



Research Article

Identification of suitable coloured mango (*Mangifera indica* L.) cultivars for Bihar conditions

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Abstract

An experiment was conducted on 15 coloured mango cultivars at Bihar Agricultural University, Sabour, Bihar during the year 2020-2021 to identify suitable coloured mango cultivars for Bihar conditions. Arunika and Kingphon were found early in panicle emergence and anthesis while much delayed panicle emergence and anthesis were observed in Sabri. The maximum length of the panicle was measured in Kingphon (43.22 cm) whereas; the minimum was in Sabri (17.76 cm). The minimum flowering duration was recorded in Kent (9.20 days) with statistically at par value in Sensation, Osteen and Sabri. While the longest flowering duration was observed in Arunika (22 days). Maya was topped (86.50 %) in the list for the flowering intensity which was found statistically at par with Kensington (72.50 %). Maximum number of fruit set per panicle was counted in Tommy Atkins (21.10) which was statistically at par with Sensation (20.60). Early fruit maturity and the highest number of fruits per plant at the maturity stage were found in Pusa Pratibha. The highest fruit weight, volume, pulp percentages and pulp/stone ratio were observed in Osteen (505.71g, 500.05 ml, 73.40% and 6.98 respectively) followed by Lily. Pusa Pitambar yielded the highest number of fruits per m³ canopy volume (2.34) with statistically at par results in Kent (1.77). The maximum TSS/Acid blend was assessed in Sensation (99.25). The total sugar content (16.48%) was found in Pusa Pratibha which was statistically at par with Pusa Surya (15.90%) and Sabri (15.47%). The total carotenoid content was estimated at maximum in Pusa Pitambar (7.19 mg 100-1 g FW). In Ambika, the highest ascorbic acid was estimated (55.00 mg 100-1 g pulp). The cultivars like Pusa Shrestha, Pusa Pratibha, Pusa Surya, Lily, Ambika and Arunika had shown delightful colour with higher yields, especially in Pusa Pitambar.

Keywords canopy volume, coloured varieties, flowering intensity, mango, yield

Introduction


Mango (*Mangifera indica* L.) is one of the most popular commercial fruit crops in India. It belongs to the family Anacardiaceae and order Sapindales and is native to the Indo-Burma region. Mango has the first rank in the area (2.29 MH) and second rank in production (20.44 MT) among all the fruit crops grown in India [1]. In Indian conditions, thousands of cultivars are conserved at various research centres and are widely growing at farmer orchards but there are a few coloured mangoes

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available cultivars have commercial importance. The coloured fruits contain antioxidant properties which cure many ailments like diabetes, cancer, heart and neurological diseases in human beings [2-3]. Especially purple-coloured mangoes are beneficial for diabetic patients. Red-coloured mangoes have high demand and are also utilized as a substituent for artificial pigments [4]. Central Institute for Subtropical Horticulture, (CISH) Lucknow has developed 'Arunika' which is rich in bio-active compounds including mangiferin and lupeol and mainly used to lower blood glucose levels by preventing glucose absorption in the intestine. It also helps to protect against breast and colon cancer. Due to the wide range of diversity in the existing mango cultivars throughout the world, the morpho-phenological attributes of different mango cultivars are also varied significantly among the cultivars [5-6]. Under tropical and sub-tropical climates, the flower bud differentiation takes place during the 6-8 months old shoots during the month of October-November. Phenological activity, thus, plays an integral role in the flower initiation in mango. Phenology is the advancement of any plant demonstrating the recognisable stages of growth. It depends on the environmental factors and the adaptation capacity of the plants to a particular environment [7]. However, proper phenological expression is the key to increasing the yield potential of the crop.

Hence, it is very important to study the diversity of the different coloured mango cultivars for their morpho-phenological traits as well as yield performance under the Bihar condition to conclude their suitability in this condition. Keeping these views in mind, the present research work was formulated to identify suitable coloured mango cultivars under Bihar conditions.

Methodology

The present experiment was laid out under the all India Co-ordinated Research Project on Fruits, Department of Horticulture (Fruit & Fruit Technology), Bihar Agricultural University, Sabour, Bhagalpur, Bihar during 2020-21. About 7-8 years old mango cultivars viz., Pusa Pitambar, Pusa Shrestha, Pusa Pratibha, Pusa Surya, Arunika, Ambika, Tommy Atkins, Kensington, Lily, Kingphon, Osteen, Kent, Sensation, Maya and Sabri were selected for this experiment. Two plants per cultivar were planted in Randomized Block Design at a 5 x 5 m distance. The average date of panicle emergence was noted based on the emergence date of panicle in previously tagged branches in all directions. Panicle length was measured at the full bloom stage with the help of a meter scale. The flowering duration (days) was counted from the date of the start of flowering to the date of full blooming. To measure flowering intensity, randomly 100 shoots were tagged before flowering and after flowering, the numbers of flowering shoots were counted. Further, it was calculated in percentage as:

$$\text{Flowering intensity} = \frac{\text{Total no. of shoots flowered} \times 100}{\text{Total no. of shoots tagged}}$$

