



## Research Article

# EVALUATION OF QUALITATIVE TRAITS IN BANANA (*Musa* spp.) GENOMES

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**Abstract:** The experiment was conducted to study different qualitative characters in banana from different genomic groups. Thirty banana genotypes from genomic groups AA, AAA, AAB, AB, ABB and BB were characterized. The different characteristics studied were bunch position, bunch shape, male flower behaviour, anther exertion, fruit position, mature fruit peel colour, pulp colour at maturity, flesh texture and predominant taste. All the thirty varieties exhibited considerable variation; more in between groups than within a specific group. Among all, the varieties from group AAA as Dwarf Cavendish, Grand Naine were found with good quality fruits with sweet and soft pulp. 'Nendran' from AAB was preferable as a culinary variety with mild taste and more firm texture. Most of the varieties in AA and AAB group showed the characteristic sweet and acidic taste. The group ABB was found with somewhat diverse characteristics. The descriptors used for characterization were found efficient in differentiating banana genotypes in between groups as well as among individual genotypes.

**Keywords:** Banana, Qualitative Characters, Genomic Groups

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## Introduction

Banana (*Musa* spp.) is the second most important fruit crop in India next to mango. Botanically bananas are the kinds of large herbaceous perennial monocot flowering plants of the genus *Musa* belonging to the family *Musaceae* of order Scitamineae. Through breeding strategies, we have to develop improved genotypes with high and stable yield, improved agronomic traits, superior fruit quality and improved keeping quality also. The success of any breeding programme depends upon the quantum of genetic variability available for exploitation. Genetic diversity available from indigenous and exotic germplasm can be used to introduce new useful traits and create new gene combinations. It firstly raises the need for collection, preservation and evaluation of new cultivars in banana germplasm with documentation of their characteristics which can be achieved through critical morphological as well as molecular characterization. Qualitative characters especially play an important role in differentiating the genotypes into genomic and sub-genomic groups presenting distinctiveness in their characteristics. Hence; the experiment containing detail study of different qualitative characters of banana genotypes, with the effect of environment on their phenotypic expression was undertaken.

## Material and methods

The experimental trial was conducted at Central Experimental Station, Wakawali at Tetawali, Tal.- Dapoli, Dist.- Ratnagiri (MS) situated in Konkan region, a longitudinal section of somewhat hilly and undulating West Coastal Zone of Indian peninsula predominantly having lateritic soil, during the period from September, 2012 to February, 2014. The germplasm material comprising of 30 varieties of banana and plantains [Table-1] had been collected from the National Research Centre for Banana (NRCB), Trichy, Tamilnadu and planted at the experimental block on February 22, 2012 at a spacing of 2.5m x 2.5m. Among total of 180 plants (6 of each variety), observations on 9 qualitative characters were recorded on 3 randomly selected plants of each of the 30 varieties as per given in 'Descriptors for Banana (*Musa* spp.)', CIRAD, inibap, IPGRI, Rome, Italy.

## Results and Discussion

All the thirty varieties of banana under present study exhibited considerable variation among the nine qualitative characters as shown in [Table-1] which is in due support with the findings of other scientists also. The banana varieties under study recorded variation with respect to the character 'bunch position' [Fig-1] as hanging vertically, slightly angled and hanging at angle 45°. Horizontal and erect bunch positions were not found. This is in consonance with the findings of Jesus *et al.* [1]. However, all the five types of bunch positions were reported by Oliveira *et al.* [2] and Javed *et al.* [3] may be due to considerably large number of accessions in the germplasm. Javed *et al.* [3] differentiated PPC (local name of a wild *Musa* species sample) by having a very compact fruit bunch hanging at an angle. Onyango *et al.* [4], Rodrigues *et al.* [5] and Brandao *et al.* [6] found four types of bunch positions except the 'erect' bunch position. Similarly, the genotypes recorded variation in bunch shape like cylindrical, truncated cone shape, asymmetric with nearly straight bunch axis and with a curve in the bunch axis. Spiral bunch shape was not observed. Jesus *et al.* [1], Onyango *et al.* [4] and Rodrigues *et al.* [5] also observed such four types of bunch shapes. Rodrigues *et al.* [5] reported that this character was important in differentiating the 'Prata Ana' banana clones from the commercial cultivar. All the five types of bunch shapes were reported by Oliveira *et al.* [2] and Javed *et al.* [3]. Brandao *et al.* [6] found three types of bunch shapes viz. cylindrical, asymmetric with nearly straight bunch axis and with a curve in the bunch axis. Male flower behavior was found with some variation like falling before the bract, falling with the bract, falling after the bract and remaining persistent. The results are matching with the findings of Javed *et al.* [3], Heslop-Harrison and Schwarzacher [7] and Jesus *et al.* [1] while Rodrigues *et al.* [5] reported all the types except male flowers remaining persistent. The banana varieties under study recorded variation in anther exertion [Fig-2] like exerted, at same level and inserted which is in accordance with the findings of Oliveira *et al.* [2], Javed *et al.* [3], Jesus *et al.* [1] and Rodrigues *et al.* [5] who also reported these three types of anther exertion. The character 'fruit position' showed much more variation [Fig-3] among the thirty varieties with types viz. fruits curved towards stalk, parallel to the stalk, curved upward (obliquely, at a 45° angle

