypes based on physio-chemical quality attributes J App and Natural Sci 9: 2199 – 2204.

[3] Desai A R and Dhandar D G (2000) Variation in physicochemical and morphogenetic characters of some mango varieties of Goa. Acta Hort 509: 243-49.

[4] Dhillon W S (2013) Fruit Production in India Narendra Publishing House New Delhi- 110006 (India).

[5] Himabindu, A, Srihari D, Rajasekhar, M, Sudhavani, V, Subbarammamma, P and Uma K (2016) Genetic variability and heritability studies of mango cultivars. International J Sci and Nature 2016: 168-72.

[6] Ivan A R (2006) Medicinal plant of World: Chemical Constituents Traditional Uses and Modern Medicinal Uses Human Press Totowa New Jersey pp 283-89.

[7] Jatav A (2014) Evaluation and correlation studies in mango genotypes under Kymore Plateau of Madhya Pradesh. Thesis submitted to J N K V V Jabalpur Madhya Pradesh.

[8] Kapoor L D (2000) Handbook of Ayurvedic medicinal plants: Herbal reference library CRC press. London 2: 179-80.

[9] Kaur M, Bal J S, Sharma L K and Bali S K 2014 An evaluation of mango (Mangifera indica L.) germplasm for future breeding programme, African J Agri Res 9: 1530-38.

[10] Mitra S, Kundu S and Mitra S K (2001) Evaluation of local strains of mango (Mangifera indica) grown in West Bengal. Indian J Agri Sci 71: 466-68.

[11] Parab A Y, Relekar P P and Pujari K H (2014) Studies on preparation of mango (Mangifera indica L.) bar from frozen Alphonso mango pulp. Asian J. Hort 9: 243-47.

[12] Prasad S, Kalra N, Singh M, Shukla Y (2008) Protective effects of lupeol and mango extract against androgen induced oxidative stress in Swiss albino mice. Asian J Androl 10: 313-18.

[13] Rathore, B.P. (2009) Genetic variability, correlation, path coefficient and D2 analysis for morphological and biochemical parameters of mango fruit (Mangifera indica L.). Part of Ph.D thesis submitted to the Navsari Agricultural University Gujarat India.

[14] Reddy, N N, Gangopadhyay K K, Rai M, Kumar R and Singh H P (2000) Adaptability of mango cultivars under subhumid Alfisols of Eastern India. J Res, Birsa AgriUni12: 163-69.

[15] Rufini J C M, Galvao E R, Prezotti L, Silva M B D and Parrella R A C (2011) Biometrical and physico-chemical characterization of fruits of accessions mango'Uba'. Revista Brasileira de Fruticultura 33: 456-64.

[16] Saleem M, Afaq F, Adhami V M, Mukhtar H (2004) Lupeolmodulates NF-kappaB and PI3K/Akt pathways and inhibits skin cancer in CD-1 mice. Oncogen 23: 5203-14.

[17] Sarker A, Amin N, Shimu I J, Akhter M P, Alam M A, Rahman M M and Sultana H (2017) Antimicrobial activity of methanolic extract of langra mango pulp. J Phar and Phyto 6: 28-30.

[18] Singh G (2013) Characterization and evaluation of seedling mango germplasm in Central and Sub-mountane zones of Punjab. Thesis submitted to G N D U Amritsar Punjab.

[19] Singh N P., Jerath N., Singh G. and Gill P P S (2012) Physico-chemical characterization of unexploited mango diversity in sub-mountane zone of Northern India. Indian J. Pl Genet. Resour 25: 261-69

[20] Singh I P (2003) Performance of different guava (Psidium guajava L.) cultivars under Tripura conditions. Prog Hort 35: 55-58.

[21] Singh R, Solanki S, Gurjar P S and Patidar R (2010) Physico-chemical characteristics of different varieties of Mango in Kymore plateau of Madhya Pradesh. Indian J Hort 67: 67-69.

[22] Singh S (2001) Evaluation of some promising mango genotypes under Sabour conditions. Prog Hort 33: 199-203.

[23] Singh S K and Bhargava R (2011) Evaluation of mango genotypes for morphophysiological attributes under hotarid zone of Rajasthan. J Tropical Agriculture 49:104-06.

[24] Singh T K, Singh J and Singh D B (2013) Performance of mango varieties in Kymore platue of Madhya Pradesh. Prog Hort 45: 268- 72.

[25] Stephen A (2012) Syzygium cumini (L.) Skeels a multipurpose tree its phytotherapic and pharmacological uses. J Phytoth Pharmaco 1: 22-32.

[26] Trivedi M K, Branton A, Trivedi D, Nayak G, Mondal S C and Jana S (2015) Morphological Characterization, Quality, Yield and DNA Fingerprinting of Biofield Energy Treated Alphonso Mango (Mangifera indica L.). J Food and Nutrition Sci 3: 245-50.

