

Panicle diversity of some mango varieties under semi-arid lateritic belt of Eastern India

Prahlad Deb*, Pradipto Kumar Mukherjee and Payel Das

Department of Horticulture & Postharvest Technology

Institute of Agriculture, Visva-Bharati

Sriniketan-731236, West Bengal, India

*Email: debprld@yahoo.com

Receipt : 30.04.2024 ; Revised : 15.05.2024 ; Acceptance : 20.05.2024

DOI : 10.53552/ijmfmap.10.1.2024.102-111

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ABSTRACT

The present experiment was conducted during February to April in the year 2022 and 2023 selecting fifteen mango varieties from Institute of Agriculture, Visva-Bharati, Sriniketan, West Bengal as well as farmers homestead garden to study their morphological characters of panicles and distribution of types of flowers under semi-arid lateritic belt of Eastern India. In the present experiment the flowering of fifteen mango varieties viz., Bangalora, Banganpalli, Alphonso, Ratna, Sindu, Bombay Green, Vastara, Dasherri, Amrapali, Mallika, Swarnarekha, Meghlanthan, SafdarPasand, Himsagar, and Langra have been studied by selecting ten panicles from each plant in both the years with respect to different morphological parameters of panicle and flower distribution. The maximum length of panicle was noted in mango variety Ratna (43.1 cm) and it has also exhibited maximum numbers of rachis (65.6). Highest flowering duration has been observed under SafdarPasand (19.9 days) and lowest in Bangalora (10.1 days). Mainly the main stem and the branches or rachis are pigmented in mango panicles as pink, light pink, pinkish green, greening pink, green etc. Maximum male flowers per pinnacle (2056.2) have been noted in the mango Ratna and minimum in SafdarPasand (104.0). Number of hermaphrodite flowers per pinnacle of fifteen different mango varieties has been ranged from 19.0 (in Langra) to 314.2 (in SafdarPasand). Mango variety Langra has produced maximum hermaphrodite flowers (58.9 %) while lowest production of perfect flower was noted in Ratna (1.7%).

Keywords : Flower distribution, mango varieties, panicle morphology.

INTRODUCTION

Mango (*Mangifera indica* L.) holds cultural, economic, and agricultural significance in India. It symbolizes abundance, fertility, and sweetness in Indian culture. As a major export and integral part of Indian cuisine, it reflects the nation's rich biodiversity and cultural heritage, making it a fitting choice as the national fruit. India's mango biodiversity is impressive, with more than a thousand varieties cultivated nationwide (Singh *et al.*, 2015). Mango is abundant source of vitamins A, C, and E, crucial antioxidants that enhance immunity and nourish skin. It also offers considerable amount of folate, potassium and fiber, promoting cardiovascular health and aiding digestion (Lebaka *et al.*, 2021). Additionally, mango leaves are believed to possess medicinal

benefits, particularly in traditional medicine for conditions like diabetes and hypertension (Kumar *et al.*, 2021).

In India, mango trees usually bloom from late winter to early spring, varying based on the area and weather conditions. This flowering phase typically occurs between December and February, marking the beginning of the fruit-bearing process (Jameel *et al.*, 2018). At this time, the trees adorn themselves with clusters of tiny, sweet-smelling flowers, adding splashes of white and pink to the scenery. These blooms play a crucial role in pollination, setting the stage for the growth of mango fruits in the subsequent months. The panicle of a mango tree refers to the flower cluster where individual flowers bloom. Each panicle consists of numerous small, fragrant flowers tightly packed

together (Geetha *et al.*, 2016). These panicles emerge from the tree's branches during the flowering season, typically in late winter to early spring (Naidu *et al.*, 2018; Sinha *et al.*, 2020) and may be late or early due to environmental fluctuation (Chaurasia *et al.*, 2023). The panicles vary in size and density, with some trees producing larger and more prolific clusters than others. Although some nutritional impact on flowering of mango and growth promotion has been reported by some workers (Deb and Reza, 2023; Deb and Reza, 2024; Choudhury and Ghosh, 2021), there is no such published reports regarding the panicle characters of different mango varieties in eastern India particularly under red and lateritic zone of West Bengal. In this context the present study has been carried out to examine the morphological characters of different mango panicles under semi arid lateritic belt of eastern India, particularly the Birbhum district of West Bengal.

