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Characterization of sucking type mango genotypes under sub-tropics of Punjab

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ABSTRACT

Nine sucking mango genotypes were evaluated for the qualitative and quantitative characteristics of plant, leaf, inflorescence, flowering and fruit morphometric as per IPGRI Mango Descriptor. The colour measurements of young emerging leaves were recorded with colour flex meter and it varied from brownish-green to purple-brown. In all genotypes, full bloom was observed in the last week of March, while fruit set from 25th March to 3rd of April. Wide variability among the sucking mango genotypes was observed with respect to fruit length/breadth ratio (1.02 - 1.84), fruit weight (77.3 - 203.7 g), fruit yield (34.7 - 100.5 kg/tree), TSS/acid ratio (21.3 - 51.7) and pulp/stone ratio (1.81 - 2.72). The incidence of mango malformation varied from 4.2 per cent in GN_3 to 15.1 per cent in GN_4. The variability in the existing germplasm can be exploited for strategic future mango improvement programmes.

Key words: Characterization, genetic variability, sucking type mango.

INTRODUCTION

In Punjab, mango is commercially grown in sub-montane zone and this region is famous for sucking type of seedling mangoes since it has a rich reservoir of genetic diversity. Mono-embryonic mango seedlings growing on roadsides, riverbanks, isolated places and government lands are being uprooted in last few decades to meet the local requirements for fodder, fuel, widening of roads, construction of check dams for ensured irrigation facilities in undulated terrains etc. (Navprem *et al*., 7). These rare native mango genetic resources are known to possess desirable horticultural traits and primarily inevitable provide livelihood has been eroded or at the verge of extinction. To strengthen the genetic base and conservation of elite sucking mangoes, a survey was carried out in early seventies and consequently more than 60 mango genotypes with unique morphological characteristics like oblong shape, unrupturable skin, superior blend of TSS/acid ratio, small stone with scanty fibres and red blush on the skin etc. were collected and planted at the Fruit Research Station, Gangian, Punjab. Several workers have also characterized the promising local mango genotypes under diverse eco-geographical conditions in tropical and sub-tropical regions of the country (Navprem *et al*., 7; Shrivastava *et al*., 12; Selvan *et al*., 10; Singh, 13), however, detailed information on various aspects like leaf, flowering and fruit characteristics in sucking type of mangoes is not available. Therefore, present investigations were planned to characterize sucking mangoes on the basis of flowering, fruit morphology and quality traits to facilitate mango breeding programme.

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MATERIALS AND METHODS

Nine elite mango genotypes of 35-year-old age, raised on *desi* mango seedlings and maintained under uniform cultural practices were evaluated for four years at PAU-Fruit Research Station, Gangian, Punjab. Vegetative, floral and fruit traits were studied usingIPGRI 'Mango Descriptors' (Anon, 2). Colour of young emerged leaves was recorded with Hunter Lab Colour Flex EZ, USA scale, *i.e.* 'L', 'a' and 'b' values. Vegetative growth and leaf characters were recorded in the month of October after the growth cessation. Tree volume (m^3) was estimated from tree height and spread (N-S and E-W) values using formula suggested by Westwood (14). Floral malformation was noted in the month of April by counting the infected panicles and percentage was worked out from total number of panicles on the tree. Ten panicles in different directions were tagged after their emergence for determining various morphological observations. Male and hermaphrodite flowers were counted from selected 300 flowers from tagged panicles and ratio was estimated. Average fruit yield data for four years was noted. Ten fruits per tree were harvested to analyze different physico-chemical characteristics. Fruit stone size (length, breadth and thickness) was measured with Vernier calipers. Juice was extracted from the pulp by straining through a muslin cloth and total soluble solids were noted with hand refractometer in term of degree Brix and values were

corrected at 20°C. Fruit juice acid content, reducing and total sugars were determined as per the standard procedures (AOAC,1). The data recorded were statistically analyzed as suggested by Gomez and Gomez (4).

