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Fruit morphological characteristics of various mango (*Mangifera indica* L.) cultivars in the plains zone of Chhattisgarh

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ABSTRACT

Morphological characteristics of mango may be the most important characteristic for selection of good mango. We evaluated ten mango varieties from Horticulture Farm, Department of Fruit Science, College of Agriculture, IGKV, Raipur, (C.G.) for qualitative and quantitative characteristics based on IPGRI mango descriptors. There were individual variations in the findings of varieties on fruit and pulp characteristics, indicating significant variation across years of research. Fruit and pulp characteristics were observed in both the years of research. Fruit length and width were found to be higher in cv. Chhattisgarh Swarnprabha (13.67 cm) and Chhattisgarh Achar (7.84 cm), respectively. While maximum fruit weight was observed in Chhattisgarh Raj (375.69 and 334.33 g) at harvesting and ripening stage. Other parameters like fruit volume, specific gravity, pulp weight and pulp percentage were maximum in Chhattisgarh Raj (327.10 cc), Chhattisgarh Pawan (1.062), Chhattisgarh Swarnaprabha (250.993 g), Chhattisgarh Swarnaprabha (78.104 %). The lowest peel weight and percentage recorded were in Chhattisgarh Nandiraj (21.80 g) and Chhattisgarh Raj (10.81%) respectively. Therefore, all these characteristics should be considered as important criteria for selecting good mango varieties.

Key word: Fruit, pulp, weight, length, mango, varieties and peel

INTRODUCTION

Mango is one of the most prominent and main fruits of the tropical climate of India. Since ancient times, it has been grown in India. It is often referred as the king of fruits, along with Hindustan fruit, because of its nutrition and practicality. In India and elsewhere, it is one of the most significant commercially farmed fruit crops and a member of the Anacardiaceae family. In the Indo-Burma region, it first appeared. Most of the mango crop is grown in Asia, especially in India, where the production is 22.42 million tons and area 2.40 M.Ha per year, with ranking first in the world, as well as the first exporter (Anon 2023). Due to the increasing international demand for fresh and processed mango products, in 2022-23, India exported 32,104.09 metric tons of fresh mangos worth Rs. 495.46 crore / USD 60.14 million during the year 2023-24 (Anon 2024). The mango is among the most widely grown tropical and subtropical fruit of the world and is a diploid fruit tree with 2n = 40 chromosomes (Kuhn *et al.,* 2017). Mango fruit was recorded as per the descriptors of International Institute for Plant Genetic Resources (Anon. 2006) to observe the morphological characters of fruit morphology and pulp due to its pleasant aroma and sweetness. The morphological diversity and horticultural characteristics of mango may be due to many factors including climate, soil nutrient status, management practices as well as genetic factors due to which wide variation is seen among the varieties which has been described by many researchers in their studies like (Kumar *et al.,* 2024; Igbari *et al.,* 2019; Rana *et al.,* 2022 and Bhamini *et al.,* 2018).

Producing greater returns and the ability to tolerate adverse environmental circumstances are the primary objectives of modern fruit breeding. Keeping all these factors in mind, studying the mango fruit and its pulp will prove to be an important factor for us. Although these methods are simple, they are not very accurate. Since not much scientific research has been carried out on the mango variety found in the Chhattisgarh region, it should be easy to plan its development in the coming years, i.e. research will become even more important in the future. Therefore, the morphology of the fruit is a very important feature.

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MATERIALS AND METHODS

Experimental set up

The present study selected ten to twenty years old mango varieties (2019-2020 and 2020-21), namely Chhattisgarh Swarnprabha, Chhattisgarh Pawan, Chhattisgarh Achar, Chhattisgarh Raj, Chhattisgarh Gaurav, Chhattisgarh Nandiraj, Dussehri, Langra, Mallika and Amarpali, planted at Research Horticulture Farm, Department of Fruit Science, College of Agriculture, IGKV, Raipur, (C.G.) at 10 m × 10 m spacing. To ensure that the selected mango orchard plants are maintained under uniform cultural practices (disc harrow ploughing, check basin irrigation, use of imidacloprid to control hopper and mealy bug, as observed), the plants were observed in common mango descriptors (Anon, 2006).

