Guidelines
for the Conduct of Test for
Distinctiveness, Uniformity and Stability

On

Banana

(*Musa* spp.)

Protection of Plant Varieties and Farmers Rights' Authority
(PPV & FRA)
Government of India

Banana (*Musa* spp.)

I. Subject

These test guidelines shall apply to all cultivars, varieties, hybrids, transgenic plants and parental lines of Banana (*Musa* spp.) restricted to the section Eumusa. All cultivated bananas are derived mainly from two wild species, *M.acuminata* and *M.balbisiana* (contributing A and B genomes respectively) either alone or in various genomic combinations. All natural varieties and hybrids of edible bananas exhibit diverse genomic combinations like AA, BB, AB, AAA, AAB, ABB, AAAA, AAAB, AABB and ABBB.

II. Plant material required

1. The Protection of Plant Varieties and Farmers' Rights Authority (PPV & FRA) shall decide when, where and in what quantity and quality of planting material are required for testing a variety applied for registration under the Protection of Plant Varieties and Farmers' Right Act (PPV & FR Act), 2001. Applicants submitting such planting material from a country other than India shall make sure that all customs and quarantine requirements stipulated under relevant national legislations and regulations are complied with. The minimum quantity of plant material to be supplied by the applicant shall be 40 uniform tissue cultured plants in one submission per location.

2. The tissue culture plants shall be healthy, vigorous, without nutrient deficiency and free from pests and diseases. The age shall be 3 months from the date of start of hardening in shade house. The plant material should possess highest genetic purity and freeness from major pests like rhizome weevil, pseudostem borer, aphids, nematodes and root mealy bugs; diseases like Fusarium wilt, leaf spot diseases. Plants should carry the certificate for its freeness from viruses like Cucumber Mosaic Virus, Banana Bunchy Top Virus, Banana Bract Mosaic Virus and Banana Streak Virus. It should comply with all phytosanitary standards.

3. The planting material must not have undergone any treatment unless the PPV&FR Authority allows or requests for such treatment. If it has been treated, full details of the treatment must be given.

III. Conduct of Tests

1. DUS testing is conducted at atleast two locations. Plant materials from South and west shall be tested at NRCB, Trichy and BRS, Kannara, KAU, Thrissur and materials from north and east shall be tested at HRC, Nagicherra, Agartala, Tripura and Bidan Chandra Krishi Vishwa Vidyalaya (BCKV), Mohanpur, West Bengal.
2. Minimum duration of tests shall normally be one main and one ratoon crop or two independent similar growing seasons depending on the variety submitted for DUS test.
3. The test shall normally be conducted at identified DUS test location.
4. The field tests shall be carried out under conditions favouring normal growth and expression of all test characteristics.
5. Test plot design:

Spacing	: depending on the stature, the spacing is
	1.8 m x 1.8 m – for short types
	2.0 m x 2.0 m – for medium types
	2.1 m x 2.1 m – for tall types
No. of plants /replication	: 10 plants
Number of replications	: 3
Total No. of plants	: 30 (10 x 3)

The reference DUS variety (variety of common knowledge) should be raised along with the candidate variety to facilitate the assessment of Distinctness. A separate block of 10 plants of DUS reference variety should be raised along with the candidate variety. Cultivation and management practices has been annexed (Annexure I).

IV Methods and observations

1. The traits described in the table of characteristics shall be used for the DUS testing of varieties.
2. All observations for the assessment of Distinctiveness and Stability shall be made on at least 5 plants or parts of 5 plants per replication.

3. For the assessment of Uniformity of characteristics on the plot as a whole, a population standard of 1% with an acceptance probability of at least 95% shall be applied. In case of sample size of 30 plants, the number of off types allowed would not be more than 1.
4. All the leaf characters shall be made on 3rd fully opened leaf from the top.
5. For the assessment of all colour characteristics the latest characteristics developed by INIBAP/IPGRI (BIOVERSITY) /CIRAD (1996) shall be referred.