RESULTS AND DISCUSSION

Leaf shape was ovate in GN_1 and GN_5 and elliptical in rest of genotypes, whereas leaf length varied between 16.0 cm in GN_{19} to 24.4 cm in GN_6; leaf breadth was maximum 6.83 cm in GN_1 and minimum 2.43 cm in GN_4 and petiole length ranged from 1.83 cm (GN_4) to 4.47 cm (GN_6). Leaf characters, *viz*., acuminate leaf apex, acute leaf base with wavy leaf margin was noted in the most of genotypes under study. The colour of emerged leaf was brownish green to purple brown as confirmed from the recorded values of 'L' 'a', and 'b' (Table 1). Initiation and end of flowering season under Punjab conditions was observed from the last week of February up to mid of March, respectively (Table 2). In all genotypes, full bloom was observed during 22nd to 28th March. Whereas, fruit set was noted during 25th March to 3rd April. Hermaphrodite flowers ranged from 40.2 to 61.9 per cent, minimum in GN_4 and maximum in GN_{12}, which is essential for the initial fruit set. Sharma and Singh (11) reported that number of hermaphrodite flowers in mango tree depends upon the variety and its adaptability in the region; however, it is not accountable for the final fruit retention. Flowering characters like panicle size (length and breadth) ranged from 13.47 to 25.88 cm and 6.06 to 10.19 cm, respectively; however, shape of inflorescence was conical in GN_1, GN_4, GN_5, GN_7, GN_{19} and broadly pyramid in GN_2, GN_3, GN_{12}. Number of rachis/panicle was maximum (22.3) in GN_7 and minimum (14.9) in GN_2. Likewise, flowers density/panicle was sparse in GN_1, dense in GN_2 and GN_{19} and medium in rest of the genotypes. The colour of petals in GN_5 and GN_6 was yellowish-pink and both genotypes produced two types of flowers, *i.e*., pentamerous and tetramerous. The colour of rachis varied from light green to reddish green (Table 2a). In the present studies, disparity in flowering characters among different genotypes selected from open-pollinated seedling population may be due to the introgression of genes during hybridization (Damodaran *et al*., 3).

Mango genotypes were also classified on the basis of fruit shape as ovate (GN_1, GN_3, GN_5), oblong (GN_2, GN_6, GN_7, GN_{12}) and ovate oblong (GN_4, GN_{19}). On ripening, the fruits in GN_2, GN_5, GN_6 and GN_{19} genotypes had attractive yellow colour with red or Sindhuri blush on their peel and fruit pulp colour ranged from yellow to orange. These genotypes can be used to develop new hybrids with appealing fruit peel colour to fetch good market remuneration. Adherence of skin to pulp was high in GN_4 and GN_7, depth of stalk cavity was shallow in GN_6, insertion of stalk was oblique in GN_2, GN_3, GN_5 and fruit beak and sinus was absent in GN_1 and GN_{19} (Table 3). Fruit apex varied from acute to obtuse, likewise density of lenticels on fruit skin was sparse to dense and size of lenticels ranged from small to medium. Wide variability was noted for the presence of aroma among fruits during fruit ripening and is considered as the most important character to identify sucking type of

Table 1. Description of leaf characters in sucking type mango genotypes.

Genotype	Leaf shape	Leaf length (cm)	Leaf breadth (cm)	Petiole length (cm)	Leaf apex	Leaf base	Leaf margin	Visual colour of emerging leaf	Leaf colour coordinates		
									L*	a**	b***
GN_1	Ovate	22.3	6.83	2.84	Acuminate	Acute	Wavy	Pinkish-brown	29.22	-1.40	7.64
GN_2	Elliptical	18.8	5.33	2.88	Acuminate	Acute	Wavy	Brownish-green	30.19	-3.21	10.09
GN_3	Elliptical	21.3	5.57	4.27	Attenuate	Acute	Wavy	Greenish-brown	28.53	12.75	6.77
GN_4	Elliptical	16.9	2.43	1.83	Acuminate	Acute	Entire	Greenish-brown	29.54	-1.60	8.62
GN_5	Ovate	17.3	4.31	3.12	Acuminate	Acute	Wavy	Greenish-brown	31.87	2.26	9.06
GN_6	Elliptical	24.4	6.60	4.47	Acuminate	Obtuse	Wavy	Brownish-purple	29.18	8.53	7.91
GN_7	Elliptical	19.6	5.13	2.73	Acuminate	Acute	Wavy	Purple-brown	35.10	4.52	10.74
GN_{12}	Elliptical	18.3	5.93	2.25	Acuminate	Obtuse	Wavy	Brownish-green	31.61	-1.87	9.90
GN_{19}	Elliptical	16.0	5.05	2.70	Acuminate	Acute	Entire	Purple-brown	34.07	3.19	8.30
$CD_{0.05}$	-	3.4	0.47	1.02	-	-	-	-	2.45	1.58	1.98