MATERIALS AND METHODS

The present experiment has been conducted during February to April in the year 2022 and 2023 selecting different mango plants from Rathindra Krishi Vigyan Kendra, Agricultural Farm, Horticultural Farm of Institute of Agriculture, Visva-Bharati, Sriniketan, West Bengal as well as farmers homestead garden. The location comes under semi arid lateritic belt of West Bengal under the Bolpur, Sriniketan Block of Birbhum district, West Bengal. This geographical location is characterized by prolonged dry winter starting from second week of the December and continues up to second week of February which is followed by a mild spring season up to the March. Dry hot summer starts from first week of the April and characterized by very high temperature up to 45°C degree and continues till mid of the June. Summer is also associated with heat wave and scorching sun. Soil condition is characterized by red and lateritic sandy loam having pH range of 5.5 to 6.5 with rich in iron and aluminium and low in organic matter content. The flowering of mango plants is considerably affected by the prevailing weather condition as well as the soil condition. In the present experiment the flowering of fifteen mango varieties particularly Bangalora, Banganpalli, Alphanso, Ratna, Sindhu, Bombay Green, Vastara, Dasheri, Amrapali,

Mallika, Swarnarekha, Meghlanthan, Safdar Pasand, Himsagar and Langra, taking three different plants in each, have been studied by selecting ten panicles from each plant for two years (2022 and 2023). With respect to different morphological parameters of panicle, flower distribution and methods of recording observations were as follows:

Length of panicle : Length of pinnacle of mango varieties has been recorded in full bloom stage with a measuring scale starting from the apical portion of the chute and up to the tip of the panicle. Length of panicle was measured in both the years and was expressed in centimetre.

Number of rachis per panicle : The branches of the panicle are known as the rachis and the total count of rachis has been recorded at full bloom stage of the panicle in both the years.

Duration of flowering : To determine the duration of flowering of mango in the panicles the difference of days counted against opening of first flower and last flower of the same pinnacle has been considered for both the years.

Panicle colour : As the colour of the panicle of different mango varieties are different, and then the visual colour has been recorded and noted against each variety which has been matched in both the years.

Determination of numbers of male and hermaphrodite flowers : Male flowers of mango is characterized by absence of small globular ovule and female flowers of mango are characterized by green or creamy or whitish green coloured ovule with obliquely placed ovary in the flowers. To count of male and hermaphrodite flowers from a single selected panicle were observed by covering the entire panicle with perforated polythene bags followed by counting the dropped as well as attached fully opened male and hermaphrodite flowers. After counting the male and hermaphrodite flowers total number of flowers have been determined for by adding the numbers for respective mango varieties in both the years.

Percent of hermaphrodite flowers: Percent of hermaphrodite flowers has been calculated by dividing the total number of hermaphrodite flowers by total number of flowers (sum of male and hermaphrodite) and multiplying it by 100.

Sex ratio: Sex ratio of mango panicles of different varieties was determined by calculating

the ratio of male and hermaphrodite flowers simply by dividing the total number of male flowers by total number of hermaphrodite flowers for each pinnacle of respective mango varieties in both the years.

Statistical analysis : Statistical analysis of the collected data with respect to different panicle parameters of fifteen mango varieties in both the years (2022 and 2023) has been arranged for ANOVA under randomized block design (RBD) considering the varieties as treatments and three plants of each varieties as replications (Gomez and Gomez, 1984). Ten panicles under each replication have been considered as the single sample of each replication. The data collected in both the years have been subjected to statistical analysis and pooled data along with critical difference and standard error of mean is cited in the tables.

RESULTS AND DISCUSSION

The statistical analysis of the observations of the present experiment has been presented in Table 1 and 2 as well as graphical representations of the parameters are presented in figure 1, 2 and 3.

Length of panicle : Length of panicle of different mango varieties varied significantly in both the years of experiment as well as in the pooled data (Table 1 and figure 1). The maximum length of panicle (43.1 cm) was noted in mango variety Ratna which was closely followed by Himsagar that produced panicle of 38.8 cm lengths. On contrary the mango varieties have shown minimum length of panicle ranging from 20.3 cm to 23.9 cm in Swarnareka, Vastara, Amrapali, Bombay Green and Banganpalli mango varieties.