V. Grouping of the varieties

1. The candidate varieties for DUS testing shall be divided into five groups to facilitate the assessment of distinctiveness. Characteristics suitable for grouping purposes, are known from experience within a variety and which in their various states are evenly distributed across all varieties in the collection, are suitable for grouping and sub grouping purposes. But in case of bananas, the internationally accepted grouping and refined by the International *Musa* Taxonomy Group shall be considered.
2. The following characteristics shall be used for grouping the varieties:

Sl.No	Main traits	Traits grouped
1	Plant general appearance	Pseudostem appearance (Characteristic 1 and 2)
2	Leaf habit	Leaf orientation (Characteristic 5), Leaf blade - shape of base (Characteristic 8)
3	Inflorescence	Peduncle length (Characteristic 9), Peduncle colour (Characteristic 10)
4	Bunch	Bunch shape (Characteristic 12), Rachis (Characteristics 15, 16 and 17), Male bud (Characteristic 18,19, 20 and 21)
5	Fruit	Fruit orientation (Characteristic 26), Fruit shape (Characteristic 28), Pedicel (Characteristic 32, 33 and 34) Peel (Characteristic 35,36 and 38), Pulp (Characteristic 39).

VI Characteristics and symbols

1. To assess Distinctiveness, Uniformity and Stability, the characteristics and their states as given in the table of characteristics shall be used.
2. Notes (1-9) shall be used to describe the state of each character for the purpose of digital / data processing and these notes shall be given against the states of each characteristic.

3. Legend

(*) is mentioned for those traits which are always taken into consideration independent of variety, group, subgroup, location, season etc.

(+) is mentioned wherever sketches are given.

4. Type of assessment of characteristics indicated in column seven for Table of Characteristics is as follows:

MG : Measurement by a single observation on a group of plants or parts of plants

MS : Measurement of a number of individual plants or parts of plants

VG : Visual assessment by a single observation on a group of plants or parts of plants

VS : Visual assessment by observation of individual plants or parts of plants

QL : Qualitative characteristics are those that are expressed in discontinuous states (e.g. colour of the flower, rachis appearance, persistence of floral relicts etc.). These states are self-explanatory and independently meaningful. All states are necessary to describe the full range of the characteristic and every form of expression can be described by a single state. The order of states is not important. As a rule, the characteristics are not influenced by environment.

QN :Quantitative characteristics are those where the expression covers the full range of variation from one extreme to the other. The expression can be recorded on a one-dimensional, continuous or discrete, linear scale. The range of expression is divided into a number of states for the purpose of description (e.g. length of pseudostem: very short (1), short (3), medium (5), long (7), very long (9)). The Test Guidelines do not specify the difference needed for distinctness. The states of expression should, however, be meaningful for DUS assessment.

PQ : Pseudo-qualitative characteristics, the range of expression is at least partly continuous, but varies in more than one dimension (e.g. shape: lanceolate (1), Ovoid (3), round (5) etc. cannot be adequately described by just defining two ends of a linear range similar to qualitative (discontinuous) characteristics. Hence the term "pseudo-qualitative" where each individual state of expression needs to be identified to adequately describe the range of the characteristic.

AH : At the time of bunch harvest
BH : Before bunch harvest
AS : At the time of shooting / flowering
BS : Before shooting / flowering

VII Table of characteristics (descriptors and descriptor states)

Plant General Appearance

Sl. No.	Characteristics	States	Note	Example Varieties	Stage of observation	Type of Assessment
1. (*) QN	Pseudostem length (m)	Very short (< 2) Short (2 - 2.5) Medium (2.6 - 3) Long (3.1 - 4) Very Long (> 4)	1 2 3 4 5	Dwarf Cavendish Namarai Poovan Karpuravalli Athiakol	AS	MG
2. QL	Pseudostem colour	Green yellow Green Red Others	1 3 5 9	Nendran Attikol Red Banana -	AS	VG

Leaf habit

3. (+) QL	Purple blotches on younger leaves	Without blotches With blotches	1 9	Monthan Grand Naine	BS (On three months old side sucker)	VG
4. PQ	Colour of the under surface of cigar leaf	Green Red purple Others	1 2 3	Monthan Nendran -	BS (On three months old side sucker)	VS
5. (+) QL	Leaf orientation	Upright Spreading Drooping	1 2 3	Kunnan Rasthali Bhat Manohar	AS	VG

