

REVISED

Guidelines
for the Conduct of Test for
Distinctiveness, Uniformity and Stability
On
Mango
(*Mangifera indica* L.)



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

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Mango (*Mangifera indica* L.)

I. Subject

These test guidelines shall apply to all varieties of Mango (*Mangifera indica* L.)

II. Material required

1. The Protection of Plant Varieties and Farmers' Rights Authority (PPV & FRA) shall decide on the quantity and quality of the plant material required for testing the variety and when and where it is to be delivered for testing for registration under the Protection of Plant Varieties and Farmers' Rights (PPV & FRA) Act, 2001. Applicants submitting such plant 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.
2. The material is to be supplied in the form of 9 rooted grafts for each location.
3. The plant material supplied should be visibly healthy, not lacking in vigour, nor affected by any pest or disease.
4. The plant material shall not have undergone any chemical or bio-physical treatment, unless the Registrar of the Authority has requested for such treatment. If, it has been treated, full details of the treatment must be provided.

III. Conduct of tests

1. The minimum duration of the DUS tests shall normally be at least two fruiting seasons in different calendar years. Tests shall be conducted at least at two locations.
2. The tests should be carried out under conditions ensuring satisfactory growth for the expression of the relevant characteristics of the variety and for the conduct of the examination. In particular, it is essential that the trees produce a satisfactory crop of fruit in each of the two growing cycles.

3. Test design

The design of the tests should be such that the plants or parts of plants may be removed for measurement or counting without prejudice to the observations which must be made up to the end of the growing cycle.

Testing at DUS testing center

The tests shall normally be carried out at the DUS testing center's for the recommended period of years. However, looking into the perennial nature of the crop, provision has been made for *on-site DUS testing* with prior precautions as mentioned below.

Testing on-site

The applicant should have well grown bearing mother plant *on-site* (for SAU, Institutes and at farmer's field). Since Uniformity & Stability of propagated trees cannot be tested on a

single tree *on-site*, the Registrar for this purpose, shall stipulate the applicant to produce grafted trees (27 Nos.) within the first 09 (Nine) years. Failing which the registration shall not be renewed.

- The applicant or his/her nominee shall submit a request to the Authority for *on-site* examination prior to start of bearing season as mentioned in Test Guidelines for site examination of the candidate variety.
- *on-site* testing may be conducted at the places specified by the applicant. The age of the trees at *on-site* shall be minimum 5 years.
- All chimeric branches/infested/malformed branches have to be removed before considering the *on-site* tree as mother tree. If the breeder/farmer objects to it such a tree cannot be considered for DUS. Such a tree with GIS position shall be permanently numbered on the procambium under the bark at 10ft or above the ground. The less of this can lead to forfeiture of registration.

Conditions for the conduct of on- site examination will be approved by the PPV and FRA, New Delhi, to ensure the site represents normal grouping structure and not exceptions such as in ponds/shade/slope/canopy restricting structures or density etc.

IV. Methods and observations

1. The characteristics described in the Table of characteristics (see Section VII) shall be used for testing the varieties and hybrids for their DUS.
2. For the assessment of Distinctiveness and Uniformity, observations shall be made on five plants or relevant parts taken from each plant, randomly. In the case of parts of plants, the minimum number to be taken from each plant should be two.
3. Mature leaves in the middle third of the youngest shoots not showing signs of active growth should be selected for the observations on the leaf.
4. Observations on the inflorescences should be made at the time of full flowering on terminal panicles of typical shoots from the exposed regions of the tree.
5. Observations on the mature fruit should be recorded when the particular fruit is ready for harvesting. At this stage flesh is still quite firm and has not become juicy but has started colouring around the stone.
6. The ripe fruit is the fruit at the stage ready for consumption. This stage is reached when the flesh is juicy and has become coloured from the stone to the skin.
7. The optimum stage of plant growth for assessment of each characteristic is given in the sixth column of the Table of characteristics are described below:

S. No.	Growth stages	Codes
1.	Anthocyanin coloration should be recorded on young leaf of the current season	A

shoot showing active growth stage of 311 BBCH scale showing beginning of shoot growth , axes of developing shoots visible about 10% of final length.

