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Tree morphological characterization of mango (*Mangifera indica* L.) varieties under agro-climatic conditions of Raipur, Chhattisgarh

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Abstract
The present study was conducted during 2023-24 and 2024-25 at the Horticulture Research Farm, IGKV, Raipur (C.G.), to assess morphological variation among fifteen mango (*Mangifera indica* L.) varieties. The experiment was laid out in a Randomized Block Design with three replications. Morphological traits were recorded using IPGRI (2006) descriptors. Significant differences were observed in tree growth habit, crown shape, branching and foliage density, trunk diameter, crown spread and tree height. Spreading growth habit was most common (67%), followed by erect (27%) and drooping (6%). Crown shape was predominantly broadly pyramidal (46%). Tree height ranged from 4.16 m (Chhattisgarh Raj) to 9.88 m (Dashehari), while trunk diameter varied from 0.78 m (Chhattisgarh Raj) to 1.59 m (Kishanbhog). Crown diameter ranged between 5.2 m (Chhattisgarh Swarnaprabha) and 15.5 m (Amrapali). The study highlights significant morphological diversity, supporting the selection and conservation of superior mango genotypes for breeding and region-specific cultivation.

Keywords: Mango varieties, tree, morphology, characterization, tree growth habit, crown shape etc.

1. Introduction
Mango (*Mangifera indica* L.), a major fruit crop in India, belongs to the Anacardiaceae family and is considered the "King of Fruits" and the national fruit due to its rich taste, aroma and cultural significance (Shah *et al.*, 2010) [15]. Originating from the Indo-Burma region, it is a diploid (2n = 40) dicot with over 69 Mangifera species, of which nine are native to India. The Fruit Research Station in Sangareddy, Andhra Pradesh, maintains over 470 varieties, many of which are monoembryonic, polyembryonic types are mostly found in coastal southern India. Mangoes are nutritionally valuable, rich in vitamin A (389 mg/100 g), vitamin C (32-200 mg/100 g), carotenoids, and essential minerals (Pleguezuelo *et al.*, 2012) [3].

India is the world's top mango producer, with 26.3 billion kg produced annually (FAO, 2023-24) [16] and 2.7 million hectares under cultivation (NHB, 2023-24) [1]. In Chhattisgarh, 78.2 thousand hectares yield 471.1 thousand metric tons (2022-23). The College of Agriculture, IGKV Raipur, has preserved and developed promising genotypes like Chhattisgarh Swarnaprabha, Chhattisgarh Pawan, Chhattisgarh Achar, Chhattisgarh Raj, Chhattisgarh Nandiraj, and Chhattisgarh Gaurav.

Although morphological characterization is simple and cost-effective, it is influenced by environmental conditions, which may reduce reliability (Matthew & Oziegbe, 2016; Subedi *et al.*, 2009) [12, 16]. Still, it remains vital for varietal identification and has been used to classify mangoes based on traits such as fruit size, shape, and nutrient content (Igbari *et al.*, 2019) [7]. Enhanced morphological studies can help in better understanding and utilization of mango varieties (Jaramillo & Baena, 2000) [9].

2. Methods and Materials
The study was conducted during 2023-24 and 2024-25 at the Horticulture Research Farm, Department of Fruit Science, College of Agriculture, IGKV, Raipur (C.G.), on 10-20 years old mango trees.

The site, located in the Chhattisgarh plains (21.25°N, 81.63°E, 289.15 m asl), has a dry, moist sub-humid climate with 1200-1400 mm annual rainfall, primarily from the South-West monsoon. Temperatures range from 6 °C (winter) to 46 °C (summer). The experiment used a Randomized Block Design (RBD) with fifteen mango varieties and three replications. Uniform cultural practices were followed, including disk harrow ploughing, check basin irrigation, and Imidacloprid application for pest control. Tree growth traits were recorded using mango descriptors by IPGRI (2006) [2], Rome, Italy.

