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Evaluation of Mango (*Mangifera indica* L.) Cultivars for Flowering, Fruiting and Yield Attributes

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Abstract

A field experiment was conducted to investigate the flowering, fruiting and yield attributes of some mango cultivars for the years 2014−15 and 2015−16. Outcome of the present research work revealed that the date of panicle emergence in different mango cultivars varied in both the years. It was observed that the panicle emergence was earliest in Gulabkhas and late in Fazli in both the years. Chausa produced maximum panicle length (35.19 cm) and breadth (24.76 cm). In the year 2014−15, earliest flowering was noted in Gulabkhas (Feb 17−Feb 26) and in the year 2015−16, earliest flowering was observed in Bombai (Feb 20−Feb 28) while, flowering was very late in Sepiya for both the years. Maximum number of flowers was observed in Langra (1839.13) while, minimum number of flowers was recorded in Amrapali (954.75). The duration of flowering varied from 22.50−36.00 days in different mango cultivars. Maximum value in terms of days was observed with Sepiya (39 days) while it was minimum (22.50 days) in case of Alphonso. The data revealed that date of fruit set ranged from 11th−8th April. Earliest fruit setting was observed in Bombai (12th−16th March) during the year 2014−15 while, earliest fruit setting was noted in Gulabkhas (10th March−16th March) during the year 2015−16. Highest number of fruit set panicle^{-1} was recorded in Langra (137.75) while, maximum fruit set per cent was noted in Bombai (41.07%). Minimum days for maturity was taken by Gulabkhas (90.17 days). Maximum yield (501.00 kg tree^{-1}) was recorded in Langra.

Keywords: Mango, cultivars, panicle, flowering, fruit set, yield

1. Introduction

Mango (*Mangifera indica* L.) is an important fruit crop of India belonging to the family Anacardiaceae. Mango is a tropical fruit tree which usually flowers in spring and produces attractive fruits. Mango inflorescence is a branched terminal panicle, up to 0.6 m long and has several hundred to several thousand flowers. Mango inflorescence is a flowering shoot called panicle and it bears two types of flowers, male and hermaphrodite flowers. Sex ratio is a variable component within panicles, tree and among cultivars. The initial fruit set is directly related to the proportion of perfect flowers (Singh et al., 2015).

A tree can have 200−3000 panicles with a potential to produce tremendous number of flowers (Barui and Ghosh, 2002). Cool temperature regulates the flowering in mango. However, in the absence of cool temperature, induction of flowering occur in response to water stress. Different degree of water stress during flower bud development is advantageous for good flowering (Singh and Singh, 2003). Furthermore, it has been demonstrated that the floral stimulus originates from mature leaves in mango and young leaves inhibit the floral bud initiation (Kulkarni, 1986. Hence Water stress during flower bud development in subtropical condition restricts the production of new leaves and consequently increases the proportion of flower inductive leaves (mature leaves). There is possibility that floral induction in mango can also occur after a period of plant water stress in favourable temperature, when canopies consist mainly of mature, inductive leaves. The skin is smooth, thick and commonly yellow or greenish when mature. Mango fruit develop rapidly after fruit set and is ready for harvesting within 13−20 weeks, depending upon the variety and climate. Mango is essentially a tropical fruit. It generally does well within temperature range of 24−27 °C but also can tolerate temperature as high as 48 °C. The requirements of water depend on the type of soil and climate, planting distance, cultivar, age of plants, developmental stages, NPK applications and weather conditions (Malik and Mitra, 2001; Reddy et al., 2001; Gawankar et al., 2010; Dhake et al., 2011). Productivity of mango is low due to several factors such as alternate bearing, fruit drop, diseases and pests. Most of the north Indian varieties, viz., Dashehari, Langra, Chausa and Bombay Green are alternate bearer, while, most of the South Indian varieties bear regularly (Pandey and Dinesh, 2010). Low productivity is the resultant effect of alternate bearing, inadequate fruit set followed by heavy fruit

drop. In mango, flowering is influenced by weather conditions and varietal genotypes and is the most important trait as it finally influences the yield.

Mango belongs to the group of plants, in which an antagonism between vegetative vigour and flowering intensity is observed. Therefore, any factor that reduces the vegetative vigour, without altering the metabolic activity, favours flowering. Mango trees are generally induced to flower between october to december in northern hemisphere and during June to August in southern hemisphere. However, irregularity of flowering in mango, which varies in time and intensity of flowering from year to year to almost complete biennial (alternate flowering habit), is not an uncommon phenomenon. Accordingly, the unravelling of the nature of flower triggering and signalling elements is of utmost importance (Narvariya et al., 2015).

