

Extent of variability in fruit morphological characters of local mango germplasm

Grado de variabilidad en las características morfológicas de los frutos del germoplasma local de mango

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ABSTRACT

A study was conducted on twenty five genotypes of seedling Mangoes to examine fruit morphological characters. Fruit shape of the evaluated germplasm varied enormously and fruits of obovoid, elliptic, round and oblong shapes were found. Fruit apex shape in the evaluated plants was round, acute and obtuse. Depth of fruit stalk cavity was either absent, shallow and of medium type, whereas, fruit neck prominence was absent to slightly prominent in the tested plants. Shape of fruit ventral shoulder was varied and found to be slopping abruptly, rising and then rounded and long curve type in the evaluated germplasm. Fruit beak varies from pointed to perceptible type and fruit sinus was absent to shallow type in the fruits from different plants. Fruit attractiveness varies from very good to excellent and fruit colour from greenish yellow to green colour of fruit skin at maturity was noted in fruits from selected trees. Peel colour of AA-15 was different amongst all the genotypes which were green with red blush. Pulp colour varied from light orange, yellow orange, orange yellow, yellow and light yellow, whereas, pulp texture was soft to intermediate in the evaluated germplasm.

Key words: *Mangifera indica*; Genotype susceptibility; Punjab; India

RESUMEN

La forma del fruto del germoplasma evaluado varió enormemente y se encontraron frutos de forma obovoide, elíptica, redonda y alargada. La forma del ápice del fruto en las plantas evaluadas fue redonda, aguda y obtusa. La profundidad de la cavidad del tallo de la fruta estuvo ausente, fue poco profunda y

de tipo medio, mientras que la prominencia del cuello de la fruta estuvo ausente o fue ligeramente prominente en las plantas probadas. La forma de la paleta ventral del fruto se varió y se encontró que se inclinaba abruptamente, se elevaba y luego se redondeaba y formaba una curva larga en el germoplasma evaluado. El pico de la fruta varía de un tipo puntiagudo a perceptible y el seno del fruto estuvo ausente a un tipo poco profundo en los frutos de diferentes plantas. El atractivo de la fruta varía de muy bueno a excelente y se observó un color de fruta de amarillo verdoso a verde en la piel de la fruta en la madurez en frutos de árboles seleccionados. El color de piel de AA-15 fue diferente entre todos los genotipos que eran verdes con rubor rojo. El color de la pulpa varió de naranja claro, amarillo anaranjado, amarillo anaranjado, amarillo y amarillo claro, mientras que la textura de la pulpa fue suave a intermedia en el germoplasma evaluado.

Palabras clave: *Mangifera indica*, susceptibilidad de genotipo, Punjab, India.

INTRODUCTION

Mango belongs to genus *Mangifera* under family Anacardiaceae and order Sapindales comprising of 69 species (Kostermans and Bompard, 1993), which are distributed throughout the world. Mango serves as an integral part in human life since it is not only a rich source of nutrients but also a common good shared in culture, life style and religion. (Lakshminarayana, 1980). Mango has rich varietal diversity and there are about 1600 varieties in the world (Pandey, 1998). The varieties existing are numerous with different qualities, some of them are superior ones, with attractive colour, tolerant to diseases etc. but not resistant to certain problems. Such mango germplasm is not known to other parts of India. Thus, there is tremendous possibility of such material to act as source for further propagation as well as breeding material for hybridization to evolve new varieties with desirable traits.

A large population of old mango seedlings is found growing in different parts of the country. These seedlings have shown wide genetic diversity in terms of fruit size, shape, colour, flavour, taste, time of maturity, fruit yield, bearing regularity, resistance to malformation and other maladies (Singh and Sharma, 2005). In Punjab the area under mango fruit plantation has declined drastically due to deforestation, population pressure, shifting interests towards high remunerative cropping systems, reoccurrence of cold wave with frost and urban development (Gill

& Navprem 2012). There is a need and demand of Punjabi folklore to conserve and protect this heritage rich fruit for the benefit of posterity.

