Characterization of some leading mango (*Mangifera indica* L.) cultivars in Bihar condition based on yield and chemical quality parameters

ABSTRACT

A conventional and simple technique to determine the ideal genotype for a breeding program is to characterize various genotypes of mangos according to their yield and chemical quality parameters. In light of this, an inquiry was carried out in the experimental area of BAU, Sabour, with the aim of characterizing a few elite mango cultivars in the agro-climatic conditions of Bihar based on factors related to yield and chemical quality. Using yield and chemical quality characteristics, twenty mango cultivars were characterized in 2008–2009. Fruit set per panicle (12.66 to 72.58 fruits per panicle), number of fruits per tree (284.15 to 784.41 fruits per tree), fruit weight (105.45 to 488.15g), fruit yield (39.67 to 343.68 kg), TSS (15.60 to 21.96 0Brix), total sugar (13.25 to 24.15 percent), reducing sugar (2.20 to 6.92 percent), acidity (0.23 to 0.43 percent), and ascorbic acid (11.49 to 55.22 mg) were among the cultivars that differed most significantly. In the Bihar agro- climatic conditions, Langra surpassed Mallika in terms of fruit quality criterion and Mallika produced a greater yield among the cultivars described below.

Key words: Mango, characterization, yield, quality.

1. Introduction

The mango *Mangifera indica* L., is the most popular fruit crop in India and a member of the Anacardiaceae family. It is a commercial fruit crop grown in tropical and subtropical regions, and in South East Asia and India, it plays a significant socioeconomic role. South-East Asian mango germplasms and high varietal riches are found in India. India has been growing mangoes for over 4,000 years. Different traditional mango varieties are found in each agro- climatic zone of India. Every cultivar has a distinct flavor, texture, taste, and size. Approximately 1600 varieties of mango exist worldwide, and the fruit exhibits great intra-specific variability [1]. Mangos are grown in every state in India, which has the largest range of mango cultivars. Mango genetic variation can be identified and presented in the simplest formal, standardized, and repeatable way possible through characterization based on chemical characteristics and fruit production [2]. To characterize some of the finest mango cultivars in Bihar based on yield and

chemical parameters, an agro-climatic study was conducted, with the primary goal being the isolation and identification of superior genotypes for use in future breeding initiatives.

2. Materials and Methods

The current study was conducted in 2008–09 on popular mango cultivars in India, including Dashehari, Langra, Fazali, Chausa, Mallika, Alphonso, Kesar, Mankhurd, Fernandin, Vanraj, Beneshan, Bangalora, Mulgoa, Neelum, Swarnrekha, Zardalu, Bombai, Bombai Green, Hemsagar, and Krishnabhog, in the experimental research area of Bihar Agricultural University, Sabour, Bhagalpur, Bihar. Sabour has a semi-arid, subtropical climate with scorching, dry summers and chilly, frostless winters. Four replications of the study were conducted using a randomized block design (RBD). Throughout the inquiry, 25-year-old trees were kept up according to consistent cultural norms. The sandy loam soil in the experimental plot was well-drained, fertile, and had a level surface. Trees were irrigated using a modified basin system, spaced 10 x 12 meters apart. The following characters' data were noted.

2.1.Fruit set per panicle

Ten panicles per cultivar were chosen at random in each direction. The total quantity of fruits in each panicle was tallied, and the average value of ten panicles was reported in terms of fruit set per panicle.

2.2.Number of fruits per tree

When the fully ripe fruits were collected, the total number of fruits on each tree was counted to record the amount.

2.3.Fruit weight

A physical balance was used to weigh the ten fully grown fruits. Every replication's cultivars were recorded, and the average was determined each time.

2.4.Fruit yield per plant

The number of fruits per plant in each treatment and replication was multiplied by the average fruit weight, and the result was represented in kilograms per plant.

2.5. Total soluble solids (TSS)

Using a refracto meter, the total soluble solids (T.S.S.) of 10 mango fruit samples that were fully developed were calculated and expressed as 0Brix.

2.6. Total sugar

The techniques of Lane and Eynone (1923) [3] were used to calculate total sugars. Using a pestle and mortar, 10 g of fruit pulp was ground and then transferred to a 250 ml volumetric flask. To generate 250 ml of distilled water in this flask, 2.0 ml of lead acetate solution and 1.9 ml of potassium oxalate solution were added after around 100 ml of distilled water. The material was then filtered using filter paper. 5.0 ml of concentrated HCl was added to 50 ml of filtrate solution in a 100 ml volumetric flask, and the mixture was left for 24 hours. After that, add two drops of phenolphthalein indicator to a 40% NaOH solution and wait for the color to turn pink. Next, add N/10 HCl dropswise until the pink hue is gone. After that, the volume was produced with distilled water, and the solution was put to a burette. Next, 50 milliliters of distilled water were added to a conical flask containing 5.0 milliliters of Fehling's solutions A and B, respectively. The solution should be cooked until it is colorless. After that, titrate the filtrate solution with two drops of methylene blue indicator until the brick red end point occurs.