The variation in the length of panicles of mango varieties in the present experiment may be due to their genetic makeup. Azam *et al.* (2018) reported the range of different mango varieties as 17.25 to 34.55 cm under Sabour, Bhagalpur, Bihar condition. Vidyashree *et al.* (2021) have reported the length of panicle of some mango varieties ranged from 29.5 to 38.3 cm under Bagalkot, Karnataka. This variation of result on panicle length in various reports may be due to the variation in the varieties. Thus the finding of Azam *et al.* (2018) and Vidyashree *et al.* (2021) has conformity with the findings of the present experiment.

Numbers of rachis per panicle : In the present study the mango varieties have also shown variation in the numbers of rachis present in the panicles (Table 1 and Figure 1). Highest number of rachis in a single panicle was noted in the variety Ratna (65.6) which was statistically *at par* with Himsagar mango variety that has produced 60.1 rachis per panicle as on the pooled data of both the years. Lowest number of rachis per panicle of different mango varieties have been observed in Bombay Green and it was 25.9. Number of rachis per panicle was also lower in Safdar Pasand that is (27.7), Swarnarekha (29.1) and Mallika (30.6). More or less similar trend has been observed in both the years with respect to number of rachis in the panicles of different mango varieties.

Branching habit of panicles of different mango varieties in the present experiment noted considerable variation in number of rachis which is completely a cause of genetic variation of mango varieties. Moreover the data on panicle length has a good positive relation with the rachis number of the panicle and higher the panicle length resulted greater number of rachis. Similar findings have also been reported by Shu (1999).

Flowering duration : The pooled data of both the years with respect to flowering duration of different mango varieties navigates the significant difference within themselves (Table 1 and Figure 1). Significantly highest flowering duration *i.e.*, 19.9 days has been observed under Safdar Pasand. Higher flowering duration has also been noted in Mallika, Swarnarekha, Amrapali, and Dasherri varieties which have been ranged from 16.0 to 17.3 days. Lowest flowering duration was noted in Bangalora variety which was statistically *at par* with Ratna and shown flowering duration 10.1 days and 11.8 days respectively.

Flowering duration of fifteen mango varieties in the present experiment varied from 10.1 to 19.9 days and this might be due to the genetic makeup of the mango varieties which lead to maintaining a steady state of production of flowering responsible enzymes for certain period of flowering (Nampila *et al.*, 2014; Chalak *et al.*, 2022). Batten and McConchie (1995) also explained the variation of production of florigenic substances and gibberellins in different quantities by different mango and litchi cultivars that caused variation in flowering

Table 1: Length of panicle, number of rachis per panicle, duration of flowering and panicle colour of different mango varieties

Variety	Length of panicle (cm)		No. of rachis/panicle		Duration of flowering (days)		Panicle colour
	2022	2023	2022	2023	2022	2023	
Bangalora	24.7	26.4	25.5	30.6	28.5	10.1	Lightpink
Banganpalli	23.2	24.7	23.9	44.8	45.9	12.0	Light pink
Alphanso	26.6	24.7	25.7	34.7	36.1	13.8	Greenish
Ratna	44.6	41.7	43.1	69.4	65.6	11.8	Deep purple
Sindhu	34.2	35.1	34.7	51.6	54.2	14.1	Pink
Bombay Green	22.3	24.4	23.4	27.5	25.9	12.0	Light pink
Vastara	19.6	21.2	20.4	32.8	33.5	15.1	Pink
Dasheri	25.7	26.2	25.9	31.7	32.4	16.0	Greenish
Amrapali	20.5	21.8	21.2	32.3	34.6	16.6	Light pink
Mallika	26.7	25.2	25.9	32.2	30.6	17.3	Greenish pink
Swarnarekha	19.5	21.0	20.3	27.8	29.1	17.1	Pinkish
Meghlanthan	35.2	36.6	35.9	42.0	42.3	16.0	Greenish pink
SafdarPasand	22.5	32.5	27.5	26.1	27.7	19.9	Pinkish
Himsagar	35.5	42.0	38.8	55.7	60.1	13.8	Light pink
Langra	28.7	31.5	30.1	35.4	37.3	16.1	Greenish
SE±m	1.29	1.43	1.37	1.66	1.75	0.62	NA
CD(0.05)	3.88	4.31	4.12	4.98	5.26	1.81	1.85

Table 2: Number of male flowers, hermaphrodite flowers, percent of hermaphrodite flowers and male-hermaphrodite flower ratio of different mango varieties:

Variety	No. of male flowers			No. of hermaphrodite flowers			Percent of Hermaphrodite flowers			Male and hermaphrodite ratio		
	2022	2023	Pooled	2022	2023	Pooled	2022	2023	Pooled	2022	2023	Pooled
Bangalora	445.2	395.4	420.3	58.6	40.2	49.4	11.6	9.2	10.4	7.59	9.83	8.71
Banganpalli	842.5	814.8	828.6	55.8	46.8	51.3	6.2	5.4	5.8	15.09	17.41	16.25
Alphanso	1342.3	1305.4	1323.8	72.1	69.6	70.9	5.1	5.0	5.1	18.61	18.75	18.68
Ratna	2009.1	2103.4	2056.2	34.6	37.2	35.9	1.7	1.7	1.7	58.06	56.54	57.30
Sindhu	362.8	314.6	338.7	186.3	213.4	199.8	33.9	40.4	37.1	1.91	1.47	1.69
Bombay Green	376.6	351.2	363.9	36.5	41.2	38.8	8.8	10.4	9.6	10.31	8.52	9.42
Vastara	373.2	346.3	359.8	111.4	119.1	115.3	22.9	25.5	24.2	3.35	2.91	3.13
Dasheri	389.3	374.5	381.9	241.0	237.8	239.4	38.2	38.8	38.5	1.61	1.57	1.59
Amrapali	312.7	321.5	317.1	127.5	116.5	122.0	28.9	26.5	27.7	2.45	2.75	2.60
Mallika	398.5	378.0	388.3	79.2	75.4	77.3	16.5	16.6	16.5	5.03	5.01	5.02
Swarnarekha	111.6	124.8	118.2	24.8	30.8	27.8	18.2	19.8	19.0	4.50	4.05	4.28
Meghlanthan	435.3	429.6	432.5	69.6	64.9	67.3	13.8	13.1	13.5	6.25	6.61	6.43
SafdarPasand	111.7	96.4	104.0	18.5	19.6	19.0	14.2	16.9	15.6	6.03	4.91	5.47
Himsagar	119.1	103.5	111.3	23.8	27.6	25.7	16.6	21.0	18.8	5.00	3.75	4.38
Langra	206.3	231.0	218.6	325.8	302.6	314.2	61.2	56.7	58.9	0.63	0.76	0.69
SE±m	14.1	13.3	13.5	3.93	4.00	3.86	1.50	1.41	1.43	0.50	0.48	0.50
CD(0.05)	42.3	39.8	40.5	11.8	12.0	11.6	4.52	4.25	4.30	1.52	1.46	1.51

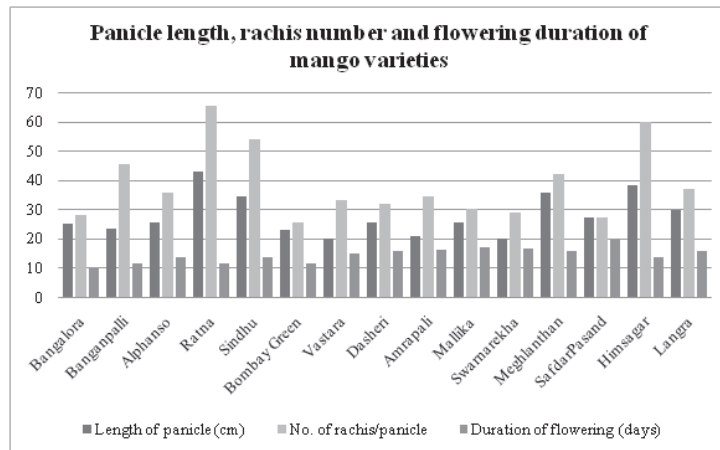


Fig. 1: Length of panicle, number of rachis per panicle and duration of flowering and panicle colour of different mango varieties