Statistical analysis

Statistical analysis of the data was carried out using MS-Excel, OPSTAT (Online Statistical Analysis Software) for each observed character under study. Randomized block design (RBD) was used for data analysis and it was replicated three times. Analysis of variance (ANOVA) was prepared for each parameter and cited in the tables. In which each plant was taken as a source of variation and ten fruits from each plant were taken as samples (Gomez and Gomez, 1983).

Fruit and pulp descriptors

Fruit length and diameter:

The length and diameter of ten mango fruits were measured in (cm) by placing the fruits on a flat surface and placing the measuring scale vertically and horizontally using digital vernier calipers. Fruit, pulp and peel weight: Fruit weight at harvest & ripening, pulp and peel weight of mango fruits were measured with digital balance and expressed in grams. Specific gravity: that was calculated by dividing the average fruit weight by the average fruit volume, which is unit less. Fruit volume (cc): To characterize the volume of fruits measured using water displacement method, the average volume of each fruit was determined in (cc). Further, other fruit and pulp characteristics of mango varieties were observed with the help of mango descriptors (Anon 2006).

RESULTS AND DISCUSSION

During the study considerable variation was observed in the morphological characteristics of fruit and pulp among the mango varieties in the plains zone of Chhattisgarh. The primary prerequisites for descriptors are uniqueness, uniformity, and consistency. The data presented in (Table 1 & 2) showed significantly in both the years (2019-20 to 2020-21).

Fruit morphological characteristics

Fruit shape observation of both the years revealed that fruits are oblong shaped in Chhattisgarh Swarnprabha and Mallika, oval in shape in Chhattisgarh Achar, Chhattisgarh Nandiraj and Langra and elliptical in other varieties. Peel colour the colour of the ripened fruit peel in Chhattisgarh Nandiraj, Dussehri and Mallika is mostly yellow. Fruit skin surface textur smooth fruit skin surface texture was found in Chhattisgarh Achar, Chhattisgarh Gaurav, Chhattisgarh Nandiraj and Dashehari and other reaming varieties are rough surface of fruit texture. Density of lenticels on fruit skin are two group in found under the medium group varieties Chhattisgarh Achar, Chhattisgarh Raj and Langra and part from this, in other group sparse under other varieties. Depth of fruit stalk cavity are categories five categories in case varieties medium group Chhattisgarh Achar and Chhattisgarh Gaurav, shallow group Chhattisgarh Pawan, Chhattisgarh Raj, Dashehari and Langra and other varieties remaining are absent. Fruit neck slightly prominent fruit neck prominence are observed in varieties Chhattisgarh Swarnprabha, Chhattisgarh Pawan, Chhattisgarh Achar and Dashehari and very prominent only one single variety Mallika and absent were noted under all remaining varieties rest. Significant variation was observed in the morphological characteristics of mango fruits among all the ten varieties, although genetic characteristics were the most important factor as cultural demands remained the same in all the ten varieties, yet considerable variation was observed in the fruits. These investigations

were carried out by Bhamini *et al.,*2018; Igbari *et al.,*2019; Rana *et al.,* 2022; Dinesh *et al.,* 2016; Sane *et al.,* 2024 and Dinesh *et al.,* 2015 vary from fruit morphological characters variety to variety.

Slope of fruit vertical shoulder slopping abruptly slope of fruit vertical shoulder was noticed under the research Chhattisgarh Swarnprabha, Chhattisgarh Pawan, Dashehari and Mallika, under the category rising and then round variety Chhattisgarh Raj, otherwise all remaning varieties under the category ending in a long curve. Fruit break type in Prominent type was Chhattisgarh Swarnprabha, under the perceptible type, Chhattisgarh Pawan, Chhattisgarh Gaurav, Chhattisgarh Nandiraj, Dashehari and Amrapali, similarly under the pointed type Chhattisgarh Achar and Chhattisgarh Raj and Mallika have been seen under Mamiform. Fruit sinus type the depth fruit sinus are divided into three categories, however as per our investigation we found deep sinus type was observed in Chhattisgarh Swarnprabha, Chhattisgarh Achar and Mallika, while group shallow was noticed in Langra while all other remaining varieties belonged to absent groups. Fruit wax there are two types of fruit wax in which Chhattisgarh Swarnprabha, Chhattisgarh Raj, Chhattisgarh Gaurav and Dussehri varieties are under waxy group and rest of the varieties are non-waxy fruits. Variation in morphological characteristics of mango fruit, which may be related to genetic structure and environmental interaction is considered homogeneous by other scientists Sushmitha *et al.,* 2024; Drabo *et al.,* 2024; Coral and Escobar-Garcia 2021; Limbongan *et al.,* 2016; Passannet *et al.,*2017 and Syed *et al.,* 2019.

