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## Studies on morphological characterization of certain selected half sib populations in mango (*Mangifera indica* L.)

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### Abstract

The present study was conducted at IIHR, Bengaluru during 2019 & 2020 with 8 mango half sib populations consists of 200 progenies (Lazzat baksh, Kesar, Goa Mankurad, Malanji, Dashehari, Sensation, Himsagar and Mandoor Khatta) were assessed and compared using morphological characters such as plant height, stem girth, number of primary branches, primary branch length, leaf length, leaf width, ratio of leaf length / leaf width, and petiole length and descriptive statistics analysis was done. Among the eight half sib groups studied, the highest mean plant height (1.88 m), stem girth (4.74 cm) and primary branch length (0.90 m) was recorded by Lazzat baksh half sib group. Highest number of primary branches (2.60) and leaf length (22.80 cm) was observed by Dashehari half sib population. The Malanji half sib population recorded highest mean leaf width (5.63 cm) while highest mean petiole length was recorded by Himsagar half sib group (6.53 cm).

**Keywords:** Mango, half-sibs, charecterization, vegetative characters

### Introduction

Mango (*Mangifera indica* L.) is one of the choicest and admired fruit crops of the tropical and subtropical areas of the world. Its significance can easily be recognized by the fact that it is known as 'King of Fruits'. The cultivation of mango is believed to have started four to six thousand years back rendering it as old as the Indian civilization itself (Mukherjee, 1953; Kostermans and Bompard, 1993) [9]. Mango has been reported to have extensive diversity due to allopolyploidy, outbreeding and phenotypic differences arising from varied agro-climatic conditions in different mango growing regions. The world needs to increase crop productivity for the development of the valuable varieties to changing environmental and biological challenges that meets to evolve the needs of local communities. To meet these needs and challenges, farmers and scientists not only must have access to a wide range of plant genetic resources but also must have access to the essential information about those plant genetic resources that will allow effective used. The lack of adequate passport, characterization, and evaluation data; people cannot use genetic resources that lack essential information. In addition, such information is necessary for proper management of the resources in the gene banks by gene bank managers. Therefore, the accurate documentation of information about the origin, characterization, and performance of germplasm is essential for effective conservation and use. Phenotypic characters are visually evaluated in most cases and are thereby subjective morphological characteristics that can improve characterizations for defining the potential use of any genotype. These traits have long been the means of studying variability among populations in fruit crops. In this study, the variability of 8 mango half sib populations (Lazzat baksh, Kesar, Goa Mankurad, Malanji, Dashehari, Sensation, Himsagar and Mandoor Khatta) was assessed and compared using morphological traits.

### Experimental material and methods

The experimental material for present investigation was comprised of 200 progenies (8 half sib mango populations) collected from different mother varieties maintained at ICAR-Indian Institute of Horticultural Research (IIHR), Bengaluru. These eight half sib groups include Lazzat baksh, Kesar, Goa mankurad, Malanji, Dashehari, Sensation, Himsagar and Mandoor khatta. All the half sib groups were provided with standard agronomic practices such as irrigation, nutrient and pest management.

Data were recorded on eight important parameters includes plant height (m), stem girth (cm), number of primary branches, primary branch length (m), leaf length (cm), leaf width (cm), ratio of leaf length/leaf width (cm), petiole length (cm). At the beginning of experiment, the age of half sib groups was 2 years old. The statistical mean was calculated using the method suggested by Goulden (1952) [4]. Range was calculated based on the difference between the lowest and the highest values present in the half sib population. The coefficient of variation was computed according to Burton and Devane (1953) [2].

$$\text{Coefficient of variation} = \frac{\text{Standard deviation}}{\text{Mean}} \times 100$$