MATERIALS AND METHODS

The present study was conducted in mango growing areas of Amritsar and Gurdaspur Districts of Punjab. More than hundred genotypes were selected on the basis of information provided by tree owners, local inhabitants and officials from Department of Horticulture, Punjab. Out of which twenty five superior genotype of seedling Mangoes to peculiar character were selected. The selected genotypes were evaluated with the help of IPGRI, Rome 'Mango Descriptor' for various vegetative, floral, fruit maturity, disorders and storage characters etc. Thirty fruits sample were randomly selected from all the sides of the tree (Table 1).

Table 1
Collected sites (codes and abbreviations).

| Collector Code | Abbreviation |
|----------------|-------------------------|
| AA | Amritsar Attari. |
| AKCA | Amritsar Khalsa College |
| AP | Amritsar Pairewal |
| AUG | Amritsar Augar Aulakh |
| AGKB | Amritsar Ghukewali |
| ABG | Amritsar Bhure Gill |
| AKS-1 | Amritsar Kotli Sakka |
| AR | Amritsar Rayya |
| GQ | Gurdaspur Qadian, |
| GJ | Gurdaspur Jawahar Bagh |
| GRB | Gurdaspur Ranjit Bagh |

Where A denotes Amritsar AA-Attari, AKCA-Khalsa College, AP-Pairewal, AUG-Ugar Aulak, AGKB-Guru Ka Bagh, ABG-Bhure Gill, AKS-Kotli Sakka, AR-Rayya. G-Denotes Gurdaspur, GQ-Qadian, GRB-Ranjit Bagh, GJB-Jawahar Bagh.

RESULTS

Fruit shape: Variability in the fruit shape amongst different evaluated seedling mango germplasm (Table 2) was observed. The shape of fruits of genotype AA-19 was obovoid, whereas fruits of genotypes AKS-1 and AGKB-64 was

elliptic shaped. Genotypes AA-3, AA-4, AA-8, AA-16, AA-20, AA-39 and AKCA-14 having roundish shaped fruits. Rest of genotypes AA-1, AA-2, AA-7, AA-9, AA-15, AA-19, AA-29, AA-42, AA-101, ABG-1, AUG-1, AP-1, AR-1, GJB-1, GQ-3 and GRB-1 have oblong shaped fruits

Shape of fruit apex: Evaluated seedling mango germplasm exhibited variability in terms shape of fruit apex (Table 2). Genotype AA-16 having roundish shaped fruit apex. Genotypes AA-1, AA-7, AA-9, AA-15, AA-19, AA-39, AA-42, AA-101, ABG-1, AP-1, AR-1, GRB-1 and GQ-3 having acute shaped fruit apex. Rest of genotypes i.e. AA-2, AA-3, AA-4, AA-8, AA-20, AA-29, AGKB-64, AKCA-14, AKS-1, AUG-1 and GJB-1 have fruits with obtuse apex.

Depth of fruit stalk cavity: Variation in depth of fruit stalk cavity was noted in the fruits from evaluated germplasm (Table 2). The genotype AA-3 was having fruits with medium depth of fruit stalk cavity whereas, the genotypes AA-1, AA-2, AA-7, AA-9, AA-15, AA-19, AA-29, AA-39, AA-101, ABG-1, AGKB-64, AKCA-14, AKS-1, AP-1, AR-1, AUG-1, GJB-1, GRB-1 and GQ-3 having fruit stalk cavity i.e. depth of the fruit stalk cavity absent. The rest of genotypes AA-4, AA-8, AA-16, AA-20 and AA-42 having shallow type of fruit stalk cavity.

Fruit neck prominence: From Table 2 it is clear that fruit neck is of two types in the evaluated germplasm i.e. slightly prominent or absent. The genotypes AA-7, AKS-1, ABG-1, GRB-1 and GJB-1 having non-prominent fruit neck i.e. fruit neck absent. Rest of genotypes AA-1, AA-2, AA-3, AA-4, AA-8, AA-9, AA-15, AA-16, AA-19, AA-20, AA-29, AA-39, AA-42, AA-101, AGKB-64, AKCA-14, AP-1, AR-1, AUG-1 and GQ-3 having slightly prominent fruit neck.