2. Observations on the leaf which should be made on mature leaves in the middle third of the youngest shoots not showing signs of active growth. B
3. Inflorescences should be selected from terminal panicles of typical shoots from the exposed regions of the tree. Observations should be made at the time of full flowering. C
4. The mature fruit is the fruit ready for harvesting. This stage is reached when the flesh is still firm and has not become juicy but has started colouring around the stone. Observations on the lenticels should be made from the lateral side of fruit. D
5. The ripe fruit is the fruit that is ready for consumption. This stage is reached when the flesh is juicy and has become coloured from the stone to the skin. E
6. Observations on seed kernels were made by removing seed testa from extracted stone (seed). Observations are recorded on cotyledon for nucellar and zygotic embryo which are differentiated based on the number of cleavages or cotyledons on surface of embryo. F

V. Grouping of varieties

1. The candidate varieties for DUS testing shall be divided into groups to facilitate the assessment of Distinctiveness. The characteristics and their states which are known not to vary or vary only slightly within a variety, are suitable for grouping purpose.
2. Grouping characteristics are those in which the documented states of expression, even where produced at different locations, can be used, either individually or in combination with other such characteristics: (a) to select varieties of common knowledge that can be excluded from the growing trial used for examination of distinctiveness; and (b) to organize the growing trial so that similar varieties are grouped together.

The following characteristics shall be used for grouping of mango varieties:

- a. Mature fruit: Shape of ventral shoulder (Characteristic 23)
- b. Mature fruit: Presence of sinus (Characteristic 26)
- c. Maturity : Fruits ready to harvest (Characteristic 29)
- d. Seed: Embryony (Characteristic 33)

VI. Characteristics and symbols

1. To assess Distinctiveness, Uniformity and Stability, the characteristics and their states as given in the Table of characteristics (Section VII) shall be used.
2. States of expression are given for each characteristic to define the characteristic and to

harmonize descriptions. Notes (1 to 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

(*) Characteristics that shall be observed during every growing season on all varieties and shall always be included in the description of the variety, except when the state of expression of any of these characters is rendered impossible by a preceding phenological characteristic or by the environmental condition of the testing region. Under such exceptional situation, adequate explanation shall be provided.

(+) See Explanation on the Table of characteristics in Section VII. It is to be noted that for certain characteristics, the plant parts are described on which observations are to be taken as given in the explanation or figure(s) for clarity.

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

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

VS: Visual assessment by observations of individual plant or parts of plants

VII. Table of characteristics

S. No.	Characteristics	States	Notes	Example variety	Stage of observation	Type of Assessment
1	2	3	4	5	6	7
1. (* (+)	Young leaf: Intensity of anthocyanin coloration	Absent	1	Gulab Khas	A	VG
		Weak	3	Dashehari		
		Medium	5	Banganapalli, Langra		
		Strong	7	Alphonso, Bombay Green		
2. (*	Leaf: Blade Length	Short (<12.0 cm)	3	Kalpaddy	B	MS
		Medium (12.0-22.0 cm)	5	Totapuri		
		Long (>22.0 cm)	7	Rajawala		
3. (* (+)	Leaf: Blade Width	Narrow (<3.0 cm)	3	Kalpaddy	B	MS
		Medium (3.0-6.0 cm)	5	Langra		
		Broad (>6.0 cm)	7	Fajri		
4. (* (+)	Leaf: Blade Shape	Ovate	3	Langra, Bombay Green	B	VS
		Elliptic	5	Lal Pairi		
		Oblong	7	Gulab Khas		
5. (*	Leaf: Colour	Light green (RHS140 A, B, C & 140D)	3	Himsagar, Chausa	B	VG
		Dark green (RHS141A & 141B)	7	Bombay Green		
6. (* (+)	Leaf: Twisting of Leaf blade	Absent	1	Safeda Lucknow	B	VS
		Present	9	Alphonso, Chausa		
7. (* (+)	Leaf: Shape of base	Acute (< 30°)	3	Allumpur Baneshan	B	VS
		Obtuse (30° - 45°)	5	Fajri, Bombay Green		
		Rounded (>45°)	7	Chiltakhas		
8. (* (+)	Leaf: Shape of apex	Attenuate	3	Lal Pairi	B	VS
		Acuminate	5	Amrapali, Dashehari		
		Acute	7	Banganapalli		
9. (*	Petiole: Length	Short (< 1.5 cm)	3	Bombay Batli, Ladavio	B	MS
		Medium (1.5-3.0cm)	5	Dashehari		
		Long (> 3.0 cm)	7	Fajri		
10. (*	Inflorescence: Time of flowering 50% of the tree (Main flowering season of the area)	Early (1st Fortnight of main flowering season)	3	Vellaikolumban	C	VG
		Medium (Second fortnight of main flowering season)	5	Dashehari, Van Raj		
		Late (Third fortnight of main flowering season)	7	Neelum		

