



Fruiting Behaviour and Fruit Quality of Different Mango Varieties under Changing Climate Scenario

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Authors' contributions

This work was carried out in collaboration among all authors. Author NS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MP and VK managed the analyses of the study. Author AC managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted to study the impact of temperature and relative humidity on fruiting behaviour and fruit quality of different mango varieties in Central Plain Zone of Uttar Pradesh during the fruiting year 2017-18 in the Garden of the Department of Horticulture, C.S. Azad University of Agriculture and Technology, Kanpur. The experiment was laid out in Randomized Block Design with 3 replications. Seven varieties of mango were taken for study. Fruiting attributes as influenced by temperature and relative humidity differed significantly in different varieties. Chausa taken highest number of days followed by Amrapali, while Dasher and Gaurjeet recorded earliest fruit setting. The maximum marble size fruit was noted in Chausa while maximum mature fruit was noted in Local. The maximum fruit drop was recorded under Chausa followed by Dasher, whereas minimum fruit drop was recorded under Local. Gaurjeet mature first (24th May) followed by Bombay Green (25th May) and Husnara (30th May). Chausa (26th June) and Amrapali (10th July) mature late and very late respectively. The maximum fruit length and width

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was found in Chausa among all of the varieties followed by Dasherri in length and Husnara in width. The maximum weight of fruit, fruit pulp, stone and peel was recorded in Chausa followed by Husnara (except peel weight), while, the maximum pulp % was recorded in Amrapali. The variety Gaurjeet and Bombay Green both mature first (71 days) followed by Husnara (75 days) while, Amrapali taken longest duration (124 days) followed by Chausa (109 days) and Local (104 days). It has been observed that during fruit setting and fruit development and maturity mango requires less RH as compared to panicle initiation. During growth and maturity RH positively correlated like temperature in all the varieties. It is concluded that mango variety Chausa being maximum in fruit weight, fruit pulp, stone and peel and medium maturing may found suitable for this region.

Keywords: Temperature; relative humidity; variety; fruiting and mango.

1. INTRODUCTION

Mango is one of the choicest fruit in the world [1,2] popularly cultivated in the tropics and the subtropics. It is mostly grown in Southeast Asia, namely, India, Pakistan, the Philippines, Indonesia, Malaysia, Thailand, Burma, Sri Lanka, and Bangladesh [3] for its economic and nutritional values. Indian subcontinent has rich diversity of mango and hence, the India is considered to be the centre of origin of mango [4]. On account of its nutritive value, taste, attractive fragrance and health promoting qualities, it is also known as the “king of fruits” [5]. Mangoes are well established commodity of international trade because of their high quality [6]. Right from the mountain valley to the plains, mango is extensively cultivated in India. Although, it is grown all over the world in many countries on a commercial basis but still it does not have the same status as it is enjoying in India, such as apple enjoying by Americans. Worldwide India is the largest producer of mango accounting 18 million tonnes during 2012-13 contributing about 50% of the global production [7]. The leading mango producing states of India are Uttar Pradesh producing 4551.83 thousand MT from an area of 265.62 thousand hectares followed by Andhra Pradesh producing 4373.61 thousand MT from an area of 363 thousand hectares [8]. Although production is high in India but productivity is the concern. The crop productivity is subjected to number of stresses and potential yields are seldom achieved with stress. Climate change is predicted to cause an increase in average air temperature of between 1.4°C and 5.8°C, increases in atmospheric CO₂ concentration, and significant changes in rainfall pattern [9]. High temperature and moisture stress increase sunburn and cracking in apples, apricot and cherries and increase in temperature at maturity will lead to fruit cracking and burning in litchi [10]. Air pollution also significantly reduced the yield of several horticultural crops and

increases the intensity of certain physiological disorders like black tip of mango which is induced by coal fume gases, sulphur dioxide, ethylene, carbon monoxide and fluoride. Leaf production increases by one leaf per month for every 3.3 to 3.7°C rise in minimum or mean temperature from 10-20°C or 13.5 to 25°C respectively. Looking to above fact, it was realized to study the performance of different mango varieties growing under the agro-climatic conditions of Uttar Pradesh for different phenological and reproductive development. Therefore, the present experiment was carried out to determine the flowering and fruiting behaviour and fruit quality of different mango cultivars.