$$\text{Total sugars (\%)} = \frac{\text{Factor} \times \text{Dilution}}{\text{Titre value} \times \text{Weight of sample or volume}} \times 100$$

2.7. Reducing sugar

Using Fehling solution as a titrate, sugar was reduced. Using a pestle and mortar, 10 grams of fruit were ground for this purpose in a blender and then transferred to a 250 milliliter volumetric flask. equal parts lead acetate solution (2 milliliters) and 100 milliliters of purified water. 1.9 ml of potassium oxalate solution was added, then distilled water was added to bring the level up to 250 ml. The sample was then filtered using filter paper to estimate the amount of sugar reduced. The filtrate was then placed in a burette, and 5 milliliters of Fehling's solutions A and B were each added to a conical flask along with 50 milliliters of distilled water. The solution should be cooked until it is colorless. Now added 2 drops of methylene blue indicator and titrated it with filtrate solution until brick red end point comes.

$$\text{Reducing sugar (\%)} = \frac{\text{Factor x Dilution}}{\text{Titre value x Weight of sample or volume}} \text{ x } 100$$

2.8. **Titratable acidity**:

The titration method was used to determine titratable acidity. 50 cc of water and 2 g of weighed fruit sample were combined for this experiment. After a thorough mixing, it was filtered. The filtered sample was titrated using a few drops of 1% phenolphthalein solution as an indicator against 0.1 N NaOH. The acidity was determined using the observed titer value, and the results were represented as a percentage of citric acid. (A.O.A.C., 2000) [4].

$$\text{Acidity (\%)} = \frac{\text{Titre value} \times \text{normality of alkali} \times \text{vol. made up} \times \text{equivalent wt. of acid}}{\text{Volume of sample taken estimation} \times \text{vol. of sample taken} \times 1000} \times 100$$

2.9. Ascorbic acid (vitamin 'C')

By titrating freshly extracted juice against 2, 6-Dichlorophenol Indophenols dye, the ascorbic acid concentration of the juice was ascertained (A.O.A.C, 2000). A 50 ml solution containing 3.00 percent metaphosphoric acid was added to 20 grams of pulp. A portion of the filtrate was titrated using a standard dye solution containing 0.025 percent 2,6-dichlorophenol indophenols. The apparition of a pink color that lasted for 15 seconds indicated the finish line. Ascorbic acid concentration was given as mg/100 g of pulp.

$$\text{Ascorbic acid content (mg/100g)} = \frac{\text{Titre value} \times \text{dye factor} \times \text{volume made up}}{\text{Weight of sample} \times \text{volume of sample taken}} \times 100$$

3. Results and Discussion

The fruit set per panicle, fruit weight, fruit production, TSS, total sugars, reducing sugars, acidity, and ascorbic acid content of the twenty most popular mango cultivars were all assessed. Tables 1 and 2 exhibit the recorded data from the current investigation.

3.1. Fruit yield parameters

3.1.1 Fruit set per panicle

It is evident from Table 1's observed data that there was a substantial variation in the amount of fruit set per panicle amongst the varieties. Hemsagar was the cultivar with the highest number of fruits per panicle 72.58 followed by Bombai Green, which had the second-highest number 61.51 while Chausa had the lowest amount 12.66 per panicle. The mango cultivars' varietal or genetic characteristics may be the cause of the variance in fruit set per panicle. Similar results in mango were reported by Majumder et al. (2011) [5], Abirami et al. (2008) [6], and

Kher and Sharma (2002) [7]. Furthermore, Iyer et al. (1989) [8] and Rai et al. (2023) [9] found that whereas the final fruit set is independent of the fraction of flawless flowers, the initial fruit set is directly correlated with it.

3.1.2. Numbers of fruit per tree

The cultivar Dashehari displayed the highest number of fruits per tree at 784.41, which was shown to be statistically comparable to the cultivars Langra (744.09 fruits per tree) and Mallika (699.38 fruits per tree). The cultivar Chausa displayed the lowest number of fruits per tree, at 284.15. Between 284.27 fruits per tree (Alphonso) and 614.85 fruits per tree (Hemsagar), were the cultivars that remained. According to Naik and Rao (1943) [10], fruit setting is greatly dependent on the first two weeks of fruit growth. Thimmappaiah and Suman (1987) [11] claimed that the quantity of fruit that ripened was determined by the initial fruit set. The internal rivalry between the many little fruits that first formed and the partially fertilized ovules that also dropped may have contributed to the early fruit retention. The dip decreased gradually during the course of development and usually stopped by day 45.