Slope of fruit ventral shoulder: The genotypes AA-1, AA-7, AA-15, AA-16, AA-20, ABG-1, GRB-1, GJB-1 and AR-1 were having abruptly slopping shoulder. Genotypes AA-3, AA-4 and AKCA-14 having rising and then rounded fruit ventral shoulder (Table 2). Rest of genotypes AA-2, AA-8, AA-9, AA-19, AA-29, AA-39, AA-42, AA-101, AGKB-64, AKS-1, AP-1, AUG-1 and GQ-3 were having vertical shoulder ending in a long curve type slope.

Fruit beak: Fruits harvested from evaluated seedling mango germplasm have two types of fruit i.e. perceptible and pointed beak (Table 2). The genotypes AA-1, AA-9 and ABG-1 were having pointed type of fruit beak. Rest of genotypes AA-2, AA-3, AA-4, AA-7, AA-8, AA-15, AA-16, AA-19, AA-20, AA-42, AA-AA-29, AA-39, AA-42, AA-101, AGKB-64, AKCA-14, AKS-1, AP-1, AR-1, AUG-1, GJB-1, GRB-1 and GQ-3 were having perceptible type of fruit beak.

Fruit sinus: Fruit sinus in the evaluated mango germplasm was found to be either absent or shallow (Table 3). The genotypes AA-7, AA-9, AA-20, AA-101, AGKB-64 and AUG-1 having shallow type of fruit sinus. Rest of genotypes AA-1, AA-2, AA-3, AA-4, AA-8, AA-15, AA-16, AA-19, AA-29, AA-39, AA-42, AA-101, ABG-1, AKCA-14, AKS-1, AP-1, AR-1, GJB-1, GRB-1 and GQ-3 genotypes having no fruit sinus i.e. fruit sinus was absent in these genotypes.

Fruit attractiveness: The data regarding attractiveness of fruits of evaluated germplasm are presented in Table 3. The genotypes AA-7, AA-1, AA-7, AA-8, AA-9, AA-15, AA-29, ABG-1, AKS-1 and GJB-1 were having fruits with excellent attractiveness value. Whereas, genotypes AA-2, AA-3, AA-4, AA-20, AA-39, AKCA-14 and AUG-1 were having fruits with very good attractiveness, rest of the genotypes i.e. AA-16, AA-19, AA-42, AA-101, AGKB-64, AP-1, AR-1, GRB-1 and GQ-3 having fruit attractiveness with good value.

Fruit colour: The data regarding the skin colour of ripe fruits of evaluated seedling mango germplasm are presented in Table 3. The fruits of genotype AA-15 attained green colour with red blush. Whereas, fruit colours of genotypes AA-8, AA-29 and GJB-1 were greenish yellow. Rest of the genotypes i.e. AA-1, AA-2, AA-3, AA-4, AA-7, AA-9, AA-16, AA-19, AA-20, AA-39, AA-42, AA-101, ABG-1, AGKB-64, AKCA-14, AKS-1, AP-1, AR-1, AUG-1, GRB-1 and GQ-3 have fruits with green colour at maturity.

Pulp colour: Variability in pulp colour of ripe fruits was noted in the evaluated seeding mango germplasm (Table 3). The genotypes AA-101, AP-1 and GJB-1 attained light orange colour of pulp. Genotype AKS-1 have fruits pulp of yellow orange colour at ripening. Genotypes AA-39 have orange colour fruit pulp. Fruits of genotypes AA-2, AA-3, AA-4, AA-9, AA-16, AA-19, AA-20, ABG-1, AKCA-14 and GQ-3 have attained yellow colour of pulp. Fruits of rest of genotypes i.e. AA-1, AA-4, AA-7, AA-8, AA-15, AA-29, AA-42, AUG-1, AGKB-64, AR-1 and GRB-1 have attained light yellow pulp colour of ripe fruit.

Pulp texture: The data regarding the pulp texture of ripe fruits of evaluated germplasm is presented in Table 3. The genotypes AA-3, AA-7, AA-9, AA-29, AA-42 and ABG-1 having soft textured pulp. Rest of genotypes i.e. AA-1, AA-2, AA-4, AA-8, AA-15, AA-16, AA-19, AA-20, AA-39, AA-101, AGKB-64, AKCA-14, AKS-1, AP-1, AR-1, AUG-1, GJB-1, GRB-1 and GQ-3 were having fruits with intermediate pulp texture when ripe.

