

**"EVALUATION OF PROMISING GENOTYPES OF MANGO
(*Mangifera indica* L.) FOR GROWTH, YIELD AND QUALITY"**

by

Miss. Attar Jasmin Rashid

(Reg. No. 2022/291)

A Thesis submitted to the
**MAHATMA PHULE KRISHI VIDYAPEETH
RAHURI – 413 722, DIST. AHMEDNAGAR
MAHARASHTRA, INDIA**

in partial fulfillment of the requirements for the degree

of

MASTER OF SCIENCE (HORTICULTURE)

in

FRUIT SCIENCE



DEPARTMENT OF HORTICULTURE

**POST GRADUATE INSTITUTE
MAHATMA PHULE KRISHI VIDYAPEETH
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MAHATMA PHULE KRISHI VIDYAPEETH
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MAHARASHTRA, INDIA.**

2024

CANDIDATE'S DECLARATION

I hereby declare that this thesis or part
there of has not been submitted
by me or other person to any
other University or Institution
for a Degree or
Diploma

Place : MPKV., Rahuri

Date : / /2024

(Jasmin R. Attar)

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Maharashtra, India.

CERTIFICATE

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The assistance and help received during the course of this investigation have been duly acknowledged.

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Maharashtra State, INDIA

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Place : MPKV., Rahuri

Date : / /2024

(S.B. Kharbade)

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LIST OF ABBREVIATIONS AND SYMBOLS

%	: Per cent
/	: Per (or)
@	: At the rate of
°B	: Degree Brix
°C	: Degree Celsius
Avg.	: Average
C.V.	: Coefficient of Variance
cc	: Cubic centimeter
CD	: Critical difference
cm	: Centimeter
cv.	: Cultivar
DAF	: Days after fruit set
<i>et al.</i>	: And others (et alia)
etc.	: Etcetera
Fig.	: Figure
g	: Gram
ha	: Hectare
Hrs.	: Hours
i.e.,	: That is
IPGRI	: International Plant Genetic Resources Institute
kg	: Kilogram (s)
kg/tree	: kilogram per tree
m	: Meter (s)
mg	: Milligram
mm	: Millimeter
mL	: Millilitre
MPKV.	: Mahatma Phule Krishi Vidyapeeth
No.	: Number
ppm	: Parts Per Million
RH	: Relative Humidity
SD	: Standard deviation
SE	: Standard error
Sr.	: Serial
t	: Tonnes
t/ha	: Tonnes per hectare
TSS	: Total Soluble Solids
<i>viz.</i>	: Videlicet (Namely)

ABSTRACT

“EVALUATION OF PROMISING GENOTYPES OF MANGO (*Mangifera indica* L.) FOR GROWTH, YIELD AND QUALITY”

By

Miss. Attar Jasmin Rashid

A candidate for the degree of

MASTER OF SCIENCE (HORTICULTURE)

in

FRUIT SCIENCE

2024

Research Guide	: Dr. S.A. Ranpise
Department	: Horticulture (Fruit Science)

An experiment entitled “Evaluation of promising genotypes of mango (*Mangifera indica* L.) for growth, yield and quality” was carried out at Instructional-cum-Research Farm, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (MS), during the year 2022-23 with an objective to study flowering and fruiting behaviour of genotypes and quality characters.

Experiment was carried out with twenty seven genotypes and six check varieties. Their morphological, biochemical and quality parameters were studied to find out the promising genotypes among them.

For morphological characters, maximum leaf length was in RHRMH-16 (35.50 cm) and minimum in RHRMH-73 (14.70 cm). The maximum leaf breadth seen in RHRMH-16 (7.10 cm) and minimum in RHRMH-73 (3.10 cm). Simple leaves were seen in all genotypes. The leaves appear to be non-waxy when observed for waxy nature in them. The leaf colour among the genotypes where 26 genotype showed dark green colour, 6 genotype showed light green and 1 genotype showed green coloured leaves.

The flowering in the genotypes found to be started in January month and end in February. The colour of panicle observed among the mango genotypes in which seventeen observed to be yellow, six observed to be yellowish green and five observed to be yellowish pink and reddish yellow each. Number of flushes observed in the genotypes was mostly two flushes in twenty-nine genotypes where zero flushes seen in three genotypes and one flush seen in one genotype. The colour of flush observed, fifteen genotypes had reddish colour, eight genotype had reddish yellow while four genotypes have yellowish red and light green colour shown by three genotypes. The hermaphrodite

flowers shown highest in RHRMH-52 (240.3) while the least hermaphrodite flowers were in RHRMH-85 (80.8). Highest male flowers observed in Alphonso (850.7) while RHRMH-85 (303) showed the least male flowers. The number of flowers highest flowering was in RHRMH-52 (1026.4) and least flowering in RHRMH-85 (383.8). The sex ratio highest value was in RHRMH-16 (0.38) while the least values were recorded for RHRMH-107 (0.18).

The days required from fruit setting to mustard stage ranged from 5 to 7.2 days for all genotypes. Number of fruits per panicle at egg stage was maximum in RHRMH-73 (8.24) and minimum in RHRMH-104 (4.24). The number of fruits at harvest stage recorded highest in RHRMH-73 (3.44) and least number were in RHRMH-38 (1.25). The RHRMH-16 (3.98 %) showed the maximum retention and Vanraj (1.67 %) showed the least retention. The fruit shape of twenty-one genotypes recorded the oblong shape, six genotypes recorded the ovoid whereas five genotypes recorded roundish and one genotype recorded the elliptic shape. Fruit weight was the highest recorded in RHRMH-5 (440.54 g) and least was recorded in RHRMH-55 (74.86 g). Fruit length of RHRMH-39 (15.2 cm) shown the maximum length and minimum length was seen in RHRMH-52 (6.9 cm). Fruit breadth of Vanraj (8.6 cm) had maximum breadth and minimum breadth shown in RHRMH-52 (3.2 cm). The colour of unripe fruit was noticed in which twenty-six genotypes noted as green colour, seven noted as green with red blush colour. As for the ripe fruit colour of peel twenty-four genotype noted as the yellow colour while eight noted as the yellow with red bush and one noted as the golden yellow colour.

The pulp colour was yellow in twenty-two genotypes while yellowish orange seen in nine genotypes and light yellow was found in two genotypes. The pulp of twenty-five genotype was fibrous, non fibrous for four genotype, low fibrous for two and intermediate for two genotypes. Pulp percentage were maximum observed in RHRMH- 5 (79.33 %) and whereas minimum pulp percentage was observed in RHRMH-96 (36.69 %). Maximum peel percentage recorded in RHRMH-30 (28.82 %) and minimum peel percentage recorded in RHRMH-5 (10.34 %).

Maximum stone weight noted in RHRMG-3 (57.95 g) and minimum noted in RHRMH- 104 (20.56 g). Maximum stone length was in RHRMH- 39 (13.1 cm) and minimum length was in RHRMG-6 (4.56 cm). As for stone breadth maximum breadth in RHRMH-55 (5.47 cm) and minimum breadth was seen in RHRMH-83 (3.20 cm). Stone percentage was in RHRMH- 52 (42.03 %) whereas minimum stone percentage was observed in Vanraj (10.14 %).

Maximum TSS found in RHRMH-93 (20.2 °B) and minimum TSS in RHRMH-44 (11.6 °B). Maximum acidity in the pulp were observed in RHRMH-44 (0.32%) and minimum observed in RHRMG-1 (0.19%). Alphonso (99.35) had maximum TSS: Acidity ratio and minimum ratio RHRMH-44 (36.25). The maximum total sugar found in RHRMH-30 (18.75%) and minimum found in RHRMH-44 (10.02 %). Maximum reducing sugar found in RHRMH-5 (4.29 %) and minimum found in RHRMH-44 (1.91 %). The maximum non reducing sugar is found in RHRMH-93 (15.13 %) and minimum found in RHRMH-6 (7.99 %).

For qualitative parameters overall acceptability score was highest (8.5) for Alphonso and least score (6.0) for RHRMH-44.

The maximum number of fruits recorded in RHRMH-104 (247.66) and minimum in RHRMH-7 (135.1). Maximum yield was in RHRMH-5 (87.01 Kg) and minimum yield in RHRMH-55 (11.62 Kg).

The longest shelf life was recorded in RHRMH-96 (7.4 days) and shortest shelf life in RHRMH-57 and RHRMG-6 (5.5 days).

The most of fruit drop occurred between pea stage to egg stage with mean (89.58) and minimum fruit drop seen from mustard to pea stage with mean (23.13).

From overall observations of all the genotypes and checks, it can be concluded that genotypes RHRMH-5, RHRMH-16, RHRMH-73, RHRMH-107 and RHRMG-1 showed better performance for most of the characters. Hence, selection of these genotypes for further evaluation could be beneficial for genetic improvement and cultivation.

1. INTRODUCTION

The mango (*Mangifera indica* L.) holds the esteemed title of being India's oldest fruit, revered as the 'King of fruits' for its abundance of nutrients, distinct flavor, delightful aroma and its significance in religious and medicinal contexts. Believed to have originated in Southeast Asia, particularly in the Indo-Burma region near the foothills of the Himalayas, the mango has spread across various geographical regions worldwide from its origins in the Indian-Myanmar area. Its exceptional qualities and medicinal benefits have made it a beloved fruit enjoyed by people from all walks of life around the globe. The mango has deeply intertwined itself with the cultural, religious, aesthetic and economic aspects of Indian society since ancient times (Mukherjee, 1951).

Widely considered one of the most consumed fresh fruits globally, mango ranks as the second most significant fruit crop in India, covering a substantial portion of both land area and production within the country's fruit cultivation. Maharashtra stands out as the leading producer of mangoes in India, contributing significantly to the country's total output. In fact, India's mango production constitutes approximately 40% of the world's total (Anon., 2022).

The mango is presumed to be the most commonly eaten fresh fruit worldwide. Mango is second most important fruit crop. It is being cultivated in India on 2332.2 thousand hectares area with an annual production of 20988.4 thousand MT along with productivity 9 MT/ha. Maharashtra has the highest mango production occupying 165.20 thousand hectares area with 407.10 thousand MT production along with 2.46 MT/ha productivity (Anon., 2022).

Most of the people love mango for its luscious tropical flavor, lot of nutrients that make healthy eating a delightful sensory experience. It is rich source of vitamin A. The ripe mango was reported to have 83.46 - 86.70 per cent moisture, 0.82 g protein, 0.38 g fat, 14.98 g carbohydrate, 11 mg calcium, 14 mg phosphorus, 0.16 mg iron, 0.135 - 1.872 Vitamin A (mg/100g), 0.038g/100 g Riboflavin and 36.4 mg/100g ascorbic acid, 12.0-23.0 TSS (⁰B) and 0.12-0.3 per cent acidity (Anon., 2010).

Mango, being a tropical evergreen fruit, exhibits a strong tendency towards alternating between heavy and light fruit-bearing seasons. The intricacies of

mango flowering pose challenges for physiologists, breeders and growers alike. Mango trees produce two types of flowers – staminate and hermaphrodite – on panicles, which may emerge terminally or from axillary buds. The proportion of hermaphrodite flowers varies among cultivars and depends on the timing of panicle emergence. Weather patterns primarily dictate the flowering period of mango trees, which typically spans a brief duration of 2 to 3 weeks, with temperature playing a significant role in its duration (Mukherjee, 1953). Flowering period in mango is mainly related to weather patterns and to some degree to cultivar differences under the same climatic conditions (Singh, 1960).

Understanding mango flowering behavior, sex expression, yield and physico-chemical attributes is crucial for evaluating their performance. Flowering is a vital determinant of mango productivity, heavily influenced by weather conditions and varietal characteristics. The process of mango flowering involves shoot initiation, floral differentiation and panicle emergence, typically occurring during October-December in tropical and subtropical climates (Davenport, 2003).

The sex ratio of mango cultivars is influenced by both genetic factors and environmental conditions, with variations observed across different locations and climates. Early morning is the peak time for flower opening, with stigma receptivity highest during the first six hours after anthesis. Developing new mango hybrids and varieties offers promising avenues for studying growth, quality and yield characteristics, although comprehensive data in these areas is still lacking, prompting ongoing research efforts to identify superior genotypes (Iyer *et al.*, 1989). It appears that the proportion of perfect flowers in a cultivar becomes critical for optimum fruit set only when the proportion drops to 1 per cent. Flowers begin to open early in the morning and anthesis has generally been completed by noon. The greatest number of flowers opens between 9 and 10 a.m. Although the receptivity of the stigma continues for 72 hr after anthesis, it is most receptive during the first 6 hr however, there are reports of stigma becoming receptive even before anthesis has occurred (Singh, 1960).

Majority of cultivars show ecogeographical preferences for growth and yield. Each cultivar is characterized by the combination of properties such as plant architecture, flowering attributes, fruit parameters like size, colour, taste, flavour, etc.

The presence of diverse characters with a continuous variation in each one creates extreme complexity in the identification and classification of cultivars. Each mango cultivar is distinct from others in colour and flavour and therefore varies in its suitability for certain uses. For successful improvement work, proper identification of genetic resources or the parental materials is the basic need. One should recognize that all the germplasm available is useful one way or other (Knight, 1993). If it is lacking marketable value, then it may be suitable for some other purposes, like disease resistance, climatic adaptation, home gardening etc. (Campbell, 1995). Some varieties are heavy yielders in respect of fruit number, while the others produce large fruits. But the main problem regarding the identification of exact cultivar is the wide range of variability in physic-chemical characters of fruit and the trees of different cultivars under different agroclimatic conditions. Thus, varietal characterization is an important component of mango crop improvement and it lays the foundation for further scientific progress in developing new cultivars

Morphological characterization serves as a fundamental method for assessing mango genetic diversity, with standardized descriptors allowing for visual assessment of traits. Understanding the physico-chemical characteristics of mango germplasm aids in identifying superior genotypes with desired traits. Both morphological and biochemical markers play vital roles in assessing genetic diversity in mango, although they may have limited detection capabilities for inter and intra-varietal polymorphisms due to environmental influences (Ramessur and Sanmukhiya, 2011). Systematic characterization of mango germplasm facilitates identifying potential candidates for breeding programs and conservation efforts aimed at reducing genetic erosion and promoting the sustainable use of mango genetic resources (Sennhenn *et al.*, 2013).

The success in mango improvement primarily depends on the nature and magnitude of variation present in the population. An ideal mango cultivar should have characters like precocious, dwarf, regular and prolific in bearing, early flowering and fruit setting, attractive fruit colour and size, resistant to major diseases and other biotic-abiotic stresses (Kanpur *et al.*, 2009). There are many factors that influence yield, maturity and quality of fruits as the same cultivar can attain different characteristics

in different growing conditions. Even in the same region, different environmental conditions at different years can affect maturity and quality of the fruit (Devilliers, 1998). For successful mango cultivation, evaluation of different promising mango varieties for a given set of ecology is one of the pre-requisites (Singh and Singh, 1996). The proper selection of varieties for different agro-climatic zones is very essential for obtaining good yield and quality of mango and to establish suitable varieties for domestic and export markets.

By keeping this point of view the present investigation of "Evaluation of promising genotypes of mango (*Mangifera indica* L.) growth, yield and quality" was carried with following objectives:

- i. To study the flowering and fruiting behaviour of genotypes of mango (*Mangifera indica* L.).
- ii. To study the quality parameters of the genotypes.

2. REVIEW OF LITERATURE

Mango (*Mangifera indica* L.), a member of the Anacardiaceae family, holds a significant position as India's premier fruit crop, often referred to as the 'King of fruits'. With approximately 1000 varieties, mango boasts the richest germplasm in India and is designated as the 'National Fruit'. Recognizing its paramount importance in Indian horticulture, efforts have been directed towards enhancing mango productivity. One key strategy involves identifying and utilizing superior cultivars to drive crop improvement initiatives. Despite numerous hybrid assessments, only a handful have demonstrated promise. Even hybrids sharing the same parentage exhibit considerable variation in fruit characteristics such as size, shape, quality and fruiting behavior, underscoring the inherent heterogeneity of mango plants. Consequently, the need arises to cultivate extensive populations of hybrid seedlings from each parental combination to effectively select desirable traits. Understanding floral biology, fruit set and yield across different mango cultivars becomes crucial for market regulation, consumer satisfaction and improved returns. The literature reviewed covers various aspects pertinent to this study, offering insights into the complexities and challenges inherent in mango cultivation and improvement.

2.1 Leaf characters

Chakraborti *et al.* (2012) observed that ratio of length : breadth of lamina was highest in Suvarnrekha (4.53) followed by Mallika (4.46) and Neelum (4.45). The ratio of lamina: petiole was highest in Suvamrekha (8.41) followed by Baneshan (7.85), Langra (6.67) and Mallika (6.57) and lower in Mankurad (1.00), Kishan Bhog (1.03), Kesar (1.05), Bombai (1.05), Bombay Green (1.05) and Alphonso (1.08) also the great variation in the colour of the leaves like brown green, light green and dark green were seen.

Chakrobaorti (2012) observed and evaluated pertaining to the tree, leaf, inflorescence, fruit characters, physico-chemical characters of fruits and the growth characters. Significant variations were observed in almost all the hybrids. Amrapali was found dwarf, suberect and round with dense foliage and higher leaf length.

Sridhar *et al.* (2022) observed leaf colour as light brick red, light green, reddish-brown and deep copper tan when leaves were young and acquires a green to dark green colour when it develops and become mature. Leaf length, width and petiole length varied from 17.88 to 29.52 cm, 4.68 to 8.35 cm and 1.79 to 5.37 cm respectively.

2.2 Flowering parameters

Anjum *et al.* (1999) conducted the study on flowering behavior, fruit setting and extent of floral malformation in five cultivars of mango viz. Aman Dashehari, Anwar Rataul, Langra, Malda and Samar Bahist and observed that the percentage of hermaphrodite flower was higher in cultivar Samar Bahist and Langa which range from 21 to 96 per cent. The least male flowers (125.75) were also found in 'Langra'. 'Anwar Ratual' depicted minimum number (59.83; 7.25 %) of hermaphrodite flowers. Proportion of hermaphrodite flowers in all the three cultivars was quite variable regarding plant side

Mane *et al.* (2001) evaluated six mango cultivars viz. Ratna, Pairi, Parbhani Hapus, Totapuri and Fazli. Among these cultivars, Ratna was the earliest to flower (15 January), while Totapuri had the longest flowering period (37 days) and the highest number of fruit set per panicle (86.43).

Muhammad *et al.* (2002) studied the panicle initiation time, total number of flowers and proportion of male to hermaphrodite flowers of three commercial mango cultivars, *i.e.* Anwar Rataul, Dashehari and Langra. They found that early panicle initiation was observed in Dashehari on eastern side of the plant followed by Langra and Anwar Rataul. They also reported that Langra had the highest number of flowers per panicle (598.75) with maximum hermaphrodite flowers (473.08; 79 %) on west and southern side of the plant, respectively and the least male flowers (125.75) were also found in Langra, while Anwar Rataul depicted minimum number (59.83; 7.25 %) of hermaphrodite flowers.

Singh (2002) studied the performance of 21 mango cultivars at Sabour, Bihar during 1997-98. He reported that Amrapali had the highest panicle length (22.50 cm) and percentage of hermaphrodite flowers (24.90).

Anila and Radha (2003) observed that in mango varieties like Alphonso, Prior, Ugandan and Rant, flowering started during Dec- Jan months but in case of Neelum variety, flowering was observed during the month of April-May.