3.1.3. Fruit weight

There was a noticeable difference in fruit weight across the several mango cultivars. The cultivars Mallika yielded the highest fruit weight of 488.15 g, followed by Vanraj, Bangalora, and Fazali, with respective values of 389.65 g, 356.87 g, and 325.50 g; Neelum showed the lowest fruit weight of 105.45 g. According to Alphorns and Swaranrekha, the remaining cultivars ranged in value from 139.06 g to 291.80 g, respectively. This variance was brought about by either the cultivars' physiological or genetic makeup. Researchers Lodh et al. (1974) [12] and Iqbal et al. (1995) [13] examined the physico-chemical properties of several significant mango varietals and discovered differences in fruit weight between the various cultivars.

3.1.4. Fruit yield

There was a noticeable difference in the yield properties of the several mango cultivars. Mallika recorded the highest fruit yield per tree of 343.68 kg, followed by Langra (1983.39 kg). The cultivar Alphonso produced the lowest fruit yield per tree, 39.67 kg, which was found to be statistically comparable to the cultivars Fernandin (40.44 kg per tree), Neelum (51.43 kg per tree), Mankhurd (61.32 kg per tree), Mulgoa (64.56 kg per tree), and Chausa (66.32 kg per tree).

The yield of the other varieties ranged from 80.41 to 166.63 kg per tree for the Kesar and Hemsagar cultivars, respectively. The intrinsic variations in a cultivar's ability to absorb and translocate photosynthates and plant hormones, as well as its fruit set, retention, tree size, and leaf area, may account for the variance in fruit output between cultivars. Singh (2002) [14], Hoda et al. (2003) [15], and Dhillon et al. (2004) [16] also showed significant yield variation. Additionally, Duran et al. (2006b) noted that variations in cultivars' fruit output and size can be attributed to probable environmental factors related to their cultivation.

Table-1: Fruit weight and yield attributes of different leading mango cultivars.

Cultivars	Fruit set per panicle	No.s of fruit per tree	Fruit weight (g)	Fruit yield (kg/tree)
Dashehari	42.80	784.41	177.71	140.71
Langra	33.72	744.09	265.24	198.39
Fazali	32.41	348.07	325.50	113.71
Chausa	12.66	284.15	232.61	66.32
Mallika	39.67	699.38	488.14	343.68
Alphonso	26.12	284.27	139.06	39.67
Kesar	23.30	436.73	185.22	80.41
Mankhurd	51.64	348.67	174.87	61.32
Fernandin	18.91	259.15	155.15	40.44
Vanraj	23.25	417.38	389.65	162.99
Beneshan	15.62	572.15	284.51	165.83
Bangalora	46.72	278.90	356.87	100.88
Mulgoa	24.28	311.58	205.30	64.56
Neelum	39.48	482.94	105.45	51.43
Swarnrekha	24.08	335.61	291.80	100.23
Zardalu	18.87	442.92	210.83	93.84
Bombai	53.33	621.98	227.72	142.60
Bombai Green	61.51	578.36	245.28	142.59
Hemsagar	72.58	614.85	268.73	166.63
Krishnabhog	32.67	537.83	245.41	132.60
SEm±	2.38	38.78	8.31	11.39
CD(P=0. 5)	6.82	111.01	23.79	32.62
CV %	11.89	14.32	5.79	16.39

3.2. Fruit quality parameters

The characterization of fruit quality of leading mango cultivars for Total Soluble Solids (TSS) Total Sugars, Reducing Sugars, Acidity and Ascorbic Acid are presented in Table-2.

3.2.1. TSS (^{0}Brix)

The TSS (^{0}Brix) observation in Table -2 demonstrated that a notably broad range of TSS (^{0}Brix) was noted in various mango cultivars. The cultivar Mallika had the highest estimated TSS of 21.96 ^{0}Brix, followed by Alphonso with a value of 20.57 ^{0}Brix; the cultivar Bangalora had the lowest TSS of 15.60 ^{0}Brix. The remaining cultivars were valued by Beneshan and Kesar, respectively, ranging from 16.60 to 19.69 ^{0}Brix. Since TSS comprises all components of soluble solids, fruit juice's TSS provides an estimate of the fruit's sweetness. It happens as a result of both improved carbohydrate mobilization from organic acids and greater hydrolysis of polysaccharides into sugars. However, Bhuyan and Guha's (1995) [17] studies, which similarly showed that TSS varied from 16.22 to 24.14 ^{0}Brix in 14 mango germplasms, had already partially corroborated these findings. Teaotia et al. (1972) [18], Samad et al. (1975) [19], Mitra et al. (2001) [20], Singh (2002) [14], Hoda et al. (2003) [15], Dhillon et al. (2004) [16], Kumar and Singh (2005) [21] in mango fruits, and Sengupta et al. (2006) [22] have reported similar observations of variance in TSS in different mango cultivars.