Table-1a Variation in qualitative characters of banana varieties

SN	Variety name	Genomic Group	Bunch position	Bunch shape
1	Anai Komban	AA	Slightly angled	With a curve in the bunch axis
2	Kanai Bansi	AA	Slightly angled	Asymmetric - Bunch axis is nearly straight
3	Dwarf Cavendish	AAA	Hanging vertically	Cylindrical
4	Grand Naine	AAA	Hanging vertically	Cylindrical
5	Robusta	AAA	Hanging vertically	Cylindrical
6	AmritSagar	AAA	Slightly angled	Asymmetric - Bunch axis is nearly straight
7	Red Banana	AAA	Slightly angled	Cylindrical
8	Jwari Bale	AAB	Slightly angled	Truncated cone shape
9	Nendran	AAB	Hanging at angle 45°	Asymmetric - Bunch axis is nearly straight
10	Poovan	AAB	Hanging vertically	Cylindrical
11	Pacheladan	AAB	Hanging at angle 45°	Asymmetric - Bunch axis is nearly straight
12	Malaikali	AAB	Hanging at angle 45°	Asymmetric - Bunch axis is nearly straight
13	Ladan Pointed	AAB	Hanging at angle 45°	Cylindrical
14	NendraPadathi	AAB	Slightly angled	With a curve in the bunch axis
15	Sabri	AAB	Slightly angled	Cylindrical
16	Kunnan	AB	Hanging at angle 45°	Truncated cone shape
17	Ney Poovan	AB	Hanging at angle 45°	Asymmetric - Bunch axis is nearly straight
18	Karpuravalli	ABB	Slightly angled	Cylindrical
19	Peyan	ABB	Hanging vertically	Cylindrical
20	Udhayam	ABB	Hanging vertically	Cylindrical
21	Ankur II	ABB	Hanging vertically	Cylindrical
22	Kachkel	ABB	Hanging vertically	Asymmetric - Bunch axis is nearly straight
23	Bangrier	ABB	Slightly angled	Cylindrical
24	Kothia	ABB	Hanging vertically	Cylindrical
25	Saba	ABB	Slightly angled	Asymmetric - Bunch axis is nearly straight
26	Nutepong	ABB	Slightly angled	Asymmetric - Bunch axis is nearly straight
27	PacheBonthaBathesa	ABB	Hanging vertically	Cylindrical
28	Ashy Bathesa	ABB	Hanging vertically	Cylindrical
29	Birbutia	ABB	Slightly angled	Cylindrical
30	<i>Musa Balbisiana</i>	BB	Hanging vertically	Cylindrical

