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

On

Chilli (Hot Pepper), Bell (Sweet) Pepper and Paprika

(*Capsicum annuum* L.)

Protection of Plant Varieties and Farmers' Rights Authority

(PPV&FRA)

Government of India

Contents

Chilli, Bell pepper and Paprika
(*Capsicum annuum* L.)

I. Subject

These test guidelines shall apply to all varieties, hybrids and parental lines of chilli (hot pepper), bell (sweet) pepper and paprika (*Capsicum annuum* L.).

II. 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 the seed material required for testing a variety applied for registration under the PPV&FR Act, 2001. Applicants submitting seed material from a country other than India shall make sure that all customs and quarantine requirements stipulated under v relevant national legislations and regulation are complied with.

2. The minimum quantity of seeds to be supplied by the applicant should be:
   Varieties, hybrids and parental lines for open cultivation and for protected cultivation
   a) Open pollinated varieties : 15g
   b) Hybrid and parental lines : 10g each

3. The seed material should have the minimum requirements for germination capacity (>85%), moisture content (<8%) and genetic purity (>98%). The seed material supplied should be visibly healthy, vigorous and free from insect pest or disease infestation.

4. The seed supplied must not have undergone any treatment unless the Competent Authority allow or request for such treatment. If it has been treated, full details of the treatment must be given.

III. Conduct of tests

1. The minimum duration of DUS test shall normally be at least two independent but similar growing seasons with reference to the ecosystem of the candidate variety.

2. The test shall normally be conducted at two test locations. If any essential characteristics of the candidate variety are not expressed for visual observation at these locations, the variety shall be considered for further examination at another appropriate test site or under special test protocol on expressed request of the applicant, for which additional quantity of seeds shall be required.

3. The field test shall be carried out under conditions favouring normal growth and expression of all test characteristics. The size of the plot shall be such that plants or parts of plants could be removed for measurement and observation without prejudicing the other observations on the standing plants until the end of the growing period. Each test shall include a minimum of 120 plants for open cultivation and 60 plants for protected cultivation which should be divided among three replications. Separate plots for observation and for measurement can only be used if they have been subjected to similar environmental conditions.

4. Test plot design shall be as follows

Bed size	:	4.5 X 3.6m
Number of rows	:	4
Row length	:	4.5m
Row to row distance	:	90cm
Plant to plant distance	:	45cm
Number of replications	:	3
Expected no. of plants	:	40 X 3=120

5. Observations should not be recorded on plants in border rows

6. Additional test protocols for special purpose shall be established by the PPV&FR Authority

IV. Methods and observations

1. The characteristics described in the Table of Characteristics (Section VII) shall be used for the testing of varieties for their DUS.

2. For the assessment of distinctiveness and stability, observations should be made on 30 plants or parts of 30 plants, which shall be equally divided among 3 replications (10 plants per replication).

3. For the assessment of uniformity of characteristics on the plot as a whole (visual assessment by a single observation on a group of plants or parts of plants), a population standard of 1% with an acceptance probability of at least 95% should be applied. In the case of a sample size of 120 and 60 plants, the number of off-types should not exceed 4 and 2, respectively.

4. For the assessment of colour characteristics, the latest Royal Horticultural Society (RHS) colour chart shall be used.

5. Unless otherwise indicated, all observations on the leaves and flowers should be made after the first flower starts and before the start of the harvest.

6. Unless otherwise indicated, all observations on the plant and fruit should be made at mature green fruit stage and/ or ripe fruit stage.

7. Unless otherwise indicated, observations on the seed should be made on fully developed dry seed

8. Stage of recording observations on specific characteristics will be as follows;

	Description	**Code**
a)	Cotyledons completely unfolded to two-true leaf stage	10
b)	Active vegetative phase	20
c)	Appearance of flowers on 50% plants	30
d)	First fruit attaining harvest maturity	40
e)	First fruit attaining physiological maturity	50
f)	Full maturity: approximately all fruits are shrunken, red/ yellow	60

V. Grouping of varieties

1. The candidate varieties for DUS testing shall be divided into groups (hot pepper as vegetable or spice, bell pepper as vegetable and paprika as spice) to facilitate the assessment of distinctness. Characteristics, which are known from experience not to vary or to vary only slightly, within a variety and in which their various states fairly distributed across all varieties in the collection are suitable for grouping purposes.