Kumar and Jaiswal (2003) studied the bearing behaviour of some south and west Indian mangoes and reported that first flowering was observed in Vanraj and Fernandin *i.e.* on 10th February and completed on 10th March (33.83 days of flowering duration), whereas, Alphonso and Keshar started flowering on 17th February and 20th February respectively and flowering completed within 29.50 days.

Singh (2003) studied the performance of different mango varieties under Bihar conditions and noticed the earlier peak panicle emergence (17th February) in Calcuttia Maldah followed by Gulab Khas, Kanchan Lal and Hanthi Jhul, whereas, at the last (27th February) in Latkampoo.

Singh and Singh (2003) studied the performance of mango hybrids for flowering, fruiting and fruit quality attributes and found that panicle emergence in Bombai was recorded earliest *i.e.* on 4th February followed by Alfazli and Arka Puneet whereas, it was noted late (on 15th February) in Arka Aruna.

Souza *et al.* (2004) evaluated the flowering date of nineteen mango varieties in Brazil and found that the varieties flowered from June to August, while some of the varieties showed the typical pattern of alternate bearing (Maya, Haden, Itiuba, Bourbon, Irwin and Tommy Atkins), some possessed an erratic pattern of production (Carlotão, Florigon, Kensington, Surpresa, Momi-k, Dashehari & Langra), while other varieties had intermediate pattern (Alphonso, Amarelinha, Comprida Roxa, P. de Amoreira, Zill and Brasil).

Kumar and Singh (2005) reported that panicle emergence was earliest (on 3rd February) in Bombai followed by Baneshan and Langra, whereas it was noted at last (on 16th February) in Dadamian.

Pandey and Kumar (2006) studied flowering behaviour of 10 mango hybrids (Amrapali, Mallika, Ratna, Neeleshan, Neeluddin, Prabhashankar, Mahmudbahar, IIHR-10, Sabri and IIHR-51), along with a local control (Langra) in terms of duration of panicle emergence, duration of flowering, number of flowers per panicle, sex ratio, fruit set and fruit retention. The maximum duration of panicle emergence was observed in Langra (55.11 days), IIHR-51 (45.39 days), Amrapali (44.86 days) and IIHR-10 (44.41 days). The duration of the flowering season ranged from 34.00 days in Langra to 12.00 days in Prabhashankar. The number of flowers per panicle ranged from 1010.66 in Ratna

to 1559.66 in Neeleshan. Sex ratio varied from 2.46 in Amrapali to 4.72 in Sabri. Maximum fruit set (29.26 %) and fruit retention (3.01 %) was recorded in Amrapali.

Uddin *et al.* (2008) studied the floral biology of four varieties of mango namely Golabkash, Pahutan, Langra and Mallika at the Regional Horticulture Research Station, Chapai Nawabgunj in 1997. The longest blooming period (27.67 days) was recorded in Mallika, whereas the shortest (16.67 days) was in Langra. The highest number of bisexual flowers per panicle (254.6) and the highest number of initial fruit set (5.87) was found in Langra, while the lowest number of bisexual flowers (40.73) was in Pahutan and the lowest number of initial fruit set (1.63) was in Mallika.

Kanpure *et al.* (2009) conducted field studies to evaluate selected mango hybrids for Kymore plateau region of Madhya Pradesh. The check variety Langra gave the maximum vegetative growth parameters, while the hybrid Swarn Jahangir and Ratna gave the minimum. Hybrid Amrapali attained the earliest flowering (14th February) and fruit setting (6th March). Floral malformation was highest (66.1 %) in hybrid Neeleshan, while it was lowest (15.0 %) in Amrapali. Hybrid Neelgoa recorded maximum fruit drop (66.8 %) followed by Langra, while it was minimum (26.9 %) in Amrapali. Amrapali and Mallika produced significantly higher number of fruits and fruit yield per tree over the check variety Langra. However, the fruit weight of Mallika was significantly higher (302.6 g) over all the varieties under study except Neeleshan.

Singh *et al.* (2009) studied the flowering and fruiting behaviour of 11 mango cultivars. namely Langra, Bombay, Mithua, Gulabkhas, Zardalu, Dashehari, Sepia, Fazli, Ketaki, Prabhashankar and Mahmood Bahar under Ranchi conditions. First flower opening was observed in Mithua and flowering was observed to be early in Gulabkhas and 100 per cent flowering occurred by 4th February. However, the minimum period for 100 per cent flower opening was recorded in Fazli (16 days). The check cultivar Langra recorded the minimum male flower (74.41 %), however the maximum was recorded in Fazli (85.12 %). Maximum perfect flower was obtained in Langra (28.59 %). Maximum fruit set was observed in Zardalu (1.02 %) and days taken for maturity were recorded maximum in Fazli (136.33 days).

Shu (2009) found that the hermaphrodite flowers tend to open in a relatively high percentage at the early stage and subsequently declines while male flowers

were lesser at the early stage and majority opened at the middle stage. Keitt cultivar has the highest sex (hermaphrodite/male) ratio of 1.44, while Haden had the lowest (0.2) ratio.

Majumder *et al.* (2011) concluded distinct variations among the findings of the germplasm on plant, leaf, inflorescence fruit characters and yield. Wide variations were observed in relation to the flowering shoot (%), perfect flower (%), fruit set per panicle (%), number of harvested fruits per plant, individual fruit weight, edible portion (%) and total soluble (%) solid ranging from 24.00 to 71.33 per cent, 8.10 to 19.17 per cent, 9.07 to 29.27 per cent, 21.33 to 60.33, 365.33 to 219.00 g, 45.22 to 79.83 per cent and 16.90 to 28.26 per cent, respectively.

Hada and Singh (2017) conducted a field experiment to investigate the flowering, fruiting and yield attributes of some mango cultivars for the years 2014-15 and 2015-16. Outcome of the 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 and it 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 to 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 to 8th April. Earliest fruit setting was observed in Bombai (12th to 16th March) during the year 2014-15 while, earliest fruit setting was noted in Gulabkhas (10th March to 16th March) during the year 2015-16. Highest number of fruit set per panicle 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) was recorded in Langra.

Azam *et al.* (2018) studied twenty mango cultivars for the flowering behaviour at Bihar Agricultural University, Sabour and observed earliest bud break in cultivar Bombay Green (19th January) followed by Bombai and Zardalu (26th January).

However, SB Chausa, Fazli and Neelum recorded a very late bud break. Maximum number of panicles was found in the cultivar Langra (2275) while the minimum number of panicles was found in Neelum (587). Maximum panicle length was observed in SB Chausa (34.5 cm) while minimum was found in Bombay green (17.25 cm) followed by Neelum (20.75 cm). There were differences between cultivars for the date of first flower opening and, in the time and duration of peak flowering. There is, therefore, a possibility of carrying out selection for earliness as well as duration of flowering. In terms of the flower types, staminate flowers were first to appear in all the cultivars followed by hermaphrodite one. The cultivar Langra showed maximum percentage of hermaphrodite flower (73.86 %) while minimum hermaphrodite flowers percentage was found in Swarnarekha.

Kumar *et al.* (2018) studied flowering and fruiting behaviour in five important cultivars of mango *viz.* Langra, Bombai, Zardalu, Bangalora and Hemsagar. The bud break, the appearance of 50 % flower in panicle and fruit set was noticed in different time among the cultivars. The flowering intensity, the percentage of hermaphrodite flower, inflorescence shape and colour, inflorescence length and breadth significantly differed among the cultivars. The fruiting behaviour like fruit set (%), fruit drop (%), number of fruits per tree and fruit weight (g) was also significantly varied among the cultivars. The earlier bud break, the appearance of 50 per cent flower in panicle and fruit set was observed in cv. Bombai and late in cv. Himsagar during both the years 2015 and 2016. The statistically pooled result of the year 2015 and 2016 showed the maximum flowering intensity percentage (62.05 %) and inflorescence length (27.72 cm) was observed in cv. Bangalora, whereas a higher percentage of hermaphrodite flowers (16.55 %) and inflorescence breadth (21.00 cm) was in cv. Zardalu. The maximum fruit set per cent (2.82 %) was found in cv. Himsagar and maximum fruit drop per cent (97.70 %) was in cv. Langra. A higher number of fruits per tree (348.25 fruits/tree) in cv. Bombai and maximum fruit weight (490.11g) were recorded in cv. Bangalore.

Sinha *et al.* (2018) studied the hybrid genotypes in which results showed the earliest bud break in cultivar Sunderprasad on 24th January however, the late bud break was observed in Fazli on 14th February. The cultivar Fazli took maximum time (124.67 days) while Sunderprasad recorded minimum time (92.67 days) from full bloom

to maturity. Cultivar Langra showed the higher percentage (74.18) of hermaphrodite flowers while a lower percentage (37.60) was observed in Jawahar. The hybrids like Hybrid-60-1, Hybrid 140 and Hybrid 60 recorded more than 50 per cent hermaphrodite flowers. Mainly two types of inflorescence shapes were observed viz., conical and pyramidal except for Bombai where the shape of inflorescence was observed to be broadly pyramidal.

Singh and Pathak (2018) investigated the flowering and fruiting behaviour of mango fruit in which earliest emergence of panicle was recorded in Bombay Green (31 Jan), whereas the minimum time for 50 % flowering (12.67 days) and period of bud break to full bloom (22.33 days) were recorded in Gulab Khas. The maximum fruit set per shoot (3.83), fruit retention (5.80 %) and fruit yield (127.63 kg) along with the minimum fruit drop were recorded in Dashehari (94.20 %).

2.3 Fruit parameters and yield parameters

Tripathi (2000) studied 93 mango germplasm and revealed that the fruit yield of cultivars Anannas, Sensation, Ladavio, Surkhuru-1, Surkhuru-2, Gaurjit, Aurumani, Rahri and Mithuwa Malda were higher in terms of kg per square metre and these cultivars were placed in high yielding group under *Tarai* conditions.

Sarkar *et al.* (2001) evaluated 10 mango hybrids for fruit characteristics under Telangana region of Andhra Pradesh, cultivars Ratna, Mahmood Bahar and Swarnajahangir recorded the highest number of fruits (91.5) and yield (15.35 kg) per tree.

Bally *et al.* (2002) reported small yield variations in thirty-three selections of cv. Kensington Pride, with no significant difference among top 19 selections in Queensland, Australia. No single selection had outstanding yield. However, two selections had significantly lower yield than the rest. Their findings indicated the difficulty in significantly improving Kensington Pride mangoes through selection from existing commercial germplasm. Identification, characterization and classification of a total of 75 mango ecotypes had also been done in Ethiopia (Yeshitela and Nessel, 2003).

Barui and Ghosh (2002) investigated the performance of ten mango cultivars of semiarid regions of West Bengal in 1995 -1998. Himsagar produced the highest fruit yield (73.9 kg) and fruit quality.

Kher and Sharma (2002) evaluated five mango cultivars, viz. Dashehari, Bombay Green, Langra, Chausa and Mallika for their performance under subtropical rainfed regions of Jammu and found that Bombay Green was first to mature during 1st week of July, whereas Mallika and Chausa were last to mature during 3rd and 4th week of July, respectively.

Singh (2002) evaluated the 21 varieties and found that the maximum yield per plant was recorded in Bangalora (250 kg) followed by Langra, Zardalu, Bombai and Amrapali.

Hoda *et al.* (2003) studied 20 mango cultivars under subtropics of Bihar and reported that the earliest completion of fruit set was observed in Fazli, while the latest in Neelum. On the basis of different ecological groups of mango cultivars, they observed that Mallika (North Indian cultivar) and Bangalora (South Indian cultivar) performed well when compared with local leading cultivars like Bombai, Zardalu and Himsagar on the basis of flowering and yield attributes. Based on overall performance, Mallika showed much potential for cultivation under Bihar conditions.

Chanana *et al.* (2005) evaluated some mango cultivars under north Indian conditions and found that fruit yield was maximum (73.00 kg/tree) in cultivar Mallika followed by Dashehari (66.33 kg/tree), while, other cultivars Langra and Amrapali recorded the fruit yield of 62.00 kg/tree and 45.67 kg/tree, respectively. On the other hand, minimum fruit yield (15.67 kg/tree) was recorded in Alphonso. In another study, Amrapali and Mallika produced significantly higher number of fruits (338.8 and 214.1) and fruits yield (69.78 and 64.68 kg/tree) over the control cultivar Langra i. e. 127.2 numbers of fruits and 35.05 kg/tree.

Zaman *et al.* (2007) conducted an experiment to evaluate some local and exotic mango germplasm at Jamalpur. They studied 11 germplasm of five-six years old and concluded that, highest number of fruits per plant at harvest was recorded in the germplasm BARI Aam-3 (45.0), followed by Gopalbhog (30.0) and that of lowest in Hybrid-10 (7.0), with close to Mallika (18.0). Fruit weight per plant was also highest in BARI Am-3 (6.11kg) and that of Gopalbhog, Mallika and Hybrid-10 were 5.26 kg, 4.96 kg and 1.39 kg, respectively.

Kanpure *et al.* (2009) reported that the hybrid Ratna and A.U. Rumani attained almost the lowest number of yield and weight of fruits among all the cultivar.

Sawant *et al.* (2018) studied that variety Keshar recorded highest number of fruits/ tree (201) and maximum yield of 43.28 kg/tree amongst all the varieties of mango.

2.4 Physico-chemical parameters

2.4.1 Fruit weight and size

Tripathi (2000) reported that the fruit weight and volume of cultivars Mallika, Nariyal, Fazli and Dadamiyan were more than 400 g and 400 ml per fruit, respectively, among 93 germplasm of mango studied in *Tarai* conditions. He found roundish fruit shape in cvs. Samar-e-Behisht, Naspatti, Zafrani Gola, Ketiki Bihar, etc., ovate oblong shape in cvs. Langra, Neelum, Sensation, Gaurjit, etc. and oblong shape in cvs. Khader, Husnara, Pairi, Karutha Kolamban etc.

Mitra and Mitra (2001) evaluated local mango strains grown in West Bengal and noted wide variations for average fruit weight from 70.9 g/fruit (Subza) to 372.5 g/fruit (Surya Pasand) and length of fruits from 12.27 cm (Surya Pasand) to 6.76 cm (Subza).

Sarkar *et al.* (2001) reported the longest fruit (10.70 cm) and the maximum stone weight (20 %) in cv. Amrapali, while the maximum fruit weight (285 g/fruit) and fruit breadth (7.95 cm) was obtained in cv. A.U. Rumani among ten mango hybrids evaluated.

Kher and Sharma (2002) reported the maximum fruit weight (440 g), size (length 14.85 cm and breadth 8.26 cm) and pulp per cent (78.78) in Mallika among five mango cultivars in subtropical rainfed regions of Jammu. Bangalora fruits were the maximum in weight (242 g/fruit) and pulp content (67.17 %) followed by Langra among 22 mango varieties evaluated in Bhagalpur, Bihar (Singh, 2002).

Anila and Radha (2003) reported that the fruits of Ratna had the maximum length, breadth, weight, volume, circumference and the minimum contribution of stone to fruit weight under Kerala conditions.

Hoda *et al.* (2003) evaluated twenty mango cultivars in Sabour, Bihar for quality attributes and reported that Fazli produced the heaviest fruits (450.98 g).

Muhammad *et al.* (2004) conducted an experiment to determine the physico-chemical characteristics of some mango cultivars like Sindhuri, Almas, Langra, Chaunsa, Anwar Retaul, Malda, Desi, Dusehri, Totapuri, Fajli, Super Badam and Lahotia. Langra, Fajri, Desri and Dusehri gave the highest fruit weight (501.4 g).

Chanana *et al.* (2005) reported that maximum fruit weight (357.44 g/ fruit) and size (length 13.09 cm and breadth 7.63 cm) was recorded in cultivar Mallika, while Alphonso recorded minimum fruit weight (201.67 g/fruit) and size (length 9.33 cm and breadth 6.13 cm).

Chatterjee *et al.* (2005) observed that highest fruit weight was recorded in Alfazli but maximum fruit length was measured in Mallika and the highest fruit breadth was contained by Langra.

Kumar and Singh (2005) evaluated the mango varieties for flowering, fruiting and fruit quality attributes and observed that Mallika recorded maximum fruit yield (171.00 kg) followed by Bangalora and Langra i.e. 130.00 and 120.00 kg per plant respectively, while least fruit yield (11.00 kg per plant) was found in Alphonso.

Patel and Khimani (2005) studied characterization and evaluation of different cultivars of mango (*Mangifera indica* L.) and found that the fruit weight ranged from 342.69 g to 497.69 g.

Pandey *et al.* (2006) conducted a research on identification of superior clones and elite seedlings of mango from Uttar Pradesh and reported that Langra clone V-3 possessed the heaviest (370 g) fruit. Seedling identified from different places exhibited a wide range of variability. The fruit weight varied from 205.8 g in Chausa seedling to 299.0 g in Janisahab Karkan collected from Saharanpur.

Bhuyan and Kobra (2007) evaluated the fruit characteristics of uncommon mango varieties grown under Joydebpur conditions, Bangladesh, they observed that Maldah recorded the highest weight (407 g). Among the mango cultivars evaluated under Punjab conditions, the heaviest fruit weight (445 g), was observed in Fazli.

Jilani *et al.* (2010) recorded maximum fruit length in Alphonso and Fajri (15.20 cm and 14.43 cm), respectively while Fajri having the maximum fruit weight (455.9 g), stone weight (48.67 g), peel weight (84.99 g) and pulp weight (320 g).

Patil *et al.* (2011) observed maximum fruit size (7.63 cm), pulp weight (597.87g) and minimum stone per cent (7.22), skin weight (25 g) in the cultivar Swamini during their study of 39 different cultivars of mango.

Singh *et al.* (2013) studied effect of weather parameters (abiotic factors) on flowering fruiting and quality behaviour of mango cultivars and observed that, the maximum mustard size of fruit was noted under Langra (171.25) followed by Sundarja (142.50). The maximum pea size of fruit (23.88), marble size of fruit (6.00), mature fruit (2.63) was noted under Dashehari. The harvesting period of mango varieties did not differed significantly except Dashehari. The earliest harvesting was observed under Dashehari (29th May).

Shirin *et al.* (2013) noticed maximum fruit weight (648 g), fruit length (16.35 cm), fruit width (8.9 cm) and fruit diameter (26.05 cm) in cv. Alam Shahi.

Himabindu *et al.* (2017) conducted a study at Horticultural Research Station, Venkataramannagudem for evaluating the variability of mango cultivars to conserve the elite ones and to identify the superior genotypes based on fruit characters for future crop improvement. Thirty four mango cultivars were characterized using morphological fruit characters in subsequent years from 2012-14 to know the genetic diversity in mango. The cultivars Sora Mamidi, Kowsuri Pasand and Elamandala appeared to be promising donors for fruit yield which showed maximum fruit weight but the cultivars Panukula Mamidi, Hyder, Nuzividu Rasalu, Suvarnarekha Navaneetham, Nalla Rasalu, Chinnarasam, Panchadara Kalasa and Cherukurasam have optimum fruit size weighing 3-4 fruits/kg.

Bora *et al.* (2017) evaluated mango fruit crops which have been successfully utilized for studying the performance of varieties under different agro climatic regions time to time. In the present study cultivars were characterized on the basis of their physico-biochemical attributes. Mallika and Neelgoa were found superior in terms of fruit weight (321.87 g) and size (12.55 cm, 8.13 cm).