2. MATERIALS AND METHODS

The experiment was conducted at Chandra Shekhar Azad University of Agriculture and Technology Kanpur in the Garden of Department of Horticulture, during November 2017 to July 2018. Well established healthy and uniform trees of 7 varieties of mango namely; Dasherri, Chausa, Amrapali, Husnara, Gaurjeet, Bombay Green, and Local were selected for the experiment. The experiment was laid out in Randomized Block Design (RBD) in three replications. All the package of practices was followed as per crop need. Observations related to date of panicle initiation, date of first flower opening, date of 50% and 100% flowering noted as per the crop stage. Male, hermaphrodite and total number of flowers was counted from the 15 panicles of each variety from all the directions. The flowers were counted after anthesis daily and removed with the help of forceps at each counting. The counting of the flowers is done till anthesis of last flower on the panicle. The average number of male (staminate) flowers per panicle was calculated, and by subtracting it from total number of flowers, total number of female flowers is obtained. Total number of marble size

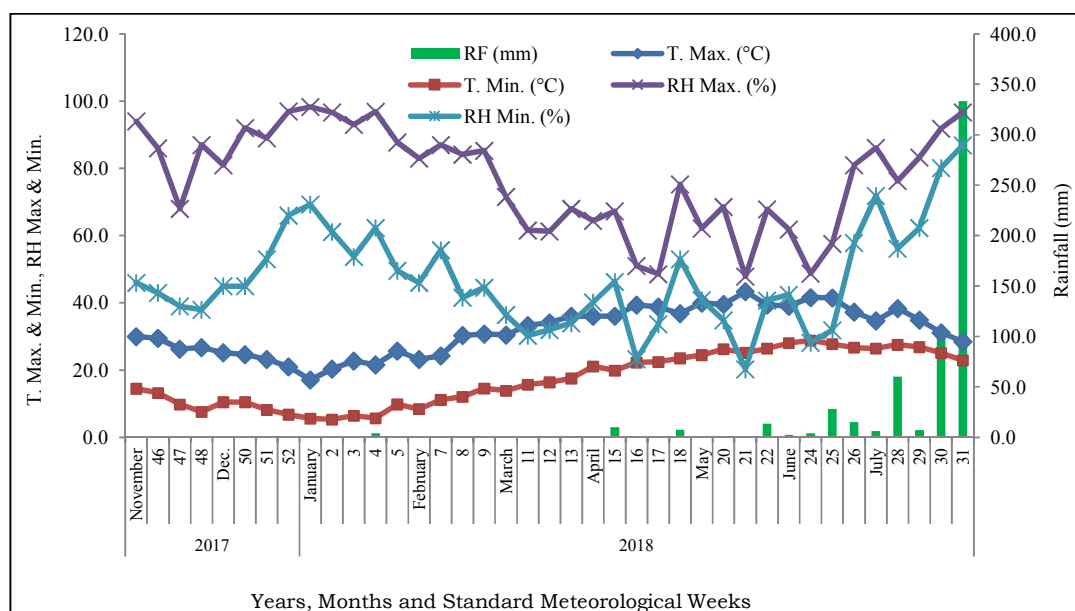


Fig. 1. Graphical presentation of the meteorological observations during the trial period

fruits and mature fruits were also counted in different varieties as per required stage. Meteorological observations are graphically presented in Fig. 1.

2.1 TSS (°brix)

Total soluble solids of the juice were determined by using Erma Hand Refractometer of 0-32 per cent range at 20°C. Mean value was expressed as per cent in total soluble solids in juice.

2.2 Extraction of Mango Juice

Ten g of mango pulp was taken in a 100 ml beaker and then it was homogenized with distilled water in a blender. The blended materials were then filtered and transferred to a 100 ml volumetric flask, and the volume was made up to the mark with distilled water.

2.3 Titration Procedure

A known quantity of solid pulp sample was blended with mortar and pestle in 20-25 ml of distilled water. The volume made up to 100 ml with distilled water and filtered. Then 5 ml aliquot was taken for titration against standard 0.1N NaOH solution using 1.0% phenolphthalein as indicator [11]. The appearance of pink colour was considered as the end point. The total acidity was calculated by following formula and expressed as citric acid per 100 g of fruit pulp.

$$\text{acid \%} = \frac{V \times N \times \text{Vol. made up} \times \text{milliequivalent factor} \times 100}{Y \times 100}$$

Where,

V= Volume of standard NaOH solution used for titration

N= Normality of standard NaOH solution used for titration

Milliequivalent factor of citric acid of (0.064)

Y= Sample size (ml)