3. Results and Discussion

It was discovered that the mango varieties showed tree morphological characteristics recorded in each other based on the observations gathered recording to mango descriptor (IPGRI). Trees morphological characteristics were recorded for years (2023-24 and 2024-25) of research and presented in Table 3.1 and illustrated in figures 3.1, 3.2 and 3.3 described below. Observations revealed variation among the mango varieties.

3.1 Tree growth habit

In the study, the growth habits of fifteen mango varieties were classified into three types: spreading, erect and drooping. Among them, eleven varieties (including Chhattisgarh Pawan, Chhattisgarh Achar, Chhattisgarh Raj, Chhattisgarh Nandiraj, Dashehari and others) exhibited a spreading habit, three varieties (Chhattisgarh Gaurav, Amin and Local genotype-1) showed an erect habit and only one variety (Chhattisgarh Swarnaprabha) displayed a drooping growth habit. Overall, the spreading type was most common (67%), followed by erect (27%) and drooping (6%). The results from the present study are similar with the findings of Majumdar *et al.* (2011) [11], Halder *et al.* (2020) [5] and Rana (2023) [14] in mango varieties.

3.2 Crown shape

The crown shape of fifteen mango varieties was classified into four types: broadly pyramidal, semi-circular, oblong and spherical. Broadly pyramidal was the most common, found in seven varieties (46%), including Chhattisgarh Gaurav, Nandiraj, Dashehari and others. Semi-circular crowns were observed in four varieties (27%), oblong in three (20%) and spherical in only one variety (7%). Thus, broadly pyramidal was the dominant crown shape among the tested varieties. The results from the present study are similar with the findings of Majumdar *et al.* (2011) [11], Ibukun and Yomi (2020) [6], Halder *et al.* (2020) [5] and Rana (2023) [14] in mango varieties.

3.3 Branching density

The branch density of fifteen mango varieties was grouped into dense, intermediate and sparse categories. Eight varieties (54%), including Chhattisgarh Raj, Chhattisgarh Gaurav, Chhattisgarh Nandiraj and others, showed dense branch density. Five varieties (33%) had intermediate density, while only two varieties (13%), Amrapali and Local genotype-1, exhibited sparse branching. Dense branch density was the most frequent among the varieties studied. These results are in close agreement with the earlier findings by Majumdar *et al.* (2011) [11], Ibukun and Yomi (2020) [6], Rana (2023) [14] in mango varieties.

3.4 Foliage density

The foliage density of fifteen mango varieties was classified into intermediate and dense types. Eight varieties (53%), including Chhattisgarh Swarnaprabha, Chhattisgarh Pawan, Chhattisgarh Raj, Mallika, Amrapali, Kurukkan, Local genotype-1 and Local genotype-2 had intermediate foliage density, while seven varieties (47%), such as Chhattisgarh Achar, Chhattisgarh Gaurav, Chhattisgarh Nandiraj, and Dashehari, exhibited dense foliage. Intermediate foliage density was slightly more common in this study. The results are in close agreements with the findings of Majumdar *et al.* (2011) [11], Ibukun and Yomi (2020) [6], Halder *et al.* (2020) [5] and Rana (2023) [14] in mango varieties.

3.5 Height of mature tree (m)

The tree height of the fifteen mango varieties ranged from 4.16 to 9.88 meters and was categorized into short (<6 m), medium (6.1-9 m) and tall (9.1-12 m) groups. Three varieties such as Chhattisgarh Raj, Kurukkan, and Chhattisgarh Swarnaprabha were short stature. The majority, including Chhattisgarh Pawan, Chhattisgarh Achar and Langra, fell into the medium height group. Five varieties such as Dashehari, Mallika, and Amrapali were tall. Overall, 47% of the varieties were medium height, 33% tall and 20% short. Similar results were determined by Bhamini *et al.* (2018) [3] and Rana (2023) [14].

