Guideline
for the Conduct of Test for
Distinctiveness, Uniformity and Stability
On
Avocado
(*Persea americana* Mill.)

Protection of Plant Varieties and Farmers' Rights Authority

(A Statutory Body created by an Act of Parliament)

Government of India, New Delhi

CONTENTS

I. Subject

These test guidelines shall apply to all varieties of Avocado (*Persea americana* Mill.)

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 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 compiled with.
2. The material is to be supplied in the form of five (5) grafts for each location.
3. The plant material supplied should be visibly healthy, not lacking in vigour, nor affected by any important pest or diseases.
4. The plant material should not have undergone any treatment, which would affect the expression of the characteristics of the variety, unless the competent authorities allow or request such treatment. If it has been treated, full details of the treatment must be given.

III. Conduct of Tests

1. The minimum duration of the DUS tests shall normally be at least two fruiting seasons in different years 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. The field tests shall be carried out under open field conditions favouring normal growth and expression of all the characteristics.

4. Test plot design be as follows

The design of the tests should be such that 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. The additional test protocol for special purposes may be established by PPV & FRA.

Number of replications: Three

Treatment unit : 1 plant pert replication (3 plants/location)

Spacing : 6*6 m

5. On-site DUS Testing

- The applicant or his/her nominee on his/her behalf shall submit a request to the Authority for conducting a reliable trial according to Test Guidelines and the instructions from Authority before on-site examination of the candidate variety.

- The applicant or his/her nominee shall submit a request to the Authority for on-site examination prior to the start of the growing cycle 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 a minimum of 3 years.
- As a minimum, 3 trees planted in uniform spacing should be available for inspection and examination for 'on-site' DUS testing. The trees must be healthy, free from pests and diseases, and raised under standard management practices.
- For farmer's variety or landraces, the authority may notify suitable guidelines on the number of plant(s) and season(s), if any.
- On-site examination shall be arranged during the fruiting season when distinguishing characteristics of the candidate variety can most easily be seen. The characteristics of the candidate variety can be examined and compared with those of the comparative varieties as per the Test Guidelines.
- The Expert Committee constituted by the PPV & FRA, in consultation with the DUS Centre, shall be authorized to inspect on-site testing and recording the appropriate characters.
- The applicant shall supply the Expert Committee with a summary of distinct characteristics supported by photographs. The Expert Committee shall take notes and observations on distinctness and shall confirm preliminary data or summary of distinctness from the applicant.
- The Expert Committee shall submit an examination report to the authority.

IV. Methods and Observations

A. The characteristics described in the Table of Characteristics (see section VII) shall be used for the testing varieties and hybrid under the categories mentioned below for their DUS testing.

1. For the assessment of Distinctiveness and Stability, observations shall be made on 3 plants or parts taken from each of 3 plants. The observation on fruits should be made at least 5 fruits per replication. In the case of parts of plants, the number should to be taken from each of the plants should be 3.
2. Observation on growth habit should be recorded at flowering stage.
3. Young twig colour should be recorded at 10% shoot development stage (20-30 days after sprouting).
4. Observations on the leaf should be made on mature leaves in the middle third of the youngest shoots not showing signs of active growth. The observation on leaves should be made at least 10 leaves per replication.
5. 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 and avoid selection of panicles inside the canopy. The observation on inflorescence should be made at least 10 inflorescence per replication
6. Flowering type observation, ten flower buds should be tagged in each tree and observed for two consequent days from the day of opening for functional female and functional male phase.

7. The pedicel, peduncle and cluster bearing traits should be recorded during the fruit harvesting period from fully mature fruits (Ready to harvest).
8. For recording days to harvest the minimum of 20 fruits should be tagged on the day of fruit set and observed for number days taken to harvest.
9. The fruit and seed characters should be recorded from fully ripe fruits (Ready for consumption). The observation on fruits and seeds should be made at least 5 per replication.
10. Seed kernel surface observation should be recorded after removing seed coat and observation should be made at least 5 seed kernels per replication.
11. Fat and carotenoid content should be analysed from the pulp of fully ripe fruits. The observation on carotenoids and fat content should be made at least 3 samples per replication.

V. Grouping of Varieties

1. The candidate varieties for DUS testing shall be divided into groups to facilitate the assessment of Distinctiveness. Characteristics, which are known from experience not to vary, or to vary only slightly within a variety and which in their various states are fairly evenly distributed across all varieties in the collection are suitable for grouping purposes.
2. The following characteristics are proposed to be used for grouping Avocado varieties:

a)	Young twig colour	(Characteristic 2)
b)	Flower type	(Characteristic 8)
c)	Peel colour	(Characteristic 24)
d)	Peel thickness	(Characteristic 26)
e)	Days to harvest	(Characteristic 34)
f)	Fat content	(Characteristic 35)

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. Notes (1 to 9) shall be given for each state of expression for different characteristics for the purpose of electronic data processing.
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 conditions of the testing region. Under such exceptional situation, adequate explanation shall be provided.

(+) See Explanation on the Table of Characteristics in Section VIII. It is to be noted that for certain characteristics. The plant parts on which observations to be taken are given in the explanation or figure(s) for clarity and not the colour variation.