3. RESULTS AND DISCUSSION

3.1 Fruiting

Fruiting in mango is very sensitive to unfavourable weather conditions prevailing at anthesis (*i.e.* period when flowers are fully open and functional), pollination and fertilization resulting in low yield because of pollination failure, poor pollen germination and pollen tube growth, and ovule abortion. Cultivars differ in their propensity to set fruit. The variety Chausa, taken highest number of days followed by Amrapali in fruit setting, while Dasherri and Gaurjeet recorded earliest fruit setting. The maximum marble size fruit was noted in Chausa which was statistically at par with rest of the varieties except Husnara. It might be due to very high rate of flower initiation (within 6 days) that provides longer time for flowering and fruit

setting. Olesen [12] reported that the duration of mango fruit development decreased by 12-16 days (7-8%) as a consequence of the 1.5°C increase of winter temperatures over the last 45 years. The maximum mature fruit was noted in Local (4.0) which was significantly highest over rest of the varieties due to less fruit drop. Amrapali recorded (1.4) fruits per panicle followed by Dasherri (1.3) and Gaurjeet (1.3). The maximum fruit drop was recorded under Chausa (91.3%) followed by Dasherri (90.9%). More fruit drop in Chausa and Dasherri and less in local is might be due to varietal differentiation. Earliest harvesting was observed under Gaurjeet (24th May) followed by Bombay Green (25th May) and Husnara (30th May). Dasherri and Local mature in the month of June 8th and 18th respectively. Late harvesting was observed under Chausa (26th June) and Amrapali (10th July).

3.2 Physico-chemical Properties of Fruits

The maximum length and width (Table 1) was found in Chausa among all of the varieties. Gowda and Ramanjaneya [13] also reported Chausa variety has maximum fruit weight and length whereas it was lowest for Dasherri. The second longest fruit was found Dasherri having

fruit length (7.2 cm) followed by Amrapali (7.0 cm). Although, the second widest fruit was found Husnara (4.3 cm) followed by Amrapali and Gaurjeet (3.9 cm). The maximum weight of fruit, fruit pulp, stone and peel was recorded in Chausa followed by Husnara (except peel weight), while, the maximum pulp % was recorded in Amrapali (73.8%) and Bambey Green (73.1%). It is because of less stone size in Amrapali and Bambey Green. Chausa gave significantly higher TSS (Table 2) as compared to Dashehari, and Amrapali. The maximum TSS of fruit was recorded under Chausa (24.10°brix) followed by Dashehari (22.73°brix), while minimum was found in Local (19.33°brix). The TSS of ripe mangoes varies from 16.5 to 24.0°Brix depending upon the variety. 'Mallika' shows maximum TSS whereas 'Banganpalli' the minimum [13]. An increase in TSS content was observed in all 'Irwin' mango fruits cultured in a plastic house and stored at 7–25°C. Gowda and Ramanjaneya [13] also found (23°brix) in Chausa. The maximum acidity (Table 2) was recorded under Local (0.55%), and the lowest was found in Chausa (0.2%) and Amrapali (0.23%). Gowda and Ramanjaneya [13] reported 0.1% in Chausa and 0.1% Amrapali [14].

Table 1. Fruit length, width, weights (fruit, pulp, stone and peel) and pulp, stone and peel per cent of different mango varieties

Varieties	Fruit length (cm)	Fruit width (cm)	Fruit weight (g)	Pulp weight (g)	Pulp %	Stone weight (g)	Stone %	Peel weight (g)	Peel %
Dasherri	7.2	3.4	111.3	77.9	68.5	15.4	14.7	18.0	16.8
Chausa	8.1	5.2	161.2	117.9	73.0	25.0	15.7	18.3	11.2
Amrapali	7.0	3.9	113.7	84.2	73.8	15.5	13.8	14.1	12.3
Husnara	6.8	4.3	139.5	100.0	70.7	23.6	17.9	15.9	11.4
Gaurjeet	6.3	3.9	121.7	86.0	69.9	17.8	15.5	17.9	14.6
B Green	5.1	3.6	91.5	67.2	73.1	14.3	16.0	9.9	10.8
Local	5.1	2.3	34.0	19.3	51.8	14.3	40.3	2.9	7.8
SE(d)	0.2	0.1	12.6	11.0	2.0	1.0	1.9	1.8	0.8
CD (P=0.05)	0.5	0.3	27.5	24.0	4.3	2.2	4.1	3.9	1.8