6. (+) QL	Petiole canal	Open with margins spreading Wide with erect margins Straight with erect margins Margins curved inwards Margins overlapping	1 2 3 4 5	Dwarf cavendish Rasthali Monthan Athiakol Bhimkol	BS	VG
7. (+) QN	Petiole length (cm)	Short (30 - 40) Medium (41 - 69) Long (> 70)	2 4 6	Grand Naine Poovan Karpuravalli	AS	MS
8. (*) (+) PQ	Leaf blade- shape of base	Both sides rounded One side rounded and one side acute Both sides acute	1 2 3	Monthan Rasthali Grand Naine	BS	VG

Inflorescence Peduncle

9. QN	Peduncle length (cm)	Short (30 – 40) Medium (41 – 69) Long (> 70)	2 4 6	Kunnan Poovan Karpuravalli	AS	MG
10. QL	Peduncle colour	Light green Green Dark green Red or Pink purple	1 2 3 4	Rasthali Monthan Poovan Red banana	AS	VG
11. (*) QL	Peduncle pubescence	Absent Present	1 9	Kunnan Grand Naine	AS	VS

Bunch

12. (*) (+) PQ	Bunch Shape	Cylindrical Irregular Conical	1 2 3	Robusta Amritsagar Monthan	AH	VG
13. (*) (+) QL	Bunch position	Hanging vertically Hanging at an angle Horizontal	1 2 3	Robusta Rasthali Ladan	AH	VS
14. PQ	Bunch - Compactness	Loose/lax Medium Compact	1 2 3	Monthan Karpuravalli Poovan	AH	VG

Rachis/Male phase

15. (+) QL	Rachis - orientation of male phase	Hanging Vertically Inclined at an angle Curved with vertical end Horizontal with inclined end	1 2 3 4	Grand Naine Rasthali Gros Michel Poovan	BH	VS
16. (*) QL	Rachis appearance	Bare Male flowers / bracts above the male bud (but the stalk is bare above flowers / bracts) Neutral/male flowers and presence of withered bracts (on the whole stalk) Rachis absent	1 2 3 4	Monthan Robusta Kullan Poovilla Chundan, Horn plantain	AH	VS
17. (*) (+) QL	Rachis - Prominence of bract scars	Weak Moderate Strong	1 2 3	Bhimkol Rasthali Anaikomban	AH	VG

Male flower bud:

All characteristics should be studied 3-7 days after the emergence of last fruit hand

18. (*) (+) QL	Male bud	Absent Degenerative Present	1 2 3	Poovilla Chundan False Horn Plantain Monthan	BH	VS
19. (*) QL	Male bud colour	Yellow Green Purple Red Others	1 2 5 7 9	*Musa swarnaphalya* *M.ac.ssp.banksii* Pisang Lilin Sanna Chenkadali -	BH	VG
20. (*) (+) PQ	Male bud shape	Lanceolate Ovoid Rounded	1 3 5	Ney Poovan Poovan *M. balbisiana*	BH	VG
21. (*)	Male flower colour	Whitish Orange yellow	1 3	Rasthali Nendran	BH	VG

QL		Pink shaded Others	5 6	Monthan -		
22. QL	Stigma colour	Creamy dull white Cream Orange Others	1 3 5 6	Robusta Monthan Malaikali -	BH	VG
23. (+) QL	Style shape	Straight Curved under stigma Curved under the base	1 3 5	Anaikomban Rasthali Kothia	BH	VG
24. (*) (+) QL	Bract behavior - Curling	Not Revolute Revolute	1 2	Athiakol Robusta	BH	VG
25. (*) PQ	Persistence of male bracts	Absent or weak Strong	1 3	Rasthali Dwarf Cavendish	BH	VG