## Results and Discussion

Significant differences were observed in Plant height of 8 half sib populations studied, Plant height varied from 0.43 m (Dashehari) to 2.43 m (Himsagar) as presented in Table 1. In Lazzat Baksh half sib group maximum and minimum plant height recorded were 2.35 m and 1.48 m respectively. In Kesar half sib group maximum plant height recorded was 2.20 m and minimum Plant height recorded was 1.11 m. In Goa mankurad half sib group maximum and minimum plant heights observed were 2.17 m and 0.46 m, respectively. In case of Malanji half sib group, maximum plant height recorded was 2.17 m and minimum plant height recorded was 0.46 m. Dashehari half sib group had maximum plant height of 1.92 m and minimum plant height of 0.43 m. In Sensation half sib population, maximum and minimum plant heights recorded were 2.25 m & 0.59 m, respectively. In Himsagar half sib population, maximum plant height recorded was 2.43 m and minimum Plant height recorded was 0.66 m. In case of Mandoor khatta half sib population, maximum and minimum Plant heights recorded were 2.03m, 0.44 m respectively. Among eight half sib populations, mean Plant height varied from 1.44 m (Dashehari half sib population) to 1.88 m (Lazzath baksh half sib population). Highest mean plant height was recorded by Lazzat Baksh half sib group (1.88 m) followed by Kesar (1.76 m), Goa mankurad & Malanji (1.67 m), Himsagar (1.58 m) half sib groups. Lowest mean plant height was recorded by Dashehari (1.44 m) followed by Mandoor khatta (1.52 m) and Sensation (1.55 m) half sib groups. Highest coefficient of variation for plant height was recorded by Mandoor khatta half sib group (24.34%) and lowest coefficient of variation for Plant height was recorded by Lazzat Baksh half sib group (11.70%). The height of plant is one of the most important quality parameters which reflect the growth and quality of mango tree. Different cultivars of mango varied in their performance and these differences are governed by various genetic, cultural and environmental factors. The growth of the mango trees is usually given by cycles with short repetitions throughout the year and it is depending on the cultivar, climate conditions and management. The knowledge about the growth pattern of the mango trees is essential for establishing effective methods to handle the culture and it allows the phenotypic characteristics expressions of each genetic material. The variation in Plant height amongst mango populations might be due to variation in genetic-make up. It is evident from data (Table 1) that with respect to plant height, significant differences were observed in Plant height among the half sib groups. Lowest mean plant height recorded by Dashehari half sib group. Maximum plant height recorded in Dashehari population was 1.92 m and

minimum Plant height observed was 0.43 m. these maximum and minimum values were less than remaining Plant height values (maximum & minimum) of half sib groups. It might be due to the dwarfing nature or less vigorous nature of Dashehari population because all half sib groups were of similar age. Dwarfness is a desirable feature to breed elite cultivars. No single character can be pointed out as the main growth factor responsible for the determination of tree size. In fact it is a function of various characters. These results were supported by Joshi *et al.* (2013) [5]. They grew nine cultivars in India and collected data on vegetative growth when the trees were 20-years-old. Most of the cultivars, including 'Bombay Green', 'Chausa', 'Langra' and 'Mallika' were classified as vigorous, while 'Dashehari' and 'Amrapali' were classed as less vigorous. Morphological growth characteristics like percentage of shoots giving new flushes and length of flushes, root number & length, bark percentage, leaf water potential and hormonal factors influencing dwarfness need to be studied in future for this half sib group.

Significant differences were observed for stem girth among the half sib populations. Data in Table 2 illustrated, stem girth varied from 1.29 cm to 7.03 cm. In Lazzat Baksh half sib group maximum and minimum stem girths recorded were 7.03 cm, 2.03 cm respectively. In Kesar half sib group maximum stem girth recorded was 6.17 cm and minimum stem girth recorded was 2.04 cm. In Goa mankurad, Malanji half sib groups maximum and minimum stem girths observed were 6.30 cm and 1.64 cm respectively. In case of Dashehari half sib group, maximum stem girth recorded was 3.87 cm and minimum stem girth recorded was 1.29 cm. Sensation half sib group had maximum stem girth of 5.70 cm and minimum stem girth of 1.43 cm. In Himsagar half sib population, maximum and minimum stem girths recorded were 5.47 cm & 1.56 cm, respectively. In case of Mandoor khatta half sib population, maximum and minimum stem girths recorded were 6.17 cm, 1.54 cm respectively. Mean stem girth varied from 2.90 cm (Dashehari half sib group) to 4.74 cm (Lazzat baksh half sib population) among the eight half sib populations. The maximum mean stem girth was recorded by Lazzat Baksh half sib population (4.74 cm) followed by Goa mankurad, malanji (4.20 cm), Kesar (4.11 cm) and Himsagar half sib population (3.78 cm). Minimum mean stem girth was recorded by Dashehari half sib group (2.90 cm) followed by Mandoor khatta (3.58 cm) and Sensation half sib populations (3.77 cm). Highest coefficient of variation for stem girth was recorded by Sensation half sib group (33.95%) followed by Mandoor khatta half sib population (32.12%) among the eight half sib populations. Similar trend of results have also been reported by Rymbai (2016) [10]. The variation in vegetative growth characters with respect to stem girth among mango varieties might be due to variation in genetic make-up. The more or less similar result has been reported by Srivastava *et al.* (1987) [12].