Table 2: Fruit morphological characteristics of evaluated genotypes.

| Selection number | Collector code | Fruit shape | Shape of fruit Apex | Depth of fruit stalk cavity | Fruit neck prominence | Slope of fruit ventral shoulder |
|------------------|----------------|-------------|---------------------|-----------------------------|-----------------------|---------------------------------|
| 1 | AP- 1 | Oblong | Acute | Absent | Slightly Prominent | Ending In a long Curve |
| 2 | AKCA – 14 | Roundish | Obtuse | Absent | Slightly Prominent | Rising And Then Rounded |
| 3 | GJB -1 | Oblong | Obtuse | Absent | Absent | Slopping Abruptly |
| 4 | AA -101 | Oblong | Acute | Absent | Slightly Prominent | Ending In a long Curve |
| 5 | AA-15 | Oblong | Acute | Absent | Slightly Prominent | Slopping Abruptly |
| 6 | AA-4 | Roundish | Obtuse | Shallow | Slightly Prominent | Rising And Then Rounded |
| 7 | AA -16 | Roundish | Round | Shallow | Slightly Prominent | Slopping Abruptly |
| 8 | AA -42 | Oblong | Acute | Shallow | Slightly Prominent | Ending In a long Curve |
| 9 | GRB-1 | Oblong | Acute | Absent | Absent | Slopping Abruptly |
| 10 | AA-3 | Roundish | Obtuse | Medium | Slightly Prominent | Rising And Then Rounded |
| 11 | GQ-3 | Oblong | Acute | Absent | Slightly Prominent | Ending In a long Curve |
| 12 | AA-20 | Roundish | Obtuse | Shallow | Slightly Prominent | Slopping Abruptly |
| 13 | AUG.1 | Oblong | Obtuse | Absent | Slightly Prominent | Ending In a long Curve |
| 14 | AA-9 | Oblong | Acute | Absent | Slightly Prominent | Ending In a long Curve |
| 15 | ABG-1 | Oblong | Acute | Absent | Absent | Slopping Abruptly |
| 16 | AGKB-64 | Elliptic | Obtuse | Absent | Slightly Prominent | Ending In a long Curve |
| 17 | AA-29 | Oblong | Obtuse | Absent | Slightly Prominent | Ending In a long Curve |
| 18 | AA-39 | Roundish | Acute | Absent | Slightly Prominent | Ending In a long Curve |
| 19 | AA-2 | Oblong | Obtuse | Absent | Slightly Prominent | Ending In a long Curve |
| 20 | AR-1 | Oblong | Acute | Absent | Slightly Prominent | Slopping Abruptly |
| 21 | AA-8 | Roundish | Obtuse | Shallow | Slightly Prominent | Ending In a long Curve |
| 22 | AA-1 | Oblong | Acute | Absent | Slightly Prominent | Slopping Abruptly |
| 23 | AA-7 | Oblong | Acute | Absent | Absent | Slopping Abruptly |
| 24 | AKS-1 | Elliptic | Obtuse | Absent | Absent | Ending In a long Curve |
| 25 | AA-19 | Obovoid | Acute | Absent | Slightly Prominent | Ending In a long Curve |

Table 3: Fruit morphological characteristics of evaluated genotypes.