[27] Uddin, M S, Uddin M Z, Barman J C, Hoque M A and Alam, S M M (2007) Studies on the performance of some local and exotic mango varieties grown at Barisal region. Int. J. Sustain. Crop Produ, 1: 16-19.

[28] Yadav P K, Chaturvedi O P, Yadav D K and Yadav H C (2010) Physico-chemical attributes of prommising mango germplasm of Northern Gangatic Plains. Plant Archives 10: 407-09.

Table 1: Physical characters: Description of physical fruit attributes in evaluated genotypes of mango

Selection number	Fruit characters					
	Collector code	Fruit length (cm)	Fruit breadth (cm)	Fruit Weight (g)	Pulp / Stone Ratio	Stone weight (g)
1.	RG-1	8.52	5.66	54.11	6.57	12.92
2.	RG-2	9.38	6.75	165.39	5.82	11.18
3.	RG-3	8.80	5.75	65.92	6.02	7.10
4.	RNPB-1	7.93	4.63	57.90	7.21	9.75
5.	RNPB-2	9.56	5.52	156.34	2.19	11.26
6.	RAPS-1	9.98	4.68	161.10	1.62	15.62
7.	RAPS-2	10.78	5.75	137.18	2.12	17.95
8.	RAPS-3	11.34	4.93	150.20	3.52	11.35
9.	RAPS-5	10.45	5.10	110.12	1.68	14.08
10.	RA-2	12.44	8.80	142.22	1.51	13.71
11.	RA-6	11.14	5.30	124.34	1.64	13.90
12.	RBS-1	8.92	4.80	56.46	1.72	5.82
13.	RBS-2	8.46	5.93	58.80	3.81	18.26
14.	NPW-1	11.98	6.00	156.78	3.39	14.49
15.	NPW-2	13.80	8.90	167.56	3.37	20.22
16.	NCPR-1	8.88	5.65	117.48	2.03	19.86
17.	NCPR-2	8.12	5.92	123.89	2.66	12.50
18.	NPW-5	12.14	7.20	189.56	2.71	23.39
19.	NKP-1	8.73	4.92	133.32	2.39	8.94
20.	NKP-2	9.42	5.90	145.49	5.87	20.81
21.	NKP-3	10.12	6.00	197.47	2.82	17.74
22.	NKP-4	9.78	6.18	174.52	3.09	22.15
23.	NA-1	7.67	4.25	112.43	4.34	21.67
24.	NA-2	8.10	5.75	123.67	1.75	19.43
25.	NA-3	7.98	4.93	114.60	1.97	11.74
	Max	13.80	8.90	197.47	7.21	23.39
	Min	7.67	4.25	54.11	1.51	5.82