Among 8 half sib populations studied, the number of primary branches ranged from 1 to 3. There was significant amount of variation observed in half sib populations with respect to number of primary branches. The perusal of data presented in table 3 & 4 shows that one primary branch was observed in Lazzat Baksh, Kesar, Goa mankurad, Malanji, Sensation & Himsagar with varied frequencies (8%, 12%, 4%, 4%, 20% and 4%). Two primary branches were observed in Lazzat baksh, Kesar, Goa mankurad, Malanji, Dashehari, Sensation, Himsagar & Mandoor khatta with varied frequencies (48%, 48%, 56%, 64%, 40%, 40%, 44% and 64%). In Lazzat Baksh,

Kesar, Goa mankurad, Malanji, Dashehari, Sensation, Himsagar & Mandoor khatta there were 3 primary branches observed with varied frequencies (40%, 40%, 40%, 32%, 60%, 40%, 52% and 36%). Majority of primary branches observed were two in six half sib groups (Lazzat baksh, Kesar, Goa mankurad, Malanji, Dashehari and Mandoor khatta). Majority of primary branches observed were three in rest of the two half sib groups (Himsagar and Sensation).

On analyzing the data from table 5, primary branch length varies from 0.11 m to 1.98 m among the studied half sib populations. In Lazzat Baksh half sib group maximum and minimum primary branch lengths recorded were 1.98 m, 0.48 m respectively. In Kesar half sib group maximum primary branch length recorded was 1.2 m and minimum primary branch length recorded was 0.11 m. In Goa mankurad half sib group maximum and minimum primary branch lengths observed were 1.28 m, 0.53 m respectively. In case of Malanji half sib group, maximum primary branch length recorded was 1.17 m and minimum primary branch length recorded was 0.27 m. Dashehari half sib group had maximum primary branch length of 1.02 m and minimum primary branch length of 0.25 m. In Sensation half sib population, maximum and minimum primary branch lengths recorded were 1.25 m & 0.32 m respectively. In Himsagar half sib population, maximum primary branch length recorded was 1.43 m and minimum primary branch length recorded was 0.30 m. In case of Mandoor khatta half sib population, maximum and minimum primary branch length recorded were 1.03m, 0.29 m respectively. Mean primary branch length varied from 0.52 m to 0.90 m. The maximum mean primary branch length was recorded in Lazzat Baksh half sib population (0.90 m) followed by Goa mankurad (0.80 m), Kesar (0.76 m), Malanji (0.72 m), Himsagar (0.67 m) half sib population where as minimum mean primary branch length (0.52 m) was recorded in Lazzat baksh half sib group followed by Mandoor khatta (0.62 m) and Sensation (0.63 m) half sib groups. Highest coefficient of variation for primary branch length was observed by Dashehari half sib population (38.4%) followed by Kesar (36.84%) half sib group among the eight half sib populations. The significant variation among the genotypes for primary branch length could be due to the genetic constitution of particular variety and interaction with environmental factors. This was supported by the findings of Samanta *et al.* (1999) [13] who observed the broad range of variation for primary branch length and leaf length among the 25 types of mango grown in West Bengal. Majumder *et al.* (2011) [8] and Joshi *et al.* (2013) [5] also reported the significant variations in number of primary branches and leaf width of mango.