Pulp and peel morphological characteristics

The morphological characteristics of pulp and peel are one of the most important characteristics of mango which attracts the interest of market and consumers. The colour and pulp quality of a good mango fruit is very important. Hence, a lot of variation was observed in these parameters in different varieties in our research for both the years (2019-20 to 2020-21) which is shown in (Table 1). Pulp colour varieties Chhattisgarh Raj, Chhattisgarh Gaurav, and Langra were noted with light yellow types whereas, Chhattisgarh Nandiraj, Dashehari, and Mallika were found with deep yellow variants, while the remaining five varieties contain yellow fruit pulp. Pulp texture ripe fruit in soft group (Chhattisgarh Swarnprabha, Chhattisgarh Gaurav, Chhattisgarh Nandiraj, and Dashehari) and firm texture in other varieties. Adherence of skin to pulp strong was found in variety Chhattisgarh Swarnprabha, absent category in Chhattisgarh Nandiraj and Dashehari, while intermediate type are Chhattisgarh Pawan, Chhattisgarh Raj and Chhattisgarh Gaurav and in the remaining four varieties under the weak group. Quality of latex oozing from peduncle Chhattisgarh Pawan was very high, medium in Chhattisgarh Nandiraj and Dussehri, and low in the remaining genotypes. Pulp juiciness was found slightly juicy in Chhattisgarh Swarnprabha, juicy in Chhattisgarh Achar, Chhattisgarh Raj, Dashehari, Langra and Amarpali whereas highly juicy in all other remained varieties. Pulp aroma was strong in varieties Chhattisgarh Nandiraj and Dashehari, mild aroma Chhattisgarh Swarnprabha, Chhattisgarh Achar and Chhattisgarh Raj and intermediate are found in others varieties. Variation in mango pulp and peel may be due to the genetic structure of the varieties as well as environmental factors. This has been supported by many scientists Arora *et al.,* 2024; Rai *et al.,* 2023; Mohamed and Hassan 2015; Ravi *et al.,* 2021 and Saliyan *et al.,* 2023.

Fruit and pulp physical characteristics

The analysis of physical attributes recorded during 2019-20 and 2020-21 revealed significant variation among the mango varieties and that are show in (Table 2). Chhattisgarh Raj had the maximum fruit weight at harvesting (375.69 g), which was higher than the other varieties, while variety Dashehari had the lowest (190.96 g). Fruit weight at ripening (g) showed the same response pattern of harvesting weight, with Chhattisgarh Raj (334.33 g) having the highest and Dashehari (162.81 g) having the lowest. A research on fruit weight among the several varieties of *cv*. Langra was documented by Anu *et al.,* (2020) produced the largest fruit weight of 843.90 g. others researcher also finding similar result Kumar *et al.,*2024; Sushmitha *et al.,*2024; Sankaran *et al.,*2020 and Handa and Singh 2018.

Table 1: Studies on fruit and pulp morphological characteristics of mango varieties during years 2019-20 to 2020-21