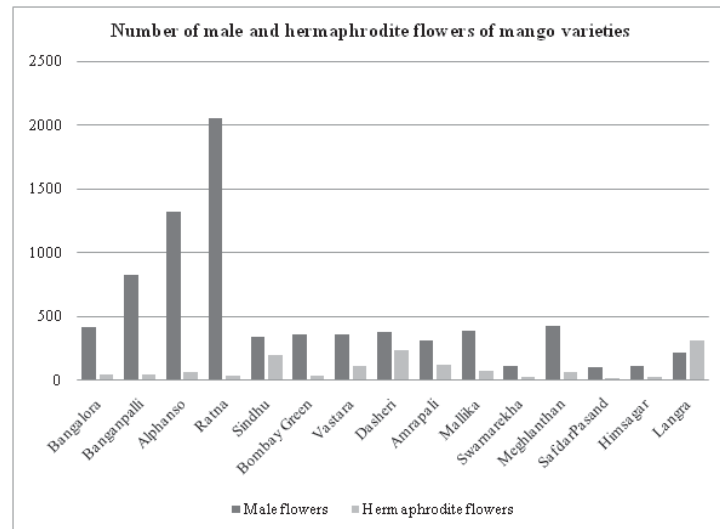


Fig. 2 : Number of male flowers and hermaphrodite flowers of different mango varieties.

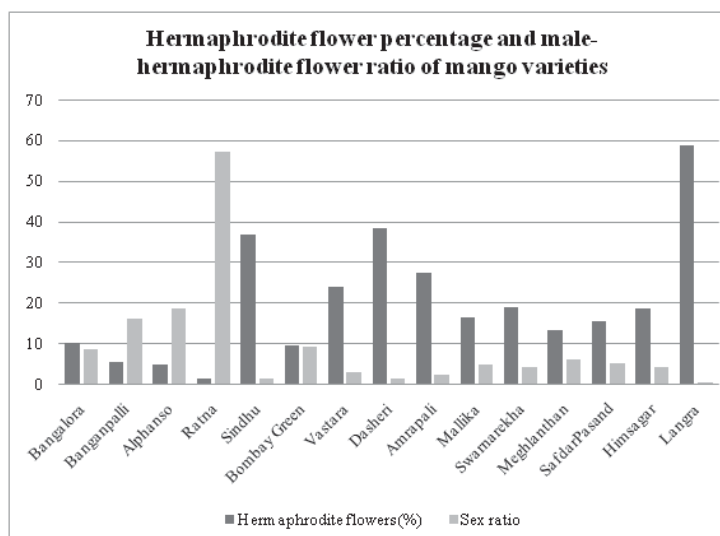


Fig. 3 : Percent of hermaphrodite flowers and male-hermaphrodite flower ratio of different mango varieties.

duration. Kumar *et al.* (2017) has reported range of flowering duration of mango varieties under western Uttar Pradesh condition as 11.33 to 19.00 days which has close proximity to the findings of the present experiment.

Colour of panicle: Mango varieties in the present study shown significant variation in their panicle (Table 1). Mainly the main stem and the branches or rachis are pigmented in mango panicles. Accordingly the panicle colors were noted. Light pink coloured panicle have been observed in Bangalora, Bombay Green, Amrapali, Himsagar mango varieties. Greenish colour in the panicles has been noted in Alfonso, Dasherri and Langra varieties. Sindhu and Vastara have shown pink coloured panicles while Swarnarekha represented pinkish panicles. Light pink colored panicle was noted in Himsagar mango variety. On the other hand greenish pink colored panicle has been observed in Mallika and Meghlanthan mango varieties.

Synthesis of different pigments particularly anthocyanin in the panicles of mango cause the variation of panicle colour. This character is governed by some genes which are present in some varieties and sometimes they are absent and thus the presence or absence of colouration in the panicle of the mango results (Koirala *et al.*, 2020). The variation of panicle colour in the present experiment is also due to the variation of their genotypic characters. Kumar *et al.* (2018) has also reported pinkish green, greenish pink, light green and light pink colour in various mango varieties.

Number of male flowers per panicle: Average number of male flowers per panicle under fifteen different mango varieties in the present experiment has been significantly varied in both the years as well as in pooled data (Table 2 and Figure 2). A huge variation has also been observed in the average number of male flowers present per panicle under the present experiment. Significantly highest number of male flowers per panicle (2056.2) has been noted in the mango variety Ratna. Alfonso mango variety has produced second highest number of male flowers per panicle (1323.8). Lowest number of male flowers was noted in SafdarPasand mango variety (104.0 numbers of male flowers) which was closely followed by Himsagar (111.3) and Swarnarekha (118.2) with respect to average number of male flowers per panicle.

The huge variation of number of male flowers of mango varieties in the present experiment (104.0 to 2056.2) was might be due to the variation of genetic components. Moreover, the varieties considered in the present experiment are diverse i. e. North Indian, South Indian, West Indian as well as hybrids. Thus the genetic variation is very common for this reason. Kishore *et al.* (2015) also found such huge variation in number of flowers in different mango varieties and that has been ranged from 384.67 to 2395.60.