3.6 Trunk diameter (m)

Mango varieties were grouped by trunk diameter into maximum, moderate and minimum categories, reflecting their vegetative growth. Varieties like Kishanbhog, Amin, Dashehari and Amrapali had the largest trunk diameters (around 1.45-1.59 m), indicating vigorous growth. Moderate trunk sizes were seen in Chhattisgarh Achar, Chhattisgarh Nandiraj, Local genotype-2 and Gaurav. Smaller trunk diameters were recorded in Chhattisgarh Pawan, Swarnaprabha, Local genotype-1, Kurukkan, and Chhattisgarh Raj. The findings of the present study are in agreement with those reported by Bhamini *et al.* (2018) [3], Tamang *et al.* (2019) [17], Indian *et al.* (2020) [8] and Rana (2023) [14] in mango varieties.

3.7 Crown diameter (m)

The study found significant variation in crown diameter among mango varieties. The varieties like Dashehari, Kishanbhog, Langra, Amrapali and Mallika had the largest crowns (around 14-15.5 m), indicating vigorous lateral growth. Moderate crown sizes were seen in Chhattisgarh Gaurav, Nandiraj and Local genotype-2 (12-13 m), while Chhattisgarh Pawan, Chhattisgarh Achar and Amin had intermediate crowns (9-10.5 m). Smaller crown diameters were recorded in Chhattisgarh Swarnaprabha, Local genotype-1, Chhattisgarh Raj and Kurukkan (5.2-6.2 m), suggesting these varieties are suitable for high-density planting or limited land spaces. The results from the present study are similar with the findings of Bhamini *et al.* (2018) [3], Tamang *et al.* (2019) [17], Indian *et al.* (2020) [8] and Rana (2023) [14] in mango varieties.

Table 1: Variability in tree characters of different Mango varieties during the year 2023-24

Varieties	Tree growth habit	Crown shape	Branching density	Foliage density	Height of mature tree (m)	Trunk diameter (m)	Crown diameter (m)
Chhattisgarh Swarnaprabha	Drooping	Semi circular	Intermediate	Intermediate	5.98	0.88	6.21
Chhattisgarh Pawan	Spreading	Oblong	Intermediate	Intermediate	7.32	0.94	9.2
Chhattisgarh Achar	Spreading	Semi circular	Intermediate	Dense	7.2	1.4	9.1
Chhattisgarh Raj	Spreading	Oblong	Dense	Intermediate	4.25	0.76	5.25
Chhattisgarh Gaurav	Erect	Broadly pyramidal	Dense	Dense	7.8	1.1	13.11
Chhattisgarh Nandiraj	Spreading	Broadly pyramidal	Dense	Dense	8.1	1.41	12.82
Dashehari	Spreading	Broadly pyramidal	Dense	Dense	9.75	1.55	15.5
Langra	Spreading	Broadly pyramidal	Dense	Dense	8.82	1.48	14.95
Mallika	Spreading	Broadly pyramidal	Intermediate	Intermediate	9.15	1.45	14.02
Amrapali	Spreading	Broadly pyramidal	Sparse	Intermediate	9.88	1.52	14.88
Amin	Erect	Spherical	Dense	Dense	9.02	1.58	10.5
Kurukkan	Erect	Semi circular	Intermediate	Intermediate	4.16	0.82	5.2
Kishanbhog	Spreading	Broadly pyramidal	Dense	Dense	9.8	1.59	15.02
Local genotype-1	Erect	Oblong	Sparse	Intermediate	8.11	0.86	5.81
Local genotype-2	Spreading	Semi circular	Dense	Intermediate	8.36	1.38	12.04