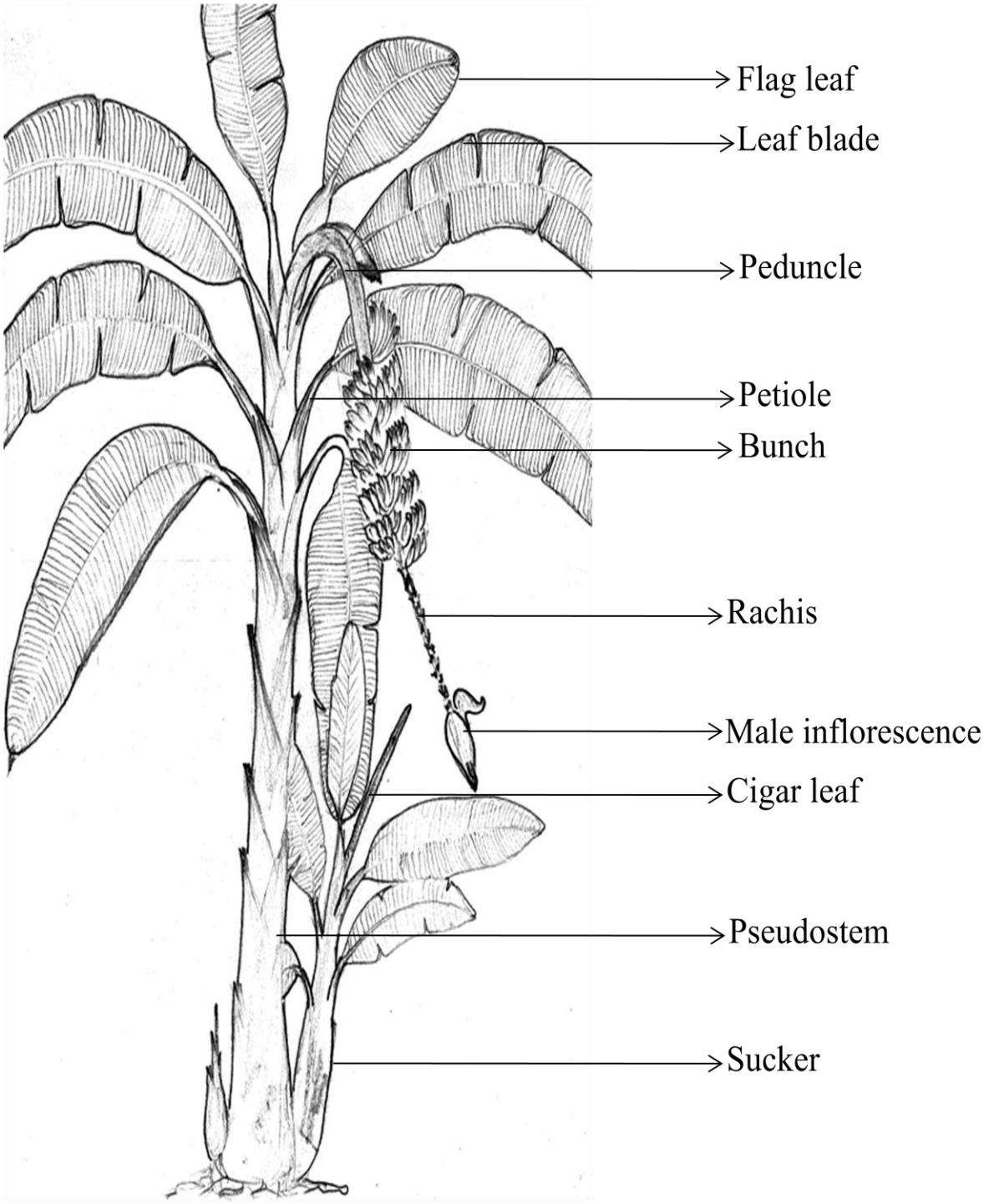
Fruit

26. (*) QL	Fruit orientation	Perpendicular to the axis Curved upward Curved towards stalk / peduncle	1 2 3	Virupakshi Monthan Robusta	AH	VS
27. (*) QN	Fruit length (cm)	Short (< 6) Medium (6.1 – 15) Long (> 15)	1 3 5	Namarai Poovan Nendran	AH	MS
28. (*) (+) PQ	Fruit shape	Straight Slightly curved Straight at the distal part	1 2 3	Poovan Nendra Padathi Bangrier, Nendran	AH	VG
29. (*) (+) PQ	Transverse section of fruit	Rounded Slight ridges Pronounced ridges	1 2 3	Poovan Robusta Ladan	AH	VS
30. (*) (+) QL	Fruit apex	Pointed Blunt tipped Bottle necked Truncate Rounded	1 2 3 4 5	Nendran Rasthali Poovan Dwarf Cavendish Motta Poovan, Popoulu	AH	VG
31. (+) QL	Persistence of floral organs	Absent Present	1 9	Poovan Anaikomban	AH	VG