2.4.2 Pulp, peel and stone parameters

Tripathi (2000) reported higher pulp content (above 75 %) in Surkhuru-2, Langra, Kesar and Au-Rumani and higher stone percentage in Rasgulla, Bangalora, Safeda Sharbati, Chausa Dwarf and Pathre. Mitra and Mitra (2001) reported that the

average pulp and peel weight in twenty local mango strains of West Bengal varied from 304.75 (Surya Pasand) to 56.25 g (Talabi) and from 39.75 (Subza) to 12.50 g (Rani). The higher pulp:stone ratio in Rugni, Sheeradhar and Surya Pasand indicated their suitability for fruit processing.

Muhammad *et al.* (2004) conducted an experiment to determine the physico-chemical characteristics of some mango cultivars like Sindhuri, Almas, Langra, Chaunsa, Anwar Retaul, Malda, Desi, Dusehri, Totapuri, Fajli, Super Badam and Lahotia. Almas gave the highest pulp weight (79.12 %) and Langra, Fajri, Desri and Dusehri gave the highest peel weight (22.60 %) and stone weight (27.28 %).

Patel and Khimani (2005) studied characterization and evaluation of different cultivars of mango (*Mangifera indica* L.) and found that the average fruit skin thickness (0.115 cm), lower stone percentage (10.3 %) were observed in LSM-8, LSM-9, LSM-10, LSM-11, Sardar, Vanraj and Master Royal.

Das *et al.* (2007) observed that Kali recorded the highest pulp percentage (78.4 %) with sweet taste and peel percentage (10 %) was observed in Mitha and minimum stone weight was found in variety Nakei (5.9 g) among the mango germplasm of Orissa.

Indian *et al.* (2018) investigate the physical attributes of different mango genotypes at Horticultural College and Research Institute (TNAU), Periyakulam during 2017-18. The genotype Au Rumani was found superior in terms of pulp weight, fruit weight, pulp percentage, pulp to stone ratio and pulp to peel ratio.

Pugalendhi and Latheef (2021) observed higher pulp percentage is a desirable character for table purpose and for breeding quality fruits. Annur 10 recorded the highest fruit breadth (19.55, 19.50 and 19.97 cm), fruit volume (102.36, 105.32 and 03.32 cc), Pulp weight (92.25, 93.25 and 94.31 g) and peel weight (32.21, 32.21 and 32.21 g).

Khan Salma (2022) observed pulp percentage ranged from 37.11 to 80.83 per cent. The maximum pulp percentage was recorded in hybrid-52 (80.83 %) whereas minimum was recorded in hybrid-16 (37.11 %).

2.4.3 Biochemical parameters and organoleptic evaluation

Jadhao *et al.* (2000) analysed thirteen cultivars of mango for their chemical composition. They concluded that total soluble solids content was the highest in cv. Kesar and Alphonso.

Mitra *et al.* (2000) studied physico-chemical characteristics of 21 mango varieties growing in West Bengal and reported that Jagannathbhog had the highest TSS (22.33 %), whereas Jhumko Rani showed the highest sugar content (14.83 %). The lowest titratable acidity (0.14 %) and the highest ascorbic acid content (123.33 mg/100 g) were observed in fruits of Jahanara and Kashir Langra, respectively.

Reddy *et al.* (2000) reported highest TSS (24.20°B) and total sugars (18.67 %) in cv. Mallika, whereas Chausa recorded the highest TSS : acid ratio and was adjudged the most palatable mango cultivar among 20 cultivars evaluated in Ranchi, Bihar.

Tripathi (2000) reported high TSS in Bijoragarh, Amrapali, Surkhuru-2, Lucknow Safeda, Dashehari, Mallika, Sepia, Dadha Peda and Surkhuru-1, whereas the minimum acidity was recorded in Chausa Dwarf, Langra, Dashehari, Chausa and Alphonso. Cultivars like Kazalio, Pulihora and Langra were found to be high in ascorbic acid content. An evaluation study of twenty local mango strains of mango grown in West Bengal showed that the TSS of the fruits was the maximum in cv. Rani and the minimum in Tephala, whereas the highest total sugars content was recorded in Safdar Pasand. The lowest titratable acidity (0.09 %) was observed in Saradamani Bhog and Sita Bhog, whereas highest ascorbic acid was reported in Shah Pasand. Based on high TSS : acid ratio (more than 100) cv. Rugni, Safdar Pasand, Saradamani Bhog, Sita Bhog and Totapari Red Small were recommended for table purpose.

Mitra and Mitra (2001) studied nineteen mango varieties of West Bengal in which the highest total soluble solids (22.66 °B) and sugar/acid ratio (226.6) and the lowest titratable acidity (0.1 %) were recorded for Misti Bhog. Lata Bombai showed the highest total sugar (16.23 %), while Lohajang had the greatest ascorbic acid (104.66 mg/100 g). The highest reducing sugar content (6.2 %) was observed in Mohan Bhog.

Singh (2001) evaluated thirty-one genotypes of mango based on higher TSS, total sugars and ascorbic acid content during ripening. He observed that collection number 20/80 was most suitable for processing purpose.

Kher and Sharma (2002) observed that Dashehari fruits were superior in TSS, TSS : acid ratio, reducing sugars and sugar : acid ratio than other four cultivars taken for performance study and recommended the cultivation of Dashehari in rainfed region of Jammu. Singh (2002) reported the maximum TSS (23 %), total sugars (15.17 %), reducing sugars (4.78 %) and total carotenoids content (8.17 mg/100 g) in Amrapali followed by Langra and Zardalu from 21 cultivars studied in Bhagalpur, Bihar conditions.

Anila and Radha (2003) studied physico-chemical characteristics of four cultivars and two hybrids under Kerala conditions and recorded the highest values of total soluble solids (TSS), sugars and ascorbic acid in the fruits of Ratna and H-151. They concluded that Ratna had all the desirable characteristics in terms of fruit length, breadth, weight, volume, circumference, the minimum stone weight, TSS and sugar content.

Hoda *et al.* (2003) evaluated twenty mango cultivars planted in Sabour during 1980 for fruit quality in 1997/99. Mallika recorded the greatest total carotenoid (4.95 mg per 100 g) contents. The highest contents of TSS, total sugar, reducing sugar and ascorbic acid were recorded for Dashehari.

Chaudhari *et al.* (2006) studied mango genotypes which possessed characteristics were as follows, high total soluble solids or TSS (17, 20, 32, 35 and 57) and medium (genotypes 32 and 45) to high (20 and 35) acidity. In general, the genotypes 16, 17, 20, 24, 27, 32, 35, 38 and 57 were promising. However, genotype 35 was found to be the most promising and can be ranked first among the 9 genotypes. It has dark green-coloured fruits with 70.5 per cent pulp, 4.4 per cent acidity, 101.7 mg/100 g vitamin C, 8.1 per cent TSS and 0.22 per cent fibre content.

Uddin *et al.* (2006) conducted an investigation on some bio-chemical characteristics of twenty two germplasm of mango. Total soluble solids content of 22 mango germplasm were measured at ripe stage. It was observed that the variation in TSS among different germplasm was highly significant. Pahlam contained the highest TSS (26.27 %) followed by Langra (25.20 %), Khirsapat (25.17 %) and Rad (25.50 %). The lowest total soluble solids (19.73 %) was recorded in Tommy Atkin.

Das *et al.* (2007) studied genetic variability in mango germplasm of Orissa and reported that Lori variety recorded the highest TSS (26 %) among the different genotypes. Bhuyan and Kobra (2007) evaluated the fruit characteristics of uncommon

mango varieties grown under Joydebpur conditions, Bangladesh and found that Nakua Goote had the highest total soluble solids content (26 %).

Syed (2009) evaluated mango cultivars for productive and commercial plantation under Punjab conditions of Pakistan and observed that maximum vitamin C contents were recorded in cultivars Sanglakh and Chaunsa (145 mg) followed by Alphonso (98.5 mg) and Zafran (93.5 mg) per 100 g of pulp, maximum TSS (24.7 °Brix) was in Dusehri and maximum acidity (0.82) was in Sanglakh.

Rajwana *et al.* (2010) carried out an experiment in which he found that a newly evolved hybrid Faiz Kareem (Anwar Ratole X Chaunsa) expressed better firmness, which indicates its potential for extended shelf-life. However, total sugars (23.71 %, total soluble solids (25.54 °Brix) and total carotenoids (24.60 µg/ g) were lower than its male parent Chaunsa but higher than female parent Anwar Rataul, which can be an advantage for extended storage and for sugar conscious consumers.

Patil *et al.* (2011) observed maximum total sugars (16.13 %) and non-reducing sugar (13.77 %) in cultivar Gujarat Hybrid while, reducing sugar was maximum (9.4 %) in Ambehod. The maximum TSS (26 °Brix) was recorded in Vashi Badam. The minimum acidity (0.23 %) was recorded in cv. Sai Sugandh.

Sethi *et al.* (2011) compared time required for ripening, post ripening life, cumulative physiological loss in weight during storage, peel colour and sensory quality of newly developed 12 mango hybrids with the important mango hybrids Pusa Arunima and Amrapali. Among hybrids, Pusa Arunima and H 3-2 took longer time for ripening (6.2 and 6.4 days, respectively) while hybrids H 4-12 and H 2-14 ripened faster (3.8 and 4.0 days, respectively). Total post-harvest life was maximum in hybrid H 3-2 (9.8 days), followed by Pusa Arunima (9.4 days).

Rana and Bharadwaj (2015) recorded total soluble solid was to be the maximum in Chausa (21°B), while the minimum (16.6 °B) in Khas-ul-Khas. The minimum acid content was recorded in Khas-ul-Khas followed by Gurjeet, Dashehari, Bombay Green, Langra and the maximum in Alphonso. Reducing sugar was observed to be maximum in Safeda, while minimum in Alphonso, Summer Bahishit Rampur, Fazli and Totapari. Total sugar content was found to vary from 13.4 to 17.8 per cent.

Bora *et al.* (2017) evaluated mango fruit crops which has been successfully utilized for studying the performance of varieties under different agro climatic regions

time to time. In the present study cultivars were characterized on the basis of their physico-biochemical attributes. Mallika excelled in terms of sugar (20.82), while Amrapali in carotenoids (8.38 mg/100 g). Among them, Mallika (22.41°B) possessed the highest amount of total soluble solids while lowest amount in Langra (16.90 °B). The study showed the potential of Amrapali in terms of its quality, being late can meet the demand for later period when no other cultivar is available.

Syed *et al.* (2017) studied 425 mango accessions from Azad Jammu & Kashmir (AJK) as well as Northern and Southern Punjab to explore the genetic diversity. Total 33 traits (25 qualitative and 8 quantitative) enabled the assessment of morphological and physico-chemical diversity of the studied indigenous mango germplasm. The first three principal components (PCs) contributed 68.06 per cent variability among all mango accessions. The PCs also successfully grouped mango accessions according to their morphological and physico-chemical characteristics. Trunk height, tree circumference, crown diameter, leaf colour, leaf blade length, petiole length, inflorescence length, inflorescence width, fruit shape, fruit weight, soluble solid contents, titratable acidity, sugar:acid ratio, reducing sugars, non-reducing sugars and total sugars were found highly variable. Many of these characters are of substantial economic significance and could be used as breeding goals to increase the germplasm repository as well as fruit yield and quality. In conclusion, morphological and physico-chemical traits were highly useful for mango germplasm characterization. Several accessions also showed potentially good traits which could be used to develop new mango cultivars through future breeding schemes.

Husen (2019) performed the characterization and evaluation of mango hybrids by morphological characteristics and chemical properties as well as fruit yield. The material was 17 mango plants hybrid (F1), 3 years old, the cultivars from crosses Arumanis -143 (Cg-48) which has a green color on the fruit skin with 6 clones of Cukurgondang red mango. To find fruit diversity, 16 characters quantitative and 23 qualitative characters were observed using Descriptors for Mango of The International Plant Genetic Resources Institute 2006 and the evaluation was done on the characters of fruit weight, fruit pulp thickness, total soluble solids, fruit yield and fruit color. The results showed that the vast diversity only occurred on characters of the weight of the fruit, seed and endocarp weight, while others had a narrow diversity. Principal component analysis on 23 qualitative characters of fruit formed 6 major components with the

cumulative diversity of 81.9 per cent, the highest proportion (PC1) of 23.2 per cent which is the character of the shape of fruit apex, skin colour of ripe fruit, fiber length in the pulp and cluster analysis of 13 genotypes formed two clusters. Evaluation of hybrid with high yield occur in F1-15 and F1-87, while high total dissolved solids observed in F1-02, F1-22, F1-49 and red fruit skin was in hybrids F1-31, F1-47, F1-44 and F1-09 successively.

Saheda *et al.* (2019) observed Mallika recorded the highest values of TSS (24.77 °Brix), total sugar (15.80 %) and reducing sugars (6.83 %) contents. The maximum ascorbic acid content was found in cv. Royal Special (62.86 mg/100g), while the titrable acids are highest in cv. Prodduturiavakai (1.47 %).

Dutta *et al.* (2020) stated that characterization and documentation of indigenous mango varieties is important for identifying potential candidates for improved utilization of the genetic resource. Murshidabad, district of West Bengal, the land of the Nawabs, is famous for its traditional mango varieties. Even after massive genetic erosion there still exists a rich collection of indigenous mango varieties in this district. Therefore they studied characterisation of the mango fruit and fruit pulp using DUS Testing based on PPV and FRA, 2008 among some indigenous mango varieties of Murshidabad district of West Bengal.

Sandhyarani *et al.* (2024) noted that none of the genotypes recorded maximum peel colour and appearance score compared to the check Banaganapalle (9.65), which was maximum among the checks. Four genotypes viz., I-1 (9.71), C-13 (9.68), D-13 (9.63) and F-16 (9.61) recorded more pulp colour and appearance score than the check Banaganapalle (9.56) which was maximum among the checks. Among the genotypes evaluated, seven genotypes viz., G-28 (9.92), F-16 (9.85), B-9 (9.78), F10 (9.76), H-32 (9.74), E-6 (9.72) and D-12 (9.65) recorded higher score for pulp texture than the best check Banaganapalle (9.64). Among the genotypes evaluated only one genotype viz., E-2 (9.47) recorded significantly highest score for pulp taste and flavour compared to the best check Chinnarasam (9.04). None of the genotypes recorded maximum score for overall acceptability of fruit compared to the check Banaganapalle (9.35), which was maximum among the checks.

3. MATERIAL AND METHODS

The present investigation entitled “Evaluation of promising genotypes of Mango (*Mangifera indica* L.) for growth, yield and quality” was carried out during 2022-2023. For morphological and biochemical characterization, thirty three genotypes were selected from “Instructional-cum-Research Farm”, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri. Twenty-seven mango genotypes and six check varieties (Sai Sugandh, Vanraj, Kesar, Alphonso, Mulgoa, Sindhu) were selected for evaluation. The details of material used and methods adopted in the present study are mentioned under the following captions.

3.1 Experimental material

3.1.1 Details of genotypes

The germplasm of mango is maintained at Instructional-cum-Research Farm, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri. Twenty-seven genotypes for evaluation along with six check varieties were selected from above location.

3.1.2 Experimental site

The morphological and biochemical analysis of fruits of all hybrid derivatives was conducted at Department of Horticulture, MPKV, Rahuri, Dist. Ahmednagar (M.S.). The Mahatma Phule Krishi Vidyapeeth, Rahuri is situated between 19° 20' and 19° 57' North latitude and 74° 02' and 74° 19' East longitude. The altitude varies from 511 to 547 m above the mean sea level.

3.1.3 Climatic conditions

3.1.3.1 General

The region falls under semi-arid and tropical zone. The annual rainfall ranges from 307 to 619 mm with an average of 520 mm. About 80 per cent rainfall is received in June to September from south west monsoon. The distribution of rain is erratic and recurrence of dry spells is a common phenomenon.

The annual average maximum temperature of the tract is 35.22°C which ranges from 30.37°C to 40.07°C and the average minimum temperature is 22.18°C with range of 17.26 °C to 27.10 °C. The mean relative humidity at 7.30 and 14.30 hours is 48.28 and 47.40 per cent, respectively. The mean evaporation ranges from 5.3 to 12.1 mm.

3.2 Experimental Methods

3.2.1 Collection of fruits

Mango fruits of twenty seven genotypes and six check varieties were collected from above mentioned location. Fruits were harvested at physiological maturity stage and were analysed for morphological and biochemical parameters.

3.3 Morphological parameters

All morphological observations were recorded as per IPGRI 2006 Descriptors for mango. (Anon., 2006)

3.3.1 Growth parameters

3.3.1.1 Leaf characters

For all leaf characters, average of 5 fully matured and healthy leaves were collected half-way along the shoot from tree and following observations were recorded.

3.3.1.2 Leaf size

a. Leaf length (cm)

The length of randomly selected five leaves of all thirty three genotypes excluding petiole was taken from tip of the bearing shoot and average was calculated and expressed in centimetres.

b. Leaf breadth (cm)

The leaf breadth of all thirty three genotypes was measured in the widest part of fully developed leaves and average was calculated and expressed in centimetres.

3.3.1.3 Leaf type

The leaves of all thirty three genotypes were visually observed and recorded for leaf type as simple, oblanceolate and alternate.

3.3.1.4 Leaf colour

The colour of leaves of all thirty three genotypes was observed and recorded as pale green, Green and Dark green.

3.3.1.5 Leaf waxiness

The leaf waxiness of all thirty three genotypes was recorded as waxy and non-waxy.

3.3.2 Flowering characters

The observations were recorded on randomly selected five panicles of each tree of all thirty three genotypes.

3.3.2.1 Date of flowering

Date of panicle emergence of all thirty three genotypes was recorded from the trees.

3.3.2.2 Number of flushes

The flushes were visually observed by visiting the orchard regularly.

3.3.2.3 Colour of flush

The colour of the inflorescence was observed and recorded as light green, yellow, reddish yellow, reddish green and reddish.

3.3.2.4 Colour of panicle

The colour of the inflorescence was observed and recorded as green, light green, yellow, reddish yellow, reddish green and reddish.

3.3.2.5 Number of flowers per panicle

Number of flowers were counted from North, South, East and West directions of plant canopy from randomly tagged panicles and averaged for each direction.

3.3.2.6 Number of hermaphrodite flowers per panicle

Number of hermaphrodite flowers were counted from North, South, East and West directions of plant canopy from randomly tagged panicles and averaged for each direction.

3.3.2.7 Number of male flowers per panicle

Total numbers of male flowers were counted at full bloom stage from tagged panicles and average was calculated.

3.3.2.8 Sex ratio

Sex ratio was calculated by dividing number of hermaphrodite flowers with number of male flowers by using following formula.

$$\text{Sex ratio} = \frac{\text{Number of hermaphrodite flowers}}{\text{Number of male flowers}}$$

3.3.3 Fruit morphology

All observations were recorded when fruits were fully ripened, unless otherwise specified. Measurements were made on 5 well developed representative fruits of thirty three genotypes of mango at the time of harvest.

3.3.3.1 Days required from fruit setting to mustard stage (days)

Date of fruit set and mustard stage was recorded when tagged panicles of each genotypes started fruit setting up to mustard stage. The date of fruit set and mustard stage was noted by the visual observation. The period from fruit setting to mustard stage was calculated and expressed in days.

3.3.3.2 Number of fruits per panicle (at egg stage)

Number of fruits was computed by counting the number of fruit set at egg stage from five randomly tagged panicles from each side and centre of tree was recorded and an average was calculated as number of fruits per panicle.