11. (* (+)	Inflorescence: Length (Primary branch)	Short (< 20.0 cm)	3	Langra	C	MS
		Medium (20.0-30.0 cm)	5	Jalimani		
		Long (> 30.0 cm)	7	Bombay Green		
12. (* (+)	Inflorescence: Width (Secondary branch)	Short (< 7.5 cm)	3	Langra	C	MS
		Medium (7.5-15 cm)	5	Chausa		
		Long (> 15 cm)	7	Sepia		
13. (* (+)	Inflorescence: Anthocyanin coloration of axis and branches	Absent or weak	1	Gilas, Chausa	C	VG
		Medium	3	Amrapali		
		Strong	5	Ambika		
14. (* (+)	Mature fruit: Length (Average)	Short (< 5.0 cm)	3	Elaichi, Chilta Khas	D	MS
		Medium (5.0-10.0 cm)	5	Gaurjit, Bombay Green		
		Long (>10.0 cm-20.0 cm)	7	Totapuri		
		Extra Long (>20.0 cm)	9	-		
15. (* (+)	Mature fruit: Width	Narrow (<5.0 cm)	3	Cherumani	D	MS
		Medium (5.0-7.0 cm)	5	Dashehari		
		Broad (>7.0 cm)	7	Fajri, Rajawala		
16. (* (+)	Mature fruit: Shape in cross section	Medium elliptic	3	M B Long	D	VS
		Broad elliptic	5	Dashehari, Amrapali		
		Circular	7	Rumani		
17. (* (*)	Mature fruit: Colour	Only green (RHS140A & 140B)	1	Bombay Green, Fajri	D	VG
		Green and yellow (RHS N144 A, B, C)	3	Bombay Yellow		
		Green and orange (RHS 151A, B, C)	5	Mallika		
		Green and pink (RHS N30A; N30B)	7	Baramasi Ahra		
		Green and purple (RHS 60 A, B, C, D)	9	Ambika		
18. (* (+)	Mature fruit: Density of lenticels	Sparse	3	Banganapalli	D	VG
		Medium	5	Kishanbhog		
		Dense	7	Neelum		
19. (* (*)	Mature fruit: Roughness of surface	Absent	1	Alphonso	D	VG
		Present	9	Arka Neelkiran		
20. (* (+)	Mature fruit: Presence of cavity at stalk	Absent	1	Dashehari	D	VG
		Present	9	Mohan Bhog		
21. (* (+)	Mature fruit: Depth of cavity at stalk	Shallow	3	Safed Mulgoa, Brindabani	D	VG
		Deep	7	Mohan Bhog		

22. (* (+)	Mature fruit: Presence of neck	Absent	1	Dashehari	D	VG
		Present	9	Totapuri		
23. (* (+)	Mature fruit: Shape of ventral shoulder	Rounded upward	1	Alphonso, Rumani	D	VG
		Rounded outward	3	Alif Laila		
		Rounded downward	5	Dilshad		
		Sloping downward	7	Starch		
		Falling abruptly	9	Totapuri		
24. (* (+)	Mature fruit: Presence of groove in ventral shoulder	Absent	1	Dashehari	D	VG
		Present	9	Khatta Gola		
25. (* (+)	Mature fruit: Bulging on ventral shoulder	Absent	1	Dashehari, Taimuria	D	VG
		Present	9	Pusa Surya		
26. (* (+)	Mature fruit: Presence of sinus	Absent	1	Dashehari, Langra, Gilas	D	VG
		Present	9	Mallika		
27. (* (+)	Mature fruit: Depth of sinus	Shallow (< 2mm)	3	Amrapali	D	VG
		Medium (2-5mm)	5	Hushnara		
		Deep (>5mm)	7	Manipur Dwarf		
28. (* (+)	Mature fruit: Bulging proximal of stylar scar	Absent or weak	1	Dashehari	D	VG
		Medium	5	Starch		
		Strong	9	Lajjat Baksh		
29. (* (*)	Maturity: Fruits ready to harvest	Early (First fortnight of fruit maturity season)	3	Bombay Green, Gaurjit	D	VS
		Medium (Second fortnight of fruit maturity season)	5	Dashehari		
		Late (Third fortnight of fruit maturity season)	7	Amrapali, Mallika, Neelum		
30. (* (*)	Ripe fruit: Predominant colour of skin	Green (RHS 134 A, B)	1	Bombay Green	E	VG
		Yellow (RHS 2A,B, RHS149 A, B and RHS150 A , B)	3	Gaurjit, Chausa		
		Orange (RHS13; RHS N25 B, C, D and RHS 28A , B)	5	Sarda Bhog, Mallika		
		Red (RHS 40 A, B and RHS 30 C,D)	7	- Neelgoa, Van Raj		
		Red and purple (RHS 53 A,B,C and RHS 55 A, B)	9	Ambika		