It is evident from data that with respect to leaf length, significant differences were observed among the half sib groups. Persual of data from table 6 revealed that leaf length varied from 13cm to 29.8 cm. In Lazzat Baksh half sib group maximum and minimum leaf lengths recorded were 29 cm, 15.4 cm, respectively. In Kesar and Dashehari half sib groups maximum leaf length recorded was 29.8 cm and minimum leaf length recorded was 15.4 cm. In Goa mankurad half sib group maximum and minimum leaf lengths observed were 28 cm, 15.11 cm, respectively. In case of Malanji half sib group, maximum leaf length recorded was 26.8 cm and minimum leaf length recorded was 15.7 cm. Sensation half sib group had maximum leaf length of 28 cm and minimum leaf length of 13 cm. In Himsagar half sib population, maximum and minimum leaf lengths recorded were 26.7cm & 17.6cm,

respectively. In case of Mandoor khatta half sib population, maximum leaf length recorded was 33.5 cm and minimum leaf length recorded was 15.9 cm. The mean leaf length varied from 21.2cm to 22.8cm among the eight half sib populations. The maximum mean leaf blade length was recorded by Dashehari half sib population (22.8 cm) followed by Mandoor khatta (22.3 cm), Himsagar (22.1 cm), Malanji (21.8 cm), Goa mankurad & Kesar (21.7 cm). Minimum mean leaf length was recorded by Sensation half sib group (21.2 cm) followed by Lazzat baksh (21.4 cm), Kesar, Goa mankurad (21.7 cm) half sib populations. Highest coefficient of variation for leaf length (19.82%) was observed by Mandoor khatta half sib group followed by Goa mankurad (19.67%) half sib population among the eight half sib population. A wider variation in length and breadth of leaf was noticed in different progenies of mango by different workers. The length and breadth of Tango variety was 25.00 cm and 6.5 cm, 25.00 and 6.20 cm in Shelly (Lavi *et al.*, 1993) [6] and 30.00 and 6.20 cm in Naomi variety (Tomer *et al.*, 1993) [14], respectively. The length of leaf was 21.20 cm and breadth of 4.6 cm was noticed in a mango mutant (Roy and Sharma, 1960) [11]. Such variation in the length and breadth of the leaf in present study and by previous workers may be attributed to the genotype of the plant. Dorji and Chinawat (2011) [3] reported that leaf length was maximum in Trongsa (94.80 mm) and minimum was in Dagana mandarin (76.40 mm).

It is evident from data (Table 7) that with respect to leaf width, significant differences were observed among the half sib groups. Data in table 7 exhibited the leaf width varied from 3.5 cm to 7 cm. In Lazzat Baksh half sib group maximum and minimum leaf widths recorded were 7.50 cm, 3.50 cm, respectively. In Kesar half sib group maximum leaf width recorded was 6.80 cm and minimum leaf width recorded was 4.30 cm. In Goa mankurad half sib group maximum and minimum leaf widths observed were 7.20 cm, 4.10 cm, respectively. In case of Malanji half sib group, maximum leaf width recorded was 6.80 cm and minimum leaf width recorded was 4.10 cm. Dashehari half sib group had maximum leaf width of 6.70 cm and minimum leaf width of 3.50 cm. In Sensation half sib population, maximum and minimum leaf widths recorded were 6.80 cm & 4.00 cm respectively. In Himsagar half sib population, maximum leaf width recorded was 7.00 cm and minimum leaf width recorded was 4.60 cm. In case of Mandoor khatta half sib population, maximum and minimum leaf widths recorded were 7.00 cm, 3.50 cm respectively. Mean leaf width varied from 5.09 cm to 5.68 cm. Highest mean leaf width was recorded by Malanji half sib group (5.68 cm) followed by Himsagar (5.57 cm), Dashehari (5.38 cm) and Sensation half sib group (5.32 cm). Lowest mean leaf width was recorded by Mandoor khatta half sib group (5.09 cm) followed by Kesar (5.18 cm) and Lazzat baksh (5.30 cm) half sib populations. Highest coefficient of variation for leaf width was observed in Lazzat baksh population (18.49%) followed by Dashehari half sib group (16.91%) among the eight half sib populations. These findings coincide with previous findings by Vicecelli *et al.* (2016) [15] who reported the leaf length and width were, on average, respectively of 243.44 mm and 55.74 mm in 'Imbu' variety of Mango. The data concerning the measures of the predominant leaves showed in close association with those found by Laroussilhe (1980) [7] for other cultivars, with leaf length ranging from 150 to 400 mm and leaf width ranging from 15 cm to 40 mm.