Varieties Characteristics	Chhattisgarh Swarnprabha	Chhattisgarh Pawan	Chhattisgarh Achar	Chhattisgarh Raj	Chhattisgarh Gaurav	Chhattisgarh Nandiraj	Dashehari	Langra	Mallika	Amrapali
Fruit morphological characters										
Fruit shape	Oblong	Elliptic	Ovoid	Elliptic	Elliptic	Ovoid	Elliptic	Ovoid	obovoid	Elliptic
Skin colour of ripening fruit	Light green	Light green	Light green	Light green	Light yellow	Yellow	Yellow	Light green	Yellow	Yellow
Fruit skin surface texture	Rough	Rough	Smooth	Rough	Smooth	Smooth	Smooth	Rough	Rough	Rough
Density of lenticels on fruit skin	Sparse	Sparse	Medium	Medium	Sparse	Sparse	Sparse	Medium	Sparse	Sparse
Depth of fruit stalk cavity	Absent	Shallow	Medium	Shallow	Medium	Absent	Shallow	Shallow	Absent	Absent
Fruit neck prominence	Slightly prominent	Slightly prominent	Slightly prominent	Absent	Absent	Absent	Slightly prominent	Absent	Very prominent	Prominent
Slope of fruit vertical shoulder	Slopping abruptly	Slopping abruptly	Ending in a long curve	Rising and then round	Ending in a long curve	Ending in a long curve	Slopping abruptly	Ending in a long curve	Slopping abruptly	Ending in a long curve
Fruit break type	Prominent	Perceptible	Pointed	Pointed	Perceptible	Perceptible	Perceptible	Perceptible	Mammiform	Perceptible
Fruit sinus type	Deep	Absent	Deep	Absent	Absent	Absent	Absent	Shallow	Deep	Absent
Fruit waxiness	Waxy	Non- waxy	Non- waxy	waxy	Waxy	Non- waxy	Waxy	Non- waxy	Non- waxy	Non- waxy
Pulp morphological characters										
Pulp colour of ripe fruit	Yellow	Yellow	Yellow	Light yellow	Light yellow	Golden yellow	Golden yellow	Light yellow	Yellow	Golden yellow
Pulp texture of ripe fruit	Soft	Firm	Firm	Firm	Soft	Soft	Soft	Firm	Firm	Firm
Adherence of skin to pulp	Strong	Intermediate	Weak	Intermediate	Intermediate	Absent	Absent	Weak	Weak	Weak
Quality of latex oozing from peduncle	Absent	Strong	Low	Low	Low	Medium	Medium	Low	Low	Low
Quality of fibre in pulp	Low	Low	High	Low	Intermediate	Intermediate	Low	Intermediate	Low	Low
Pulp juiciness	Slightly juicy	Very juicy	Juicy	Juicy	Very juicy	Very juicy	Juicy	Juicy	Very juicy	Juicy
Pulp aroma	Mild	Intermediate	Mild	Mild	Intermediate	Strong	Strong	Intermediate	Intermediate	Intermediate

Table 2: Studies on fruit and pulp measurement characteristics of mango varieties during years 2019-20 to 2020-21