31. (* (+)	Ripe fruit: Main colour of pulp	Light yellow (RHS 149 A, B1C,D)	1	Totapuri	E	VG
		Medium yellow (RHS 2 A,	3	Rumani		
		Light orange (RHS 20 C,	5	Dashehari		
		Medium orange (RHS22	7	Nisar Pasand		
		Dark orange (RHS 24 A, B, C, D)	9	Amrapali		
32. (* (+)	Seed: Kernel in lateral view	Oblong	3	Nissarpasand, Dashehari	F	VG
		Reniform	7	Safeda Lucknow		
33. (* (+)	Seed: Embryony	Monoembryonic	1	Dashehari, Langra, Chausa	F	VG
		Polyembryonic	9	Kurukkan, Chandrakaran, Moovandan		

VIII. Explanation for the Table of Characteristics

Characteristic 1: Young leaf: Intensity of anthocyanin coloration



Absent
(1)



Weak
(3)



Medium
(5)



Strong
(7)

Characteristic 3: Leaf blade: Width



Narrow
(3)

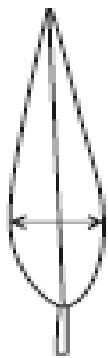


Medium
(5)

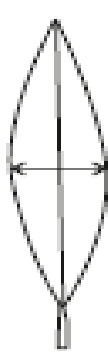


Broad
(7)

Characteristic 4: Leaf blade: shape



Ovate
(3)



Elliptic
(5)



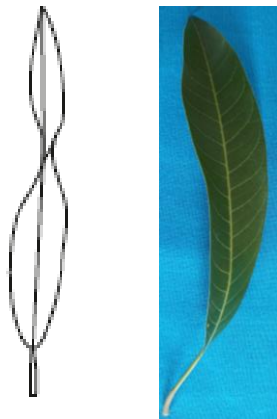
Oblong
(7)



Characteristic 6: Leaf blade: twisting



Absent
(1)



Present
(9)

Characteristic 7: Leaf blade: Shape of base



Acute
(3)



Obtuse
(5)



Rounded
(7)

Characteristic 8: Leaf blade: Shape of apex



Attenuate
(3)

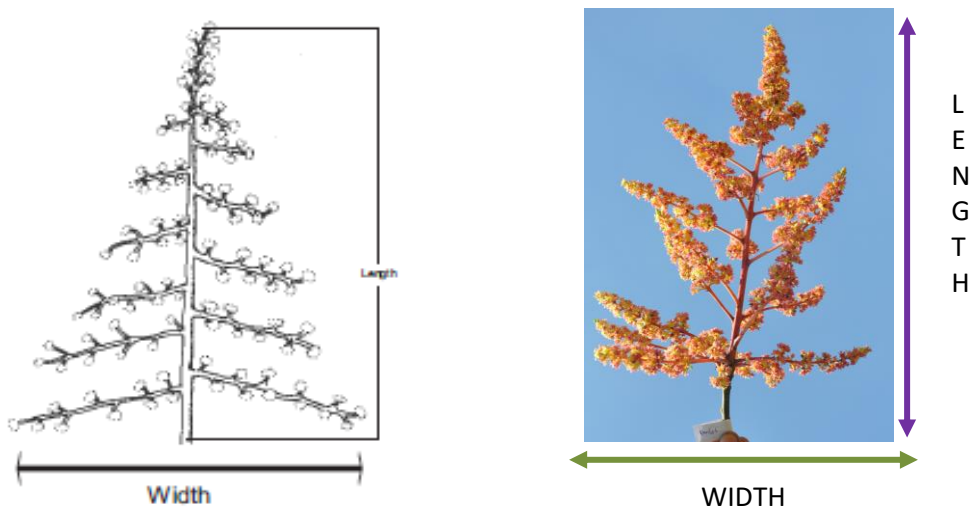


Acuminate
(5)