| Selection number | Collector code | Fruit beak type | Fruit sinus type | Fruit attractiveness | Fruit colour | Pulp color | Pulp texture |
|------------------|----------------|-----------------|------------------|----------------------|----------------------|---------------|--------------|
| 1 | AP- 1 | Perceptible | Absent | Good | Green | Light Orange | Intermediate |
| 2 | AKCA – 14 | Perceptible | Absent | Very Good | Green | Yellow | Intermediate |
| 3 | GJB -1 | Perceptible | Absent | Excellent | Greenish Yellow | Light Orange | Intermediate |
| 4 | AA -101 | Perceptible | Shallow | Good | Green | Light Orange | Intermediate |
| 5 | AA-15 | Perceptible | Absent | Excellent | Green With Red Blush | Light Yellow | Intermediate |
| 6 | AA-4 | Perceptible | Absent | Very Good | Green | Light Yellow | Intermediate |
| 7 | AA -16 | Perceptible | Absent | Good | Green | Yellow | Intermediate |
| 8 | AA -42 | Perceptible | Absent | Good | Green | Light Yellow | Soft |
| 9 | GRB-1 | Perceptible | Absent | Good | Green | Light Yellow | Intermediate |
| 10 | AA-3 | Perceptible | Absent | Very Good | Green | Yellow | Soft |
| 11 | GQ-3 | Perceptible | Absent | Good | Green | Yellow | Intermediate |
| 12 | AA-20 | Perceptible | Shallow | Very Good | Green | Yellow | Intermediate |
| 13 | AUG.1 | Perceptible | Shallow | Very Good | Green | Light Yellow | Intermediate |
| 14 | AA-9 | pointed | Shallow | Excellent | Green | Yellow | Soft |
| 15 | ABG-1 | pointed | Absent | Excellent | Green | Yellow | Soft |
| 16 | AGKB-64 | Perceptible | Absent | Good | Green | Light Yellow | Intermediate |
| 17 | AA-29 | Perceptible | Absent | Excellent | Greenish Yellow | Light Yellow | Soft |
| 18 | AA-39 | Perceptible | Absent | Very Good | Green | Orange | Intermediate |
| 19 | AA-2 | Perceptible | Absent | Very Good | Green | Yellow | Intermediate |
| 20 | AR-1 | Perceptible | Absent | Good | Green | Light Yellow | Intermediate |
| 21 | AA-8 | Perceptible | Absent | Excellent | Greenish Yellow | Light Yellow | Intermediate |
| 22 | AA-1 | Pointed | Absent | Excellent | Green | Light Yellow | Intermediate |
| 23 | AA-7 | Perceptible | Shallow | Excellent | Green | Light Yellow | Soft |
| 24 | AKS-1 | Perceptible | Absent | Excellent | Green | Yellow Orange | Intermediate |

| | | | | | | | |
|----|-------|-------------|--------|------|-------|--------|--------------|
| 25 | AA-19 | Perceptible | Absent | Good | Green | Yellow | Intermediate |
|----|-------|-------------|--------|------|-------|--------|--------------|

DISCUSSION

Fruit Shape: In the present investigation, various types of fruit shape was noted i.e. fruits with obovoid shape in the genotype AA-19, AKS-1 and AGKB-64 having Elliptic shaped fruits, in genotypes AA-3, AA-4 and AKCA-14 roundish shaped fruits, in genotypes AA-1, AA-2 and GRB-1 oblong shaped fruits.

Shape of fruit apex: Differences between the shape of fruit apex of various genotypes were also noted. Genotype AA-16 having round shaped fruit apex, AA-1, AA-7, AA-9 and GQ-3 having acute shaped fruit apex AA-2, AA-3 and GJB-1 having obtuse fruit apex.

Shape of fruit apex: The genotype AA-4, AA-8, AA-16, AA-20 and AA-42 having shallow fruit stalk cavity. Genotype AA-3 have fruit stalk cavity with medium depth, rest of all genotypes have no fruit stalk cavity or fruit stalk cavity absent.

Fruit neck prominence: The genotypes AA-7, AKS-1, ABG-1, GRB-1 and GJB-1 having no prominent fruit neck. Rest of genotypes having slightly prominent fruit neck.

Slope of fruit ventral shoulder: No uniformity in the slope of fruit ventral shoulder was observed in the evaluated germplasm. Genotypes AA-1, AA-7 and AR-1 were have abruptly slopping ventral shoulder. Whereas, genotypes AA-3, AA-4 and AKCA-14 were having rising and then rounded type ventral shoulder. Genotypes AA-2, AA-8 and GQ-3 were having ventral shoulder ending in a long curve type of slope.

Fruit beak: The genotypes AA-1, AA-9, ABG-1 were having pointed fruit beak. Rest of genotypes was having perceptible type of fruit beak.