Even in the same region, different environmental conditions at different years can affect maturity and quality of the fruit (Devilliers, 1998). Therefore, evaluation of different promising mango cultivars for a given set of ecology is one of the pre-requisite for successful mango cultivation.

2. Materials and Methods

The present field experiment was conducted at Horticulture Unit, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, U.P., India during the year 2014–15 and 2015–16. The experimental orchard comes under the Indo-gangetic alluvial track in eastern Uttar Pradesh in class II of land capability class and irrigated by tube well. Varanasi is situated in eastern part of Utter Pradesh, which lies between 25°19'59'' N latitude and 83°00'00'' E longitude at an elevation of 76.80 m MSL. The mean annual rainfall is about 850–1100 mm. The experiment was carried out on healthy and bearing of 20 years old trees.

The number of treatments were eleven and replicated thrice. Therefore, altogether thirty-three plants were selected for this investigation. Amrapali, Langra, Dashehari, Mallika, Chausa, Fazli, Bombai, Himsagar, Sepiya, Alphonso and Gulabkhas cultivars were taken for study as treatments.The experiment was laid out in Randomized Block Design (RBD). The observations were recorded on flowering characteristics as date of panicle emergence, panicle length (cm), panicle breadth (cm), date of flowering, number of flowers panicle^{-1} and duration of flowering. Fruiting characteristics and yield attributes were also recorded as date of fruit set, number of fruit set panicle^{-1}, fruit set per cent, fruit maturity (days) and yield (kg tree^{-1}).

3. Results and Discussion

3.1. Panicle emergence and size

3.1.1 Date of panicle emergence

It was found from the data presented in Table 1 that date of panicle emergence in different mango cultivars varied in both the years. It was observed that the panicle emergence was earlier in Gulabkhas and late in Fazli in both the years. The variation in flowering behavior may be attributed to the genetic variation responding to the climatic conditions. Panicles initiation in all the cultivars started from the south side of the plant. This seems to be due to more exposure of south side of the plant to sunlight hence becoming warmer than all other directions. This warmness might be the cause of earliest panicle initiation at the South side in various cultivars.

Table 1: Data regarding date of panicle emergence and size of panicles of different mango cultivars

Treatment (Cultivars)	Date of panicle emergence		Length of panicle (cm)			Breadth of panicle (cm)		
	2014–15	2015–16	2014–15	2015–16	Pooled mean	2014–15	2015–16	Pooled mean
Amrapali	Feb13–Feb 18	Feb 10–Feb 16	24.15	25.24	24.70	15.37	14.99	15.18
Langra	Feb 18–Feb 23	Feb 20–Feb 24	30.34	29.38	29.86	21.23	19.17	20.20
Dashehari	Feb 12–Feb 16	Feb 11–Feb 18	24.94	26.66	25.80	16.06	15.79	15.92
Mallika	Feb 8–Feb 15	Feb 10–Feb 17	25.13	26.01	25.57	15.06	15.21	15.14
Chausa	Feb 27–March 3	Feb 24–March 3	35.60	34.78	35.19	23.29	26.23	24.76
Fazli	Feb 28–March 7	Feb 27–March 4	29.89	28.25	29.07	15.05	15.57	15.31
Bombai	Feb 2–Feb 7	Feb 4–Feb 8	27.03	28.54	27.79	15.79	15.37	15.58
Himsagar	Feb 13–Feb 17	Feb 11–Feb 19	27.48	28.97	28.22	16.26	15.85	16.06
Sepiya	Feb 28–March 5	Feb 26–March 2	30.95	32.99	31.97	15.07	14.40	14.74
Alphonso	Feb 14–Feb 17	Feb 16–Feb 20	25.93	27.91	26.92	23.25	22.28	22.77
Gulabkhas	Feb 1–Feb 5	Feb 3–Feb 8	25.77	28.31	27.04	16.42	15.59	16.00
SEm±			1.80	1.62	19.67	0.66	0.36	0.38
CD (*p*=0.05)			5.31	4.79	4.95	1.96	1.07	1.12

The results corroborated with the findings by Kanpure et al. (2009); Asif et al. (2002); Majumder et al. (2011); Kumar et al. (2014); Makhmale et al. (2015); Ghavale et al. (2016).