4. The optimum stages of plant growth for assessment of each characteristic are given in the sixth column of the Table of characteristics are described below:

Decimal code for growth stages

Corresponding Growth Stages	Codes
Vegetative: Young twig colour should be recorded at 10% shoot development stage and the observations on the leaf should be made on mature leaves in the middle third of the youngest shoots not showing signs of active growth.	10
Flowering: Inflorescences should be selected from terminal panicles of typical shoots from the exposed regions of the tree. For recording data on inflorescence rachis colour fully developed inflorescence with visibly separated unopened flowers should be selected.	20
Maturity: The mature fruit is the stage where fruit is fully matured ready for ripening after harvest.	30
Ripening: The ripe fruit is the stage where fruit is fully ready for consumption. The peel colour will turn to its varietal colour during this stage.	40
Seed: Observations on seed traits should be recorded after separating seeds from the fruit.	50

4. Characteristics denoted with symbols QL and QN in the first column of the Table of characteristics shall be indicated as:

(+): See explanations on the Table of Characteristics

QL: Qualitative characteristic

QN: Quantitative characteristic

5. Type of assessment of characteristics indicated in column seven of 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

VII. Table of characteristics
A. Descriptors for Avocado

Sl. No.	Characteristics	State	Note	Example varieties	Stage of observation	Type of assessment
1	2	3	4	5	6	7
1. * (+) QL	Growth habit	Spreading	3	Pinkerton	10	VG
		Upright	5	Arka Supreme		
2. * (+) QL	Young twig colour	Yellow (Yellow orange group 14D)	3	PA- 026 (IC-0644455)	10	VG
		Green (Green group 141 A)	5	Arka Supreme		
		Red (Greyed-orange group 166A)	7	Arka Coorg Ravi		
3. * (+) QL	Leaf shape	Ovate	3	Arka Supreme	10	VS
		Narrowly obovate	5	Gem Hass		
		Roundish	7	PA- 026 (IC-0644455)		
		Oblong-lanceolate	9	Hass		
4. * (+) QL	Leaf apex shape	Acute	3	Hass	10	VS
		Intermediate	5	Maluma Hass		
		Obtuse	7	Fair child		
5. * (+) QL	Leaf base shape	Acute	3	Arka Coorg Ravi	10	VS
		Obtuse	5	Arka Supreme		
6. * (+) QL	Mature leaf colour	Light green (Green group 141D)	3	PA- 026(IC-0644455)	10	VG
		Green (Green group 141A)	5	Hass		
7. * (+) QL	Flowering type	Type A	1	Hass	20	VG
		Type B	9	Arka Coorg Ravi		
8. * (+) QL	Inflorescence rachis colour	Creamish yellow (Yellow group 4D)	3	Arka Supreme	20	VS
		Yellow (Yellow group 8B)	5	PA- 026 (IC-0644455)		

		Green (Yellow-green group 149C)	7	Fuerte		
		Red (Red group 40B)	9	PA-115		
9. * (+) QN	Inflorescence length	Short (<10 cm)	3	CHES-PAN	20	MS
		Intermediate (10-15 cm)	5	Arka Supreme		
		Long (> 15 cm)	7	Pinkerton		
10. * (+) QL	Compactness of rachis	Compact	1	CHES-PAN	20	VS
		Loose	9	Arka Supreme		
11. * (+) QL	Fruiting habit	Solitary	1	CHES- PAN	30	VG
		Cluster bearing	9	Fairchild		
12. * (+) QL	Fruit shape	Spheroid	3	Reed	30	VG
		Ellipsoid	5	Carmen Hass		
		Narrowly obovate	7	Pinkerton		
		Pyriform	9	Arka Supreme		
13. * (+) QL	Fruit base shape	Depressed	3	Arka Supreme	30	VG
		Flattened	5	PA- 047 (IC-0644462)		
		Inflated	7	PA- 026 (IC-0644455), Arka Coorg Ravi		
14. * (+) QL	Fruit apex shape	Flattened	3	CHES-PAN	30	VG
		Rounded	5	Arka Supreme		
15. * (+) QL	Fruit apex position	Central	3	CHES-PAN	30	VG
		Asymmetric	5	Arka Coorg Ravi		
16. * (+) QL	Fruit peel surface	Rough	3	Hass	30	VG
		Intermediate	5	Degania		
		Smooth	7	Ettinger		
17. * (+) QL	Pedicel position on fruit	Central	3	Arka Supreme	30	VG
		Asymmetrical	5	Arka Coorg Ravi		
18. * (+) QL	Pedicel shape	Cylindrical	3	Fuerte	30	VG
		Conical	5	Arka Coorg Ravi,		
		Rounded	7	PA- 026(IC-0644455)		
19.		Absent	1	Arka supreme	30	VG

* (+) QL	Nail head pedicel apex shape	Present	9	PA- 059		
20. * (+) QL	Pedicel colour at maturity	Yellow (Yellow group 8A)	3	PA- 026(IC-0644455)	30	VG
		Green (Yellow-green group 145A)	5	Fuerte		
		Red (Red group 43A)	7	PA- 018(IC-0644453)		
21. * (+) QN	Pedicel length	Short (< 2.0 cm)	1	Arka Supreme	30	MS
		Long (>2.0 cm)	9	Fuerte		
22. * (+) QN	Peduncle length	Short (< 7.5 cm)	3	Fairchild	30	MS
		Intermediate (7.5-15 cm)	5	Arka Supreme		
		Long (> 15 cm)	7	Pinkerton		
23. * (+) QL	Peel colour	Green (Green group 141B)	3	Arka Coorg Ravi	40	VG
		Yellow (Yellow-green group 154A)	5	PA- 026 (IC-0644455)		
		Red (Orange- red group 30C)	7	PA-079 (IC-0644467)		
		Purple (Purple group 79C)	9	Arka Supreme		
24. * QN	Fruit weight	Small (< 250 g)	3	PA-039	40	MS
		Medium (250-500 g)	5	Arka Supreme		
		Large (> 500 g)	7	PA-023		
25. * (+) QN	Peel thickness	Thin (<1.0 mm)	3	Arka Supreme	40	MS
		Thick (> 1.0 mm)	7	Gem Hass		
26. * (+) QL	Density of lenticels on fruit	Sparse	1	PA- 026 (IC-0644455)	40	VG
		Dense	9	Lamb Hass		
27. * (+) QL	Uniformity of pulp colour	Uniform	3	PA- 026 (IC-0644455)	40	VG
		Non-Uniform	5	Hass		
28.	Pulp Recovery	Low (< 60%)	3	PA-041	40	MS