32. QL	Fruit pedicel attachment at ripeness	Weak Medium Strong	1 2 3	Rasthali Poovan Monthan	AH	VG
33. (*) QN	Pedicel surface	Glabrous Pubuscent	1 2	Monthan Robusta	AH	VS
34. (*) QN	Pedicel length (cm)	Very short (< 0.6) Short (0.6 – 1) Medium (1.1 – 1.5) Long (> 1.5)	1 2 3 4	Thella Chakkarakeli Robusta Rasthali Monthan	AH	MG
35. QL	Peel colour before ripening	Pale green Green Dark green Red / purple Others	1 2 3 4 9	Rasthali Monthan Poovan Red Banana -	AH	VG
36. QL	Adherence of peel	Weak Medium Strong	1 2 3	Rasthali Poovan Monthan	AH	VS
37. QL	Waxiness of the fruit	Not waxy Waxy	1 2	Rasthali Karpuravalli, Ash Monthan	AH	VG
38. (*) QL	Peel colour at full ripeness	Pale yellow Golden yellow Ashy yellow Green Red orange Others	1 2 3 4 5 6	Rasthali Poovan Ash Monthan Robusta Red Banana -	AH	VG
39. (*) QL	Fruit pulp colour at ripeness	White Cream Yellow Orange yellow	1 2 3 4	Rasthali Malaivazhai Pisang Mas Nendran	AH	VG
40. (*) QN	No. of hands per bunch	Few (5 - 6) Medium (7 - 8) Many (> 8)	1 2 3	Amirtsagar Rasthali Grand Naine	AH	MS
41. (*) QN	No. of fingers per hand	Few (< 9) Medium (9 - 13) Many (> 13)	1 2 3	Moongil, Horn plantain Nendran Grand Naine	AH	MS