3.3.3.3 Number of fruits per panicle (at harvest stage)

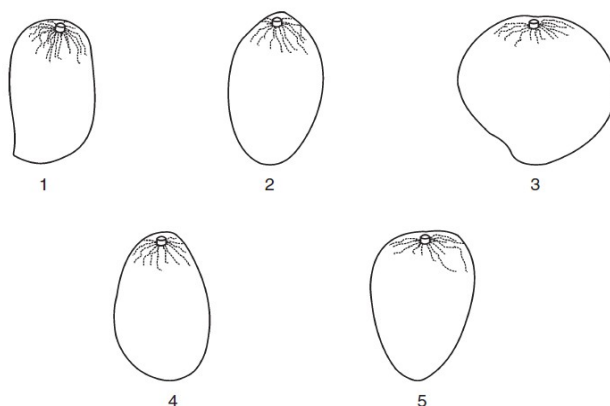
Number of fruits was computed by counting the number of fruit set at from five randomly tagged panicles from each side and centre of tree was recorded and an average was calculated as number of fruits per panicle.

3.3.3.4 Fruit retention at harvest (%)

The number of fruits at mustard stage of tagged panicles and fruits on the same panicle at harvest was counted and recorded and fruit retention was calculated and expressed in percentage.

3.3.3.5 Fruit shape

The fruit shape of thirty three genotypes was observed and recorded as oblong, elliptic, roundish, ovoid and obovoid.



(1. Oblong 2. Elliptic 3. Roundish 4. Ovoid 5. Obovoid)

Fig. 3.1. Fruit shape

3.3.3.6 Fruit length (cm)

The length of five randomly selected fruits of each thirty three genotypes was measured from the base to apex of the fruit with a vernier calliper and an average was calculated and expressed in centimetres.

3.3.3.7 Fruit breadth (cm)

The fruits which were used for recording the length of the fruit were also used for recording the fruit breadth and was measured at the widest portion of the fruit with a vernier calliper and expressed in centimetres.

3.3.3.8 Fruit weight (g)

Five fruits of each genotype were weighed with an electronic balance and average was calculated and expressed in grams.

3.3.3.9 Colour of fruit (Unripe)

Fruit colour in all genotypes was recorded by visual observations as green, yellow, orange, purple and red at harvesting time.

3.3.3.10 Fruit peel colour (Ripe)

Fruit peel colour of thirty three genotypes was observed after ripening as green, greenish yellow, yellow, green with red blush and green with purple patches.

3.3.3.11 Peel (%)

Peel percentage was calculated by dividing average peel weight by average fruit weight and expressed in percentage.

$$\text{Peel percentage} = \frac{\text{Peel weight (g)}}{\text{Fruit weight (g)}} \times 100$$

3.3.4 Pulp

3.3.4.1 Pulp colour

Pulp colour was observed and recorded as light yellow, golden yellow, yellowish orange, orange, greenish yellow, yellow, light orange and dark orange.

3.3.4.2 Pulp fibrousness

Pulp fibrousness was recorded as absent, low, intermediate and high.

3.3.4.3 Pulp (%)

The fruit pulp was separated from the fruit peel and stone. The pulp was weighed and pulp percentage was calculated using the following formula and expressed in percentage.

$$\text{Pulp percentage} = \frac{\text{Pulp weight (g)}}{\text{Fruit weight (g)}} \times 100$$

3.3.5 Stone

3.3.5.1 Stone length (cm)

The length of five stones of each genotypes was measured and an average was calculated and expressed in centimetres.

3.3.5.2 Stone breadth (cm)

The width of five stones of each genotypes was measured and an average was calculated and expressed in centimetres.

3.3.5.3 Stone weight (g)

The fruit was peeled and stone was separated from the pulp and after proper cleaning of pulp portion of the fruit, weight of the stone was taken with the aid of an electronic balance and expressed in grams.

3.3.5.4 Stone percentage (%)

The stone was weighed and stone percentage was calculated using the following formula and expressed in percentage.

$$\text{Stone percentage} = \frac{\text{Stone weight (g)}}{\text{Fruit weight (g)}} \times 100$$

3.3.. Shelf life (days)

The fruit after ripening were kept at room temperature. The shelf life was taken for post ripening period of fruits and expressed in days. The optimum shelf-life of the fruit is considered when the fruit exhibit the symptoms of over ripening by shrivelling and over softening.

3.4 Yield parameters

3.4.1 Number of fruits per tree

The number of fruits per tree at harvest were counted and recorded.

3.4.2 Yield (kg/tree)

Yield per tree was calculated by multiplying the average weight of the fruits with total number of fruits per tree at harvest and expressed in kilogram (kg).

3.5 Qualitative characters (Organoleptic evaluation)

The ripe fruits were examined for their sensory qualities for accessing the aroma, flavour and texture when they were ripe. It was carried out by panel of 5 judges with 9-point Hedonic scale score (Amerine *et al.*, 1965) as given below.

Sensory Score	Rating
9	Like extremely
8	Like very much
7	Like moderately
6	Like slightly
5	Neither like nor dislike
4	Dislike slightly
3	Dislike moderately
2	Dislike very much
1	Dislike extremely

(Source: Amerine *et al.* 1965)

The overall rating was obtained by averaging score of evaluation. The fruits with score of 5.5 and above were rated as acceptable.

3.6 Biochemical parameters

3.6.1 Total soluble solids (°Brix)

Total soluble solids (TSS) of pulp was estimated with the help of a hand refractometer calibrated in °Brix at 20 °C. The prism of refractometer was washed with distilled water and wiped by muslin cloth after recording each observation (A.O.A.C., 1984).

3.6.2 Reducing sugars (%)

The reducing sugars were estimated by using Lane and Eynon (1923) method with modification suggested by Ranganna (1977). A known weight (5 g) of sample was blended with distilled water using lead acetate (45 %) for precipitation of extraneous material and potassium oxalate (22 %) to delead the solution. This lead-free extract was used to estimate reducing sugars by titrating against standard Fehling's mixture (Fehling's A and B) using methylene blue as an indicator to a brick red end point.

3.6.3 Non-reducing sugars (%)

The non-reducing sugar content was determined by subtracting the value of reducing sugar from that of the total sugar and multiplying the values with 0.95 (as 0.95 g of sucrose on hydrolysis gives 1 g of monosaccharides i.e. glucose and fructose) and expressed as percentage.

3.6.4 Total sugars (%)

The total sugars were estimated by the same procedure of reducing sugars after acid hydrolysis of an aliquot of delead sample with 35 per cent hydrochloric acid, followed by neutralization with sodium hydroxide (40 %). This filtrate was used for titration against standard Fehling's mixture (Fehling's A and B) using methylene blue as an indicator to brick red end point (Ranganna, 1977).

3.6.5 Titratable acidity (%)

The titratable acidity was determined by titrating against standard alkali (N/10 NaOH) using phenolphthalein as an indicator and expressed as percentage in terms of citric acid (A.O.A.C., 1984).

3.6.6 pH of pulp

pH of the pulp was recorded using pH meter.

3.6.7 TSS: Acidity ratio

The ratio was calculated by dividing total soluble solids (TSS) by titratable acidity content of fruit.

3.7 Percentage of fruit drop with reason at different stages

In each genotype, 10 panicles were tagged at fully opened stage and the percentage of initial fruits set and subsequent drop were recorded at biweekly intervals in order to assess the intensity of fruit drop in each genotype.

3.8 Physiological disorders (if any)

3.8.1 Incidence of malformation (%)

Per cent severity was recorded quantifying number of affected panicles. Disease index was calculated by multiplying incidence and severity values. On the basis of calculated Disease Index (DI), a disease rating scale (1-9) was used for grading of different cultivars: Grade 1= Free from disease (Resistant); Grade 3= 0.1-1.0 % DI (Moderately resistant); Grade 5= 1.0-10.0 % DI (Tolerant); Grade 7= 10.1-20 % DI (Moderately susceptible); Grade 9= >20 % DI (Susceptible) (Kumar and Beniwal, 1992).

Rating	Reaction
1	Resistant
3	Moderately resistant
5	Tolerant
7	Moderately susceptible
9	Susceptible

3.8.2 Incidence of black tip (%)

Fruits were observed for the incidence of black tip and expressed in percentage.

3.8.3 Incidence of spongy tissue (%)

The fruits after ripening were observed for the incidence of spongy tissue and were expressed in percentage.

3.8.4 Incidence of water tissue (%)

The fruits after ripening were observed for the incidence of water tissue and were expressed in percentage.

3.9 Incidence of pest and diseases (if any)

3.9.1 Incidence of powdery mildew (%)

The trees were observed for the incidence of powdery mildew on the basis of symptoms present in the inflorescence. Thereafter, disease incidence was calculated as the number of infested panicles showing symptoms out of total number of panicles observed. The per cent disease intensity (PDI) was calculated using the formula developed by McKinney (1923) is given below.

$$\text{PDI (\%)} = \frac{\text{Sum of all disease ratings}}{\text{Number of panicles observed} \times \text{Maximum disease grade}} \times 100$$

The assessment carried out using the self-designed 0 to 5 grades disease rating scale on the basis of area of mango inflorescence affected by powdery mildew from the given disease rating on powdery mildew by Akhtar and Alam, (2002); Raheel *et al.* (2008); Galli *et al.* (2008) and Thind *et al.* (2005).

Rating Scale	Area of Inflorescence Covered (%)
0	Inflorescence free from infection
1	1-10 % Inflorescence covered by powdery mildew
2	11-25 % Inflorescence covered by powdery mildew
3	26-50 % Inflorescence covered by powdery mildew
4	51-75 % Inflorescence covered by powdery mildew
5	>75 % Inflorescence covered by powdery mildew

3.9.2 Incidence of anthracnose

The trees were observed for the incidence of anthracnose and expressed in percentage.

3.9.3 Incidence mango hopper

Number of nymphs and adults on a single panicle (10 cm)/inflorescence from each direction (East, West, South and North) of selected tree were visually counted during season. During off season, standard sweep net (4 sweeps /tree, one sweep in each direction) was used to sample the adult hoppers resting on tree trunk after disturbance by using net. Sweeps were made across the zone of flight of hoppers. The net was emptied after each sweep and hoppers were counted.

3.9.4 Incidence of thrips

Ten terminal twigs from lower canopy of each of experimental tree were selected randomly for counting thrips population.

3.9.5 Incidence of fruit fly

For recording the observations of mango fruit fly, five methyl eugenol traps were placed in mango orchard after initiation of inflorescence. From each trap,

numbers of male fruit flies were recorded at weekly interval from flowering to end of mango season.

3.10 Statistical analysis

The data collected on individual characters were tabulated and subjected to statistical analysis through mean analysis as described by Panse and Sukhatme (1985).

4. RESULTS AND DISCUSSION

"Evaluation of promising genotypes of mango (*Mangifera indica* L.) for growth, yield and quality" entitled research was carried out during 2022-23. Twenty-seven genotypes and six check varieties were selected from which some of were from Research-cum-Instructional Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri and some from the Plant Nursery of Horticulture Department, Mahatma Phule Krishi Vidyapeeth. These genotypes were screened for morphological and biochemical characters. In that, five promising genotypes along with six check varieties (Sai Sugandh, Vanraj, Kesar, Alphonso, Mulgoa, Sindhu) were selected on the basis of quality parameters. The observation for morphological and biochemical characters were recorded in respect of all thirty-three genotypes. The results of present experiment are discussed below.

4.1 Morphological parameters

In the present research, thirty three genotypes were studied for morphological characters. The observations in respect of leaf, flower and fruit characters were recorded and presented below under suitable headings.

4.1.1 Leaf parameters

The data concerning to leaf characters such as leaf size, leaf type, leaf colour and leaf waxiness has been presented in Table 4.1 and 4.2.

4.1.1.1 Leaf size

4.1.1.1.1 Leaf length and breadth (cm)

During the research it was seen that the leaf length varied from 14.70 to 35.50 cm where the maximum leaf length was recorded in RHRMH-16 (35.50 cm) followed by Kesar (34.57 cm), RHRMH-30 (31.50 cm), RHRMH-38 (30.50 cm) and Alphonso (28.40 cm) and the minimum is recorded in RHRMH -73 (14.70 cm) followed by RHRMH -57 (15.90cm), RHRMH-52 (18.10 cm), Sai Sugandh (18.70 cm) and RHRMH-5 (19.50 cm).

RHRMH-16 (35.50 cm) was having leaf length near to Kesar (34.57 cm) while RHRMH-38 (30.50 cm) and RHRMH-107 (28.10 cm) were having near values to Alphonso (28.40 cm) in leaf length.

The leaf breadth, it varied from 3.10 to 7.10 cm where the maximum leaf breadth was recorded in RHRMH-16 (7.10 cm) followed by RHRMH-30 (6.50 cm),

RHRMH-107 (5.95 cm), RHRMH-84 (5.90 cm) and RHRMH-44 (5.85 cm) and the minimum is recorded in RHRMH-73 (3.10 cm) followed by Sai Sugandh (3.45 cm), RHRMH-57 (3.80 cm), Mulgoa (3.86 cm) and RHRMH-52 (4.00 cm).

For the leaf breadth, RHRMH-5 (5.60 cm) and RHRMH-98 (5.55 cm) having nearby values with Alphonso. Kesar having values nearby to RHRMH-96 (5.47 cm) and RHRMH-55 (5.30 cm) for leaf breadth.

The variation in the leaf length and breadth may be due to climatic condition, genetic variation and growth stages.

Sinha *et al* (2018) studied results showed the similar findings in their investigation.

4.1.1.2 Leaf type

The simple leaf type was recorded for all thirty-three genotypes (Table 4.2).

Litz (2003) also reported simple, alternate and oblanceolate leaves in mango.

4.1.1.3 Leaf colour

Some variations was observed in the leaf colour among the thirty-three genotypes where 26 genotypes showed dark green colour, 6 genotypes showed light green and 1 genotype was green coloured leaves.

Mature leaf colour may be varying from light to dark green according to Singh (1960). While Ali (2013) reported that based on cultivar young leaves were specific in nature and can be used for identification of different mango varieties.

Grouping of genotypes according to leaf colour

No.	Leaf colour	Number of genotypes
1.	Dark green	26
2.	Green	01
3.	Light green	06

4.1.1.4 Leaf waxiness

The non-waxy appearance on the leaves in all genotypes were noticed.

Table 4.1. Morphological characterization in mango genotypes for leaf parameters

Sr. No.	Genotype	Leaf size	
		Length (cm)	Breadth (cm)
1	RHRMH - 5	19.50	5.60
2	RHRMH - 6	23.00	4.10
3	RHRMH - 7	25.20	5.53
4	RHRMH - 16	35.50	7.10
5	RHRMH - 30	31.50	6.50
6	RHRMH - 38	30.50	4.10
7	RHRMH - 39	25.50	4.20
8	RHRMH - 44	20.95	5.85
9	RHRMH - 52	18.10	4.00
10	RHRMH - 55	26.15	5.30
11	RHRMH - 57	15.90	3.80
12	RHRMH - 72	22.67	5.13
13	RHRMH - 73	14.70	3.10
14	RHRMH - 83	23.60	5.10
15	RHRMH - 84	24.30	5.90
16	RHRMH - 85	22.50	5.70
17	RHRMH - 93	22.70	4.80
18	RHRMH - 96	26.60	5.47
19	RHRMH - 98	27.68	5.55
20	RHRMH - 104	26.30	5.50
21	RHRMH - 107	28.10	5.95
22	RHRMG - 1	22.00	4.80
23	RHRMG - 2	24.30	5.50
24	RHRMG - 3	22.30	4.70
25	RHRMG - 4	22.50	4.80
26	RHRMG - 5	21.70	4.60
27	RHRMG - 6	22.30	4.90
28	Sai Sugandh	18.70	3.45
29	Vanraj	20.80	4.76
30	Kesar	34.57	5.30
31	Alphonso	28.40	5.60
32	Mulgoa	20.60	3.86
33	Sindhu	20.30	4.12
	Range	14.70 - 35.50	3.10 - 7.10
	Minmum	14.70	3.10
	Maximum	35.50	7.10
	Mean	23.92	4.99
	S.D	4.73	0.88
	S.E. $\pm$	0.82	0.15
	CV (%)	19.78	17.64

Table 4.2. Morphological characterization in mango genotypes for leaf parameters

Sr. No.	Genotype	Leaf type	Leaf colour	Leaf waxiness
1	RHRMH - 5	Simple	Dark Green	Nonwaxy
2	RHRMH - 6	Simple	Dark Green	Nonwaxy
3	RHRMH - 7	Simple	Dark Green	Nonwaxy
4	RHRMH - 16	Simple	Dark Green	Nonwaxy
5	RHRMH - 30	Simple	Dark Green	Nonwaxy
6	RHRMH - 38	Simple	Dark Green	Nonwaxy
7	RHRMH - 39	Simple	Light Green	Nonwaxy
8	RHRMH - 44	Simple	Dark Green	Nonwaxy
9	RHRMH - 52	Simple	Dark Green	Nonwaxy
10	RHRMH - 55	Simple	Light Green	Nonwaxy
11	RHRMH - 57	Simple	Light Green	Nonwaxy
12	RHRMH - 72	Simple	Dark Green	Nonwaxy
13	RHRMH - 73	Simple	Dark Green	Nonwaxy
14	RHRMH - 83	Simple	Dark Green	Nonwaxy
15	RHRMH - 84	Simple	Dark Green	Nonwaxy
16	RHRMH - 85	Simple	Dark Green	Nonwaxy
17	RHRMH - 93	Simple	Dark Green	Nonwaxy
18	RHRMH - 96	Simple	Dark Green	Nonwaxy
19	RHRMH - 98	Simple	Light Green	Nonwaxy
20	RHRMH - 104	Simple	Dark Green	Nonwaxy
21	RHRMH - 107	Simple	Dark Green	Nonwaxy
22	RHRMG - 1	Simple	Light Green	Nonwaxy
23	RHRMG - 2	Simple	Dark Green	Nonwaxy
24	RHRMG - 3	Simple	Dark Green	Nonwaxy
25	RHRMG - 4	Simple	Dark Green	Nonwaxy
26	RHRMG - 5	Simple	Dark Green	Nonwaxy
27	RHRMG - 6	Simple	Dark Green	Nonwaxy
28	Sai Sugandh	Simple	Light Green	Nonwaxy
29	Vanraj	Simple	Dark Green	Nonwaxy
30	Kesar	Simple	Dark Green	Nonwaxy
31	Alphonso	Simple	Dark Green	Nonwaxy
32	Mulgoa	Simple	Green	Nonwaxy
33	Sindhu	Simple	Dark Green	Nonwaxy

4.1.2 Flowering parameters

The data regarding flowering characters has been presented under following sub-headings.

4.1.2.1 Date of flowering

Among the studied genotypes the RHRMH-73 and Vanraj (13th January) flowered earlier while RHRMH-52, RHRMG-4, RHRMG-5, RHRMG-6 (28th February) were the late bloomed as presented in Table 4.3.

As reported in Kulkarni (2004), generally flowering was affected by the local environmental conditions, genetic characteristics and by hormonal aspects.

4.1.2.2 Colour of panicle

In the Table 4.3 data of colour of panicle is presented. According to the mango descriptor, a significant variation in the colour of the rachis was observed among the different mango genotypes studied, indicated a notable difference in the colour characteristics of mango genotype.

Rajwana *et al.* (2011) and Kobra *et al.* (2012) also noted similar results regarding colour of mango inflorescence among various mango cultivars.

Grouping of genotypes according to colour of panicle

No.	Colour of panicle	Number of genotypes
1.	Yellow	17
2.	Yellowish green	06
3.	Yellowish pink	05
4.	Reddish Yellow	05

4.1.2.3 Number of flushes

Number of vegetative flushes most observed in the mango genotypes were vary from 0 to 2. Two flushes were seen in the most genotypes during the experiment (Table 4.4).