* QL		Medium (60–80%)	5	Arka Supreme		
		High (> 80%)	7	Arka Coorg Ravi		
29. * QL	Pulp texture	Firm	1	Hass	40	VG
		Soft	9	Ettinger		
30. * (+) QL	Seed shape	Oblate	3	Gem Hass	50	VG
		Spheroid	5	Reed		
		Ellipsoid	7	Ettinger		
		Broadly ovate	9	Arka Supreme		
31. * (+) QL	Seed position	Apical	3	Arka Supreme	50	VG
		Central	5	Hass		
32. * (+) QL	Seed kernel surface	Smooth	3	Hass	50	VG
		Intermediate	5	Arka Supreme		
		Rough	7	PA-059		
33. * (+) QL	Presence of seed	Present	1	Arka Supreme	50	VG
		Absent	9	PA-039		
34. * QL	Days to harvest	Early (6-7 months)	1	Arka Supreme	40	VS
		Late (9-10 months)	9	Accession-22 (IC-0644474)		
35. * QN	Fat content	Low (< 8%)	3	Reed, PA- 039	40	MS
		Medium (8 to 15 %)	5	Arka Coorg Ravi		
		High (>15%)	7	Hass, Arka Supreme		
36. * (+) QN	Carotenoid content	High (> 6 mg/100g)	3	Pinkerton, PA- 026(IC-0644455)	40	MS
		Medium (2 to 6 mg/100g)	5	Fuerte, Reed		
		Low (< 2mg/100g)	7	Ettinger		

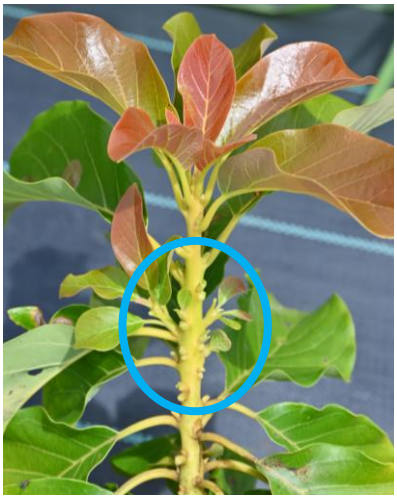
VII Explanations for table of characteristics

Characteristic 1: Growth habit

Spreading type
(3)

Upright type
(5)

Characteristic 2: Young twig colour

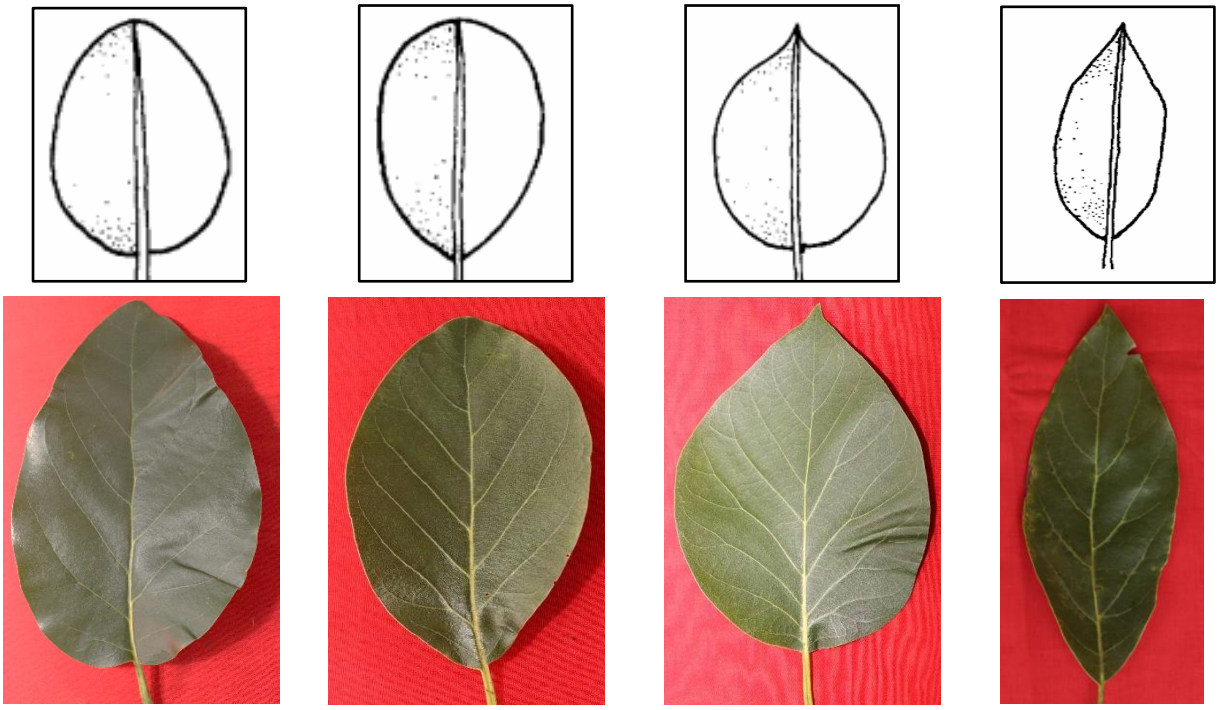


Yellow
(Yellow orange group 14D)
(3)