Acute
(7)

Characteristic 11 & 12: Inflorescence: Length and Width



Characteristic 13: Inflorescence: Anthocyanin coloration of axis and branches



Absent & Weak
(1)

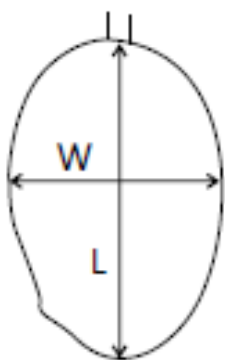


Medium
(3)

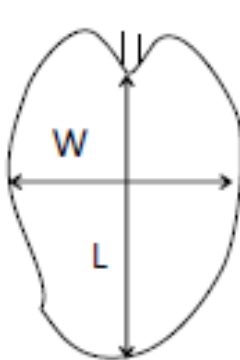


Strong
(5)

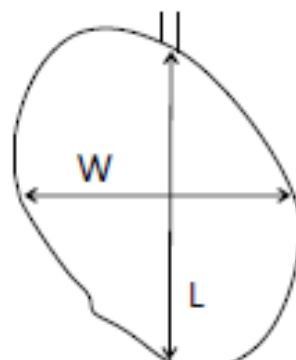
Characteristic 14 & 15: Mature Fruit: Length and Width



Short & Narrow
(3)

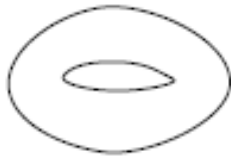


Medium
(5)

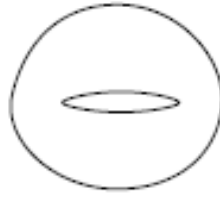


Long & Broad
(7)

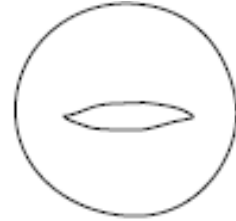
Characteristic 16: Mature Fruit: Shape in cross section



Medium elliptic
(3)



Broad elliptic
(5)



Circular
(7)

Characteristic 18: Mature fruit: Density of lenticels



Sparse
(3)

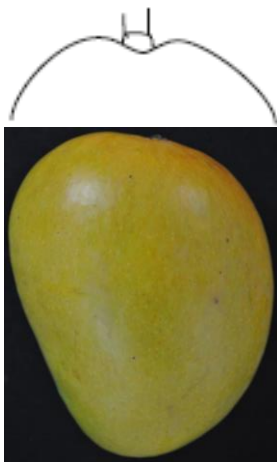


Medium
(5)

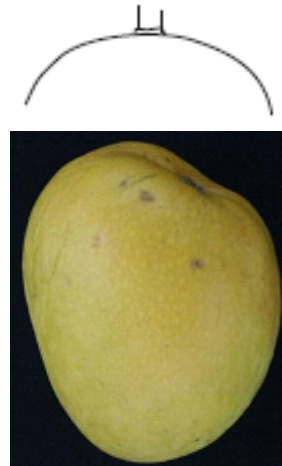


Dense
(7)

Characteristic 20: Mature fruit: Presence of cavity at stalk

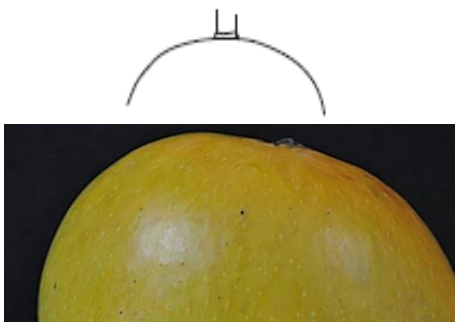


Absent
(1)

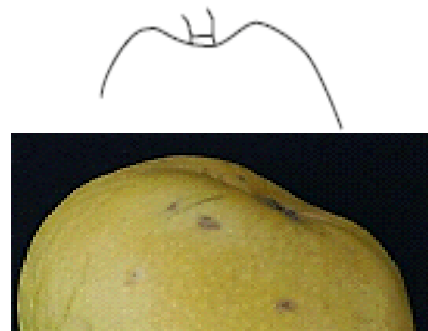


Present
(9)