Grouping of genotypes according to number of flushes

No.	Number of flushes	Number of genotypes
1.	0	03
2.	1	01
3.	2	29

Table 4.3. Morphological characterization in mango genotypes for flowering parameters

Sr. No.	Genotype	Date of Flowering	Colour of Panicle
1	RHRMH - 5	15-01-2023	Yellowish pink
2	RHRMH - 6	15-01-2023	Yellow
3	RHRMH - 7	23-01-2023	Yellow
4	RHRMH - 16	17-01-2023	Yellowish pink
5	RHRMH - 30	16-01-2023	Yellowish pink
6	RHRMH - 38	17-01-2023	Yellowish pink
7	RHRMH - 39	15-01-2023	Reddish yellow
8	RHRMH - 44	20-02-2023	Yellow
9	RHRMH - 52	28-02-2023	Yellow
10	RHRMH - 55	05-02-2023	Yellow
11	RHRMH - 57	04-02-2023	Yellow
12	RHRMH - 72	16-01-2023	Reddish yellow
13	RHRMH - 73	13-01-2023	Reddish yellow
14	RHRMH - 83	23-02-2023	Yellow
15	RHRMH - 84	15-02-2023	Yellow
16	RHRMH - 85	08-02-2023	Yellow
17	RHRMH - 93	23-01-2023	Yellow
18	RHRMH - 96	21-02-2023	Yellow
19	RHRMH - 98	14-01-2023	Yellowish green
20	RHRMH - 104	24-01-2023	Yellowish green
21	RHRMH - 107	15-01-2023	Yellowish green
22	RHRMG - 1	25-02-2023	Yellow
23	RHRMG - 2	25-02-2023	Yellow
24	RHRMG - 3	23-02-2023	Yellowish pink
25	RHRMG - 4	28-02-2023	Yellowish green
26	RHRMG - 5	28-02-2023	Yellow
27	RHRMG - 6	28-02-2023	Yellow
28	Sai Sugandh	15-01-2023	Reddish yellow
29	Vanraj	13-01-2023	Yellowish green
30	Kesar	16-02-2023	Yellow
31	Alphonso	15-01-2023	Reddish yellow
32	Mulgoa	25-02-2023	Yellowish green
33	Sindhu	27-02-2023	Yellow

4.1.2.4 Colour of flushes

The data regarding the colour of flush of thirty-three genotypes has been recorded and presented in Table 4.4. The colour of flushes was seen to be reddish, reddish yellow, yellowish red and light green.

Grouping of genotypes according to colour of flush

No.	Colour of flush	Number of genotypes
1.	Reddish	15
2.	Reddish Yellow	08
3.	Yellowish Red	04
4.	Light Green	03

4.1.2.5 Number of hermaphrodite flowers per panicle

The information in Table 4.5 showed that the range for hermaphrodite flowers varied from 80.80 to 240.30. In which the highest hermaphrodite flowers were observed in RHRMH-52 (240.30) followed by RHRMH-6 (240.10), RHRMH-104 (196.80), RHRMG-1 (186.10) and Kesar (180.50) while the least hermaphrodite flowers were seen in RHRMH-85 (80.80) followed by RHRMG-6 (106.20), RHRMH-30 (110.23), RHRMH-38 (113.20) and Sai Sugandh (114.80).

While values near to Kesar (180.50) were of RHRMG-1 (186.10) and RHRMH-7 (180.30) whereas RHRMH-39 (159.10) was having value similar to Alphonso (160.60).

The environment significantly impacts this parameter, as different mango cultivars have specific ecological and geographical requirements for optimal flowering and fruiting.

The observations had accordance with Anila and Radha (2003) in their findings.

4.1.2.6 Number of male flowers per panicle

In Table 4.5 the data related on number of male flowers presented which was varied from 303.00 to 850.70 having the highest male flowers in Alphonso (850.70) followed by RHRMH-104 (787.20), RHRMH-52 (786.10), RHRMH-7 (780.60) and RHRMH-107 (772.50) while RHRMH-85 (303.00) showed the least male flowers followed by RHRMH-38 (329.20), RHRMH-44 (387.50), RHRMH-16 (397.25) and RHRMG- 2 (418.60).

RHRMH-104 (787.20) showed the value near to Alphonso (850.70) while RHRMH-107 (772.50) showed value near to Kesar (770.20).

The genetic composition of the plant plays a role in determining the overall number of male flowers it produces.

These observations were in close conformity with findings of Ubale and Banik (2015).

Table 4.4. Morphological characterization in mango genotypes for flowering parameters

Sr. No.	Genotype	Number of Flushes	Colour of Flush
1	RHRMH - 5	2	Reddish
2	RHRMH - 6	2	Reddish
3	RHRMH - 7	2	Reddish
4	RHRMH - 16	2	Reddish
5	RHRMH - 30	2	Reddish
6	RHRMH - 38	2	Reddish
7	RHRMH - 39	2	Reddish yellow
8	RHRMH - 44	0	-
9	RHRMH - 52	2	Reddish
10	RHRMH - 55	0	-
11	RHRMH - 57	0	-
12	RHRMH - 72	2	Reddish
13	RHRMH - 73	2	Reddish yellow
14	RHRMH - 83	2	Reddish Yellow
15	RHRMH - 84	2	Reddish Yellow
16	RHRMH - 85	2	Reddish Yellow
17	RHRMH - 93	2	Light Green
18	RHRMH - 96	2	Reddish Yellow
19	RHRMH - 98	2	Reddish Yellow
20	RHRMH - 104	2	Reddish Yellow
21	RHRMH - 107	2	Reddish Yellow
22	RHRMG - 1	2	Reddish Yellow
23	RHRMG - 2	2	Reddish
24	RHRMG - 3	2	Reddish
25	RHRMG - 4	1	Light Green
26	RHRMG - 5	2	Reddish yellow
27	RHRMG - 6	2	Reddish yellow
28	Sai Sugandh	2	Reddish
29	Vanraj	2	Reddish
30	Kesar	2	Reddish
31	Alphonso	2	Light Green
32	Mulgoa	2	Reddish
33	Sindhu	2	Reddish

Table 4.5. Morphological characterization in mango genotypes for flowering parameters

Sr. No.	Genotype	Number of Hermaphrodite flowers per panicle	Number of Male flowers per panicle
1	RHRMH - 5	139.75	648.75
2	RHRMH - 6	240.10	697.70
3	RHRMH - 7	180.30	780.60
4	RHRMH - 16	150.75	397.25
5	RHRMH - 30	110.23	528.10
6	RHRMH - 38	113.20	329.20
7	RHRMH - 39	159.10	580.20
8	RHRMH - 44	124.10	387.50
9	RHRMH - 52	240.30	786.10
10	RHRMH - 55	157.20	520.10
11	RHRMH - 57	148.30	496.70
12	RHRMH - 72	177.37	501.00
13	RHRMH - 73	140.36	638.43
14	RHRMH - 83	124.40	435.40
15	RHRMH - 84	154.80	619.20
16	RHRMH - 85	80.80	303.00
17	RHRMH - 93	157.20	569.20
18	RHRMH - 96	118.80	475.20
19	RHRMH - 98	173.60	518.40
20	RHRMH - 104	196.80	787.20
21	RHRMH - 107	136.50	772.50
22	RHRMG - 1	186.10	744.40
23	RHRMG - 2	128.80	418.60
24	RHRMG - 3	138.20	528.20
25	RHRMG - 4	158.40	581.60
26	RHRMG - 5	145.30	552.10
27	RHRMG - 6	106.20	471.20
28	Sai Sugandh	114.80	545.30
29	Vanraj	144.80	651.60
30	Kesar	180.50	770.20
31	Alphonso	160.60	850.70
32	Mulgoa	138.70	485.20
33	Sindhu	143.20	619.30
	Range	80.80-240.30	303.00-850.70
	Minimum	80.80	303.00
	Maximum	240.30	850.70
	Mean	150.59	575.46
	S.D	34.31	142.04
	S.E. $\pm$	5.97	24.73
	CV (%)	22.79	24.68

4.1.2.7 Number of flowers per panicle

The data represented in the Table 4.6 showed the range of number of flowers between 383.80 to 1026.40 with the highest flowers in RHRMH-52 (1026.40) followed by Alphonso (1011.30), RHRMH-104 (984.00), RHRMH-7 (960.90) and Kesar (950.70) and the least flowers in RHRMH-85 (383.80) with followed by RHRMH-38 (442.40), RHRMH- 44 (511.60), RHRMG- 2 (547.40) and RHRMH-16 (548.00).

Flower production in a particular variety is shaped by a combination of environmental influences and genetic factors, which together affect the total number of flowers and their distribution within panicles.

Rathor *et al.* (2009) also showed the similar type of results in their investigation.

4.1.2.8 Sex ratio

The sex ratio of the genotypes was recorded and presented in Table 4.6 range varied from 0.18 to 0.38 with RHRMH-16 (0.38) had the highest value followed by RHRMH-72 (0.35), RHRMH-6 (0.34), RHRMH-38 (0.34) and RHRMH- 98 (0.33), while the lowest sex ratio was recorded in RHRMH-107 (0.18) followed by Alphonso (0.19), RHRMH-30 (0.21), Sai Sugandh (0.21) and RHRMH-5 (0.22).

The Kesar (0.23) recorded similar value with RHRMH-7 (0.23) and RHRMG- 6 (0.23).

Mainly the environmental factors along with genetic characters affect the sex ratio in the plants.

The variation in sex ratio of mango hybrids was also reported by Sharma *et al.* (1998) and Kanpure *et al.* (2009).

4.1.3 Fruit morphology

All the observations were taken when the fruit had reached maturity. Measurements were taken from a sample of five fruits that were representative.

4.1.3.1 Days required from fruit setting to mustard stage (days)

The presented data in Table 4.7 shown that the number of days required for fruit setting to mustard stages ranged from 5 to 7.2 days in all genotypes during the experimental year 2022-23. The twenty one genotypes required 5.6 to 7 days while seven genotypes required 5 to 5.5 days and remaining five required 7.1 to 7.2 days.

Table 4.6. Morphological characterization in mango genotypes for flowering parameters

Sr. No.	Genotype	Number of Flowers per panicle	Sex Ratio
1	RHRMH - 5	788.50	0.22
2	RHRMH - 6	937.80	0.34
3	RHRMH - 7	960.90	0.23
4	RHRMH - 16	548.00	0.38
5	RHRMH - 30	638.33	0.21
6	RHRMH - 38	442.40	0.34
7	RHRMH - 39	739.30	0.27
8	RHRMH - 44	511.60	0.32
9	RHRMH - 52	1026.40	0.31
10	RHRMH - 55	677.30	0.30
11	RHRMH - 57	645.00	0.30
12	RHRMH - 72	678.37	0.35
13	RHRMH - 73	778.79	0.22
14	RHRMH - 83	559.80	0.29
15	RHRMH - 84	774.00	0.25
16	RHRMH - 85	383.80	0.27
17	RHRMH - 93	726.40	0.28
18	RHRMH - 96	594.00	0.25
19	RHRMH - 98	692.00	0.33
20	RHRMH - 104	984.00	0.25
21	RHRMH - 107	909.00	0.18
22	RHRMG - 1	930.50	0.25
23	RHRMG - 2	547.40	0.31
24	RHRMG - 3	666.40	0.26
25	RHRMG - 4	740.00	0.27
26	RHRMG - 5	697.40	0.26
27	RHRMG - 6	577.40	0.23
28	Sai Sugandh	660.10	0.21
29	Vanraj	796.40	0.22
30	Kesar	950.70	0.23
31	Alphonso	1011.30	0.19
32	Mulgoa	623.90	0.29
33	Sindhu	762.50	0.23
	Range	383.8-1026.4	0.18-0.38
	Minimum	383.80	0.18
	Maximum	1026.40	0.38
	Mean	726.05	0.27
	S.D	167.06	0.05
	S.E. $\pm$	29.08	0.01
	CV (%)	23.01	18.67

Genetic differences among cultivars contributes in variations in fruit set. Additionally, successful fruit set depends on factors such as pollen availability and viability, pollinator populations and the compatibility of a cultivar with itself (self-compatibility) and with other cultivars (cross-compatibility), as reported by Anjum *et al.* (1999).

4.1.3.2 Number of fruits per panicle (At egg stage)

It was apparent from presented data in Table 4.7 that number of fruits per panicle ranged from 4.24-8.42 with RHRMH-73 (8.24) having maximum fruits which followed by RHRMG-4 (7.06), RHRMH-52 (7.02), RHRMH-96 (6.86), RHRMH-39 (6.76) while minimum seen in RHRMH-104 (4.24) which followed by Vanraj (4.89), Sindhu (5.04), Sai Sugandh (5.16) and RHRMH-93 (5.36).

RHRMH-107 (5.83) and RHRMH-83 (5.73) were having values near to Kesar (5.83) whereas RHRMH-44 (6.29) and RHRMH-7 (6.16) were having values near to Alphonso (6.25).

The environmental condition, physiological character and genetic characters of genotypes causes the reduction in the number of fruits at different stages.

Hada and Singh (2017) conducted the field experiment and similar results were found by them.

4.1.3.3 Number of fruits per panicle (At harvest stage)

It was evident from Table 4.8 data recorded the number of fruits per panicle ranged from 1.25-3.44, RHRMH-73 (3.44) had the highest number of fruits followed by RHRMH-52 (3.42), Mulgoa (3.14), RHRMG-4 (3.01) and RHRMH-30 (2.91). The least number were recorded in RHRMH-38 (1.25) followed by Vanraj (1.45), RHRMH-107 (1.53), RHRMG-5 (1.54) and RHRMH-83 (1.55).

Kesar (2.17) having nearby value with RHRMH-84 (2.21) and RHRMG-2 (2.14) while RHRMH-30 (2.91) and RHRMG-1 (2.84) with Alphonso (2.89).

Singh and Pathak (2018) were reported the similar finding in their research work for the number of fruits per panicle.

Table 4.7. Morphological characterization in mango genotypes for fruit parameters

Sr. No.	Genotype	Day required from fruit setting to mustard stages (Days)	Number of fruits/ panicle (egg stage)
1	RHRMH - 5	6.3	5.84
2	RHRMH - 6	6.2	6.75
3	RHRMH - 7	6.1	6.16
4	RHRMH - 16	7.1	6.03
5	RHRMH - 30	5.2	6.35
6	RHRMH - 38	5.2	5.93
7	RHRMH - 39	6.1	6.76
8	RHRMH - 44	5.0	6.29
9	RHRMH - 52	5.6	7.02
10	RHRMH - 55	6.7	5.98
11	RHRMH - 57	6.6	6.46
12	RHRMH - 72	5.6	6.43
13	RHRMH - 73	6.7	8.42
14	RHRMH - 83	6.4	5.73
15	RHRMH - 84	6.4	6.42
16	RHRMH - 85	7.1	5.84
17	RHRMH - 93	6.3	5.36
18	RHRMH - 96	6.4	6.86
19	RHRMH - 98	7.1	6.55
20	RHRMH - 104	5.8	4.24
21	RHRMH - 107	6.1	5.83
22	RHRMG - 1	7.2	6.15
23	RHRMG - 2	7.2	5.96
24	RHRMG - 3	5.5	5.72
25	RHRMG - 4	5.5	7.06
26	RHRMG - 5	6.1	6.43
27	RHRMG - 6	6.1	5.66
28	Sai Sugandh	5.5	5.16
29	Vanraj	5.1	4.89
30	Kesar	6.3	5.83
31	Alphonso	6.1	6.25
32	Mulgoa	6.1	6.57
33	Sindhu	7.0	5.04
	Range	5.0-7.2	4.24-8.42
	Minimum	5.0	4.24
	Maximum	7.2	8.42
	Mean	6.17	6.12
	S.D	0.64	0.75
	S.E. $\pm$	0.11	0.13
	CV (%)	10.37	12.25

Table 4.8. Morphological characterization in mango genotypes for fruit parameters

Sr. No.	Genotype	Number of fruits /panicle (at harvest)	Fruit retention (%)
1	RHRMH - 5	2.63	3.21
2	RHRMH - 6	2.55	3.23
3	RHRMH - 7	2.21	3.10
4	RHRMH - 16	2.72	3.98
5	RHRMH - 30	2.91	3.90
6	RHRMH - 38	1.25	2.27
7	RHRMH - 39	2.55	3.26
8	RHRMH - 44	2.66	3.87
9	RHRMH - 52	3.42	3.79
10	RHRMH - 55	2.45	3.05
11	RHRMH - 57	1.83	2.34
12	RHRMH - 72	2.12	2.57
13	RHRMH - 73	3.44	3.90
14	RHRMH - 83	1.55	1.97
15	RHRMH - 84	2.21	2.80
16	RHRMH - 85	2.12	2.40
17	RHRMH - 93	1.76	2.47
18	RHRMH - 96	2.49	2.80
19	RHRMH - 98	2.31	2.66
20	RHRMH - 104	1.87	2.62
21	RHRMH - 107	1.53	2.24
22	RHRMG - 1	2.84	3.62
23	RHRMG - 2	2.14	3.11
24	RHRMG - 3	1.89	3.22
25	RHRMG - 4	3.01	3.90
26	RHRMG - 5	1.54	1.96
27	RHRMG - 6	1.87	2.45
28	Sai Sugandh	2.02	2.80
29	Vanraj	1.45	1.67
30	Kesar	2.17	2.43
31	Alphonso	2.89	3.65
32	Mulgoa	3.14	3.57
33	Sindhu	1.74	2.28
	Range	1.25-3.44	1.67-3.98
	Minimum	1.25	1.67
	Maximum	3.44	3.98
	Mean	2.28	2.94
	S.D	0.57	0.66
	S.E. $\pm$	0.10	0.11
	CV (%)	25.09	22.34

4.1.3.4 Fruit retention (%)

The data in the Table 4.8 shown the 1.67-3.98 per cent range fruit retention in the studied genotypes. The RHRMH-16 (3.98 %) shown the maximum retention followed by RHRMH-30 (3.90 %), RHRMH-73 (3.90 %), RHRMG-4 (3.90 %) and RHRMH-44 (3.87 %) while Vanraj (1.67 %) shown the least retention followed by RHRMG-5 (1.96 %), RHRMH-83 (1.97 %), RHRMH-107 (2.24 %) and RHRMH-38 (2.27 %).

While Kesar (2.43 %), RHRMG-6 (2.45 %) and RHRMH-85 (2.40 %) apparently had the near values. RHRMG-1 (3.62 %) had the near value to Alphonso (3.65 %). The differences in fruit set per panicle and fruit retention are likely due to a combination of genetic factors specific to each variety and environmental weather conditions.

The similar finding was also reported by Chauhan (1972), while evaluating the mango hybrids. Singh and Pathak (2018) were reported the similar finding in their research work.

4.1.3.5 Fruit shape

The Table 4.9 recorded that twenty-one-genotype shown the oblong shape, six genotypes shown the ovoid whereas five genotypes shown roundish and one genotype shown the elliptic shape.

Variations in fruit shape were attributed to a combination of genetic predisposition, environmental influences and cultural practices, underscoring its significance in mango variety differentiation (Ali, 2013 and Jamil *et al.*, 2015). The morphology of the fruit, particularly its shape, was a crucial factor in identifying and characterizing various mango varieties and accessions (Rajwana *et al.*, 2011; Khan *et al.*, 2015).