The number of fruits set per panicle was counted on randomly tagged shoots at the pea stage and per cent fruit setting per panicle was calculated thereof. The retained fruits were counted at the time of maturity from those tagged panicles and fruit retention per cent was calculated. After harvesting, the weighting of individual fruit was done by digital balance and recorded in grams. The volume of each fruit was calculated using the water displacement method and expressed in millilitres. Peel, Stone and pulp percentages were calculated by the following formula:

$$\text{Peel/Stone/Pulp (\%)} = \frac{\text{Weight of peel/Stone/Pulp}}{\text{Total weight of the fruit}} \times 100$$

The pulp/stone ratio was considered by dividing the fruit pulp weight by stone weight while for calculating the yield per m³ of canopy volume, the following formula was used:

$$\text{Yield (fruits/x}^3\text{)} = \frac{\text{Total numbers of fruits/tree}}{\text{Canopy volume (m}^3\text{)}} \times 100$$

For fruit quality parameters, TSS/Acid blend was calculated by dividing the TSS by the total titratable acidity of mango fruits. The ascorbic acid was estimated by using 2, 6-Dichlorophenol indophenol dye method [8] while total sugar content was assessed following the method described by Lane and Eynon, [9]. The total carotenoid content was estimated by the protocol standardized by Roy, [10]. The experimental data collected during this research for numerous characters were statistically analysed using Analysis of Variance (ANOVA) at a 5 per cent level of significance and critical difference (CD) in O. P. Sheoran, "Hisar Statistical package for Agricultural Scientists (OPSTAT)," CCS HAU.

Results and Discussion

Floral characters

Significant variation was observed among the cultivars regarding phenological attributes (Figure 1). Panicle emergence was noted earliest in Arunika and Kingphon (12th February). However, Sabri had very most delayed panicle emergence (7th March). Similar findings have been reported earlier by Singh et al., and Gill et al., [6, 11] in various mango cultivars. Maximum panicle length (43.22 cm) was measured in Kingphon followed by Pusa Pratibha (34.09 cm) and Pusa Pitambar (30.22 cm) whereas; it was recorded minimum in Sabri (17.76 cm).

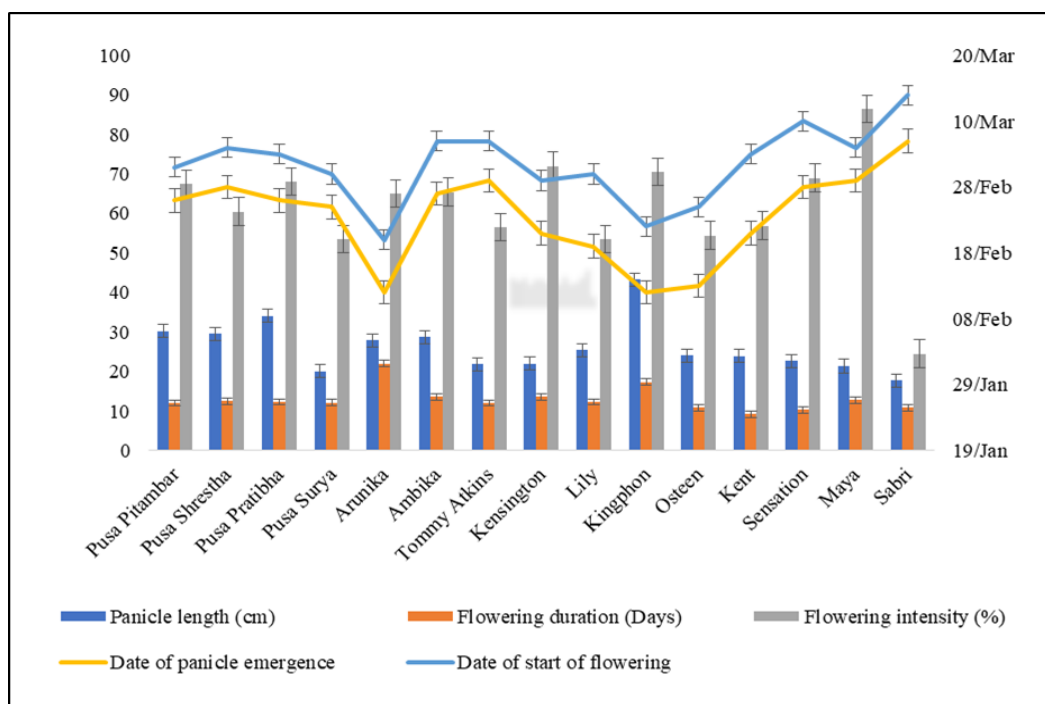


Figure 1. Graphical representation of different flowering characters

It might be due to the genetic constitution of the cultivars and their interaction with environmental factors. Further, the physiological parameters of the shoot are also responsible for the variation in panicle length and breadth among the cultivars [12]. The anthesis of the first flower was