VIII. Explanation and pictorial representation of the table of characteristics

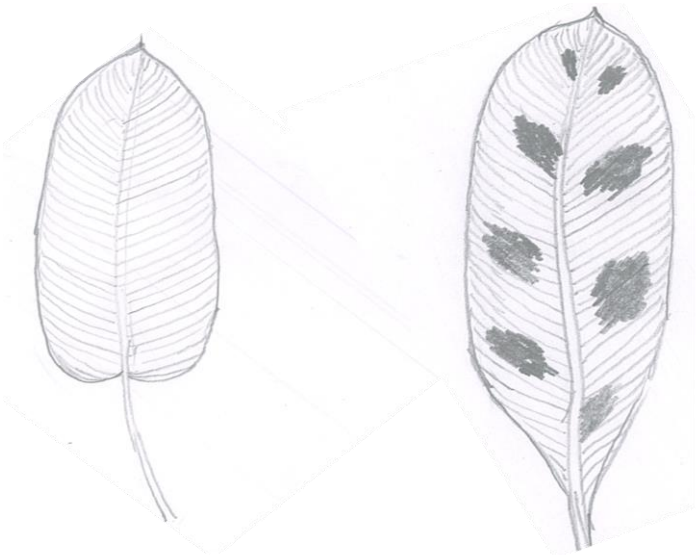
Pictorial representation of the plant



Characteristic VII: 1. Pseudostem length

Recorded from the base of the pseudostem to emerging point of the peduncle

Characteristic VII: 3. Purple blotches on younger leaves



1
Without blotches

9
With blotches

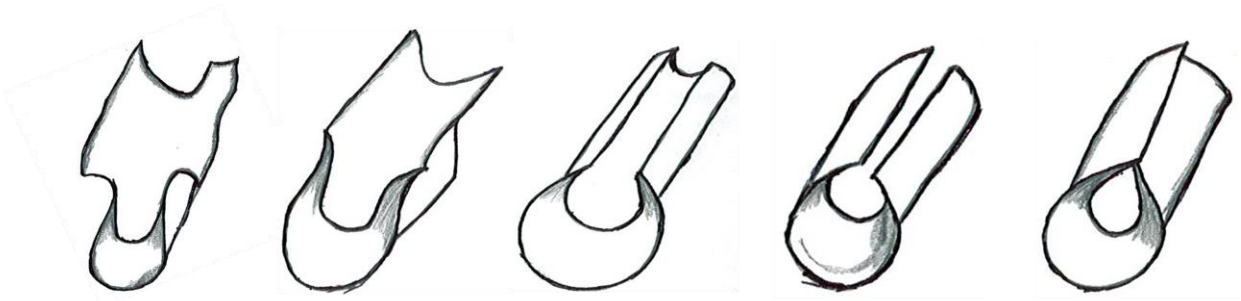
Characteristic VII: 5. Leaf orientation

1
Upright

2
Spreading

3
Drooping

Characteristic VII: 6. Petiole canal



1
Open with margins spreading

2
Wide with erect margins

3
Straight with erect margins

4
Margins curved inwards

5
Margins overlapping

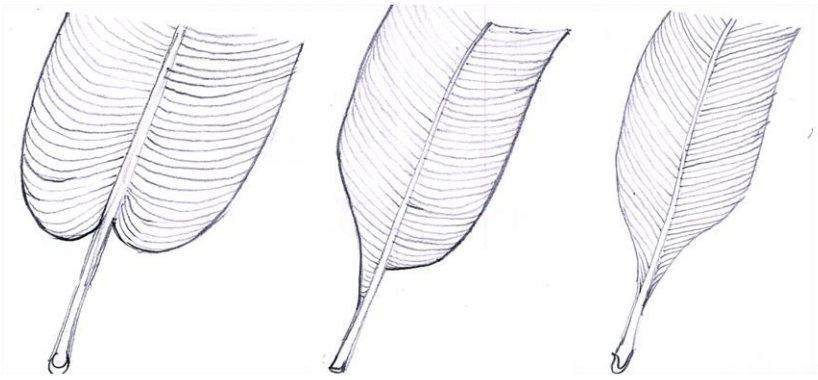
Characteristic VII: 7. Petiole length

2
Short

4
Medium

6
Long

Characteristic VII: 8. Leaf blade - shape of base



1
Both sides rounded

2
One side rounded and one side acute

3
Both sides acute

Characteristic VII: 9. Peduncle length (cm)