Grouping of genotypes according to fruit shape

No.	Fruit shape	Number of genotypes
1	Oblong	21
2	Ovoid	06
3	Roundish	05
4	Elliptic	01

Table 4.9. Morphological characterization in mango genotypes for fruit parameters

Sr. No.	Genotype	Fruit weight (g)	Fruit Shape
1	RHRMH - 5	440.54	Ovoid
2	RHRMH - 6	100.74	Oblong
3	RHRMH - 7	192.52	Ovoid
4	RHRMH - 16	395.24	Ovoid
5	RHRMH - 30	136.98	Roundish
6	RHRMH - 38	179.38	Oblong
7	RHRMH - 39	374.48	Oblong
8	RHRMH - 44	312.18	Oblong
9	RHRMH - 52	93.92	Roundish
10	RHRMH - 55	74.86	Oblong
11	RHRMH - 57	151.62	Oblong
12	RHRMH - 72	239.47	Oblong
13	RHRMH - 73	187.72	Oblong
14	RHRMH - 83	105.72	Oblong
15	RHRMH - 84	140.38	Oblong
16	RHRMH - 85	136.86	Oblong
17	RHRMH - 93	133.59	Oblong
18	RHRMH - 96	93.85	Oblong
19	RHRMH - 98	149.36	Oblong
20	RHRMH - 104	82.93	Roundish
21	RHRMH - 107	208.43	Ovoid
22	RHRMG - 1	245.37	Ovoid
23	RHRMG - 2	240.26	Oblong
24	RHRMG - 3	256.02	Oblong
25	RHRMG - 4	170.76	Round
26	RHRMG - 5	148.3	Oblong
27	RHRMG - 6	257.93	Elliptic
28	Sai Sugandh	280.94	Oblong
29	Vanraj	306.42	Ovoid
30	Kesar	238.75	Oblong
31	Alphonso	260.86	Oblong
32	Mulgoa	304.17	Roundish
33	Sindhu	190.02	Oblong
	Range	74.86 - 440.54	
	Minimum	74.86	
	Maximum	440.54	
	Mean	206.99	
	S.D	93.35	
	S.E. $\pm$	16.25	
	CV (%)	45.10	

4.1.3.6 Fruit weight (g)

The Table 4.9 shown the fruit weight ranged from 74.86 to 440.54 g. The highest fruit weight was recorded in RHRMH-5 (440.54 g) followed by RHRMH-16 (395.24), RHRMH-39 (374.48 g), RHRMH -44 (312.18 g) and Vanraj (306.42 g) and least was recorded in RHRMH-55 (74.86 g) followed by RHRMH-104 (82.93 g), RHRMH-96 (93.85 g), RHRMH-52 (93.92 g) and RHRMH-6 (100.74 g).

RHRMH-72 (239.47 g) had the similar fruit weight with Kesar (238.75 g) while RHRMG-6 (257.93 g) having near weight with Alphonso (260.86 g).

The variation in fruit weight may be attributed to genetic or varietal factors, a finding were supported by previous studies conducted by Kulkarni *et al.* (2002) and Kumar *et al.* (2018), also reported similar variations in fruit weight.

4.1.3.7 Fruit length and breadth (cm)

The recorded data for fruit length is shown in Table 4.10 which was ranged from 6.9-15.2 cm in which the RHRMH-39 (15.2 cm) shown the maximum length while RHRMH-44 (14.9 cm), Sai Sugandh (12.9 cm), RHRMG-6 (11.5 cm), RHRMH-5 (10.8 cm) followed it and minimum length was seen in RHRMH-52 (6.9 cm) followed by RHRMH-30 (7.1 cm), RHRMH-104 (7.4 cm), RHRMH-55 (7.6 cm) and RHRMH-96 (7.6 cm).

RHRMH-85 (8.6 cm), RHRMH-107 (8.6 cm), RHRMG-3 (8.6 cm), RHRMG-1 (8.6 cm), RHRMH-83 (8.5 cm) near to value with Kesar (8.5 cm) and Alphonso (8.4 cm) had near value with RHRMH-83 (8.5 cm) and Sindhu (8.3 cm).

The Table 4.10 presented data of fruit breadth ranged from 3.2 - 8.6 cm in which Vanraj (8.6 cm) have maximum breadth followed by RHRMH-5 (8.5 cm), RHRMH-16 (7.6 cm), Mulgoa (7.4 cm), RHRMG-1 (7.1 cm) while the minimum breadth shown in RHRMH-52 (3.2 cm) followed by RHRMH-55 (3.3 cm), RHRMH-93 (4.4 cm), RHRMH-96 (4.5 cm) and RHRMH-83 (4.5 cm).

Kesar (6.8 cm) had near values with genotype RHRMH-39 (6.7 cm) while Alphonso (6.5 cm) had near value with genotype RHRMH-107 (6.6 cm)

The size of fruit is a result of the interaction between a varieties genetic characteristics and environmental conditions, leading to variations in fruit size.

The findings were in close association with Kher and Sharma (2002).

Table 4.10. Morphological characterization in mango genotypes for fruit parameters

Sr. No.	Genotype	Fruit	
		Length (cm)	Breadth (cm)
1	RHRMH - 5	10.8	8.5
2	RHRMH - 6	7.9	5
3	RHRMH - 7	9.6	6.3
4	RHRMH - 16	9.6	7.6
5	RHRMH - 30	7.1	5.6
6	RHRMH - 38	10.2	6.1
7	RHRMH - 39	15.2	6.7
8	RHRMH - 44	14.9	6.4
9	RHRMH - 52	6.9	3.2
10	RHRMH - 55	7.6	3.3
11	RHRMH - 57	9.1	5.3
12	RHRMH - 72	10.6	6.2
13	RHRMH - 73	8.9	6.4
14	RHRMH - 83	8.5	4.5
15	RHRMH - 84	8.7	5.2
16	RHRMH - 85	8.6	5.1
17	RHRMH - 93	9.2	4.4
18	RHRMH - 96	7.6	4.5
19	RHRMH - 98	9.3	5.2
20	RHRMH - 104	7.4	4.6
21	RHRMH - 107	8.6	6.6
22	RHRMG - 1	8.6	7.1
23	RHRMG - 2	10.2	6.3
24	RHRMG - 3	8.6	7.1
25	RHRMG - 4	9.5	5.56
26	RHRMG - 5	9	5.15
27	RHRMG - 6	11.5	6.45
28	Sai Sugandh	12.9	5.8
29	Vanraj	10	8.6
30	Kesar	8.5	6.8
31	Alphonso	8.4	6.5
32	Mulgoa	9.8	7.4
33	Sindhu	8.3	6.3
	Range	6.9-15.2	3.2-8.6
	Minimum	6.9	3.2
	Maximum	15.2	8.6
	Mean	9.44	5.93
	S.D	1.92	1.27
	S.E. $\pm$	0.33	0.22
	CV (%)	20.29	21.34

4.1.3.8 Colour of fruit (unripe)

The colour of unripe fruits varied among genotypes, with the majority being green, while a few genotypes were green with red blush, as presented in Table 4.11.

Peel colour of mango fruit is considered as genotype dependent trait. Mango peel red blush is genotype-dependent, caused by anthocyanin pigment (Lizada, 1991 and Bally, 2006).

Grouping of genotypes according to fruit colour

No.	Fruit colour	Number of genotypes
1	Green	26
2	Green with red blush	07

4.1.3.9 Fruit peel colour (ripe)

The Table 4.11 represented the data of fruit peel colour when it ripens and it is recorded as per Mango descriptors. Fruits shown the yellow, yellow with red blush and golden yellow colour after ripening.

Grouping of genotypes according to fruit peel colour

No.	Fruit peel colour	Number of genotypes
1	Yellow	24
2	Yellow with red blush	08
3	Golden Yellow	01

4.1.4 Pulp

4.1.4.1 Pulp colour

The Table 4.12 represent the data for the pulp colour which shown to be yellow, yellow orange and light yellow in genotypes. The intensity of pulp colour may serve as a visual indicator of higher carotenoid content, suggesting that deeper coloured pulps may contain more of these carotenoids (Desai and Dhandar, 2000).

Grouping of genotypes according to pulp colour

No.	Pulp colour	Number of genotypes
1	Yellow	22
2	Yellowish orange	09
3	Light yellow	02

Table 4.11. Morphological characterization in mango genotypes for fruit parameters

Sr. No.	Genotype	Colour of Fruit (unripe)	Fruit Peel Colour (ripe)
1	RHRMH - 5	Green with red blush	Yellow with red blush
2	RHRMH - 6	Green	Yellow
3	RHRMH - 7	Green	Yellow
4	RHRMH - 16	Green with red blush	Yellow with red blush
5	RHRMH - 30	Green	Yellow with red blush
6	RHRMH - 38	Green with red blush	Yellow
7	RHRMH - 39	Green with red blush	Yellow with red blush
8	RHRMH - 44	Green	Yellow
9	RHRMH - 52	Green	Yellow
10	RHRMH - 55	Green	Yellow
11	RHRMH - 57	Green	Yellow
12	RHRMH - 72	Green	Yellow
13	RHRMH - 73	Green	Golden Yellow
14	RHRMH - 83	Green	Yellow
15	RHRMH - 84	Green	Yellow
16	RHRMH - 85	Green	Yellow
17	RHRMH - 93	Green	Yellow
18	RHRMH - 96	Green	Yellow
19	RHRMH - 98	Green with red blush	Yellow with red blush
20	RHRMH - 104	Green	Yellow
21	RHRMH - 107	Green	Yellow
22	RHRMG - 1	Green	Yellow
23	RHRMG - 2	Green	Yellow
24	RHRMG - 3	Green	Yellow
25	RHRMG - 4	Green	Yellow
26	RHRMG - 5	Green	Yellow
27	RHRMG - 6	Green	Yellow
28	Sai Sugandh	Green with red blush	Yellow with red blush
29	Vanraj	Green with red blush	Yellow with red blush
30	Kesar	Green	Yellow
31	Alphonso	Green	Yellow with red blush
32	Mulgoa	Green	Yellow
33	Sindhu	Green	Yellow

4.1.4.2 Pulp fibrousness

In data concerning the pulp fibrousness is presented in Table 4.12 as fibrous, non-fibrous, intermediate and low fibrous.

The presence of fine fibers is essential to safeguard the fruit's interior from damage and collapse during handling and transportation, but excessive fiber content is not desirable from a consumer's perspective (Iyer, 1991).

Grouping of genotypes according to pulp fibrousness

No.	Pulp fibrousness	Number of genotypes
1	Fibrous	25
2	Non fibrous	04
3	Low fibrous	02
4	Intermediate	02

4.1.4.3 Pulp percentage

The data recorded for the pulp percentage is presented in Table 4.13 in which pulp percentage ranged from 36.69 to 79.33 per cent where maximum pulp percentage was in RHRMH- 5 (79.33 %) followed by Alphonso (76.73 %), Vanraj (76.03 %), Kesar (74.66 %), Mulgoa (73.36 %) whereas minimum pulp percentage was observed in RHRMH-96 (36.69 %), followed by RHRMH- 52 (36.89 %), RHRMH-55 (44.48 %), RHRMH-93 (45.92 %) and RHRMH-6 (46.59 %).

The pulp percentage which had near value with Alphonso (76.73 %) and Kesar (74.66 %) was RHRMH-5 (79.33 %).

These observations were in close conformity with findings of Das *et al.* (2007).

4.1.4.4 Peel percentage

The Table 4.13 shows the recorded data for the peel percentage in genotype ranged from 10.34-28.82 per cent. Maximum percentage were seen in RHRMH-30 (28.82 %) followed by RHRMG-4 (28.56 %), RHRMH-93 (26.60 %), RHRMH-104 (26.20 %) and RHRMH-96 (26.19 %) whereas minimum percentage were in RHRMH-5 (10.34 %) followed by Alphonso (12.13 %), Kesar (12.51 %), RHRMG-6 (12.95 %) and Vanraj (13.83 %).

RHRMG-6 (12.95 %) is near in peel percentage with Alphonso (12.13 %) and Kesar (12.51 %).

Begum *et al.* (2014) also shown the similar finding in their experimental results.

Table 4.12. Morphological characterization of mango genotypes for fruit pulp

Sr. No.	Genotype	Pulp Colour	Pulp Fibrousness
1	RHRMH - 5	Yellow Orange	Fibrous
2	RHRMH - 6	Yellow	Fibrous
3	RHRMH - 7	Yellow Orange	Fibrous
4	RHRMH - 16	Yellow Orange	Fibrous
5	RHRMH - 30	Yellow	Fibrous
6	RHRMH - 38	Yellow Orange	Intermedite
7	RHRMH - 39	Yellow	Fibrous
8	RHRMH - 44	Yellow	Fibrous
9	RHRMH - 52	Yellow Orange	Fibrous
10	RHRMH - 55	Light Yellow	Low fibrous
11	RHRMH - 57	Yellow	Fibrous
12	RHRMH - 72	Yellow	Fibrous
13	RHRMH - 73	Yellow	Non fibrous
14	RHRMH - 83	Yellow	Fibrous
15	RHRMH - 84	Yellow	Fibrous
16	RHRMH - 85	Yellow	Fibrous
17	RHRMH - 93	Yellow	Fibrous
18	RHRMH - 96	Yellow	Intermedite
19	RHRMH - 98	Light Yellow	Fibrous
20	RHRMH - 104	Yellow	Fibrous
21	RHRMH - 107	Yellow	Fibrous
22	RHRMG - 1	Yellow	Non fibrous
23	RHRMG - 2	Yellow	Fibrous
24	RHRMG - 3	Yellow Orange	Fibrous
25	RHRMG - 4	Yellow Orange	Fibrous
26	RHRMG - 5	Yellow	Fibrous
27	RHRMG - 6	Yellow	Fibrous
28	Sai Sugandh	Yellow Orange	Fibrous
29	Vanraj	Yellow	Non fibrous
30	Kesar	Yellow Orange	Low fibrous
31	Alphonso	Yellow	Non fibrous
32	Mulgoa	Yellow	Fibrous
33	Sindhu	Yellow	Fibrous

Table 4.13. Morphological characterization of mango genotypes for pulp parameters

Sr. No.	Genotype	Pulp (%)	Peel (%)	Stone (%)
1	RHRMH - 5	79.33	10.34	10.33
2	RHRMH - 6	46.59	23.71	29.70
3	RHRMH - 7	59.79	19.13	21.09
4	RHRMH - 16	72.59	14.14	13.53
5	RHRMH - 30	47.40	28.82	24.57
6	RHRMH - 38	58.24	20.23	21.54
7	RHRMH - 39	72.99	15.96	11.04
8	RHRMH - 44	68.07	15.94	15.99
9	RHRMH - 52	36.89	21.08	42.03
10	RHRMH - 55	44.48	26.00	29.52
11	RHRMH - 57	54.59	23.89	21.52
12	RHRMH - 72	63.47	19.53	17.00
13	RHRMH - 73	61.37	20.53	18.10
14	RHRMH - 83	55.63	22.25	23.11
15	RHRMH - 84	53.08	21.53	25.38
16	RHRMH - 85	60.77	19.33	20.17
17	RHRMH - 93	45.92	26.60	27.49
18	RHRMH - 96	36.69	26.19	37.12
19	RHRMH - 98	47.79	23.70	28.51
20	RHRMH - 104	49.01	26.20	24.79
21	RHRMH - 107	65.20	16.58	18.22
22	RHRMG - 1	66.30	16.00	17.71
23	RHRMG - 2	60.96	18.27	20.77
24	RHRMG - 3	58.83	18.53	22.63
25	RHRMG - 4	52.52	28.56	19.90
26	RHRMG - 5	54.52	24.58	21.03
27	RHRMG - 6	64.67	12.95	22.38
28	Sai Sugandh	70.67	17.55	12.75
29	Vanraj	76.03	13.83	10.14
30	Kesar	74.66	12.51	12.83
31	Alphonso	76.73	12.13	11.26
32	Mulgoa	73.36	14.14	12.50
33	Sindhu	72.41	15.30	12.28
	Range	36.69-79.33	10.34-28.82	10.14-42.03
	Minimum	36.69	10.34	10.14
	Maximum	79.33	28.82	42.03
	Mean	60.05	19.58	20.51
	S.D	11.70	5.11	7.57
	S.E. $\pm$	2.04	0.89	1.32
	CV (%)	19.48	26.10	36.91

4.1.5 Stone

4.1.5.1 Stone weight (g)

The Table 4.14 shows the recorded data for the stone weight ranged from 20.56 to 57.95 g in which maximum weight was seen in RHRMG-3 (57.95 g) followed by RHRMG-6 (57.73 g), RHRMH-16 (53.47 g), RHRMH-44 (49.93g) and RHRMG-2 (49.91 g). While minimum was observed in RHRMH- 104 (20.56 g) followed by RHRMH-55 (22.10 g), Sindhu (23.34 g), RHRMH- 83 (24.43 g) and RHRMH- 85 (27.61 g).

The findings of this study regarding stone weight corroborate the results of earlier research by Jilani *et al.* (2010) and Anila and Radha (2003).

4.1.5.2 Stone length and breadth (cm)

The evident presented in the Table 4.14 showed the stone length ranged from 4.56 to 13.1 cm in which the maximum length was noted in RHRMH- 39 (13.1 cm) followed by RHRMH-44 (12.5 cm), RHRMH-38 (10.1 cm), RHRMH-72 (9.3 cm) and RHRMH-5 (9.21 cm). The minimum length was RHRMG-6 (4.56 cm) followed by RHRMG-5 (4.68 cm), RHRMH-104 (5.63 cm), Mulgoa (5.85 cm) and RHRMH-96 (5.97 cm).

In which RHRMH-98 (6.21 cm) and RHRMG-1 (6.21 cm) were having nearby value with Alphonso (6.25 cm) where RHRMH-52 (6.2 cm) with Kesar (6.15 cm).

The stone breadth in Table 4.14 showed that presented data ranged from 3.2 to 5.47 cm with maximum length in RHRMH-55 (5.47 cm) followed by RHRMH-7 (5.31 cm), RHRMH- 72 (5.3 cm), RHRMG-4 (5.12 cm) and RHRMH-5 (4.92 cm) whereas minimum breadth was seen in RHRMH-83 (3.2 cm) followed by Kesar (3.21 cm), RHRMG-5 (3.22 cm), RHRMG-6 (3.26 cm) and RHRMH-107 (3.28 cm).

Alphonso (3.54 cm) had similar values with RHRMH-98 (3.51 cm) whereas Kesar (3.21 cm) had with RHRMH-83(3.2 cm) and RHRMG-5 (3.22 cm).

Studies by Kundu and Ghosh (1992), Abirami *et al.* (2004) and others (Anila and Radha, 2003; Pradeepkumar *et al.*, 2006; Maity, 2007; Singh *et al.*, 2011) have consistently shown variations in mango stone size, likely influenced by genetic and environmental factors, which in turn affect the fruit's edible proportion.