Table 2: Fruit morphological characteristics of evaluated genotypes of mango

Selection number	Collector Code	Fruit Shape	Shape of fruit Apex	Depth of fruit stalk cavity	Fruit neck prominence	Fruit attractiveness	Fruit taste	Fruit Colour	Pulp Colour	Pulp texture	Seed shape	Present of seed
1.	RG-1	Oblong	Obtuse	Absent	Slightly Prominent	Excellent	Sweet	Green	Yellow	Soft	Oblong	Present
2.	RG-2	Oblong	Obtuse	Shallow	Absent	Excellent	Sub-acidic	Green	Yellow	Soft	Oblong	Present
3.	RG-3	Roundish	Acute	Shallow	Slightly Prominent	Excellent	Sub-acidic	Green	Yellow	Soft	Oblong	Present
4.	RNPB-1	Oblong	Acute	Absent	Slightly Prominent	Excellent	Sweet	Green	Light Yellow	Soft	Oblong	Present
5.	RNPB-2	Oblong	Obtuse	Absent	Slightly Prominent	Very Good	Sweet	Greenish Yellow	Light Yellow	Soft	Reniform	Present
6.	RAPS-1	Obovoid	Round	Absent	Slightly Prominent	Good	Sweet	Green	Light Orange	Soft	Oblong	Present
7.	RAPS-2	Roundish	Acute	Shallow	Slightly Prominent	Very Good	Sweet	Greenish Yellow	Yellow	Soft	Oblong	Present
8.	RAPS-3	Oblong	Acute	Absent	Absent	Good	Sweet	Green	Yellow	Soft	Oblong	Present
9.	RAPS-5	Oblong	Acute	Absent	Slightly Prominent	Good	Sub-acidic	Green	Light Yellow	Soft	Oblong	Present
10.	RA-2	Oblong	Acute	Absent	Absent	Very Good	Sweet	Green	Light Orange	Soft	Oblong	Present
11.	RA-6	Oblong	Obtuse	Absent	Slightly Prominent	Excellent	Sub-acidic	Greenish Yellow	Yellow	Soft	Oblong	Present
12.	RBS-1	Roundish	Acute	Absent	Slightly Prominent	Excellent	Sweet	Green	Orange	Soft	Reniform	Present
13.	RBS-2	Oblong	Acute	Absent	Slightly Prominent	Excellent	Sweet	Green	Light Yellow	Soft	Oblong	Present
14.	NPW-1	Oblong	Obtuse	Absent	Slightly Prominent	Very Good	Sweet	Greenish Yellow	Yellow	Soft	Oblong	Present
15.	NPW-2	Elliptic	Round	Shallow	Absent	Good	Sweet	Green	Yellow	Soft	Oblong	Present
16.	NCPR-1	Oblong	Obtuse	Shallow	Slightly Prominent	Good	Sweet	Green	Light Yellow	Soft	Reniform	Present
17.	NCPR-2	Roundish	Obtuse	Medium	Slightly Prominent	Excellent	Sweet	Green	Yellow	Soft	Oblong	Present
18.	NPW-5	Oblong	Acute	Shallow	Slightly Prominent	Good	Sweet	Green	Yellow	Soft	Oblong	Present
19.	NKP-1	Oblong	Round	Absent	Slightly Prominent	Excellent	Sweet	Greenish Yellow	Yellow	Soft	Reniform	Present
20.	NKP-2	Elliptic	Obtuse	Absent	Slightly Prominent	Good	Sweet	Greenish Yellow	Light Yellow	Soft	Oblong	Present
21.	NKP-3	Obovoid	Acute	Shallow	Slightly Prominent	Very Good	Sweet	Green	Orange	Soft	Oblong	Present
22.	NKP-4	Oblong	Acute	Absent	Slightly Prominent	Very Good	Sweet	Green	Yellow	Soft	Oblong	Present
23.	NA-1	Oblong	Acute	Absent	Slightly Prominent	Very Good	Sweet	Green	Yellow	Soft	Reniform	Present
24.	NA-2	Roundish	Obtuse	Shallow	Absent	Excellent	Sweet	Greenish Yellow	Light Yellow	Soft	Oblong	Present
25.	NA-3	Obovoid	Acute	Shallow	Absent	Excellent	Sweet	Green	Yellow	Soft	Oblong	Present

Table 3: Bio-chemical attributes of evaluated genotypes of mango

Selection Number	Collector code	Total soluble solids (%)	Acidity (%)	TSS : acid Ratio	Reducing sugars (%)	Total sugars (%)	Ascorbic acid (mg/100g of pulp)
1.	RG-1	18.20	0.45	40.57	2.47	16.64	26.53
2.	RG-2	13.60	0.48	17.30	3.64	17.21	33.58
3.	RG-3	15.10	0.46	23.90	5.14	21.34	27.42
4.	RNPB-1	19.60	0.51	38.58	4.34	18.21	34.58
5.	RNPB-2	16.60	0.64	32.18	3.42	20.28	35.52
6.	RAPS-1	14.20	0.72	29.50	2.18	19.92	29.92
7.	RAPS-2	19.10	0.82	26.47	4.07	20.77	37.91
8.	RAPS-3	15.10	0.57	30.05	4.63	18.60	34.84
9.	RAPS-5	17.30	0.53	32.62	3.20	17.87	42.42
10.	RA-2	13.10	0.63	16.96	4.44	16.64	35.25
11.	RA-6	16.60	0.65	33.32	2.96	16.72	30.93
12.	RBS-1	20.20	0.74	52.31	1.42	17.02	37.18
13.	RBS-2	14.10	0.53	30.28	3.11	19.91	44.68
14.	NPW-1	13.10	0.61	29.85	2.72	19.63	38.14
15.	NPW-2	13.80	0.52	31.48	3.63	20.66	47.09
16.	NCPR-1	15.10	0.78	33.47	2.92	20.44	36.42
17.	NCPR-2	17.00	0.76	27.36	4.46	21.07	36.78
18.	NPW-5	19.10	0.54	28.71	4.64	21.14	40.37
19.	NKP-1	16.30	0.47	27.96	2.47	20.28	42.87
20.	NKP-2	15.40	0.44	29.90	3.72	21.19	41.12
21.	NKP-3	17.00	0.80	32.52	2.13	19.73	37.47
22.	NKP-4	18.80	0.66	30.10	3.23	20.13	50.46
23.	NA-1	13.00	0.59	31.81	3.42	20.71	37.18
24.	NA-2	14.00	0.46	16.84	4.12	16.97	40.77
25.	NA-3	14.90	0.69	30.37	3.44	20.42	36.28
	Max	20.20	0.82	52.31	5.14	21.34	50.46
	Min	13.00	0.44	16.84	1.42	16.64	26.53