Table-1b Variation in qualitative characters of banana varieties

SN	Variety name	Genomic Group	Male flower behaviour	Anther exertion	Fruit position
1	Anai Komban	AA	Falling after the bract	Same level	Curved upward obliquely at 45°
2	Kanai Bansi	AA	Falling after the bract	Same level	Curved upward obliquely at 45°
3	Dwarf Cavendish	AAA	Falling after the bract	Exserted	Curved upward obliquely at 45°
4	Grand Naine	AAA	Falling after the bract	Exserted	Curved upward obliquely at 45°
5	Robusta	AAA	Falling after the bract	Exserted	Curved upward obliquely at 45°
6	AmritSagar	AAA	Falling after the bract	Exserted	Curved upward obliquely at 45°
7	Red Banana	AAA	Falling after the bract	Inserted	Curved upward obliquely at 45°
8	Jwari Bale	AAB	Falling after the bract	Same level	Perpendicular to the stalk
9	Nendran	AAB	Falling after the bract	Inserted	Pendant
10	Poovan	AAB	Falling after the bract	Same level	Curved upward obliquely at 45°
11	Pacheladan	AAB	Falling after the bract	Inserted	Perpendicular to the stalk
12	Malaikali	AAB	Falling after the bract	Exserted	Perpendicular to the stalk
13	Ladan Pointed	AAB	Falling after the bract	Inserted	Perpendicular to the stalk
14	NendraPadathi	AAB	Falling after the bract	Exserted	Perpendicular to the stalk
15	Sabri	AAB	Falling after the bract	Exserted	Curved upward obliquely at 45°
16	Kunnan	AB	Falling before the bract	Inserted	Curved upward obliquely at 45°
17	Ney Poovan	AB	Falling after the bract	Same level	Curved towards stalk
18	Karpuravalli	ABB	Falling after the bract	Inserted	Curved upward obliquely at 45°
19	Peyan	ABB	Falling after the bract	Exserted	Curved upward obliquely at 45°
20	Udhayam	ABB	Falling after the bract	Inserted	Parallel to the stalk
21	Ankur II	ABB	Falling before the bract	Inserted	Perpendicular to the stalk
22	Kachkel	ABB	Falling after the bract	Same level	Perpendicular to the stalk
23	Bangrier	ABB	Falling after the bract	Exserted	Curved upward obliquely at 45°
24	Kothia	ABB	Falling after the bract	Exserted	Curved upward obliquely at 45°
25	Saba	ABB	Falling before the bract	Inserted	Perpendicular to the stalk
26	Nutepong	ABB	Falling before the bract	Inserted	Parallel to the stalk
27	PacheBonthaBathesa	ABB	Falling after the bract	Inserted	Parallel to the stalk
28	Ashy Bathesa	ABB	Falling with the bract	Inserted	Curved upward obliquely at 45°
29	Birbutia	ABB	Falling after the bract	Inserted	Curved upward obliquely at 45°
30	<i>Musa Balbisiana</i>	BB	Male flowers persistent	Exserted	Curved upward obliquely at 45°

upward), perpendicular to the stalk and pendant. Oliveira *et al.* [2], Javed *et al.* [3], Jesus *et al.* [1], Onyango *et al.* [4] and Rodrigues *et al.* [5] also found all these types of fruit positions. Mature fruit peel colour has shown variation to some extent among the 30 varieties of banana. Mature fruits with yellow, bright yellow and orange-red ('Red Banana') peel colour were observed. The colours like orange, grey spots, brown/rusty-brown, pink/pink purple, red-purple or black were not observed. All the colour types except black were reported by Oliveira *et al.* [2],

Javed *et al.* [3] and Heslop-Harrison and Schwarzacher [7]. However, Onyango *et al.* [4] and Brandao *et al.* [6] observed opaque yellow, yellow, green and pink together, red, pink and only green coloured mature fruit peels of bananas. The banana varieties under study recorded variation in pulp colour at maturity like cream, ivory, yellow and orange. No one variety has shown white, beige-pink or any other pulp colour at maturity. This is in agreement with the findings of Brandao *et al.* [6] who reported mature fruit pulp with white, opaque white, cream, yellow