Table 4.14. Morphological characterization of mango genotypes for stone parameters

Sr. No.	Genotype	Stone weight (g)	Stone length (cm)	Stone breath (cm)
1	RHRMH - 5	45.5	9.21	4.92
2	RHRMH - 6	29.92	7.32	4.54
3	RHRMH - 7	40.61	8.6	5.31
4	RHRMH - 16	53.47	8.11	4.1
5	RHRMH - 30	33.66	6.9	4.52
6	RHRMH - 38	38.63	10.1	4.44
7	RHRMH - 39	41.36	13.1	4.12
8	RHRMH - 44	49.93	12.5	4.17
9	RHRMH - 52	39.47	6.2	4.18
10	RHRMH - 55	22.10	7.7	5.47
11	RHRMH - 57	32.63	8.1	4.4
12	RHRMH - 72	40.71	9.3	5.3
13	RHRMH - 73	33.98	7.4	4.3
14	RHRMH - 83	24.43	7.1	3.2
15	RHRMH - 84	35.63	8.1	3.5
16	RHRMH - 85	27.61	8.5	4.8
17	RHRMH - 93	36.72	6.6	3.45
18	RHRMH - 96	34.84	5.97	3.34
19	RHRMH - 98	42.58	6.21	3.51
20	RHRMH - 104	20.56	5.63	3.34
21	RHRMH - 107	37.98	6.68	3.28
22	RHRMG - 1	43.45	6.21	3.61
23	RHRMG - 2	49.91	6.32	4.42
24	RHRMG - 3	57.95	8.12	4.53
25	RHRMG - 4	33.98	7.61	5.12
26	RHRMG - 5	31.19	4.68	3.22
27	RHRMG - 6	57.73	4.56	3.26
28	Sai Sugandh	35.82	7.2	3.65
29	Vanraj	31.08	8.78	3.45
30	Kesar	30.63	6.15	3.21
31	Alphonso	29.37	6.25	3.54
32	Mulgoa	28.91	5.85	3.51
33	Sindhu	23.34	6.6	3.42
	Range	20.56-57.95	4.56-13.1	3.2-5.47
	Minimum	20.56	4.56	3.2
	Maximum	57.95	13.1	5.47
	Mean	36.84	7.50	4.03
	S.D	9.58	1.88	0.70
	S.E. $\pm$	1.67	0.33	0.12
	CV (%)	26.00	24.99	17.41

4.1.5.3 Stone percentage (%)

The data recorded for the pulp percentage is presented in Table 4.13 in which stone percentage ranged from 10.14 to 42.03 per cent where maximum stone percentage was in RHRMH- 52 (42.03 %) followed by RHRMH-96 (37.12 %), RHRMH-6 (29.70 %), RHRMH- 55 (29.52 %), RHRMH-98 (28.51 %) whereas minimum stone percentage was observed in Vanraj (10.14 %), followed by RHRMH- 5 (10.33 %), RHRMH-39 (11.04 %), Alphonso (11.26 %) and Sindhu (12.28 %).

The stone percentage which had near value with Alphonso (11.26 %) with RHRMH -39 (11.04 %) and Kesar (12.83 %) was RHRMH-16 (13.63 %).

The finding was accordance with Indian *et al.* (2018).

4.2 Biochemical parameters

4.2.1 Total soluble solids (°Brix)

The evident data of total soluble solids presented in the Table 4.15 ranged from 11.6-20.2 °B with the maximum TSS found in RHRMH-93 (20.2 °B) followed by RHRMH-96 (20.03 °B), Kesar (19.97 °B), Alphonso (19.87 °B) and RHRMH-30 (19.71 °B) while minimum TSS was in RHRMH-44 (11.6 °B) followed by RHRMH-6 (13.14 °B), RHRMH-39 (13.15 °B), RHRMG-3 (14.16 °B) and RHRMH-85 (15.02 °B).

Singh (2002) also observed the variation in TSS in his findings. Variation in TSS may occur due to varietal character of the mango.

4.2.2 Titratable acidity (%)

From the Table 4.15 the acidity of pulp ranged from 0.19-0.32 per cent in which the maximum acidity in the pulp were seen in RHRMH-44 (0.32 %), followed by RHRMH-98 (0.31 %), Sai Sugandh (0.29 %), RHRMH-72 (0.28 %) and RHRMG-2 (0.28 %) and minimum observed in RHRMG-1 (0.19 %) followed by Alphonso (0.20 %), RHRMH-7 (0.20 %), RHRMG-6 (0.21 %) and RHRMH -96 (0.21 %).

RHRMG-4 (0.22 %) and RHRMH-73 (0.22 %) and Kesar (0.22 %) had similar values for acidity while RHRMH-7 (0.20 %) and Alphonso (0.20 %) had similar value.

The differences in acidity among various mango varieties may be attributed to their inherent varietal characteristics. The titratable acidity values obtained in this study are consistent with the findings reported by Saheda *et al.* (2019)

Table 4.15. Mean performance of mango genotypes for total soluble solids, pH, acidity and TSS: Acidity

Sr. No.	Genotype	TSS (⁰ B)	pH	Acidity (%)	TSS: Acidity Ratio
1	RHRMH - 5	19.10	3.85	0.23	83.04
2	RHRMH - 6	13.14	3.21	0.25	52.56
3	RHRMH - 7	16.25	3.91	0.20	81.25
4	RHRMH - 16	18.36	3.04	0.21	82.67
5	RHRMH - 30	19.71	3.58	0.25	78.84
6	RHRMH - 38	18.74	3.48	0.25	74.96
7	RHRMH - 39	13.15	3.50	0.23	57.17
8	RHRMH - 44	11.60	4.55	0.32	36.25
9	RHRMH - 52	16.55	3.67	0.23	71.96
10	RHRMH - 55	16.57	3.82	0.21	78.90
11	RHRMH - 57	19.22	4.01	0.21	91.52
12	RHRMH - 72	19.13	3.48	0.28	68.32
13	RHRMH - 73	17.62	3.88	0.22	71.00
14	RHRMH - 83	18.10	3.31	0.23	78.70
15	RHRMH - 84	18.51	3.58	0.24	77.13
16	RHRMH - 85	15.02	3.41	0.23	65.30
17	RHRMH - 93	20.20	4.10	0.21	96.19
18	RHRMH - 96	20.03	3.91	0.21	95.38
19	RHRMH - 98	17.90	3.12	0.31	57.74
20	RHRMH - 104	16.74	3.81	0.25	66.96
21	RHRMH - 107	18.02	3.85	0.25	56.08
22	RHRMG - 1	17.09	4.12	0.19	89.95
23	RHRMG - 2	17.90	3.22	0.28	63.93
24	RHRMG - 3	14.16	3.48	0.25	56.64
25	RHRMG - 4	19.05	3.71	0.22	86.59
26	RHRMG - 5	16.34	3.60	0.24	68.08
27	RHRMG - 6	17.84	3.65	0.21	84.95
28	Sai Sugandh	19.37	3.18	0.29	66.79
29	Vanraj	17.77	3.25	0.28	63.46
30	Kesar	19.97	3.91	0.22	90.77
31	Alphonso	19.87	4.20	0.20	99.35
32	Mulgoa	19.28	3.68	0.24	80.33
33	Sindhu	19.32	3.86	0.27	71.56
	Range	11.6-20.2	3.04-4.55	0.19-0.32	36.25-99.35
	Minimum	11.6	3.04	0.19	36.25
	Maximum	20.2	4.55	0.32	99.35
	Mean	17.41	3.66	0.24	74.07
	S.D	2.27	0.34	0.03	14.33
	S.E. $\pm$	0.40	0.06	0.01	2.50
	CV (%)	13.05	9.41	13.38	19.35

4.2.3 pH of pulp

The data presented in the Table 4.15 showed that pH ranged 3.04-4.55 with maximum pH found in RHRMH-44 (4.55) followed by Alphonso (4.2), RHRMG-1 (4.12), RHRMH-93 (4.1) and RHRMH-57 (4.01) and minimum pH found in RHRMH-16 (3.04) followed by RHRMH-98 (3.12), Sai Sugandh (3.18), RHRMH-6 (3.21) and RHRMG-2 (3.22).

RHRMG-1 (4.12) and Alphonso (4.2) had similar value with each other while RHRMH-7 (3.91), RHRMH-96 (3.91) and Kesar (3.91) had similar value.

Pleguezuelo *et al.* (2012) confirmed that mango pH increases and acidity decreases as fruit matures and ripens. Similar finding was seen in Akhtar *et al.* (2010).

4.2.4 TSS : Acidity ratio

The Table 4.15 presented the data of TSS to acidity ranged from 36.25 to 99.35 with Alphonso (99.35) had maximum ratio followed by RHRMH-93 (96.19), RHRMH-96 (95.38), RHRMH-57 (91.52) and Kesar (90.77) while RHRMH-44 (36.25) had minimum ratio followed by RHRMH-6 (52.56), RHRMH-107 (56.08), RHRMG-3 (56.64) and RHRMH-39 (57.17).

The similar findings have also been reported by Dhillon *et al.* (2004), Sharma and Josan (1995) and Kher and Sharma (2002).

4.2.5 Total sugars (%)

The Table 4.16 presented the data recorded for total sugar ranged from 10.02 to 18.75 per cent in which maximum total sugar found in RHRMH-30 (18.75 %) followed by Sai Sugandh (18.27 %), RHRMH-93 (18.19 %), RHRMG-4 (18.04 %) and Alphonso (18.03 %) and minimum found in RHRMH-44 (10.02 %) followed by RHRMH-52 (10.06 %), RHRMH- 6 (11.21 %), RHRMH-39 (11.89 %) and RHRMG-3 (12.92 %).

RHRMG-4 (18.04 %) and RHRMH-96 (18.01) were having nearby value with Alphonso (18.03 %) and Kesar (17.93 %).

Singh (1968) and Uddin *et al.* (2007) also observed variations in total sugars, ranging from 11.5-25 per cent and 12.71-20.34 per cent, respectively, which may be attributed to genetic diversity and differences in agro-climatic conditions.

Table 4.16. Mean performance of mango genotypes for total sugars, reducing sugars and non-reducing sugars

Sr. No.	Genotype	Total Sugar (%)	Reducing Sugar (%)	Non-reducing sugar (%)
1	RHRMH - 5	14.04	4.29	9.96
2	RHRMH - 6	11.21	3.39	7.99
3	RHRMH - 7	15.07	3.41	11.83
4	RHRMH - 16	16.73	3.87	13.05
5	RHRMH - 30	18.75	3.85	15.09
6	RHRMH - 38	16.89	3.21	13.84
7	RHRMH - 39	11.89	2.05	9.94
8	RHRMH - 44	10.02	1.91	8.21
9	RHRMH - 52	10.06	2.01	8.15
10	RHRMH - 55	14.75	2.91	11.99
11	RHRMH - 57	16.43	3.27	13.32
12	RHRMH - 72	17.51	3.81	13.89
13	RHRMH - 73	14.87	3.97	11.10
14	RHRMH - 83	16.29	3.26	13.19
15	RHRMH - 84	16.41	2.94	13.62
16	RHRMH - 85	13.81	2.71	11.24
17	RHRMH - 93	18.19	3.22	15.13
18	RHRMH - 96	18.01	3.11	15.06
19	RHRMH - 98	16.05	3.01	13.19
20	RHRMH - 104	14.01	2.82	11.33
21	RHRMH - 107	13.02	2.84	10.32
22	RHRMG - 1	16.01	3.96	12.25
23	RHRMG - 2	16.05	3.87	12.37
24	RHRMG - 3	12.92	2.17	10.86
25	RHRMG - 4	18.04	3.07	15.12
26	RHRMG - 5	14.83	2.77	12.20
27	RHRMG - 6	15.81	3.29	12.68
28	Sai Sugandh	18.27	3.98	14.49
29	Vanraj	15.91	3.57	12.52
30	Kesar	17.93	4.02	14.11
31	Alphonso	18.03	4.19	14.05
32	Mulgoa	17.51	3.52	14.17
33	Sindhu	17.44	3.38	14.23
	Range	10.02-18.75	1.91-4.29	7.99-15.13
	Minimum	10.02	1.91	7.99
	Maximum	18.75	4.29	15.13
	Mean	15.54	3.26	12.44
	S.D	2.38	0.64	2.04
	S.E. $\pm$	0.42	0.11	0.35
	CV (%)	15.34	19.49	16.40

4.2.6 Reducing sugars (%)

The evident data presented in Table 4.16 for reducing sugars in mango ranged from 1.91 to 4.29 per cent. The maximum reducing sugar found in RHRMH-5 (4.29 %) followed by Alphonso (4.19 %), Kesar (4.02 %), Sai Sugandh (3.98 %) and RHRMH-73 (3.97 %) with minimum found in RHRMH-44 (1.91 %) followed by RHRMH-52 (2.01 %), RHRMH-39 (2.05 %), RHRMG-3 (2.17 %) and RHRMH-85 (2.71 %).

Rathor *et al.* (2009) and Uddin *et al.* (2007) also reported the similar finding in reducing sugar of mango.

4.2.7 Non-reducing sugars (%)

The non reducing sugar ranged from 7.99 to 15.13 per cent with recorded data is presented in Table 4.16. In which the maximum non reducing sugar is found in RHRMH-93 (15.13 %) and RHRMG-4 (15.12 %) followed by RHRMH-30 (15.09 %) , RHRMH-96 (15.06 %) and Sai Sugandh (14.49 %) whereas minimum found in RHRMH-6 (7.99 %) followed by RHRMH-52 (8.15 %), RHRMH-44 (8.21 %), RHRMH-39 (9.94 %) and RHRMH-5 (9.96 %).

RHRMH-72 (13.89 %) were having the near value with Kesar (14.11 %) and Alphonso (14.05 %).

The differences in reducing sugars, non-reducing sugars and total sugars among various mango varieties may be attributed to factors such as genetic diversity, inherent characteristics and adaptability to specific climatic conditions in different regions.

The present findings are agreed with the results reported by Naz *et al.* (2014) and Rana and Bharadwaj. (2015).

4.3 Qualitative parameters (Organoleptic evaluation)

A ten-point hedonic scale was used to conduct sensory analysis, evaluating key quality attributes such as flavour, pulp colour, pulp texture and taste. The overall acceptability score was calculated by averaging the mean scores for each attribute, as shown in Table 4.17.

Table 4.17. Characterization of mango genotypes for quality parameters

Sr. No.	Genotype	Colour of pulp	Flavour	Pulp texture	Taste	Overall acceptability
1	RHRMH - 5	8.1	8.2	8.1	8.2	8.2
2	RHRMH - 6	6.8	6.5	6.5	6.5	6.6
3	RHRMH - 7	7.1	6.5	7.2	6.5	6.8
4	RHRMH - 16	8.5	8.5	8	8.5	8.4
5	RHRMH - 30	7.5	7.5	8	7.3	7.6
6	RHRMH - 38	8	7	7.5	7.5	7.5
7	RHRMH - 39	6.5	6.5	6	6.5	6.4
8	RHRMH - 44	6	6	6	6	6.0
9	RHRMH - 52	7	7.2	7.2	7.2	7.2
10	RHRMH - 55	7.5	6	7	7.5	7.0
11	RHRMH - 57	7	6.5	6.5	6.5	6.6
12	RHRMH - 72	7.9	7.2	7.2	7.2	7.4
13	RHRMH - 73	8.5	8	8.5	8.1	8.3
14	RHRMH - 83	7.9	6.5	6.8	6.5	6.9
15	RHRMH - 84	8	7.2	7.2	7.2	7.4
16	RHRMH - 85	8	7.9	7.9	7.9	7.9
17	RHRMH - 93	7.9	6.8	6.8	6.8	7.1
18	RHRMH - 96	7.1	7.1	7.1	7.1	7.1
19	RHRMH - 98	7.9	7.8	7.8	7.8	7.8
20	RHRMH - 104	7.8	7.1	7.1	7.1	7.3
21	RHRMH - 107	8.5	8	8.2	8	8.2
22	RHRMG - 1	8.2	8.1	8.1	8.2	8.2
23	RHRMG - 2	7.9	7.7	7.8	7.7	7.8
24	RHRMG - 3	7.9	8	8	8	8.0
25	RHRMG - 4	7.7	7.7	7.7	7.7	7.7
26	RHRMG - 5	8	7.9	8	7.9	8.0
27	RHRMG - 6	8	7.8	8	7.8	7.9
28	Sai Sugandh	8	8	8	8	8.0
29	Vanraj	8.1	8.1	8	8	8.1
30	Kesar	8.5	8.2	8.2	8.5	8.4
31	Alphonso	8.5	8.5	8.5	8.5	8.5
32	Mulgoa	8.1	8	8	8.1	8.1
33	Sindhu	8.1	7.9	8	7.9	8.0
	Range	6-8.5	6-8.5	6-6.5	6-8.5	6-8.5
	Minimum	6	6	6	6	6
	Maximum	8.5	8.5	8.5	8.5	8.5
	Mean	7.77	7.45	7.54	7.52	7.57
	S.D	0.60	0.72	0.68	0.68	0.64
	S.E. $\pm$	0.10	0.12	0.12	0.12	0.11
	CV (%)	7.75	9.62	8.98	9.04	8.42

The highest score for colour of pulp (8.5) was attained by Alphonso, Kesar, RHRMH-107, RHRMH-73, RHRMH-16 whereas lowest score (6.0) was attained by RHRMH-44. As for flavour highest score (8.5) obtained by Alphonso and RHRMH-16 and lowest (6.0) was obtained by RHRMH-44 and RHRMH-55, like this for pulp texture highest score (8.5) was acquired by Alphonso and RHRMH-73 and lowest score (6.0) acquired by RHRMH-44 and RHRMH-39. As for taste highest score (8.5) acquired by Alphonso, Kesar and RHRMH-16 and lowest score (6.0) by RHRMH-44.

The overall acceptability score was highest (8.5) for Alphonso which was followed by RHRMH-16 (8.4), Kesar (8.4), RHRMH-73 (8.3) and least score (6.0) for RHRMH-44 followed by RHRMH-39 (6.4), RHRMH-6 (6.6), RHRMH-57 (6.6) and RHRMH-7 (6.8).

The current results align with the findings of Sadhyarani *et al.* (2024), who also reported variations in scores among different mango products.

4.4 Yield parameters

4.4.1 Number of fruits per tree

The Table 4.18 represented the data recorded for the number of fruits per tree which ranged from 135.1 to 247.66. The maximum number of fruits was found in RHRMH-104 (247.66) followed by RHRMH-96 (213.21), RHRMH-16 (201.26), Kesar (198.36) and RHRMH-93 (198.23) and minimum recorded in RHRMH-7 (135.1) followed by RHRMH-6 (139.6), RHRMH-44 (140.65), RHRMH-57 (142.33) and RHRMH-83 (143.27).

RHRMH-93 (198.23) and Kesar (198.36) were having values near to each other while Alphonso (187.55) and RHRMH-85 (188.43), RHRMH-107 (186.25) were having values near to each other.

The differences in fruit production per tree may be attributed to factors such as tree size, fruit size, leaf area and the absorption and translocation of photosynthates, as reported by Dhillon *et al.* (2004) and Singh *et al.* (1986).

The similar finding was reported by Sawant *et al.* (2018) and Gunjate *et al.* (2009).