Measured from the leaf crown to the first hand of fruit

Angle between the pseudostem and general axis of the bunch

Characteristic VII: 12. Bunch shape

1
Cylindrical

2
Irregular

3
Conical

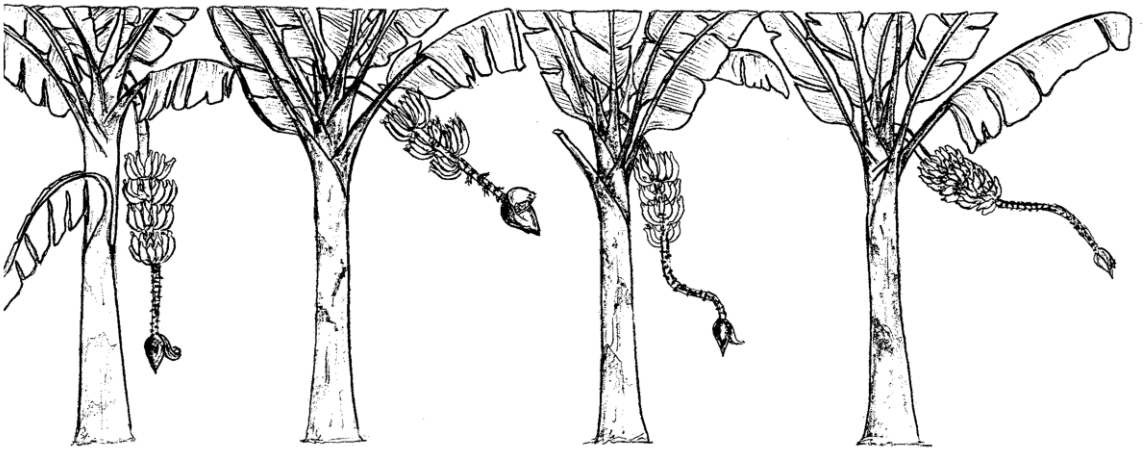
Characteristic VII: 13. Bunch Position

1
Hanging vertically

2
Hanging at an angle

3
Horizontal

Characteristic VII: 15. Rachis - orientation of male phase

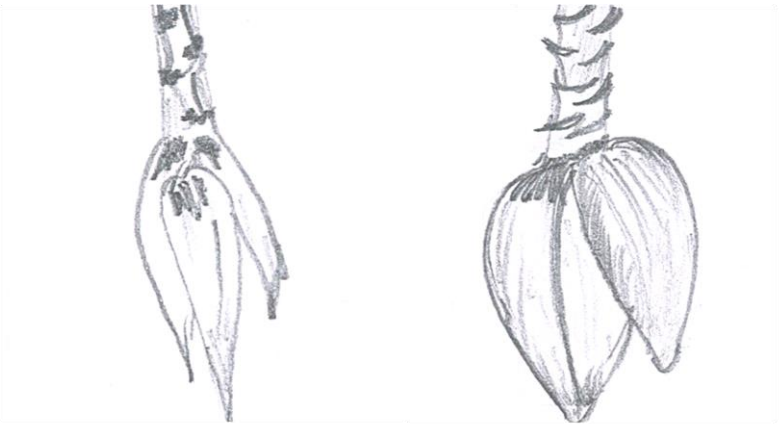


1	2	3	4
Hanging vertically	Inclined at an angle	Curved with vertical end	Horizontal with inclined end

Characteristic VII: 17. Rachis - prominence of bract scars

1	2	3
Weak	Moderate	Strong

Characteristic VII: 18. Male bud



2
Degenerative

3
Present

Characteristic VII: 20. Male bud shape

1
Lanceolate

3
Ovoid

5
Rounded

Characteristic VII: 23. Style Shape

1
Straight

3
Curved under stigma

5
curved under the base

Characteristic VII: 24. Bract behavior - curling

1
Not-Revolute

2
Revolute

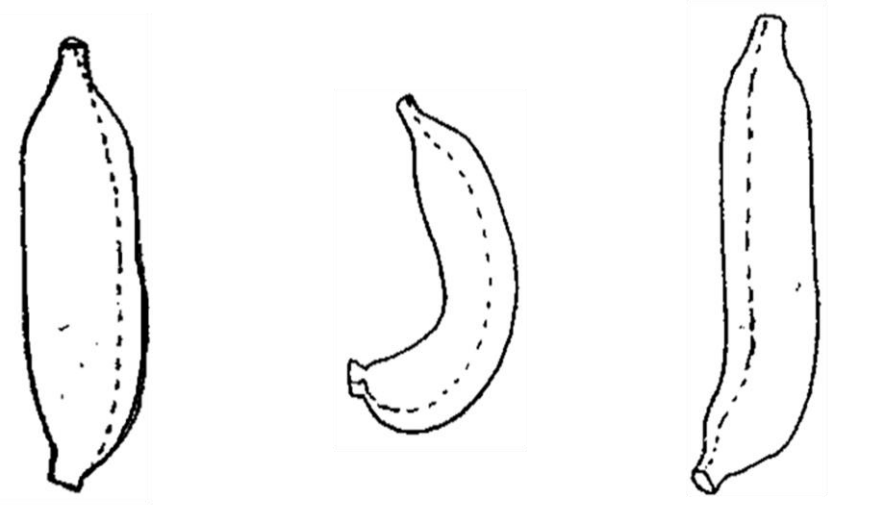
Characteristic VII: 26. Fruit orientation