Significant differences were observed for ratio of leaf length /



width among the half sib populations. Data in Table 8 illustrated, ratio varied from 1.29 cm to 7.03 cm. In Lazzat Baksh half sib group maximum and minimum leaf length / leaf width ratios recorded were 5.09 cm, 2.43 cm respectively. In Kesar half sib group maximum leaf length / leaf width ratio recorded was 5.70 cm and minimum leaf length / leaf width ratio recorded was 2.76 cm. In Goa mankurad half sib group maximum and minimum leaf length / leaf width ratios observed were 5.6 cm, 2.09 cm respectively. In case of Dashehari half sib group, maximum leaf length / leaf width ratio recorded was 5.60 cm and minimum leaf length / leaf width ratio recorded was 2.43 cm. Sensation half sib group had maximum leaf length / leaf width ratio of 4.82 cm and minimum leaf length / leaf width ratio of 3.17 cm. In Himsagar half sib population, maximum and minimum leaf length / leaf width ratios recorded were 4.90 cm & 3.58 cm respectively. In case of Mandoor khatta half sib population, maximum and minimum leaf length / leaf width ratios recorded were 5.60 cm, 3.29 cm respectively. Among 8 half sib populations studied, the ratio of mean leaf length/ leaf width varied from 3.85 cm to 4.40 cm. The maximum mean leaf length/ leaf width ratio was recorded by Mandoor khatta half sib population (4.40 cm) followed by Kesar (4.22 cm), Dashehari (4.17 cm), Goa mankurad (4.12 cm) and Lazzat Baksh half sib group (4.09). Minimum mean leaf length/ leaf width ratio was recorded by malanji half sib group (3.85 cm) followed by Himsagar (3.98 cm) and Sensation half sib group (3.99 cm).

The highest coefficient of variation for leaf length/ leaf width was recorded in Goa mankurad half sib group (18.44%) followed by Dashehari half sib population (16.54%) among the eight half sib populations. Similar trend was reported by Vicecelli *et al.* (2016) <sup>[15]</sup> in Imbu variety of Mango, where the leaf length/width ratio had an average of 4.37 cm.

Persual of data from table 9 revealed that the petiole length varied from 2.96 cm to 7.97 cm among the 8 half sib populations. In Lazzat Baksh half sib group maximum and minimum petiole lengths recorded were 6.32 cm, 2.98 cm respectively. In Kesar half sib group maximum petiole length recorded was 6.02 cm and minimum petiole length recorded was 3.15 cm. In Goa mankurad half sib group maximum and

minimum petiole lengths observed were 7.11 cm, 3.12 cm respectively. In case of Malanji half sib group, maximum petiole length recorded was 5.90 cm and minimum Petiole length recorded was 2.96 cm. Dashehari half sib group had maximum petiole length of 6.08 cm and minimum petiole length of 3.33 cm. In Sensation half sib population, maximum and minimum petiole lengths recorded were 6.93 cm & 3.01 cm respectively. In Himsagar half sib population, maximum petiole length recorded was 7.97 cm and minimum petiole length recorded was 3.19 cm. In case of Mandoor khatta half sib population, maximum and minimum petiole lengths recorded were 7.50 cm, 3.85 cm, respectively. Mean petiole length among the half sib populations varied from 4.24 cm to 6.53 cm. Highest mean petiole length was recorded by Himsagar half sib group (6.53 cm) followed by Mandoor khatta (5.87 cm), Goa mankurad (4.85 cm) and Dashehari (4.69 cm) half sib groups. Lowest mean petiole length was recorded by Sensation half sib group (4.24 cm) followed by Malanji (4.39 cm), Kesar (4.43 cm) and Lazzat Baksh (4.55 cm). Highest coefficient of variation for petiole length was observed by Himsagar half sib group (18.68%) followed by Kesar half sib group (16.25%). Similar findings were reported Vicecelli *et al.* (2016) <sup>[15]</sup> and Ahmed *et al.* (2016) <sup>[1]</sup> in different mango genotypes growing in different agro climate regions.

### Conclusion

Different half sib groups varied in their performance with respect to the studied morphological characters. Height of the plant is an important character in any crop. In case of mango, dwarfness is a desirable feature to breed elite cultivars. Dashehari half sib group recorded lowest mean plant height, lowest mean stem girth and lowest mean primary branch length among the half sib populations studied. This might be due to genotype x environment effects apart the xenic effects unknown pollen parent which caused the dwarfing. Morphological growth characteristics like percentage of shoots giving new flushes and length of flushes, root number & length, bark percentage, leaf water potential and hormonal factors influencing dwarfness need to be studied in future for this half sib group.