Green
(Green group 141 A)
(5)

Red
(Greyed orange group 166A)
(7)

Characteristic 3: Leaf shape



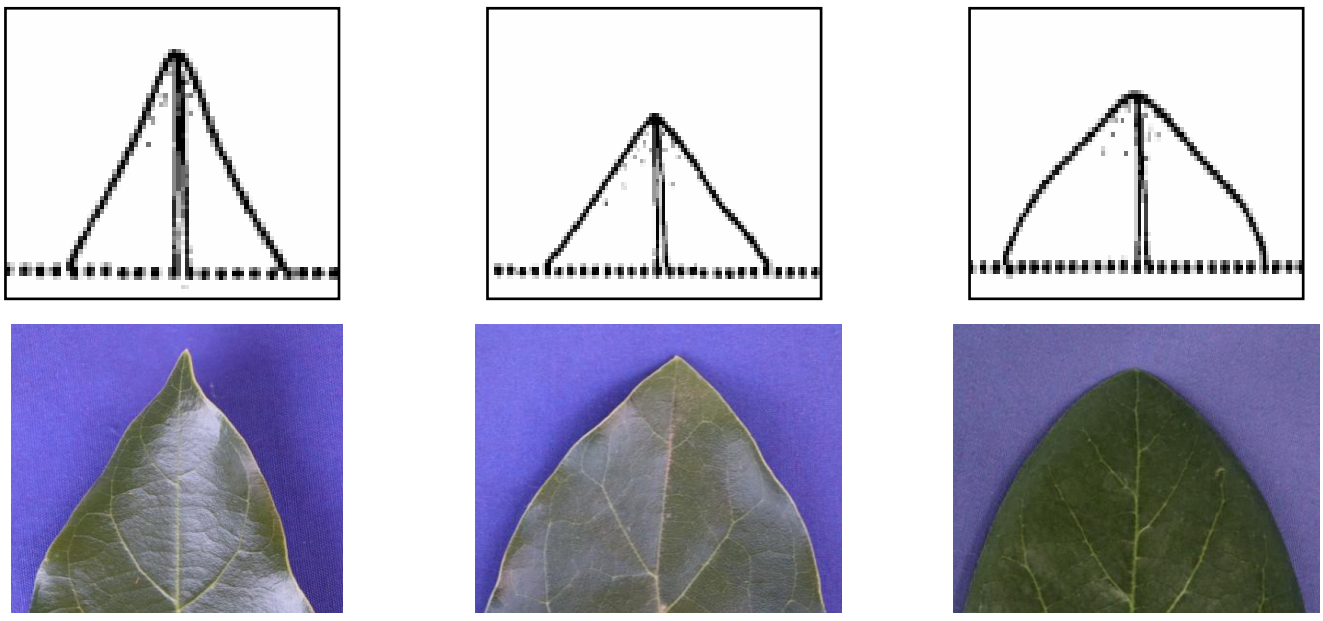
Ovate
(3)

Obovate
(5)

Roundish
(7)

Oblong-lanceolate
(9)

Characteristic 4: Leaf apex shape

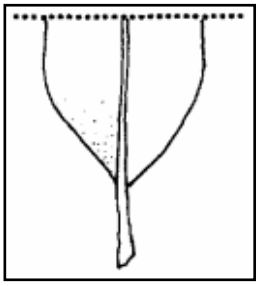


Acute
(3)

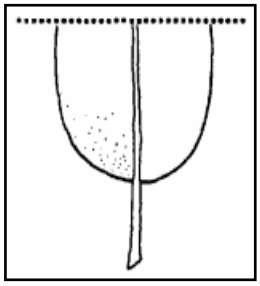
Intermediate
(5)

Obtuse
(7)

Characteristic 5: Leaf base shape



Acute
(3)



Obtuse
(5)

Characteristic 6: Mature leaf colour

Light Green
(Green group 141D)
(3)

Green
(Green group 141A)
(5)

Characteristic 7: Flower type

Cultivar type	Day 1		Day 2	
	Morning	**Afternoon**	**Morning**	**Afternoon**
A		Closed	Closed	
B	Closed			Closed

a. Functional male phase

b. Functional female phase

Characteristic 8: Inflorescence colour

Cream
(Yellow group 4D)
(3)

Yellow
(Yellow group 8B)
(5)

Green
(Yellow-green group149C)
(7)

Red
(Red group 40C)
(9)

Characteristic 9: Inflorescence Length

Short (<10 cm)
(3)

Intermediate (10-15 cm)
(5)

Long (> 15 cm)
(7)

Characteristic 10: Compactness of rachis

Compact
(1)