L* = Light, a** = Redness, b*** = Yellowness

Table 2. Description of flowering characters in sucking type mango genotypes.

Genotype	Initiation of flowering	Full bloom	Time of fruit set	Male flower (%)	Hermaphrodite flower (%)	Panicle length (cm)	Panicle breadth (cm)	Shape of inflorescence
GN_1	28th Feb - 2nd March	24th March	27th - 29th March	46.3	53.7	14.4	6.5	Conical
GN_2	27th Feb - 4th March	25th March	28th - 30th March	50.4	49.6	17.5	10.2	Broadly pyramid
GN_3	1st March - 4th March	22nd March	25th - 27th March	57.3	42.7	18.1	7.3	Broadly pyramid
GN_4	26th - 28th Feb	26th March	31st March - 2nd April	59.8	40.2	20.6	6.7	Conical
GN_5	26th Feb - 1st March	26th March	30th - 31st March	49.5	50.5	18.1	6.4	Conical
GN_6	1st March - 3rd March	28th March	30th - 31st March	44.6	55.4	17.5	6.1	Pyramid
GN_7	28th Feb - 2nd March	26th March	29th - 31st March	38.2	61.8	25.9	9.9	Conical
GN_{12}	1st March - 4th March	28th March	1st - 3rd April	38.1	61.9	13.5	6.6	Broadly pyramid
GN_{19}	1st - 5th March	27th March	30th March - 2nd April	53.7	56.3	20.4	8.9	Conical
$CD_{0.05}$	-	-	-	4.5	2.7	1.20	0.75	-

Table 2a. Description of flowering and fruit attributes in sucking type mango genotypes.

Genotype	No. of rachis/ panicle	Flower density	Petal colour	Pubescence	Rachis colour	Flower type	Leaf panicle presence	Fruit shape	Fruit colour	Pulp colour
GN_1	16.5	Sparse	Yellow	Absent	Light greenish	Pentamerous	Absent	Ovate	Light green	Orange
GN_2	14.9	Dense	Yellow	Absent	Greenish with pink patches	Pentamerous	Absent	Oblong	Sindhuri	Yellow
GN_3	18.6	Medium	Yellow	Absent	Greenish	Pentamerous	Absent	Ovate	Light yellow	Yellow
GN_4	19.3	Medium	Yellow	Absent	Light greenish	Pentamerous	Absent	Ovate oblong	Light yellow	Creamish yellow
GN_5	21.7	Medium	Pinkish, yellow	Present	Greenish with pink patches	Penta and tetramerous	Present	Ovate	Yellow with red blush	Orange
GN_6	20.4	Medium	Pinkish, yellow	Absent	Reddish green	Penta and tetramerous	Absent	Oblong	Highly coloured	Yellow
GN_7	22.3	Medium	Yellow	Absent	Light green	Pentamerous	Absent	Oblong	Green yellow	Orange
GN_{12}	17.1	Medium	Yellow	Absent	Greenish	Pentamerous	Absent	Oblong	Yellowish green	Creamish yellow
GN_{19}	15.9	Dense	Yellow	Absent	Greenish	Pentamerous	Absent	Ovate oblong	Sindhuri blush at shoulder with yellow base	Orange
$CD_{0.05}$	1.57	-	-	-	-	-	-	-	-	-

Table 3. Description of fruit attributes in sucking type mango genotypes.