Table 4.18. Characterization of mango genotypes for yield parameters and shelf life

Sr. No.	Genotype	Number of fruits/ trees	Yield (kg/tree)	Shelf life (Days)
1	RHRMH - 5	197.5	87.01	6.2
2	RHRMH - 6	139.6	14.06	6.1
3	RHRMH - 7	135.1	26.01	7.3
4	RHRMH - 16	201.26	79.55	6.4
5	RHRMH - 30	159.44	21.84	6.3
6	RHRMH - 38	145.01	26.01	7.1
7	RHRMH - 39	183.5	68.72	7.2
8	RHRMH - 44	140.65	43.91	5.9
9	RHRMH - 52	161.02	15.12	6.5
10	RHRMH - 55	155.23	11.62	7.3
11	RHRMH - 57	142.33	21.58	5.5
12	RHRMH - 72	148.23	35.50	6.4
13	RHRMH - 73	183.34	34.42	7.3
14	RHRMH - 83	143.27	15.15	6.3
15	RHRMH - 84	156.44	21.96	6.1
16	RHRMH - 85	188.43	25.79	6.6
17	RHRMH - 93	198.23	26.48	7.2
18	RHRMH - 96	213.21	20.01	7.4
19	RHRMH - 98	188.56	28.16	7.3
20	RHRMH - 104	247.66	20.54	6.4
21	RHRMH - 107	186.25	38.82	6.6
22	RHRMG - 1	195.21	47.90	6.7
23	RHRMG - 2	174.8	42.00	7.1
24	RHRMG - 3	197.23	50.49	7.2
25	RHRMG - 4	184.84	31.56	7.2
26	RHRMG - 5	150.21	22.28	5.7
27	RHRMG - 6	149.54	38.57	5.5
28	Sai Sugandh	178.56	50.16	6.7
29	Vanraj	150.23	46.03	6.2
30	Kesar	198.36	47.36	6.3
31	Alphonso	187.55	48.92	6.6
32	Mulgoa	148.15	45.06	6.9
33	Sindhu	146.23	27.79	6.6
	Range	135.1-247.66	11.62-87.01	5.5-7.4
	Minimum	135.1	11.62	5.5
	Maximum	247.66	87.01	7.4
	Mean	171.97	35.77	6.61
	S.D	26.71	18.11	0.55
	S.E. $\pm$	4.65	3.15	0.10
	CV (%)	15.53	50.62	8.28

4.4.2 Yield (kg/tree)

The yield per tree as shown in Table 4.18 ranged from 11.62-87.01 kg where the maximum yield was recorded in RHRMH-5 (87.01 kg) followed by RHRMH-16 (79.55 kg), RHRMH-39 (68.72 kg), RHRMG-3 (50.49 kg) and Sai Sugandh (50.16 kg) where the minimum yield was recorded RHRMH-55 (11.62 kg) followed by RHRMH-6 (14.06 Kg), RHRMH-52 (15.12 kg), RHRMH-83 (15.15 kg) and RHRMH-96 (20.01 kg).

RHRMG-1 (47.90 kg) was having near value with Alphonso (48.92 kg) and Kesar (47.36 kg).

The variation in fruit yield among different mango cultivars can be attributed to a combination of physiological and genetic factors, including photosynthate and hormone regulation, fruit set and retention, tree size and leaf area and inherent genetic differences, as reported by multiple studies (Hoda *et al.*, 2003; Singh, 2002; Singh and Chadha, 1981; Srivastava *et al.*, 1987; Chanana *et al.*, 2005).

Kumar and Singh (2005) evaluated mango varieties and they found the similar finding in their experiment.

4.5 Shelf life (days)

The Table 4.18 presented the evident data for the shelf life of mango which ranged from 5.5-7.4 days. In which the longest shelf life was seen in RHRMH-96 (7.4 days) which was followed by RHRMH- 98, RHRMH-73, RHRMH-55 and RHRMH-7 (7.3 days) while the shortest shelf life seen in RHRMH-57 and RHRMG-6 (5.5 days) and followed by RHRMG-5 (5.7 days), RHRMH-44 (5.9 days) and RHRMH-6 (6.1 days).

Alphonso (6.6 days) shelf life which was similar to RHRMH-85 and RHRMH-107 (6.6 days) and Kesar (6.3 days) shelf life similar with RHRMH- 83 and RHRMH- 30 (6.3 days).

Shelf-life differences among mango varieties may be due to variations in peel thickness, composition and fruit firmness, aligning with findings by Rajwana *et al.* (2010) and Sethi *et al.* (2011).

4.6 Fruit drop (%) at different stages

The Table 4.19 showed the data recorded for the fruit drop at different stages (mustard, pea, egg and at harvest stages). In which we observed that the most of fruit drop occurred between pea stage to egg stage with mean (89.58) followed by egg stage to harvest (62.9) and minimum fruit drop observed from mustard to pea stage with mean (23.13).

Maximum fruit drop between mustard stage and pea stage was observed in RHRMH-85 (40.66 %) followed by RHRMH-98 (31.63 %) and least seen RHRMG-4 (12.17 %) followed by Alphonso (12.35 %). The maximum fruit drop at pea stage seen in RHRMH-104 (92.96 %) which was followed by the Vanraj (92.44 %), Kesar (91.84 %), Sindhu (91.67 %) and RHRMH-5 (91.57 %) and least seen in RHRMH-38 (85.16 %) followed by RHRMH-73 (87.14 %). And fruit drop seen at egg stage to harvest was maximum in RHRMH-38 (78.92 %) followed by RHRMG-5 (76.05 %) and least seen in RHRMH- 52 (51.28 %) followed by Mulgoa (52.21 %) and Alphonso (53.76 %).

The variation in the fruit drop at different stages mainly occurred due to initial internal competition between large number of small fruits and some incompletely fertilized ovules which dropped. Another reason for fruit drop is weather condition, genetic nature of varieties.

Similar finding was reported by Anila and Radha (2003) and Muhammad *et al.* (2002).

4.7 Physiological disorders (if any)

During period of investigation no physiological disorder had been noticed on the mango genotypes.

4.8 Incidence of disease and pest (if any)

During period of investigation no incidence of disease and pest had been noticed on the mango genotypes.

Table 4.19. Fruit drop percentage in mango genotypes at different stages

Sr. No.	Genotype	Fruit drop between mustard and pea stage (%)	Fruit drop between pea and egg stage (%)	Fruit drop between egg and harvest stage (%)
1	RHRMH - 5	15.46	91.57	54.97
2	RHRMH - 6	27.19	88.24	62.22
3	RHRMH - 7	23.76	88.65	64.12
4	RHRMH - 16	26.59	87.97	54.89
5	RHRMH - 30	20.09	89.34	54.17
6	RHRMH - 38	27.49	85.16	78.92
7	RHRMH - 39	21.79	88.96	62.28
8	RHRMH - 44	27.45	87.39	57.71
9	RHRMH - 52	19.48	90.34	51.28
10	RHRMH - 55	20.09	90.68	59.03
11	RHRMH - 57	29.00	88.37	71.67
12	RHRMH - 72	19.71	90.29	67.03
13	RHRMH - 73	25.74	87.14	59.14
14	RHRMH - 83	30.35	89.53	72.95
15	RHRMH - 84	23.35	89.38	65.58
16	RHRMH - 85	40.66	88.87	63.70
17	RHRMH - 93	29.12	89.38	67.16
18	RHRMH - 96	31.50	88.73	63.70
19	RHRMH - 98	31.63	88.97	64.73
20	RHRMH - 104	15.50	92.96	55.90
21	RHRMH - 107	28.55	88.04	73.76
22	RHRMG - 1	22.83	89.85	53.82
23	RHRMG - 2	26.30	88.26	64.09
24	RHRMG - 3	17.22	88.24	66.96
25	RHRMG - 4	12.17	89.59	57.37
26	RHRMG - 5	16.29	90.22	76.05
27	RHRMG - 6	19.03	90.83	66.96
28	Sai Sugandh	15.78	91.52	60.85
29	Vanraj	25.24	92.44	70.35
30	Kesar	19.90	91.84	62.78
31	Alphonso	12.35	91.00	53.76
32	Mulgoa	20.96	90.54	52.21
33	Sindhu	20.75	91.67	65.48
	Range	12.17-40.66	85.16-92.96	51.28-78.92
	Minimum	12.17	85.16	51.28
	Maximum	40.66	92.96	78.92
	Mean	23.13	89.58	62.9
	S.D	6.28	1.67	7.13
	S.E. $\pm$	1.09	0.29	1.24
	CV (%)	27.15	1.86	11.34

Table 4.20. Desirable parameters of five promising genotypes

Sr. No	Characters	Promising genotypes				
		RHRMH-5	RHRMH-16	RHRMH-73	RHRMH-107	RHRMG-1
1.	Fruit colour	Yellow with red blush	Yellow with red blush	Golden yellow	Yellow	Yellow
2.	Fruit length (cm)	10.8	9.6	8.9	8.6	8.6
3.	Pulp colour	Yellow orange	Yellow orange	Yellow	Yellow	Yellow
4.	Fruit weight (g)	440.54	395.24	187.72	208.43	245.37
5.	Number of hermaphrodite flowers	139.75	150.75	140.36	136.50	186.10
6.	Sex ratio	0.22	0.38	0.22	0.18	0.25
7.	Fruit retention percent	3.21	3.98	3.90	2.24	3.62
8.	TSS °B	19.10	18.36	17.62	18.02	17.09
9.	Acidity (%)	0.23	0.21	0.22	0.25	0.19
10.	Yield (kg/tree)	87.01	79.55	34.42	38.82	47.90
11.	Overall acceptability	8.2	8.4	8.3	8.2	8.2

5. SUMMARY AND CONCLUSION

In India, mango is a fruit crop of immense socio-economic value, earning it the title 'King of fruits' due to its exceptional taste and high nutritional content. Beyond its culinary appeal, mango also holds medicinal significance, contributing to its commercial importance. However, the crop's high genetic variability, resulting from seed propagation and random selection, has led to significant differences in quality and yield. This diversity encompasses traditional varieties, local selections and elite cultivars. To leverage this diversity, researchers have employed systematic characterization of physical and chemical traits to identify superior genotypes. The results found during the time of experiment are summarized below.

Summary

5.1 Morphological parameters

5.1.1 Leaf parameters

The data showed the leaf length varied from 14.70 to 35.50 cm with maximum length in RHRMH-16 (35.50 cm) and minimum in RHRMH-73 (14.70 cm). The data showed for leaf breadth varied from 3.10 to 7.10 cm. The maximum leaf breadth seen in RHRMH-16 (7.10 cm) and minimum in RHRMH-73 (3.10 cm).

Simple leaves were seen in all genotypes.

Some variations were seen in the leaf colour among the genotypes where 26 genotype showed dark green colour, 6 genotype showed light green and 1 genotype showed green coloured leaves.

The leaves appear to be non-waxy when observed for waxy nature in them.

5.1.2 Flowering parameters

Among the studied genotypes for experiment seen that the RHRMH-73 and Vanraj (13th January) were the first to start flowering while RHRMH-52, RHRMG-4, RHRMG-5, RHRMG-6 (28th February) were the late flowered.

The colour of panicle observed among the mango genotypes in which seventeen observed to be yellow, six observed to be yellowish green and five observed to be yellowish pink and reddish yellow each.

Number of flushes observed in the genotypes was mostly two flushes in twenty-nine genotypes where zero flushes seen in three genotypes and one flush seen in one genotype.

The data regarding the colour of flush observed fifteen genotypes had reddish colour, eight genotype had reddish yellow while four genotypes have yellowish red and light green colour shown by three genotypes.

The hermaphrodite flowers shown highest in RHRMH-52 (240.3) while the least hermaphrodite flowers were in RHRMH-85 (80.8). Highest male flowers observed in Alphonso (850.7) while RHRMH-85 (303) showed the least male flowers. The number of flowers highest flowering was in RHRMH-52 (1026.4) and least flowering in RHRMH-85 (383.8). The sex ratio showed the variation from 0.18 to 0.38 having highest value in RHRMH-16 (0.38) while the least values were recorded for RHRMH-107 (0.18).

5.1.3 Fruit morphology

The data revealed that days required from fruit setting to mustard stage ranged from 5 to 7.2 days for all genotypes.

The data recorded for number of fruits per panicle at egg stage ranged from 4.24-8.42 with RHRMH-73 (8.24) having maximum fruits and minimum in RHRMH-104 (4.24). The number of fruits at harvest stage ranged from 1.25-3.44 while RHRMH-73 (3.44) having highest number of fruits and least number were in RHRMH-38 (1.25).

The 1.67-3.98 per cent ranged fruit retention in the studied genotypes. The RHRMH-16 (3.98 %) showed the maximum retention and Vanraj (1.67 %) showed the least retention.

The fruit shape of twenty-one genotypes recorded the oblong shape, six genotypes recorded the ovoid whereas five genotypes recorded roundish and one genotype recorded the elliptic shape.

Fruit weight ranged from 74.86 to 440.54 g with the highest fruit weight was recorded in RHRMH-5 (440.54 g) and least was recorded in RHRMH-55 (74.86 g).

Fruit length ranged from 6.9-15.2 cm in which the RHRMH-39 (15.2 cm) shown the maximum length and minimum length was seen in RHRMH-52 (6.9 cm). Fruit

breadth ranged from 3.2 to 8.6 cm in which Vanraj (8.6 cm) had maximum breadth and minimum breadth shown in RHRMH-52 (3.2 cm).

The colour of unripe fruit was noticed in which twenty-six genotypes noted as green colour, seven noted as green with red blush colour. As for the ripe fruit colour of peel twenty-four genotype noted as the yellow colour while eight noted as the yellow with red bush and one noted as the golden yellow colour.

5.1.4 Pulp

The pulp colour was yellow in twenty-two genotypes while yellowish orange seen in nine genotypes and light yellow was found in two genotypes. The pulp of twenty-five genotype was fibrous, non fibrous for four genotype, low fibrous for two and intermediate for two genotypes.

Pulp percentage ranged from 36.69 to 79.33 per cent were maximum pulp percentage observed in RHRMH- 5 (79.33 %) and whereas minimum pulp percentage was observed in RHRMH-96 (36.69 %). Peel percentage ranged from 10.34-28.82 per cent. Maximum percentage recorded in RHRMH-30 (28.82 %) and minimum percentage recorded in RHRMH-5 (10.34 %).

5.1.5 Stone

Stone weight ranged from 20.56 to 57.95 g in which maximum weight noted in RHRMG-3 (57.95 g) and minimum noted in RHRMH- 104 (20.56 g).

Stone length ranged from 4.56 to 13.1 cm in which the maximum length was in RHRMH- 39 (13.1 cm) and minimum length was in RHRMG-6 (4.56 cm). As for stone breadth ranged from 3.20 to 5.47 cm with maximum breadth in RHRMH-55 (5.47 cm) and minimum breadth was seen in RHRMH-83 (3.20 cm).

Stone percentage ranged from 10.14 to 42.03 per cent where maximum stone percentage was in RHRMH- 52 (42.03 %) whereas minimum stone percentage was observed in Vanraj (10.14 %).

5.2 Biochemical parameters

Among different genotypes the total soluble solids ranged from 11.60-20.2 °B with the maximum TSS found in RHRMH-93 (20.2 °B) and minimum TSS in RHRMH-44 (11.6 °B).

Acidity of pulp ranged from 0.19-0.32 per cent in which the maximum acidity in the pulp were observed in RHRMH-44 (0.32 %) and minimum observed in RHRMG-1 (0.19 %). pH ranged 3.04-4.55 with maximum pH found in RHRMH-44 (4.55) and minimum pH found in RHRMH-16 (3.04). While TSS to acidity ratio ranged from 36.25 to 99.35 with Alphonso (99.35) had maximum ratio followed by RHRMH-93 (96.19) and minimum ratio RHRMH-44 (36.25) followed by RHRMH-6 (52.56).

The total sugar ranged from 10.02 to 18.75 per cent in which maximum total sugar found in RHRMH-30 (18.75 %) and minimum found in RHRMH-44 (10.02 %). Noticeable difference in reducing sugar has been noticed, maximum reducing sugar found in RHRMH-5 (4.29 %) and minimum found in RHRMH-44 (1.91 %). The non reducing sugar ranged from 7.99 to 15.13 per cent. The maximum non reducing sugar is found in RHRMH-93 (15.13 %) and minimum found in RHRMH-6 (7.99 %).

5.3 Qualitative parameters (Organoleptic evaluation)

The overall acceptability score was highest (8.5) for Alphonso and least score (6.0) for RHRMH-44.

5.4 Yield parameters

The number of fruits per tree which ranged from 135.1 to 247.66. The maximum number of fruits recorded in RHRMH-104 (247.66) and minimum in RHRMH-7 (135.1).

The yield per tree ranged from 11.62-87.01 kg where the maximum yield was in RHRMH-5 (87.01 Kg) and minimum yield in RHRMH-55 (11.62 Kg).

5.5 Shelf life

The shelf life of mango which ranged from 5.5-7.4 days. The longest shelf life was recorded in RHRMH-96 (7.4 days) and shortest shelf life in RHRMH-57 and RHRMG-6 (5.5 days).

5.6 Fruit drop at different stages

The most of fruit drop occurred between pea stage to egg stage with mean (89.58) and minimum fruit drop seen from mustard to pea stage with mean (23.13).

5.7 Physiological disorders (if any)

There was no incidence of any physiological disorder during the period of investigation.

5.8 Incidence of disease and pest (if any)

There was no incidence of any disease or pest occurred during the period of investigation.

Conclusions

The present investigation's findings led to the following conclusions being drawn. There are differences between the genotypes, according to the study on the physio-morphological, floral biology and fruit features of mango genotypes. This provides the chance to choose genotype based on desired traits.

The variability of the genotypes that were gathered could be used to generate an enhanced mango variety. In order to develop and carry out conservation strategies for *in situ*, on-farm, as well as *ex situ* conservation and management of these genetic resources, communities, scientists and policy managers will find great value in the genotype diversity data collected for mangoes.

Evaluation with given characters and five genotypes found to be promising with the desirable characters out of the twenty-seven genotypes and six check varieties. The genotypes RHRMH-5, RHRMH-16, RHRMH-73, RHRMH-107 and RHRMG-1 were found to be appealing for taste, colour, flavour and had commendable yield, fruit retention, TSS and acidity.

By evaluating these genotypes for further research is might be helpful for farmers, researcher and scientist for the development of new variety with the desirable characters and it might also use for genetic improvement in the near future.

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7. APPENDICES

Appendix-1: Details of Meteorological data during experimental period

Meteorological week no.	Temperature (°C)		Relative Humidity (%)		Sunshine (hrs.)	Rainfall (mm)
	Max.	Min.	Max.	Min.		
December 2022						
49	30.1	16.3	87.9	38.9	6.2	0.0
50	28.9	17.3	87.1	44.0	6.1	0.0
51	30.3	16.2	83.0	34.0	8.8	0.0
52	31.7	16.0	80.6	30.6	9.0	0.0
January 2023						
1	28.1	15.1	82.9	48.0	6.4	0.0
2	28.6	11.6	86.3	25.4	8.9	0.0
3	30.1	13.5	82.9	29.6	9.1	0.0
4	29.3	15.3	78.3	39.7	7.5	0.1
February 2023						
5	29.1	15.7	79.6	38.4	8.1	0.0
6	30.6	14.6	76.1	25.1	10.1	0.0
7	31.5	14.7	69.7	22.0	10.7	0.0
8	32.9	15.3	71.9	19.0	10.5	0.0
March 2023						
9	33.9	16.5	70.0	19.7	9.0	0.0
10	31.4	17.4	79.7	30.3	6.9	1.8
11	30.6	18.3	78.6	37.0	5.6	0.6
12	30.4	17.3	85.1	27.9	7.8	1.0
13	33.9	19.7	67.4	25.0	9.6	0.0
April 2023						
14	34.7	21.7	66.9	27.7	8.3	4.2
15	35.8	23.4	70.4	28.1	7.6	1.8
16	38.0	22.3	69.1	20.9	9.0	0.6
17	35.4	22.8	70.9	36.9	9.3	3.9
May 2023						
18	31.2	22.6	75.4	44.1	9.0	2.6
19	37.2	25.0	67.0	25.6	8.9	0.6
20	39.5	24.8	62.3	20.3	11.5	0.0
21	39.7	25.6	63.3	21.3	10.5	0.0
22	39.9	27.1	62.4	20.0	10.4	0.0
June 2023						
23	36.5	25.6	74.7	36.6	9.7	0.9
24	37.4	26.2	67.7	34.0	10.1	5.5
25	36.3	25.6	73.0	35.0	7.6	0.2
26	29.9	24.0	84.3	65.0	1.0	4.5

8. VITAE

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