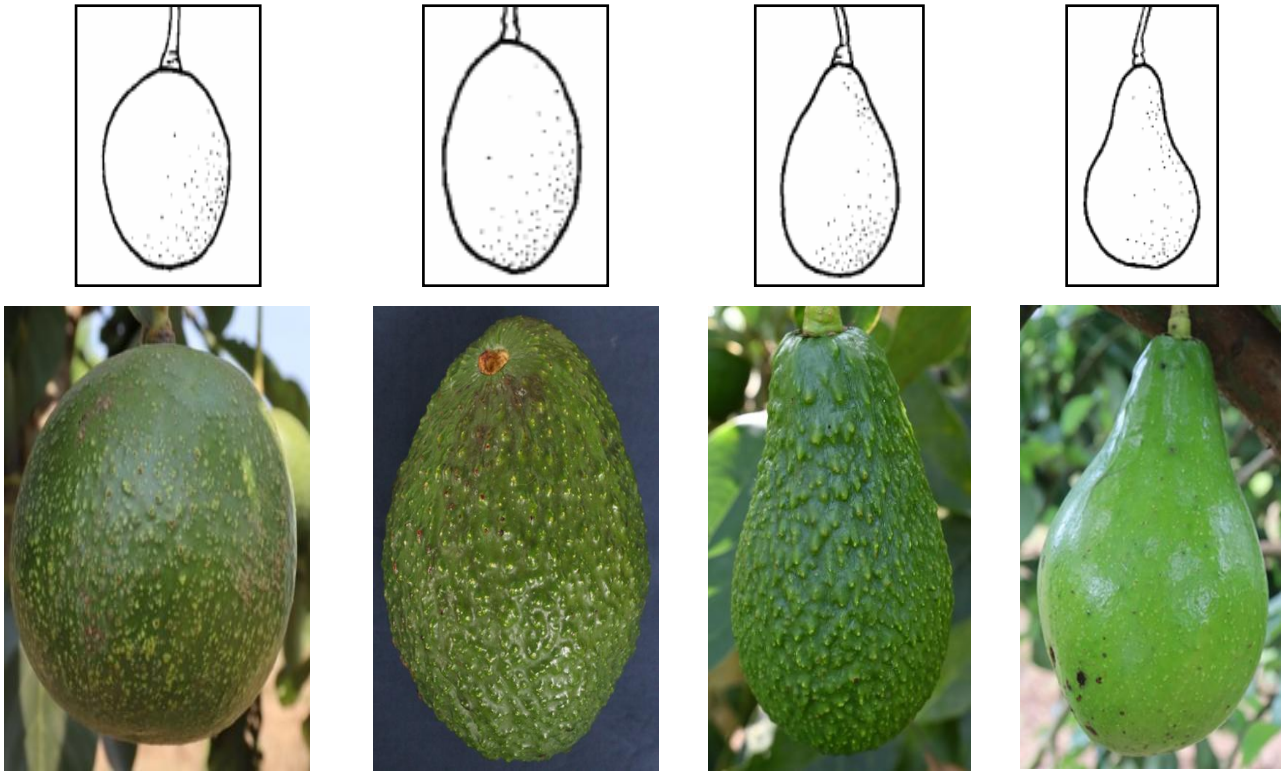
Loose
(9)

Characteristic 11: Fruiting habit

Solitary
(1)

Clustering habit
(9)

Characteristic 12: Fruit shape



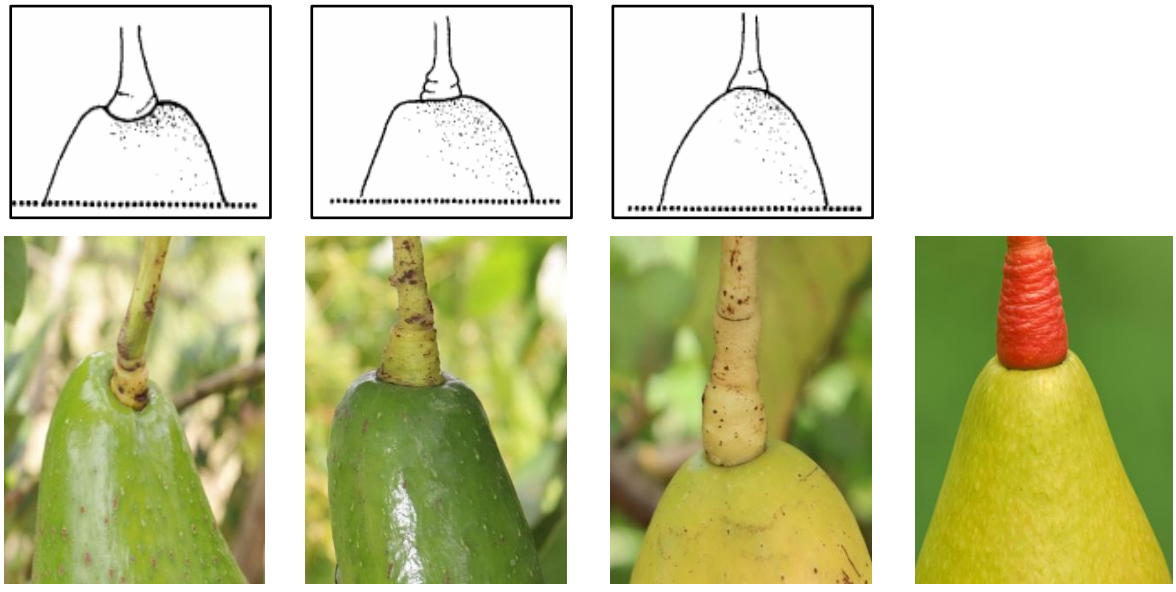
Spheroid
(3)

Ellipsoid
(5)

Narrowly obovate
(7)

Pyriform
(9)