Genotype	Adherence of pulp to skin	Depth of stalk cavity	Insertion of stalk	Fruit apex	Density of lenticels	Size of lenticels	Flavour	Fruit beak	Fruit sinus
GN_1	Medium	Absent	Vertical	Obtuse	Medium	Medium	Good	Absent	Absent
GN_2	Low	Absent	Oblique	Acute	Dense	Small	Pleasant	Pointed	Slightly shallow
GN_3	Medium	Absent	Oblique	Acute	Medium	Small	Pleasant	Pointed	Slightly shallow
GN_4	High	Absent	Vertical	Acute	Sparse	Small	Pleasant	Prominent	Medium
GN_5	Low	Absent	Oblique	Rounded	Medium	Small	Pleasant	Prominent	Slightly shallow
GN_6	Medium	Shallow	Vertical	Obtuse	Medium	Medium	Pleasant	Prominent and pointed	Slightly shallow
GN_7	High	Absent	Vertical	Obtuse	Medium	Small	Pleasant	Pointed	Slightly shallow
GN_{12}	Medium	Absent	Vertical	Acute	Medium	Small	Good	Pointed	Slightly shallow
GN_{19}	Medium	Absent	Vertical	Obtuse	Medium	Medium	Pleasant	Absent	Absent

mangoes. Fruits of GN_1 and GN_{12} developed good flavour, taste and aroma, whereas other genotypes possessed pleasant attributes. Fruit dorsal shoulder was sloping downward in most of the genotypes except GN_5 and GN_{12} where it narrowed abruptly; and ventral shoulder was rounded outward (Table 4). Fruit stone shape was reniform and oblong, whereas, pulp fibres content was absent in GN_1 and GN_5, while other possessed less or more. On the basis of fruit maturity period, sucking mangoes were classified as early season (1st week of July), mid-season (2nd & 3rd week of July) and late season (beyond 4th week of July).

Table 4. Description of fruit attributes in sucking type mango genotypes.

Genotype	Fibreness	Presence of neck	Dorsal shoulder	Ventral shoulder	Vein on stone	Stone shape	Stone fibre length	Amount of fibres on stone	Harvesting time
GN_1	Absent	Absent	Sloping downward	Rounded upward	Slightly depressed	Reniform	Short	High	2nd week of July
GN_2	Present all over	Present	Sloping downward	Rounded outward	leveled surface	Oblong	Long	High	3rd week of July
GN_3	Sparsely present	Present	Sloping downward	Rounded outward	elevated	Reniform	Long	High	2nd week of July
GN_4	Sparsely present	Absent	Sloping downward	Rounded downward	Slightly depressed	Oblong	Long	High	3rd week of July
GN_5	Absent	Present	Falling Abruptly	Sloping downward	leveled surface	Oblong	Short	High	1st week of August
GN_6	Present	Present	Rounded downward	Rounded upward	depressed	Oblong	Medium	Medium	2nd week of July
GN_7	Fibrous	Absent	Sloping downward	Rounded outward	Slightly depressed	Reni form	Long	High	2nd week of July
GN_{12}	Fibrous all over	Absent	Falling Abruptly	Round upward	leveled surface	Reniform	Long	High	4th week of July
GN_{19}	Medium	Absent	Sloping downward	Rounded outward	Leveled surface	Oblong	Long	High	4th week of July

A substantial variation in vegetative growth characters were observed in sucking type mangoes (Table 5). Maximum (598.1 m^3) tree volume was observed in GN_6 and minimum in GN_7. The variation in plant growth characters in different genotypes might be due to inherent character and climatic conditions of the growing region. Average fruit yield for four years was the highest (100.5 kg/tree) in GN_3 indicated regularity in bearing habit and the lowest fruit yield (34.7 kg/tree) was in GN_7. Kumar (5) observed that variation in fruit yield potential in different mango varieties is affected by additive genes and it is influenced by environmental factors. Incidence of floral malformation in GN_3 was appreciably low (4.2 %), whereas, it varied from 7.2 per cent in GN_2 and 15.1 per cent in GN_4. Mishra (6) reported that malformation ranged from 0 to 58.58 per cent in different mango varieties/hybrids under Madhya Pradesh conditions and consequently, genotypes with lower incidence may primarily be selected for the resistance breeding programme.