Fruit sinus: Differences were observed in the fruit sinus type of the evaluated germplasm. The genotypes AA-7, AA-9, AA-20, AA-101 and AUG-1 were having shallow type fruit sinus. Rests of the evaluated genotype were having fruit sinus absent or no fruit sinus.

Fruit attractiveness: Excellent attractive fruit were noted in the genotype AA-1, AA-7, AA-8, AA-9, AA-15, AA-29, ABG-1, AKS-1 and GJB-1. Genotypes AA-2, AA-3, AA-4, AA-20, AA-39, AKCA-14 and AUG-1 were having good attractive fruits. Rest of genotypes having good fruits. The present results are in agreement with the previous research findings of Guirado *et al.*, (2009) who reported that Osteen and Kent look very promising cultivars.

Fruit colour: Differences between the fruit colour of the evaluated germplasm were observed in the present investigation AA-15 attained green with Red blush colour. Genotypes AA-8, AA-29, and GJB-1 attained greenish yellow colour. Rest of genotypes attained green skin colour at maturity. Present finding are in conformity with the previous research work of Pinto *et al.*, (2000) who also noted variation in skin colour in different

mango varieties (red blush peel), similar results are shown by Das *et al.*, (2007) and Guirado *et al.*, (2009) in mango. In the present study, varieties having attractive colour can be a very good source for hybridization. The fruits of AA-15 found to be promising in terms of colour hence the genotype was most attractive amongst different evaluated genotypes.

Pulp colour: The genotypes AA-101, AP-1 and GJB-1 have light orange coloured pulp. Whereas, genotypes AKS-1 have fruits with yellow orange coloured pulp. Fruits of genotype AA-39 orange yellow coloured pulp. Yellow coloured pulp was found in genotypes AA-2, AA-3, AA-9, AA-16, AA-19, AA-20, ABG-1, AKCA-14 and GQ3. Rest of the genotypes have light yellow coloured pulp of ripe fruits. Present findings are in conformity with the findings of Siller *et al.*, (1994) and Desai *et al.*, (2000) who also noted variation in pulp colour in the different mango varieties.

Pulp Texture: No uniformity was found in the pulp texture of the evaluated germplasm. AA-3, AA-7, AA-9, AA-29, AA-42 and ABG-1 having soft texture of pulp. Rest had intermediate pulp texture of ripe fruits.

Conclusions: Fruit shape of the evaluated germplasm varied enormously and fruits of obovoid, elliptic, round and oblong shapes were found. Fruit apex shape in the evaluated plants was round, acute and obtuse. Depth of fruit stalk cavity was either absent, shallow and of medium type, whereas, fruit neck prominence was absent to slightly prominent in the tested plants.

Shape of fruit ventral shoulder was varied and found to be slopping abruptly, rising and then rounded and long curve type in the evaluated germplasm. Fruit beak varies from pointed to perceptible type and fruit sinus was absent to shallow type in the fruits from different plants.

Fruit attractiveness varies from very good to excellent and fruit colour from greenish yellow to green colour of fruit skin at maturity was noted in fruits from selected trees. Peel colour of AA-15 was different amongst all the genotypes which was green with red blush. Pulp colour varied from light orange, yellow orange, orange yellow, yellow and light yellow, whereas, pulp texture was soft to intermediate in the evaluated germplasm.

Fruit stalk insertion was found to be of vertical and oblique type and density of lenticels on fruit skin was medium, sparse and dense in the fruits from evaluated plants.

The different genetic resources having desirable horticultural traits have been isolated during the studies. Genotype AA-15 can be rated with high consumer appeal due to its attractive green with red blush colour.

The germplasm with desirable traits can be proved to be good genetic material for the utilization in future breeding programmes for improving the mango varieties in Punjab. The present investigations are quite useful for future conservation and mass plantation of seedling mango in common lands of villages, unutilized lands, road sides, canal banks so as to provide fruit to the poor people. These studies showed that there exists a great variability among different mango seedling progenies and this can be exploited for the selection of elite genotypes in future after evaluating their performance and provide livelihood to local population.

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