Treatment	Fruit weight at harvest (g.)			Fruit weight at ripening (g.)			Specific gravity			Fruit volume (cc)		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
Chhattisgarh Swarnaprabha	340.90	338.68	339.79	318.96	315.66	320.14	1.01	1.01	1.01	314.74	320.54	317.64
Chhattisgarh Pawan	280.73	274.97	277.85	257.39	256.00	256.69	1.05	1.05	1.05	243.76	239.85	241.81
Chhattisgarh Achar	332.36	336.07	334.22	302.05	299.66	300.86	1.00	1.00	1.00	299.67	295.56	297.61
Chhattisgarh Raj	385.07	365.10	375.09	348.66	320.00	334.33	1.02	1.02	1.02	339.33	324.87	327.10
Chhattisgarh Gaurav	330.86	306.64	318.75	301.40	286.66	294.03	1.03	1.03	1.03	292.33	284.00	288.16
Chhattisgarh Nandiraj	205.11	198.15	201.63	185.97	181.00	183.48	1.09	1.09	1.09	170.10	179.70	174.90
Dashehari	186.62	195.29	190.96	160.30	165.33	162.81	1.03	1.03	1.03	154.66	157.37	156.02
Langra	311.58	309.61	310.59	282.16	278.66	280.41	1.05	1.05	1.05	267.29	274.18	270.74
Mallika	265.28	247.37	256.32	233.01	220.00	226.50	1.02	1.02	1.02	227.00	218.70	222.85
Amrapali	310.89	323.70	317.30	301.08	305.66	303.37	1.03	1.03	1.03	292.26	301.66	296.96
SE(m) ±	3.97	2.49	2.30	2.56	3.35	2.01	0.03	0.03	0.03	3.41	3.99	2.04
C.D. at 5%	11.90	7.46	6.89	7.67	10.03	6.02	0.01	0.01	0.01	10.23	11.96	6.12
Varieties	Fruit length (cm)			Fruit breadth (cm)			Peel weight (g)			Pulp weight (g)		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
Chhattisgarh Swarnaprabha	13.33	14.01	13.67	1.433	1.433	1.433	44.53	44.44	44.490	13.963	13.734	13.849
Chhattisgarh Pawan	10.13	10.51	10.32	2.867	2.867	2.867	55.75	49.47	47.61	21.66	15.43	18.54
Chhattisgarh Achar	9.76	9.45	9.61	2.683	2.683	2.683	35.25	31.65	33.45	11.67	10.56	11.12
Chhattisgarh Raj	8.82	9.91	9.36	3.400	3.400	3.400	47.15	26.14	36.65	13.52	8.09	10.81
Chhattisgarh Gaurav	10.53	10.00	10.67	2.600	2.600	2.600	39.87	30.23	35.05	13.23	10.52	11.88
Chhattisgarh Nandiraj	9.03	9.12	9.08	3.633	3.633	3.633	23.87	19.73	21.80	12.82	10.90	11.86
Dashehari	9.63	9.41	9.52	1.867	1.867	1.867	17.11	28.15	22.63	10.68	17.04	13.86
Langra	9.03	9.30	9.16	1.567	1.567	1.567	31.36	29.15	30.25	11.12	10.46	10.79
Mallika	12.06	12.37	12.22	1.510	1.510	1.510	48.08	43.74	45.91	20.64	19.88	20.26
Amrapali	11.30	10.73	11.01	2.857	2.857	2.857	42.48	33.77	38.13	14.12	11.04	12.58
SE(m) ±	1.10	1.14	1.18	0.152	0.152	0.152	2.53	2.81	1.89	0.94	1.01	0.71
C.D. at 5 %	2.75	2.85	2.95	0.455	0.455	0.455	7.578	8.445	5.665	2.832	3.026	2.154

The maximum fruit volume was seen in Chhattisgarh Raj (327.10) and Dashehari minimum fruit volume (156.02). Specific gravity was observed maximum (1.062) with the variety Chhattisgarh Pawan. The minimum was observed with Chhattisgarh Achar (1.011). Indian *et al.,* 2018 and Kumar and Jaiswal 2003 evaluated several mango genotypes fruit volume and specific gravity study. Maximum fruit length (13.67 cm) was recorded in Chhattisgarh Swarprabha which was found to be statistically significantly higher, followed by Mallika (12.22 cm) and Amrapali (11.01 cm), while minimum (9.08 cm) was found in Chhattisgarh Nandiraj. Maximum fruit width (7.84 cm) was recorded in Chhattisgarh Achar and minimum (5.61 cm) was found in Chhattisgarh Nandiraj. This disparity among varieties was due to genetic and environmental factors which were also supported by other workers Hada and Singh 2017; Senapati *et al.,*2022; Bora *et al.,*2017; Shivran *et al.,*2024; Mohamed *et al.,*2024 and Abdullahi *et al.,*2024. Maximum peel weight was recorded in variety Chhattisgarh Pawan (47.61 g) and cv. Chhattisgarh Nandiraj (21.80 g) is minimum. Pulp weight in Chhattisgarh Swarnaprabha (250.99 g) which was significantly higher among all the varieties studied. However, the minimum pulp weight was noted in variety Dashehari (116.88 g). Hada and Singh 2017; Sinha *et al.,* 2020; Singh *et al.,* 2019 and Ahmed and Mohamed 2015, Kumar *et al.,* 2023 in Litchi crop reported that similar like observation on research finding.

CONCLUSION

There are differences in the fruit morphology of different mango varieties, according to studies on fruit morphological characterization. This information is helpful in variety selection as in the past varieties were established and identified based on morphological characters, hence these characters will be highly helpful in understanding the dynamics of mango germplasm and variety identification. Mango fruit's morphological traits are crucial in increasing demand for a variety, and by preserving the fruit's color and pulp quality, they can aid in the creation of new varieties.

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