Characteristic 13: Fruit base shape



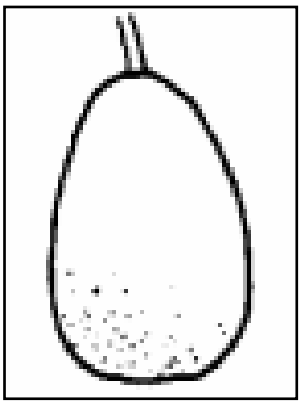
Depressed
(3)

Flattened
(5)

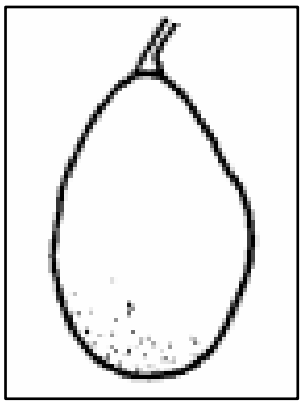
Inflated
(7)

Others

Characteristic 14: Fruit apex shape

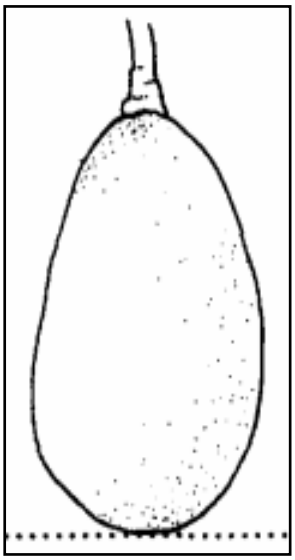



Flattened
(3)

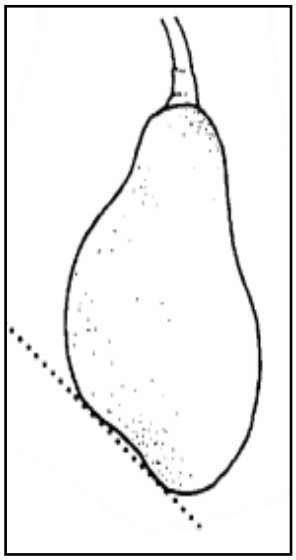



Rounded
(5)

Characteristic 15: Fruit apex position




Central
(3)




Asymmetric
(5)

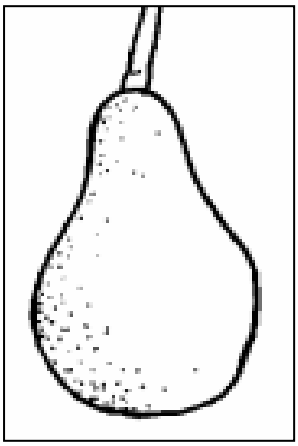
Characteristic 16: Fruit peel surface

Rough
(3)

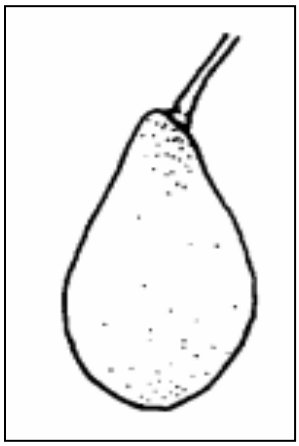
Intermediate
(5)

Smooth
(7)

Characteristic 17: Pedicel position on fruit

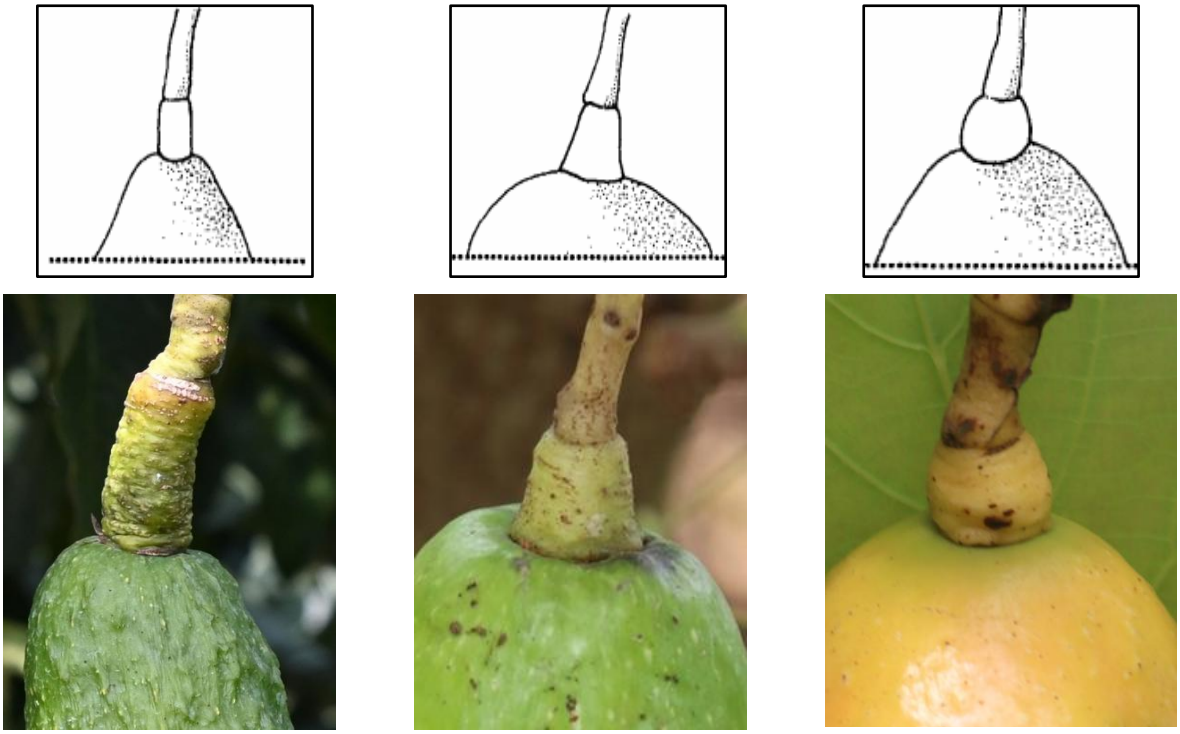


Central
(3)