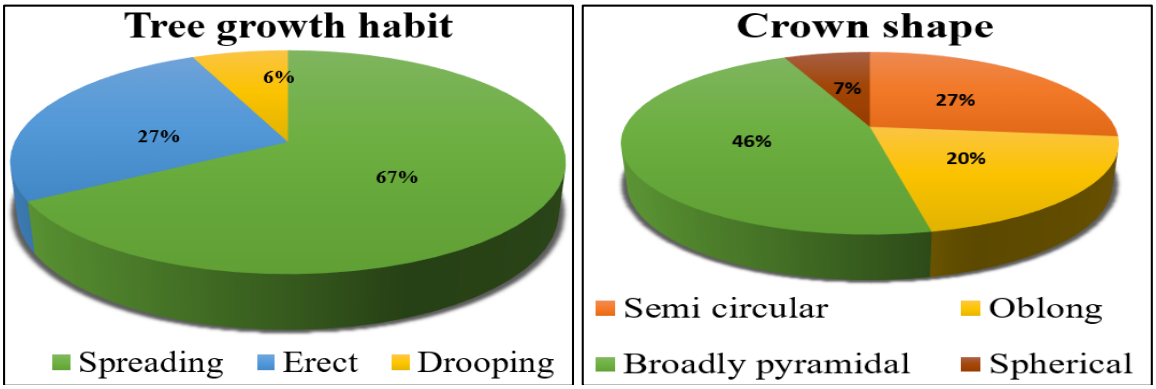

Fig 3.1: Tree growth habit and crown shape percentage of different Mango varieties

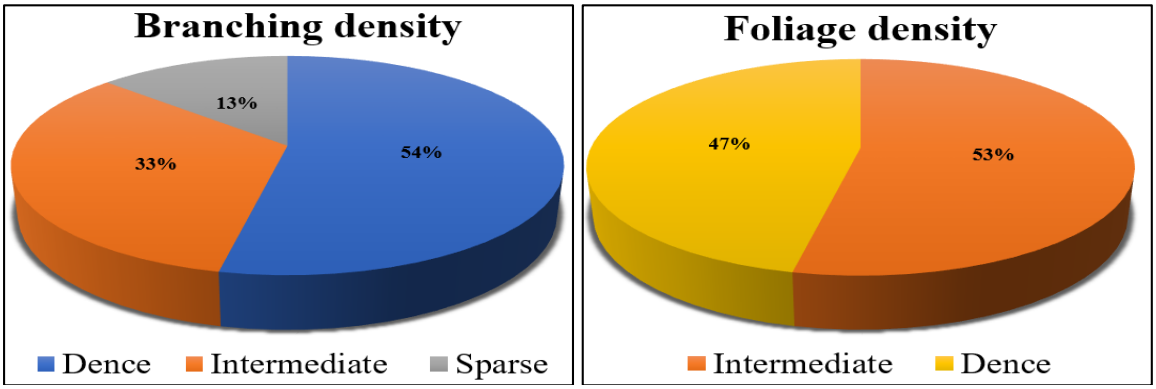

Fig 3.2: Branching density and foliage density percentage of different Mango varieties

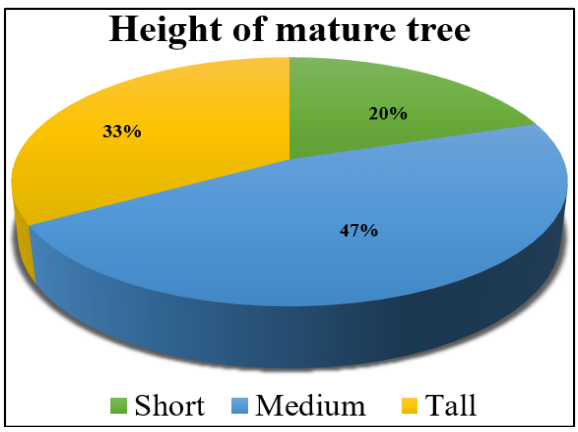

Fig 3.3: Height of mature tree percentage of different Mango varieties

4. Conclusion

The study demonstrated considerable variation in vegetative traits among fifteen mango varieties. The majority exhibited a spreading growth habit (e.g., Chhattisgarh Pawan, Dashehari), with broadly pyramidal crown shape being most frequent in Langra and Amrapali. Dense branching was observed in varieties like Chhattisgarh Raj and Kishanbhog, while intermediate foliage density was slightly more common. Maximum tree height was recorded in Amrapali (9.88 m), while the shortest was Kurukkan (4.16 m). Kishanbhog exhibited the highest trunk diameter (1.59 m) and crown diameter (15.02 m), indicating vigorous growth, whereas Chhattisgarh Raj had the smallest trunk (0.76 m) and crown diameter (5.25 m).

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