observed in Arunika (20th February) followed by Kingphon (22nd February) and Osteen (25th February) while it was delayed maximum in Sabri (14th March). Similar results were also found Earlier by Barua et al., [13]. The flowering duration was recorded as a minimum in Kent (9.20 days) with statistically at-par results in cultivars Sensation (10.30 days), Osteen and Sabri (10.80 days). While maximum flowering duration was observed in Arunika (22 days). The highest flowering intensity was measured in Maya (86.50%) which was found statistically at par with Kensington (72.50%) while, the lowest value of flowering intensity was observed in Sabri (24.50%).

Fruiting and yield characters

Among the 15 cultivars under the present investigation, a significant difference in the fruiting and yield characteristics was observed (Table 1). The maximum number of fruits per panicle at the pea stage was counted in Tommy Atkins (21.10) which was statistically at par with Sensation (20.60). The obtained findings agreed with the results of Kumar et al., [14].

Table 1. Fruiting and yield parameters of different coloured mango (*Mangifera indica* L.) cultivars

SN.	Cultivars	No. of fruit set/panicle at pea stage	No. of fruit retention at maturity	Date of fruit maturity	Fruit weight (g)	Fruit volume (cc)	Peel (%)	Stone (%)	Pulp (%)	Pulp/stone ratio	Yield (fruits/m ³)
1.	Pusa Pitambar	12.40	1.25	01-July	252.16	237.00	19.40	20.27	60.34	2.98	2.34
2.	Pusa Shrestha	13.10	1.30	01-July	322.06	320.00	14.69	16.37	68.94	4.21	1.41
3.	Pusa Pratibha	11.10	1.70	25-June	241.48	214.00	15.94	20.17	63.89	3.18	1.35
4.	Pusa Surya	15.85	0.70	29-June	242.18	186.50	23.05	23.64	53.31	2.26	0.93
5.	Arunika	17.75	1.10	29-June	230.02	165.00	23.33	22.23	54.44	2.45	1.15
6.	Ambika	14.90	1.30	26-June	199.63	209.50	22.51	20.19	57.30	2.84	1.54
7.	Tommy Atkins	21.10	1.25	30-June	274.49	192.50	18.55	18.31	63.14	3.53	0.62
8.	Kensington	15.60	0.80	01-July	238.64	227.00	20.06	18.34	61.61	3.36	0.81
9.	Lily	11.40	0.90	29-June	428.60	412.00	17.05	12.66	70.29	5.61	0.57
10.	Kingphon	12.45	0.80	27-June	229.64	237.50	29.05	20.21	50.74	2.52	0.79
11.	Osteen	12.90	0.70	04-July	505.71	500.05	16.07	10.53	73.40	6.98	0.57
12.	Kent	13.40	0.60	30-June	389.66	411.00	11.39	19.26	69.35	3.61	1.77
13.	Sensation	20.60	0.90	03-July	150.66	137.00	27.72	25.45	46.83	1.84	1.18
14.	Maya	15.50	0.90	07-July	189.73	191.50	26.53	16.13	57.34	3.55	0.72
15.	Sabri	15.60	0.70	02-July	132.04	121.00	16.07	18.45	65.48	3.55	1.31
SEm(±)		0.96	0.11	-	16.07	11.99	1.26	0.83	1.89	0.28	0.23
CD (P<0.05)		2.90	0.35	-	48.44	36.16	3.79	2.49	5.68	0.84	0.70

The present finding revealed that the maximum number of fruits retained per panicle at maturity was seen in Pusa Pratibha (1.70). Many factors like diseases and insect-pest infestation, climatic factors and pollination methods as well as genetic factors played a significant role in fruit retention at harvest [15]. The earliest fruit maturity has been seen in Pusa Pratibha (25th June). On the other hand, it was delayed maximum in Maya (7th July). Further, the fruit weight and volume were recorded as a minimum in Sabri (132.04 g and 121 cc, respectively) with a maximum in Osteen (505.71 g and 500.05 cc, respectively). The variations in fruit size could be due to the variation in the genetic makeup of individual cultivars and are heavily influenced by environmental conditions [16]. In terms of peel percentage, the maximum was calculated in Kingphon (29.05%), whereas the minimum value was recorded in Kent (11.39%). Fruit peel content is a key factor for determining the fruit quality and shelf life of any fruit crop. The peel percentages of an individual cultivar depend on the fruit volume [11]. The minimum stone per cent was evaluated in Osteen (10.53%) which was at par with Lily (12.66%). Whereas, the maximum stone percent was calculated in Sensation (25.45%).