Characteristic 21: Mature fruit: Depth of cavity at stalk

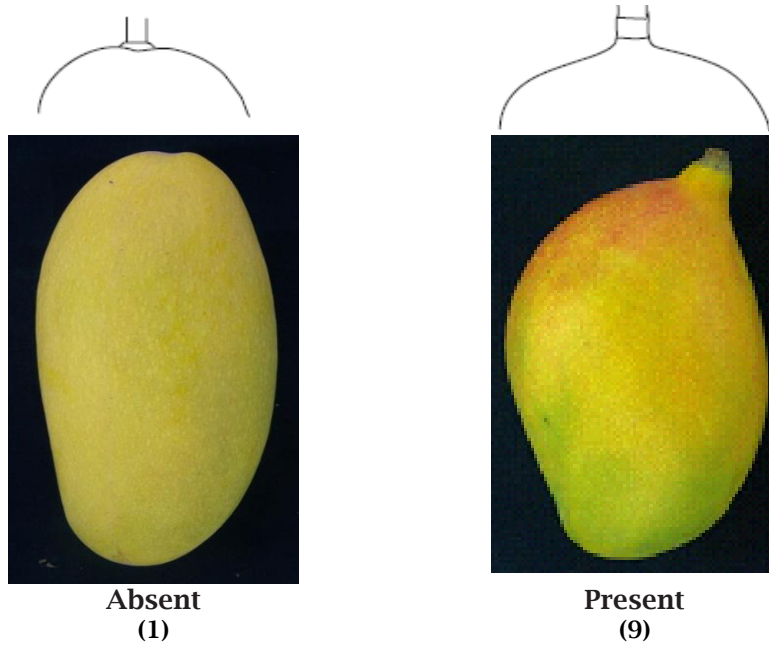


Shallow
(3)

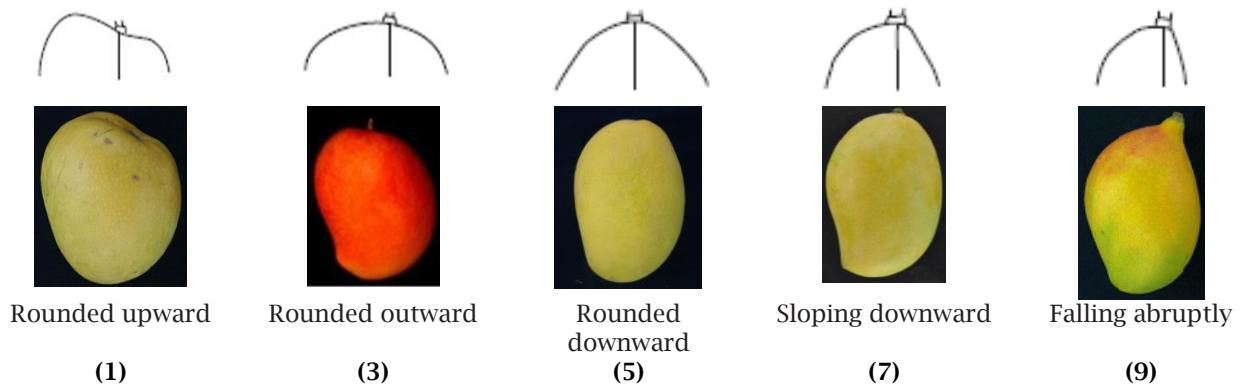


Deep
(7)

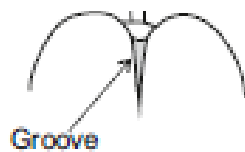
Characteristic 22: Mature Fruit: Presence of neck



Characteristic 23: Mature Fruit: Shape of ventral shoulder



Characteristic 24: Mature Fruit: Length of groove in ventral shoulder



**Absent
(1)**

**Present
(9)**

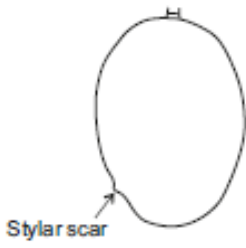
Characteristic 25: Mature Fruit: bulging on ventral shoulder