3.1.2. Size of panicles

From the experiment, it was recorded that Chausa produced maximum panicle length (35.19 cm). Whereas, Amrapali produced minimum panicle length (24.70 cm). Maximum breadth of panicle was recorded in Chausa (24.76 cm). Likewise, the minimum breadth of panicle recorded in Sepiya (14.74 cm). The variation in panicle size might be due to response of trait to environmental condition. Kumar and Jaiswal (2004) stated that possible cause of difference in panicle length and width may be due to environmental conditions. The results were in accordance with the findings of Majumder et al. (2011); Kundu et al. (2009).

3.2 Flowering characteristics

3.2.1. Date of flowering

Table 2 showed earliest flowering in cultivar Gulabkhas (Feb 17–Feb 26) in the year 2014–15 whereas in the year 2015–16, earliest flowering was observed in cultivar Bombai (Feb 20–Feb 28). Flowering was very late in cultivar Sepiya for both the years. Time of flowering is an important parameter since it affects time of maturity, which in turn relates to the marketing of any commodity. Most of the time, the commodity coming into the market very early or late attracts the consumers and offers higher price to the growers (Iqbal et al., 2012). The similar observations were also noted by Chanana et al. (2005).

3.2.2. No. of flowers panicle^{-1}

It was clearly observed that there was significant difference in number of flowers produced panicle^{-1}. Maximum number of flowers was observed in Langra (1839.13). Variation in number of flowers panicles^{-1} attributed to inherent genetic differences of the mango cultivars. The result obtained in the present study coincide with the results of Thimmappaiah and Suman (1987), Kumar and Jaiswal (2004); Mukherjee (1953); Asif et al. (2002).

3.2.3. Duration of flowering

The duration of flowering varied from 22.50–36.00 days in different mango cultivars. Maximum value in terms of days was observed with Sepiya (36 days) while it was minimum (22.50 days) in case of Alphonso. The variation in flowering behavior may attribute to the genetic characters and the

Table 2: Data regarding flowering characteristics of different mango cultivars

Treatment (Cultivars)	Date of start of flowering		No. of flowers per panicle			Duration of flowering (days)		
	2014-15	2015–16	2014–15	2015-16	Pooled mean	2014–15	2015-16	Pooled mean
Amrapali	Feb 26–Feb 28	Feb 22–Feb 25	941.50	968.00	954.75	29.00	27.33	28.17
Langra	March 10–March 15	March 9–March 15	1817.67	1860.58	1839.13	28.33	30.33	29.33
Dashehari	March 3–March 8	March 1–March 6	1391.67	1362.25	1376.96	26.67	31.67	29.17
Mallika	Feb 28–March 7	Feb 24–March 7	1207.92	1249.25	1228.58	31.33	29.00	30.17
Chausa	March 12–March 18	March 5–March 12	1124.58	1183.58	1154.08	32.67	33.67	33.17
Fazli	March 6–March 17	March 4–March 15	1053.92	1054.17	1054.04	34.67	34.67	34.67
Bombai	Feb 22–Feb 25	Feb 20–Feb 28	1051.50	1009.83	1030.67	26.67	32.67	29.67
Himsagar	Feb 27–March 2	Feb 20–March 5	1132.42	1182.42	1157.42	34.33	31.33	32.83
Sepiya	March 8–March 17	March 17–March 23	1304.92	1351.58	1328.25	36.67	35.33	36.00
Alphonso	Feb 25–Feb 28	Feb 23–Feb 27	974.75	946.75	960.75	20.67	24.33	22.50
Gulabkhas	Feb 17–Feb 26	Feb 21–Feb 25	1012.58	948.58	980.58	24.33	21.67	23.00
SEm±			21.47	27.06	14.54	3.05	2.64	2.51
CD (*p*=0.05)			63.33	79.84	42.91	8.99	7.80	7.42

climatic condition. These results are in close association with Hoda et al. (2003), Kanpure et al. (2009), Majumder et al. (2011); Iqbal et al. (2012).

3.3. Fruiting characteristics

3.3.1. Date of fruit set, fruit set no. panicle^{-1} and fruit set %

The data presented in Table 3 showed that date of fruit set ranged from 11th March–8th April. The results obtained in the present study coincide with the results of Anjum et al. (1999) and Hoda et al. (2003). Maximum fruit set was recorded in Langra (137.75). On the other hand, minimum fruit set was recorded in Alphonso (27.84). Maximum fruit set was noted in Bombai (41.07%). Likewise, minimum fruit set was obtained in Fazli (24.11%). Singh (1990) support these findings and according to him Fruit set is a varietal character depending upon several factors such as time of flowering, sex ratio, efficient cross pollination and intensity of drop. He further added that varieties differed from one another in