According to Bora et al., [16], the variation in stone features is related to environmental interaction and genetic makeup. Further, for pulp percentage, Osteen measured the maximum (73.40%) while it was recorded minimum (46.83%) in Sensation. The pulp/stone ratio was estimated maximum in Osteen (6.98), whereas the minimum (1.57) ratio was noted in Sensation. Similar results were also observed by Gill et al., [11]. The highest number of fruits/m³ of canopy volume was estimated in Pusa Pitambar (2.34) it was found statistically at par with Kent (1.77). Whereas, it was recorded minimum in Lily and Osteen with a similar value of 0.57. The fluctuation in fruit yield per unit volume of mango tree was also noted earlier by Barua et al., [13] in Bangladesh.

Biochemical assessment

All the mango cultivars had a higher level of TSS with less acidity (Table 2) which resulted in a higher TSS/Acid ratio. The TSS/Acid blend was estimated maximum in Sensation (99.25) which was found at par with Arunika, Pusa Pratibha, Pusa Shrestha, Sabri and Kensington (95.11, 92.69, 88.71, 88.12 and 83.97 respectively) while, minimum in Tommy Atkins (49.73). The lowest amount of TSS/acid ratio concluded that these cultivars are not suitable for fresh consumption [17]. Pusa Pratibha was found on top in total sugar content (16.48%) which was statistically at par with cultivars Pusa Surya and Sabri (15.90% and 15.47% respectively). A maximum carotenoid of 7.19 mg 100⁻¹ g FW was estimated in Pusa Pitambar; however, a minimum was assessed in Lily (1.80 mg 100⁻¹ g FW). The total carotenoid content in mango fruits increased gradually with maturity and reaches a peak at the ripening of the fruit [18]. The results of the present study have been confirmed by the earlier experiment of Bora et al., [16]. In the present study, ascorbic acid ranged between 21.25 mg to 55.00 mg 100⁻¹ g pulp in Pusa Surya and Ambika respectively. The kind and level of genetic diversity present in the experimental sample could explain such variations in ascorbic acid content [16].

Table 2. Biochemical estimation of different coloured mango (*Mangifera indica* L.) cultivars

SN.	Cultivars	TSS/Acid blend	Total Sugar (%)	Total Carotenoids (mg100 ⁻¹ g)	Ascorbic acid (mg100 ⁻¹ g)
1.	Pusa Pitambar	78.62	13.35	7.19	42.19
2.	Pusa Shrestha	88.71	14.37	3.26	44.38
3.	Pusa Pratibha	92.69	16.48	3.71	41.25
4.	Pusa Surya	68.18	15.90	2.35	21.25
5.	Arunika	95.11	10.47	4.43	53.75
6.	Ambika	75.42	12.08	3.88	55.00
7.	Tommy Atkins	49.73	10.39	2.71	42.63
8.	Kensington	83.97	10.10	2.49	38.13
9.	Lily	54.80	11.47	1.80	33.75
10.	Kingphon	76.99	12.14	2.45	23.50
11.	Osteen	79.38	9.84	2.11	24.69
12.	Kent	67.00	10.30	2.20	39.63
13.	Sensation	99.25	10.34	1.90	27.88
14.	Maya	78.53	12.09	2.62	38.13
15.	Sabri	88.12	15.47	3.38	36.88
SEm(±)		5.95	0.34	0.31	4.72
CD (P=0.5)		17.94	1.05	0.96	14.25

Conclusion

From the present investigation, it can be concluded that Kingphon is the best cultivar for all the phonological attributes under the Bihar condition. The cultivars Osteen and Lily are superior in fruiting characteristics like maximum fruit weight, volume, pulp percentages and pulp/stone ratio while Pusa Pitambar performed very well for yield attributes. Besides cultivars viz., Sensation, Pusa Pratibha, Pusa Surya, Pusa Pitambar, Ambika and Arunika were found great in almost all the



biochemical properties. Some identified promising coloured mango cultivars from this experiment can be used as donor parents to improve existing mango cultivars into coloured, attractive and high-yielding characters under Bihar conditions.

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