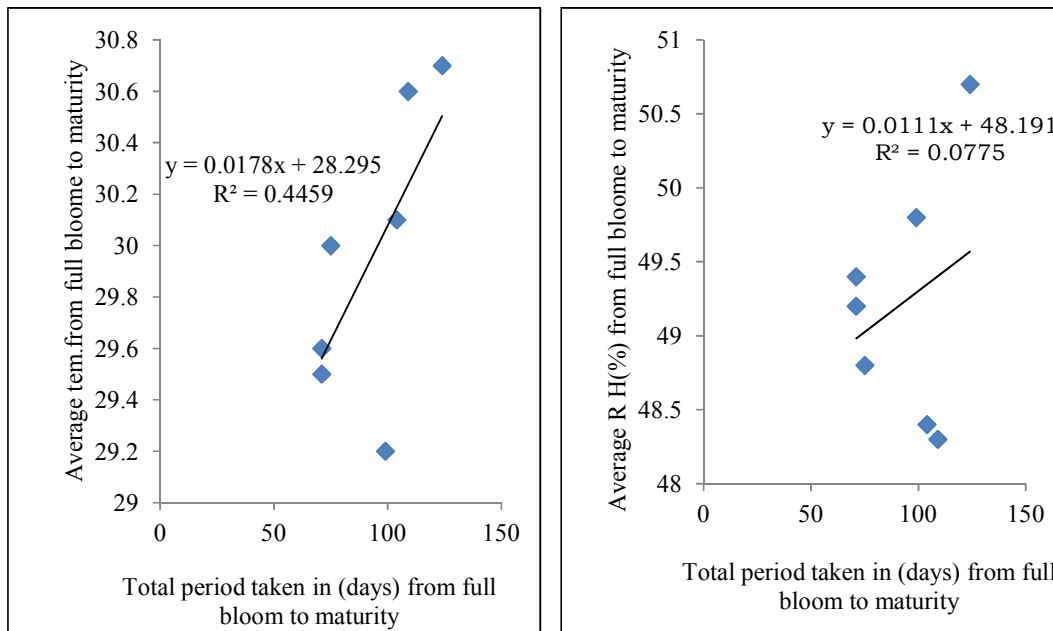
Table 2. Fruit quality (TSS °brix and Citric Acid %) of different mango varieties

Varieties	TSS (°brix)	Citric acid (%)
Dasherri	22.73	0.35
Chausa	24.10	0.20
Amrapali	22.00	0.23
Husnara	21.74	0.27
Gaurjeet	21.50	0.25
B. Green	20.81	0.41
Local	19.33	0.55
SE(d)	1.43	0.05
CD (P=0.05)	3.11	0.10

Table 3. Period taken from full bloom to maturity and its relation with temperature and relative humidity

Varieties	Range of dates	Days*	T. Max.	T. Min.	T. Ave.	RH Max.	RH Min.	RH Ave.
Dasheri	02-Mar-08-Jun	99	37.1	21.3	29.2	63.2	36.4	49.8
Chausa	10-Mar-26-Jun	109	38.3	23.0	30.6	61.0	35.5	48.3
Amrapali	09-Mar-10-Jul	124	38.1	23.4	30.7	63.3	38.1	50.7
Husnara	17-Mar-30-May	75	38.0	22.0	30.0	61.7	35.8	48.8
Gaurjeet	15-Mar-24-May	71	37.5	21.5	29.5	62.5	36.2	49.4
B. Green	16-Mar-25-May	71	37.6	21.5	29.6	62.2	36.2	49.2
Local	07-Mar-18-Jun	104	37.8	22.3	30.1	61.3	35.5	48.4

* Total period taken in (days) from full bloom to maturity

**Fig. 2. Period taken in (days) from full bloom to maturity**

3.3 Total Period Taken in (days) from Full Bloom to Maturity

The variety Gaurjeet and Bombay Green (Table 3) both mature first (71 days) followed by Husnara (75 days) and Dasheri (99 days). Amrapali taken longest duration (124 days) followed by Chausa (109 days) and Local (104 days). It has been observed that during fruit development mango requires less RH as compared to flowering and fruit setting. During growth and maturity RH positively correlated like temperature in all the varieties (Fig. 2). Olesen [12] reported that the duration of mango fruit development decreased by 12-16 days (7-8%) as a consequence of the 1.5°C increase of winter temperatures over the last 45 years.

4. CONCLUSION

It is concluded that mango variety Chausa in terms of quality, being maximum in fruit weight, fruit pulp, stone and peel and medium maturing may found suitable for this region.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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