3.2.2. Total Sugar

Cultivar Langra had the highest sugar content of 24.15 percent, followed by Beneshan (18.65 percent), while cultivar Vanraj (13.25 percent) had the lowest. The remainder of the cultivars ranged from 14.36% (Swarnrekha) to 18.47% (Alphonso).

3.2.3. Reducing sugar

Langra was the cultivar with the highest reduction in sugar content (6.92%), followed by Mallika (5.83%), and Mulgoa (2.20%), which had the lowest reduction in sugar content. The remaining cultivars ranged in value from 5.45 percent (Krishnabhog) to 2.22 percent (Fazali). According to Syamal and Mishra (1989) [23], there were variations in the sugar levels of mango cultivars; Langra was the best in this regard. Additionally, Doreyappa and Huddar (2004) [24] noted that during maturity, the various cultivars' total and reducing sugars altered. Palaniswamy et al. (1974) [25] and Doreyappa Gowda et al. (1994) [26] both observed similar observations.

3.2.4. Acidity

Cultivar Bombai Green has the highest acidity of 0.43 percent, with Fernandin (0.39 percent), Krishnabhog (0.38 percent), Kesar (0.36 percent), Alphonso and Vanraj (0.35 percent), and Chausa (0.34 percent) following closely behind. In Fazali, the lowest amount of acidity (0.23 percent) was found. Among the remaining cultivars, the remaining acidity content ranged from

0.25 percent (Langra) to 0.29 percent (Dashehari, Swarnrekha, and Bombai). Fruit quality can be determined by analyzing the acidity and flavor combination. Fruit maturity and acidity are tightly correlated, even though acidity is a hereditary trait unique to each cultivar. Fruit ripens and reaches maturity at which point its acidity progressively lowers. According to Kumar et al. (1992) [27], this could be because enzymes, especially invertage, transform acids into salts and sugars.

3.2.5. Ascorbic Acid

Following analysis, the ascorbic acid content data was shown in Table 2. It is evident from the statistics that the cultivar Langra yielded the highest ascorbic acid content at 55.22 mg, with values of 52.67 mg, 48.52 mg, and 47.15 mg produced by Mankhurd, Alphonso, and Fernandin, in that order. The cultivar Bangalora yielded a minimum of 11.49 mg of ascorbic acid, which was statistically shown to be at par with the cultivar Swarnrekha at a value of 12.56 mg. A large fluctuation in ascorbic acid content (2.90 mg/100 g – 136.50 mg/100 g) has been found by Doreyappa and Ramanujaneya (1994) [24], which further validated this type of result. Ascorbic acid concentration was also noted by Mitra et al. (2001) [20] to be between 21.66 to 125.40 mg/100 g. A possible explanation for this difference in ascorbic acid level is the type and degree of genetic diversity seen in the test sample.

Table-2: Chemical -quality parameters of different leading mango cultivars. .

Cultivars	TSS (^{0}Brix)	Total Sugar (%)	Reducing Sugar (%)	Acidity (%)	Ascorbic Acid (mg/100g)
Dashehari	19.33	17.87	5.15	0.29	33.92
Langra	19.18	24.15	6.92	0.25	55.22
Fazali	17.32	16.99	2.22	0.23	21.25
Chausa	18.55	16.88	4.65	0.34	14.56
Mallika	21.95	17.18	5.83	0.32	32.32
Alphonso	20.57	18.47	2.39	0.35	48.52
Kesar	19.69	16.81	4.38	0.36	33.55
Mankhurd	17.59	14.91	2.28	0.23	52.67
Fernandin	17.44	14.89	2.36	0.39	47.15
Vanraj	17.29	13.25	3.16	0.35	17.21
Beneshan	16.60	18.65	3.35	0.26	14.49
Bangalora	15.60	17.89	2.90	0.27	11.49
Mulgoa	17.68	14.50	2.20	0.27	31.53
Neelum	18.32	14.49	3.61	0.26	23.49
Swarnrekha	19.13	14.36	3.48	0.29	12.26

Zardalu	19.41	14.81	3.78	0.26	18.14
Bombai	19.62	17.39	3.37	0.29	17.71
Bombai Green	18.27	17.24	3.30	0.43	14.27
Hemsagar	18.39	18.16	3.48	0.26	18.21
Krishnabhog	17.54	16.86	5.45	0.38	42.59
SEm±	0.37	0.33	0.09	0.01	0.74
CD(P=0. 5)	1.05	0.96	0.25	0.02	2.13
CV %	3.43	3.44	4.10	4.07	4.55

4. Conclusion

Based on the data, it can be said that several cultivars varied in terms of yield and chemical quality indices. Of these, Mallika and Langra outperformed in majority of the characteristics under the agro- climatic conditions of Bihar.

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