**Table 1:** Descriptive statistics for extent of variability in plant height (m) belonging to different half sib groups of Mango (*Mangifera indica* L.)

S. No	Half sib group	Minimum	Maximum	Mean ± SE	S.D	C.V (%)
1.	Lazzat Baksh	1.48	2.35	1.88 ± 0.06	0.22	11.70
2.	Kesar	1.11	2.20	1.76 ± 0.03	0.28	15.90
3.	Goa Mankurad	0.46	2.17	1.67 ± 0.02	0.39	23.35
4.	Malanji	0.46	2.17	1.67 ± 0.02	0.39	23.35
5.	Dashehari	0.43	1.92	1.44 ± 0.02	0.29	20.13
6.	Sensation	0.59	2.25	1.55 ± 0.05	0.31	20.00
7.	Himsagar	0.66	2.43	1.58 ± 0.02	0.35	22.15
8.	Mandoor khatta	0.44	2.03	1.52 ± 0.01	0.37	24.34

**Table 2:** Descriptive statistics for extent of variability in stem girth (cm) belonging to different half sib groups of Mango (*Mangifera indica* L.)

S. No	Half sib group	Minimum	Maximum	Mean ±SE	S.D	C.V (%)
1.	Lazzat Baksh	2.43	7.03	4.74 ± 0.18	1.09	22.99
2.	Kesar	2.04	6.17	4.11 ± 0.14	0.72	17.51
3.	Goa Mankurad	1.64	6.30	4.2 ± 0.10	1.12	26.66
4.	Malanji	1.64	6.30	4.2 ± 0.10	1.12	26.66
5.	Dashehari	1.29	3.87	2.9 ± 0.13	0.79	27.24
6.	Sensation	1.43	5.70	3.77 ± 0.12	1.28	33.95
7.	Himsagar	1.56	5.47	3.78 ± 0.13	1.05	27.77
8.	Mandoor khatta	1.54	6.17	3.58 ± 0.12	1.15	32.12

**Table 3:** Descriptive statistics for extent of variability in number of primary branches for the half sib groups (Lazzat Baksh, Kesar, Goa mankurad and Malanji) of Mango (*Mangifera indica* L.)

S. No	Half sib group	States	Frequency	Range	Mean ± SE	S.D	C.V (%)
1.	Lazzat Baksh	1	8%	1-3	2.30 ± 0.12	0.62	26.95
		2	48%				
		3	40%				
2.	Kesar	1	12%	1-3	2.28 ± 0.13	0.67	29.38
		2	48%				
		3	40%				
3.	Goa mankurad	1	4%	1-3	2.36 ± 0.11	0.58	24.16
		2	56%				
		3	40%				
4.	Malanji	1	4%	1-3	2.28 ± 0.10	0.54	23.68
		2	64%				
		3	32%				

**Table 4:** Descriptive statistics for extent of variability in number of primary branches for the half sib groups (Dashehari, Sensation, Himsagar and Mandoor khatta) of Mango (*Mangifera indica* L.)

S. No	Half sib group	States	Frequency	Range	Mean ± SE	S.D	C.V (%)
1.	Dashehari	1	-	2-3	2.60 ± 0.10	0.50	19.23
		2	40%				
		3	60%				
2.	Sensation	1	20%	1-3	2.20 ± 0.15	0.76	34.54
		2	40%				
		3	40%				
3.	Himsagar	1	4%	1-3	2.40 ± 0.11	0.58	24.16
		2	44%				
		3	52%				
4.	Mandoor khatta	1	-	2-3	2.30 ± 0.09	0.48	20.86
		2	64%				
		3	36%				

**Table 5:** Descriptive statistics for extent of variability in primary branch length (m) belonging to different half sib groups of Mango (*Mangifera indica* L.)

S. No	Half sib group	Minimum	Maximum	Mean ± SE	S.D	C.V (%)
1.	Lazzat Baksh	0.48	1.98	0.90 ± 0.06	0.31	34.44
2.	Kesar	0.11	1.20	0.76 ± 0.05	0.28	36.84
3.	Goa Mankurad	0.53	1.28	0.80 ± 0.03	0.18	22.50
4.	Malanji	0.27	1.17	0.72 ± 0.04	0.21	29.16
5.	Dashehari	0.25	1.02	0.52 ± 0.04	0.20	38.40
6.	Sensation	0.32	1.25	0.63 ± 0.04	0.21	33.30
7.	Himsagar	0.30	1.43	0.67 ± 0.04	0.23	34.30
8.	Mandoor khatta	0.29	1.03	0.62 ± 0.03	0.19	30.64

**Table 6:** Descriptive statistics for extent of variability in leaf length (cm) belonging to different half sib groups of Mango (*Mangifera indica* L.)