Number of hermaphrodite flowers per panicle: The variation in the number of hermaphrodite flowers per panicle of fifteen different mango varieties noted ranged from 19.0 to 314.2 (Table 2 and Figure 2). Significantly highest number of hermaphrodite flowers was observed in the mango variety Langra while it was lowest under SafdarPasand. Mango variety Dasherri has also exhibited higher number of hermaphrodite flowers (239.4) and similar observation was noted in case of mango variety Sindu (199.8). On contrary, lower production of hermaphrodite flowers was observed under Himsagar as well as Swarnarekha variety with average hermaphrodite flowers of 25.7 and 27.8 respectively.

The sex differentiation of mango panicle depends on variation in the production of plant hormones and many other biomolecules which are determined and governed by genotypes of mango. Thus, genotypic variation causes difference in production of perfect flowers (Devenport, 2007). Vidyashree *et al.* (2021) has found 125 to 246 numbers of hermaphrodite flowers in some varieties and they have also mentioned that the variation was due to the genetic composition as well as weather condition prevailed during the flowering of mango varieties.

Percentage of hermaphrodite flowers: Significantly higher proportion of hermaphrodite flowers was noted under the mango variety Langra in both the years (Table 2 and Figure 3). It is evident from the pooled data that 58.9 % hermaphrodite flowers were produced by Langra variety mango. Variety Dasherri and Bombay Green have also produced higher proportion of hermaphrodite flowers in both the years as 38.5 and 37.1% respectively. Mango variety Ratna has exhibited significantly lowest proportion of hermaphrodite

flowers in both the years as well as in pooled data (1.7%). Variety Banganpalli and Alphonso have also been recorded lower proportion of hermaphrodite flowers in their panicles as 5.8 and 5.1% respectively.

Kishore *et al.* (2015) has reported the range in number of perfect flowers of different mango varieties as 3.39 to 34.03. The range of variation of percentage of hermaphrodite flowers as differed from the findings of Kumar *et al.* (2014) might be due to the variation in the genotypes as well as the prevalence of climatic condition.

Male and hermaphrodite ratio: Male and hermaphrodite ratio of different mango varieties in the present study has shown significant variation and it ranged from 0.69 to 57.30 (Table 2 and Figure 3). The mango variety Ratna has exhibited maximum male and hermaphrodite ratio. On contrary Langra has recorded lowest male and hermaphrodite ratio. Low male and hermaphrodite ratio was also noted in Dasherri, Sindhu, Amrapali, and Vastara mango varieties and they exhibited the ratio of 1.59, 1.69, 2.60 and 3.13.

In the present study the varieties with higher production of perfect flowers like Langra, Dasherri, Sindhu, Amrapali, and Vastara have shown very narrow male and hermaphrodite ratio which indicated a very good proportion of perfect flowers and better fruit set. On contrary Ratna, Alphonso, Banganpalli have exhibited lower proportion on perfect flowers and thus very high male and hermaphrodite ratio *i.e.*, higher population of male flowers per panicle. The attributed cause might be the genotypic variation, prevalence of climatic condition, growing zone as well as the influence of soil condition (Reddy and Sweetey, 2018; Kumar *et al.*, 2014; Abourayya *et al.*, 2011).

CONCLUSION

In the present experiment, significant variations on various morphological characters of panicle and flowering pattern have been observed in fifteen selected mango varieties. The maximum length of panicle was noted in mango variety Ratna (43.1 cm) with maximum numbers of rachis (65.6). Highest flowering duration has been observed under SafdarPasand (19.9 days) and lowest in Bangalora (10.1 days). Mainly the main stem and the branches or rachis are pigmented in mango

panicles as pink, light pink, pinkish green, greening pink, green etc. Maximum male flowers per pinnacle (2056.2) have been noted in the mango Ratna and minimum in Safdar Pasand (104.0). Number of hermaphrodite flowers per pinnacle of fifteen different mango varieties varied from 19.0 (in Langra) to 314.2 (in Safdar Pasand). Mango variety Langra has produced maximum hermaphrodite flowers (58.9 %) while lowest production of perfect flower was noted in Ratna (1.7%).

CONFLICT OF INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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