Asymmetrical
(5)

Characteristic 18: Pedicel shape

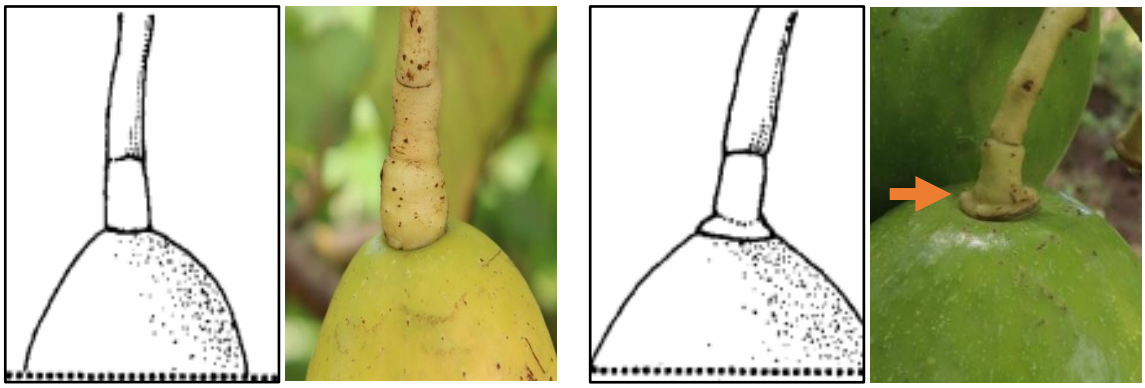


Cylindrical
(3)

Conical
(5)

Rounded
(7)

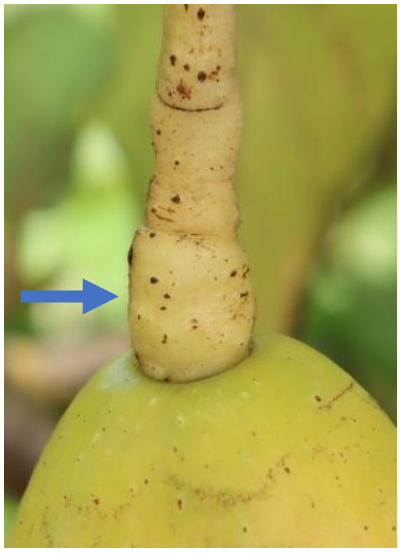
Characteristic 19: Nail head pedicel apex shape



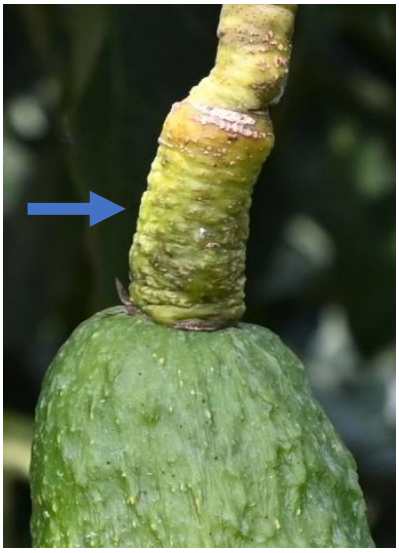
Absent
(1)

Present
(9)

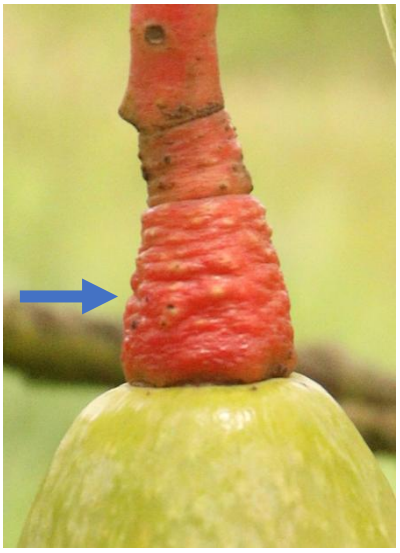
Characteristic 20: Pedicel colour



Yellow
(Yellow group 8A)
(3)



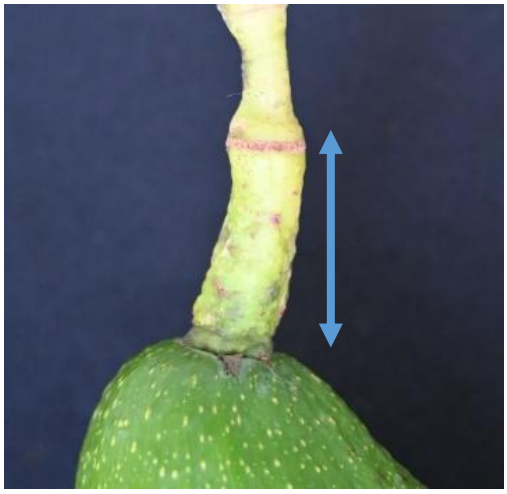
Green
(Yellow-green group 145A)
(5)