Fruit weight also differed significantly among various genotypes (Table 5) with maximum (203.7 g) in GN_6 and minimum (77.3 g) in GN_1. Fruit weight of 185.4, 170.5 and 162.1 g was found in GN_{19}, GN_{12} and GN_4, respectively. GN_{12} and GN_2 recorded maximum (1.84) and minimum (1.04) fruit length/breadth ratio, respectively. Fruit thickness ranged from 4.12 cm in GN_{12} to 6.87 cm in GN_6. GN_4 had maximum stone length/breadth ratio. Average pulp/stone ratio in different genotypes exhibited variation from 1.81 to 2.72, being minimum in GN_1 and maximum in GN_2. Fruit pulp recovery per cent was found to be the highest in GN_{12}, followed by GN_2, GN_4 and the lowest in GN_6. Chemical quality attributes among the different genotypes also depicted wide genetic variability (Table 5). Total soluble solids were the highest (20.4%) in GN_{19}, which was at par with GN_3, but appreciably superior than the other genotypes under study. Important sucking mangoes growing under Uttar Pradesh state had shown wide genetic variability in total soluble solids in juice and it ranged from 13.5 to 18.2 per cent (Rabbani and Singh, 9). However, maximum (0.69%) fruit juice acid content was noted in GN_6 and minimum in GN_2. The variation in TSS/acid ratio ranged from 21.3 to 51.1, being minimum in GN_6 and maximum in GN_2. Total sugars and reducing sugars content in fruit juice varied from 11.36 to 16.13 and 2.99 to 5.24 per cent, respectively. The present attributes related to sucking type of mangoes are corroborated with the findings of Nayak *et al*. (8) that ideal mango cultivar should possess

Table 5. Vegetative and physico-chemical characters in sucking type mango genotypes.

Character	GN_1	GN_2	GN_3	GN_4	GN_5	GN_6	GN_7	GN_{12}	GN_{19}	$CD_{0.05}$
Tree volume (m^3)	480.5	338.4	347.4	373.7	498.8	598.1	280.1	308.9	587.1	31.4
Fruit yield (kg/tree)	37.1	41.3	100.5	48.8	57.4	85.5	34.7	60.1	83.7	16.7
Malformation (%)	11.0	7.2	4.2	15.1	13.7	7.3	11.8	12.8	9.7	2.9
Fruit weight (g)	77.3	123	142.1	162.1	124.1	203.7	126.4	170.5	185.4	10.4
Fruit length/breadth ratio	1.39	1.02	1.53	1.72	1.21	1.18	1.40	1.84	1.46	0.14
Fruit thickness (cm)	4.34	5.10	4.65	5.05	4.82	6.87	4.61	4.12	4.73	0.21
Pulp (%)	54.7	60.5	57.6	59.1	58.4	52.0	55.3	62.1	55.2	0.49
Peel (%)	15.0	17.2	19.5	18.2	16.6	23.2	15.1	14.6	21.0	0.16
Stone (%)	30.3	22.3	22.9	22.7	25.0	24.8	29.6	23.3	23.8	1.05
Stone length/breadth ratio	1.58	1.71	2.03	2.60	1.95	1.32	2.00	2.16	2.15	NS
Stone thickness (cm)	2.19	2.16	1.96	2.1	2.12	3.54	2.27	2.5	2.08	NS
Peel thickness (mm)	2.1	1.4	1.2	0.8	1.4	2.4	1.8	1.0	1.5	NS
Pulp/stone ratio	1.81	2.72	2.53	2.67	2.26	2.20	1.87	2.58	2.34	0.34
TSS (%)	17.8	18.1	20.1	17.8	18.4	14.7	19	18.9	20.4	0.49
Acidity (%)	0.43	0.35	0.43	0.57	0.51	0.69	0.40	0.49	0.45	0.03
TSS/acid ratio	41.3	51.7	46.7	31.2	36.1	21.3	47.5	38.6	45.3	4.75
Total sugars (%)	12.91	15.39	15.93	14.00	13.70	11.36	14.71	14.15	16.13	2.45
Reducing sugars (%)	4.96	5.24	3.21	4.8	4.08	2.19	2.99	4.53	3.89	0.44

distinct fruit pulp (sweetness, acidity, firmness, flavour, pulp/stone ratio) and appearance (peel colour, uniform fruit size and shape) parameters.

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