Angle between the central rachis to the fruit

Characteristic VII: 27. Fruit length

Measured from the pedicel to the tip of the fruit

Characteristic VII: 28. Fruit Shape

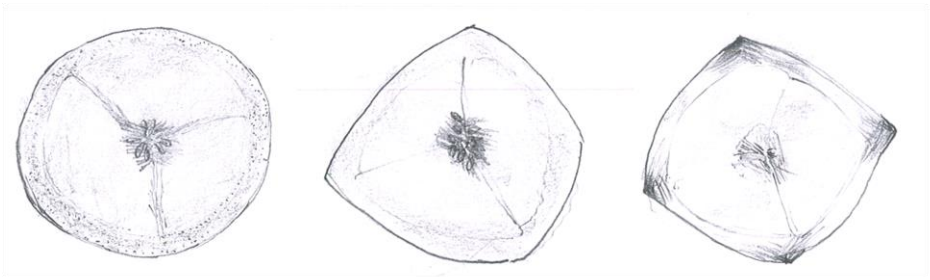


1
Straight

2
Slightly Curved

3
Straight at the distal part

Characteristic VII: 29. Transverse section of fruit

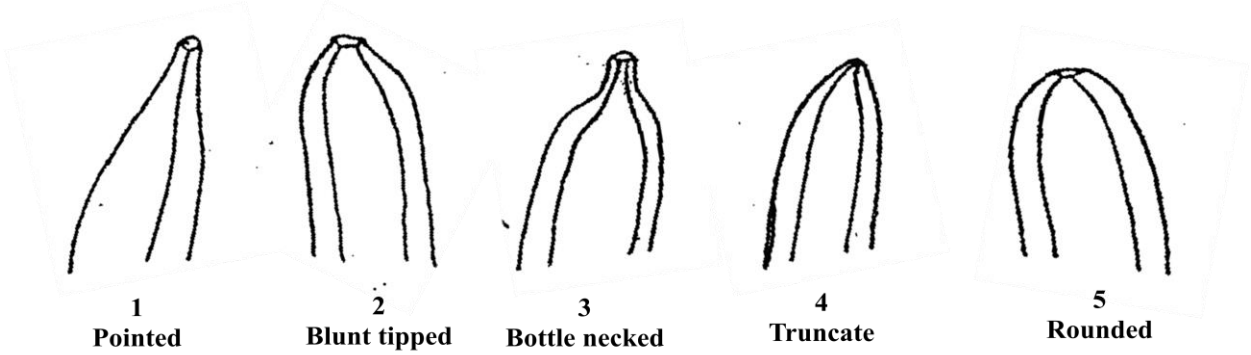


1
Rounded

2
Slightly ridges

3
Pronounced ridges

Characteristic VII: 30. Fruit apex



1
Pointed

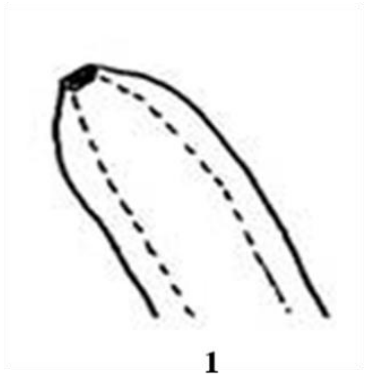
2
Blunt tipped

3
Bottle necked

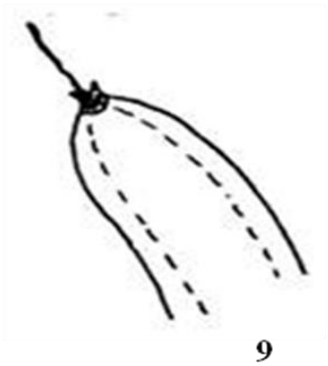
4
Truncate

5
Rounded

Characteristic VII: 31.Persistence of floral organs



1
Absent



9
Present

IX. LITERATURE

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X. Working Group details

The test guidelines developed by the Task Force constituted by the PPV & FR Authority.

Constitution of the Task Force

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Dr.Anuradha Agrawal	Principal Scientist, Conservation Division, NBPGR, National Bureau of Plant Genetic Resources, New Delhi-110012	Member
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Dr. Tejbir Singh	Registrar, PPV & FR Authority, New Delhi-110012	Member Secretary

Nodal Persons

1. PI : Dr. S. Uma, Principal Scientist, NRCB, Trichy.
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3. Co-PI : Dr. M.S. Saraswathi, Senior Scientist, NRCB, Trichy.

Co-Nodal Persons

1. Dr. S. Das, Senior Horticulturist, Horticulture Research Complex, Nagicherra, Agartala, Tripura.
2. Mr. Khokan Roy, Assistant Director, Horticulture Research Complex, Nagicherra, Agartala, Tripura.
3. Mr. Pulak Chaudhuri, Deputy Director, Horticulture Research Complex, Nagicherra, Agartala, Tripura.

XI. DUS test centres

Nodal DUS centre	Co-Nodal DUS centre
National Research Centre for Banana, Thogamalai Road, Thayanur P.O. Trichy, TamilNadu-620102	Horticulture Research Centre (HRC) Nagicherra, Agartala, Tripura.