Table 3: Data regarding fruiting characteristics of different mango cultivars

Treatment (Cultivars)	Date of fruit set		No. of fruit set panicle^{-1}			Fruit set (%)			Fruit maturity (days)		
	2014-15	2015–16	2014–15	2015–16	Pooled mean	2014–15	2015–16	Pooled mean	2014–15	2015–16	Pooled mean
Amrapali	March 15-March 19	March 17-March 20	68.84	72.52	70.68	38.18	36.44	37.31	114.33	111	112.67
Langra	March 24–March 29	March 20–March 26	135.38	140.11	137.75	31.23	29.4	30.31	96.33	100.33	98.33
Dashehari	March 24–March 26	March 22–March 27	98.66	108.39	103.52	39.22	39.58	39.4	112.33	109.67	111
Mallika	March 26–April 3	March 23 – April 7	80.45	80.55	80.5	37.83	35.2	36.52	109	106.67	107.83
Chausa	March 29–April 6	March 23 – April 4	77.37	77.85	77.61	34.39	33.09	33.74	135.67	132	133.83
Fazli	March 28–April 8	March 30 – April 6	58.42	65.99	62.2	23.54	24.67	24.11	130.33	134.67	132.5
Bombai	March 12–March 16	March 11 – March 14	78.89	82.66	80.77	42.01	40.13	41.07	91.33	93.33	92.33
Himsagar	March 19–March 26	March 17 – March 23	59.52	71.99	65.76	33.52	37.53	35.53	113.67	111.33	112.5
Sepiya	March 28 – April 7	March 26 -April 8	110.91	112.32	111.61	35.3	36.66	35.98	132.67	137.67	135.17
Alphonso	March 18–March 26	March 21 – March 28	26.75	28.93	27.84	27.58	28.52	28.05	96	94.33	95.17
Gulabkhas	March 13 – March 15	March 10 – March 16	58.95	59.99	59.47	32.89	30.98	31.94	89.67	90.67	90.17
SEm±			3.41	1.46	3.41	1.86	1.31	1.35	5.34	4.26	4.17
CD (p=0.05)			10.07	4.3	10.07	5.5	3.87	3.99	15.76	12.59	12.31

these respects and this lead to varying fruit set in different varieties. Singh (1988) also supported this and stated that weather conditions also affected fruit set.

3.3.2. Fruit maturity (days)

Sepiya took more days to maturity (135.17) while, minimum days for maturity was taken by Gulabkhas (90.17). The difference in maturity of fruits of different cultivars might be due to the difference in date of panicle emergence and prevailing environmental conditions, besides their genetic makeup (Kundu et al., 2009). Variation in fruit maturity in different varieties might be due to change in location or inherent genetic variation (Singh, 2002 and Hoda et al., 2003). Similar findings had also reported by Sardar et al.(1998) and Majumder et al. (2011).

3.4. Yield attributes (kg tree^{-1})

There was significant difference obtained in yield in different cultivars (Figure 1). It is clearly indicated from Graph 1 that maximum yield tree^{-1} was found in Langra (501.00 kg tree^{-1}) while, minimum yield tree^{-1} was observed in Gulabkhas (92.66 kg tree^{-1}). It might be due to varietal differences. The findings

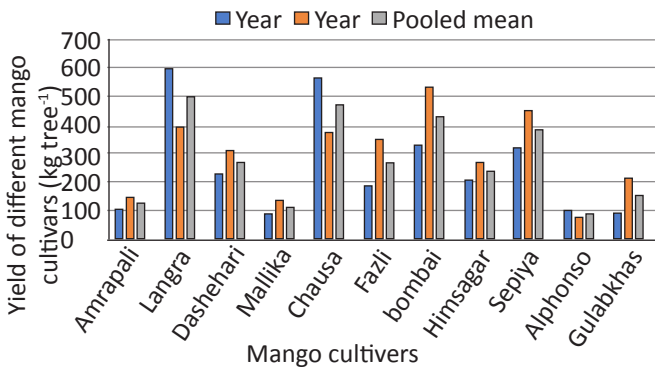

Figure 1: Yield of different mango cultivars (kg tree^{-1})

of this study are supported by the idea that yield is highly variable factor depending upon the cultivars and age of plants, climatic conditions, incidence of pests and diseases. Majority of the workers had the idea that yield potential was a varietal character. The increase in yield in terms of weight might be either due to the large sized fruits or due to more number

of fruits per plant^{-1}. Similar results were obtained by Kumar and Singh (2005), Sinha et al., (2007) and Kundu et al. (2009).

4. Conclusion

The cultivar Langra showed the higher per cent of flowering, fruiting and yield under Indo-gangetic plains of Uttar Pradesh.

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