Red
(Red group 43A)
(7)

Characteristic 21: Pedicel length

Shortest < 1.5 cm
(1)



Longest > 1.5cm
(9)

Characteristic 22: Peduncle length

Short < 7.5 cm
(3)

Intermediate 7.5 - 15 cm
(5)

Long > 15 cm
(7)

Characteristic 23: Peel colour

Green
(Green group 141B)
(3)

Yellow
(Yellow-green group 154A)
(5)

Red
(Orange- red group 30C)
(7)

Purple
(Purple group 79C)
(9)

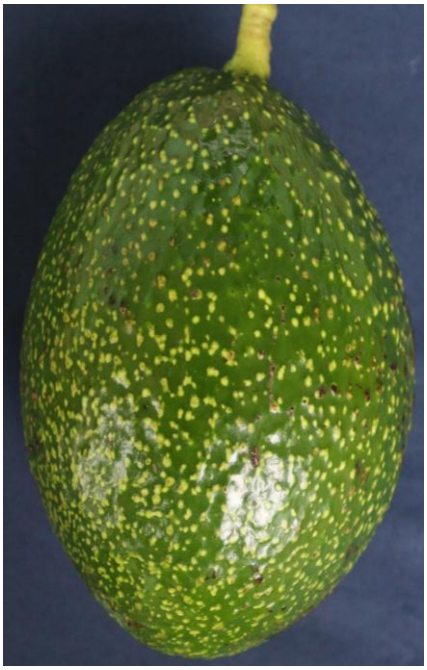
Characteristic 25: Peel thickness

Thin (< 1.0 mm)
(3)

Thick (> 1.0 mm)
(7)

Characteristic 26: Density of lenticels on fruit

Sparse
(1)



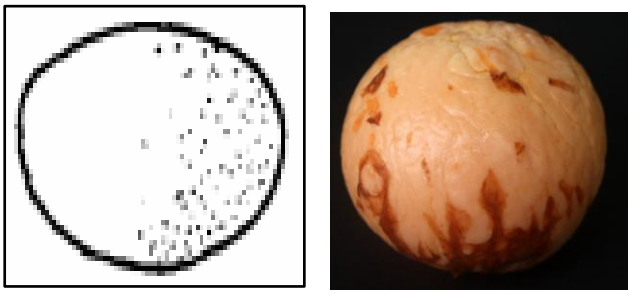
Dense
(9)

Characteristic 27: Uniformity of pulp colour

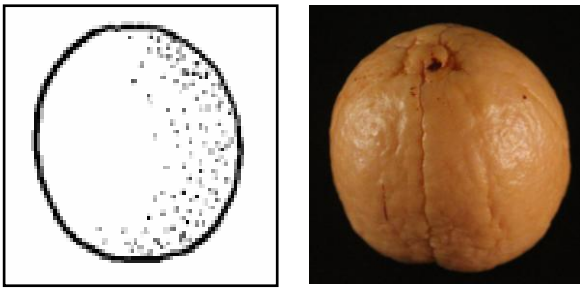
Uniform
(3)

Non-Uniform
(5)

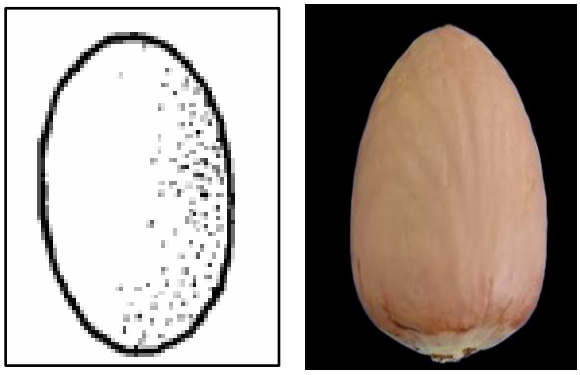
Characteristic 30: Seed shape



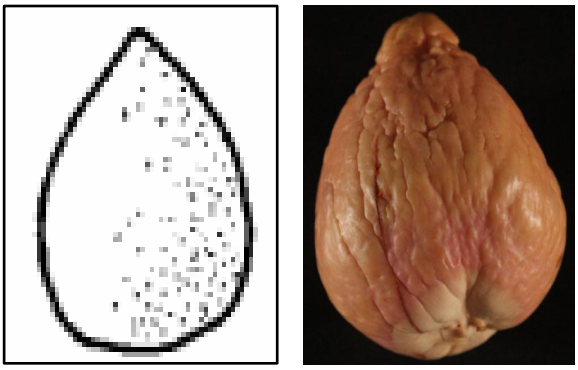
Oblate
(3)



Spheroid
(5)



Ellipsoid
(7)



Broadly Ovate
(9)

Characteristic 31: Seed position

Apical
(3)

Central
(5)

Characteristic 32: Seed kernel surface

Smooth
(3)

Intermediate
(5)

Rough
(7)

Characteristic 33: Presence of seed

Present
(1)

Absent
(9)

IX. Working group:

This test guideline of Avocado (*Persea americana* Mill.) has been developed by the Task Force committee constituted by the PPVFR Authority.

Sl. No	**Name & Designation**	**Role**
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6	Dr. U K Dubey Joint Registrar, Plant Authority Bhawan Protection of Plant Varieties and Farmers' Rights Authority, New Delhi-12 Email: uk.dubey@gov.in Mobile: 7217633991	Member Secretary
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Collaborating Centre (DUS Test)
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