Table-1c Variation in qualitative characters of banana varieties

SN	Variety name	Genomic Group	Mature fruit peel colour	Pulp colour at maturity	Flesh texture	Predominant taste
1	AnaiKomban	AA	Yellow	Cream	Soft	Sweet and acidic
2	Kanai Bansi	AA	Yellow	Cream	Soft	Slightly tasty
3	Dwarf Cavendish	AAA	Yellow	Cream	Soft	Sweet
4	Grand Naine	AAA	Yellow	Cream	Soft	Sweet
5	Robusta	AAA	Yellow	Cream	Firm	Sweet
6	AmritSagar	AAA	Yellow	Ivory	Soft	Sweet
7	Red Banana	AAA	Orange red	Yellow	Soft	Sweet
8	Jwari Bale	AAB	Bright yellow	Cream	Soft	Slightly tasty
9	Nendran	AAB	Bright yellow	Orange	Firm	Slightly tasty
10	Poovan	AAB	Yellow	Ivory	Firm	Sweet and acidic
11	Pacheladan	AAB	Bright yellow	Cream	Firm	Sweet and acidic
12	Malaikali	AAB	Bright yellow	Cream	Soft	Sweet and acidic
13	Ladan Pointed	AAB	Bright yellow	Cream	Soft	Sweet and acidic
14	NendraPadathi	AAB	Bright yellow	Cream	Soft	Sweet and acidic
15	Sabri	AAB	Yellow	Cream with brown tinges	Soft	Sugary
16	Kunnan	AB	Bright yellow	Cream	Firm	Sweet
17	Ney Poovan	AB	Bright yellow	Cream	Firm	Sweet
18	Karpuravalli	ABB	Yellow	Cream	Firm	Sugary
19	Peyan	ABB	Bright yellow	Cream	Firm	Slightly tasty
20	Udhayam	ABB	Yellow	Cream	Firm	Sweet and acidic
21	Ankur II	ABB	Bright yellow	Cream	Firm	Sweet and acidic
22	Kachkel	ABB	Bright yellow	Cream	Firm	Sweet and acidic
23	Bangrier	ABB	Bright yellow	Cream	Firm	Tasteless
24	Kothia	ABB	Bright yellow	Cream	Soft	Sweet and acidic
25	Saba	ABB	Bright yellow	Cream	Firm	Slightly tasty
26	Nutepong	ABB	Bright yellow	Ivory	Soft	Sweet
27	PacheBonthaBathesa	ABB	Bright yellow	Cream	Soft	Sweet
28	Ashy Bathesa	ABB	Bright yellow	Cream	Soft	Sweet
29	Birbutia	ABB	Bright yellow	Cream	Soft	Slightly tasty
30	<i>Musa Balbisiana</i>	BB	Bright yellow with reddish tinge	Cream	Soft	Sweet



Grand Naine (AAA)

Birbutia (ABB)

Ladan Pointed (AAB)

Fig-1 Variation in Bunch Position



Kothia (ABB)

Kachkel (ABB)

Ankur-II (ABB)

Fig-2 Anther exsertion





Fig-3 Fruit Position on Bunch

and orange colour. Flesh texture was observed with the least variation with types firm or soft. Both types were found in the present study. It is in accordance with the findings of Onyango *et al.* [4] and Brandao *et al.* [6]. Considerable variation was found with respect to the predominant taste like mild or slightly tasty or tasteless, sweet, sugary and 'sweet and acidic'. None of the variety has shown astringent or any other type of taste. All the types of tastes were reported by Oliveira *et al.* [2], Javed *et al.* [3], Jesus *et al.* [1], Onyango *et al.* [4] and Rodrigues *et al.* [5]. Among the all, the genomic group AAA was found with good quality fruits with sweet and soft pulp. Varieties from AB genomic group viz. 'Kunnan' and 'Ney Poovan' were also found with the good quality fruits sweet in taste and small in size. Most of the varieties in AA and AAB genomic group could be preferred for their characteristic sweet and acidic taste. The genomic group ABB was found with somewhat mixtures of varieties, some showing sweet taste with soft texture, some showed sweet with firm texture, some were slightly tasty while one viz. 'Bangrier' was found tasteless [Table-1]. Among the culinary varieties having mild taste and more firm texture, 'Nendran' (AAB) was found as the best.

### Conclusion

All the thirty varieties exhibited considerable variation among the qualitative characters. The variation in characters was found more in between the above groups than found within a specific group. Among the all, the varieties from genomic group AAA as Dwarf Cavendish, Grand Naine were found with good quality fruits with sweet and soft pulp while 'Nendran' from AAB was found preferable as a culinary variety with mild taste and more firm texture. Most of the varieties in AA and AAB genomic group could be preferred for their characteristic sweet and acidic taste. The group ABB was found with somewhat diverse characteristics than the others. The descriptors used for characterization were found efficient in differentiating in between the banana genotypes among groups as well as among individual genotypes also. In Maharashtra, culinary purpose varieties have somewhat less or almost negligible demand compared to the South India. But as per the nutritional value is concerned, such starchy cooking bananas might be proved as a solution to the problem of food shortage. Hence, their use should be brought into notice of people and cultivation of different varieties, also other than table purpose, must be promoted at the commercial level.

**Application of research:** Studying and evaluating qualitative characters, especially in the crops like Banana which is generally vegetative propagated crop, helps to classify the genotypes in different genomes also revealing their evolutionary relationships or if artificially bred, their links tracing back to their common ancestors. Such grouping relationships rendering their closeness or distinctiveness can then be taken into consideration while their further breeding programmes and crop improvement.

**Research Category:** Plant genetics

### Abbreviations:

Genome A- from wild banana species- *Musa acuminata*

Genome B- from wild banana species- *Musa balbisiana*  
IPGRI- International Plant Genetic Resources Institute  
NRCB- National Research Centre for Banana, India

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