S. No	Half sib group	Minimum	Maximum	Mean ± SE	S.D	C.V (%)
1.	Lazzat Baksh	15.40	29.00	21.4 ± 0.77	3.88	18.13
2.	Kesar	15.50	29.80	21.7 ± 0.70	3.54	16.31
3.	Goa Mankurad	15.11	28.00	21.7 ± 0.85	4.27	19.67
4.	Malanji	15.70	26.80	21.8 ± 0.57	2.85	13.07
5.	Dashehari	15.50	29.80	22.8 ± 0.86	4.30	18.85
6.	Sensation	13.00	28.00	21.2 ± 0.76	3.80	17.92
7.	Himsagar	17.60	26.70	22.1 ± 0.51	2.55	11.53
8.	Mandoor khatta	15.90	33.50	22.3 ± 0.88	4.42	19.82

**Table 7:** Descriptive statistics for extent of variability in leaf width (cm) belonging to different half sib groups of Mango (*Mangifera indica* L.)

S. No	Half sib group	Minimum	Maximum	Mean ± SE	S.D	C.V (%)
1.	Lazzat Baksh	3.50	7.50	5.30 ± 0.19	0.98	18.49
2.	Kesar	4.30	6.80	5.18 ± 0.14	0.71	13.70
3.	Goa Mankurad	4.10	7.20	5.33 ± 0.17	0.85	15.94
4.	Malanji	4.10	6.80	5.68 ± 0.13	0.65	11.44
5.	Dashehari	3.50	6.70	5.38 ± 0.18	0.91	16.91
6.	Sensation	4.00	6.80	5.32 ± 0.17	0.85	15.97
7.	Himsagar	4.60	7.00	5.57 ± 0.12	0.64	11.49
8.	Mandoor khatta	3.50	7.00	5.09 ± 0.15	0.77	15.12

**Table 8:** Descriptive statistics for extent of variability in ratio of leaf length / width (cm) belonging to different half sib groups of Mango (*Mangifera indica* L.)

S. No	Half sib group	Minimum	Maximum	Mean ± SE	S.D	C.V (%)
1.	Lazzat Baksh	2.43	5.09	4.09 ± 0.12	0.63	15.40
2.	Kesar	2.76	5.70	4.22 ± 0.13	0.66	15.63
3.	Goa Mankurad	2.09	5.60	4.12 ± 0.15	0.76	18.44
4.	Malanji	2.95	5.25	3.85 ± 0.09	0.45	11.68
5.	Dashehari	2.43	5.60	4.17 ± 0.13	0.69	16.54
6.	Sensation	3.17	4.82	3.99 ± 0.09	0.45	11.27
7.	Himsagar	3.58	4.90	3.98 ± 0.07	0.35	8.79
8.	Mandoor khatta	3.29	5.60	4.40 ± 0.12	0.63	14.31

**Table 9:** Descriptive statistics for extent of variability in petiole length (cm) belonging to different half sib groups of Mango (*Mangifera indica* L.)

S. No	Half sib group	Minimum	Maximum	Mean ± SE	S.D	C.V (%)
1.	Lazzat Baksh	2.98	6.32	4.55 ± 0.38	0.91	20.00
2.	Kesar	3.15	6.02	4.43 ± 0.36	0.72	16.25
3.	Goa Mankurad	3.12	7.11	4.85 ± 0.32	0.76	15.67
4.	Malanji	2.96	5.90	4.39 ± 0.38	0.70	15.94
5.	Dashehari	3.33	6.08	4.69 ± 0.32	0.62	13.21
6.	Sensation	3.01	6.93	4.24 ± 0.30	0.87	20.51
7.	Himsagar	3.19	7.97	6.53 ± 0.33	1.22	18.68
8.	Mandoor khatta	3.85	7.50	5.87 ± 0.36	0.81	13.79

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