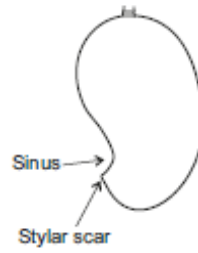
**Absent
(1)**

**Present
(9)**

Characteristic 26: Mature Fruit: Presence of sinus



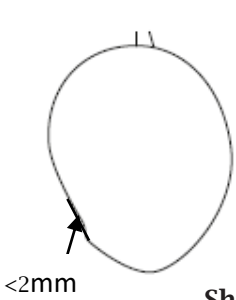
**Absent
(1)**



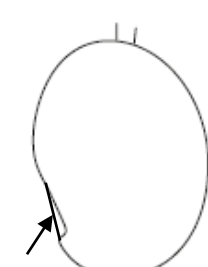
**Present
(9)**



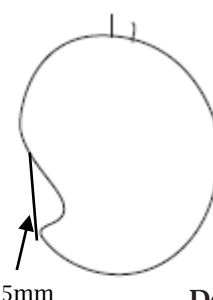
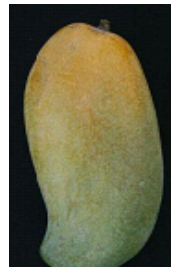
Characteristic 27: Mature Fruit: Depth of sinus



**Shallow
(3)**



**Medium
(5)**



**Deep
(7)**



Characteristic 28: Mature Fruit: Bulging proximal of stylar scar



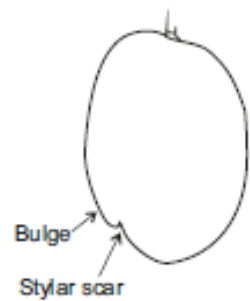
**Absent or weak
(1)**



**Medium
(5)**



**Strong
(9)**



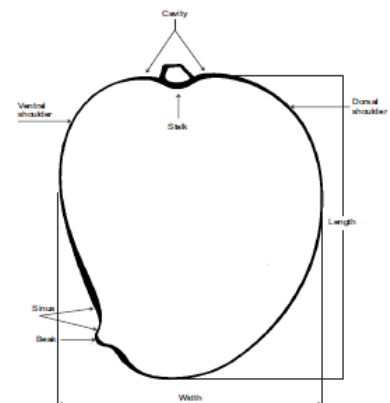
Characteristic 32: Seed: Shape in lateral view



**Oblong
(3)**



**Reniform
(7)**



Characteristic 33: Seed: Embryony



**Monoembryonic
(1)**



**Polyembryonic
(9)**

IX. Working Group details:

The test guidelines developed by the task force (4/2006) constituted by the PPV & FR Authority for Mango (*Mangifera indica* L) with consultation by Nodal officer, CISH, Lucknow and Co-Nodal officer ICAR-IIHR, Bangalore & Regional Fruit Research Station (DBSKKV), Vengurla, Maharashtra. The Technical inputs also provided by the PPV & FR Authority.

The Members of the task Force (4/2006)

1.	Dr. Kirti Singh	Chairman
2.	Dr. N. D. Jambhale	Member
3.	Dr. B. M. C. Reddy	Member
4.	Dr. S. K. Roy	Member
5.	Dr. Shailendra Rajan	Member
6.	Dr. A. K. Singh	Member

Expert team for revision of DUS guidelines on Mango

1.	Dr. Shailendra Rajan, ICAR-CISH, Lucknow	Chairman
2.	Dr. A. K. Singh, Pr. Sci. (Hort.), ICAR-CISH, Lucknow	Member
3.	Dr. P. K. Singh, Pr. Sci., Plant Breeder, ICAR- IISR, Lucknow	Member
4.	Dr. Veena G. L., Scientist (Fruit Science), ICAR-CISH, Lucknow	Member
5.	Shri Vineet Singh, SRF, ICAR-CISH, Lucknow	
6.	Dr. Ravi Prakash, Registrar, PPV&FR Authority, New Delhi	Member Secretary

X. DUS testing centers

Nodal DUS Test Centre	Other DUS Test Centers
Central Institute for Subtropical Horticulture, PO Kakori, Rehmankhera, Lucknow (UP)	Division of Fruit Crops, IIHR, Bangalore
	Regional Fruit Research Station, Vengurle- 416516, Distt, Sindhudurg (M.S.)
	ICAR-CISH Regional Research Station, Malda, West Bengal