2. The following characteristics shall be used for grouping *Capsicm annuum* varieties:

(a) Plant	:	Habit (characteristic 2)
(b) Flower/Fruit	:	Orientation (characteristic 24)
(c) Fruit	:	Fruit bearing habit (characteristic 25)
(d) Fruit	:	Colour (at mature green fruit stage on plants) (characteristic 26)
(e) Fruit	:	Shape in longitudinal section (characteristic 30)
(f) Fruit	:	Colour (at ripe fruit stage on plants) (characteristic 37)
(g) Fruit	:	Shape at base (characteristic 41)
(h) Fruit	:	Shape at apex (characteristic 42)

VI. Characteristics and symbols

1. To assess distinctness, uniformity and stability, the characteristics and their states as given in the Table of Characteristics (section VII) shall be used.
2. Notes (1-9) shall be used to describe the state of each character for the purposes of digital data processing and these notes shall be given against the states of the different characteristics.
3. Legend

(*) Characteristics that shall be observed during every growing season on all varieties and always be included in the description of the variety, except when the state of expression of a preceding phenological characteristic or by environmental conditions of the testing region.

(+) See explanations 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 of figure(s) for clarity and not for the colour variation.

4. Type of assessment of characteristics indicated in column 7 of table of characteristics is as follows: The optimum stage of plant growth for assessment of each characteristic is indicated in the sixth column of Table of characteristics. These are explained below:

MG	:	Measurement by a single observation on a group of plants or parts of plants
MS	:	Measurement on a number on individual plant or parts of plants
VG	:	Visual assessment by a single observation on a group of plants or parts of plants
VS	:	Visual assessment by observations on individual plant or parts of plants

VII. Table of Characteristics:

S. No.	Characteristics	States	Note	Example variety/ varieties	Stage of observation	Type of assessment
1 (*)	Seedling: Anthocyanin colouration of hypocotyl	Absent	1	LCA 333	10	VG
		Present	9	Arka Lohit		
2 (*) (+)	Plant: Habit	Spreading	3	Kashi Anmol (KA2)	50	VG
		Semi-upright	5	Pant C-1		
		Upright	7	Arka Lohit		
3 (*)	Plant: Length of main stem (cm)	Short (up to 5)	3	Kashi Anmol	50	MS
		Medium (5.01-10)	5	Arka Meghana JCA 283		
		Long (>10)	7	Arka Lohit Pusa Jwala		
4 (*)	Plant: Length of first internode (on primary branches in cm)	Very short (up to 1)	1	------	50	MS
		Short (1.01-2)	3	Pusa Sadabahar		
		Medium (2.01-4)	5	Kashi Anmol Lam 353		
		Long (4.01-6)	7	Arka Lohit Arka Harita		
		Very long (>6)	9	Arka Khyati Pusa Jwala		
5 (*)	Plant: Anthocyanin colouration of nodes	Absent	1	BC 25	30	VG
		Present	9	Arka Suphal Prasanth (LCA334)		
6	Plant: Intensity of anthocyanin colouration of nodes	Weak	3	Pusa Jwala Pusa Sadabahar	30	VG
		Medium	5	Arka Lohit Prasanth		
		Strong	7	Arka Suphal Arka Meghana		
7a	Plant: Height (cm) (hot pepper and paprika)	Short (<40)	3	Kashi Anmol Kashi Sindhuri(IVPBC-535)	50	MS
		Medium (40.01-80)	5	Chilli Japani Longi Arka Abhir		
		Tall (>80)	7	Arka Lohit Byadagi Dabbi		
7b	Plant: Height (cm) (bell pepper)	Short (<40)	3	Solan Bharapur Arka Mohini	50	MS
		Medium (40.01-60)	5	Yolo Wonder Arka Gaurav		
		Tall (>60)	7	Arka Basant California Wonder		
8a	Plant: Spread (cm) (hot pepper and paprika) (average of distance between the extremes at widest points taken in two directions)	Narrow (<50)	3	Arka Lohit Pusa Sadabahar	50	MS
		Medium (50.01-100)	5	Prasanth Arka Suphal		
		Broad (>100)	7	Arka Khyati Arka Meghana		

S. No.	Characteristics	States	Note	Example variety/ varieties	Stage of observation	Type of assessment
8b	Plant: Spread (cm) (bell pepper) (average of distance between the extremes at widest points taken in two directions)	Narrow (<50)	3	Arka Basant Arka Gaurav	50	MS
		Medium (50.01-100)	5	Arka Mohini California Wonder		
		Broad (>100)	7	---------		
9 (*)	Stem: Pubescence (hairiness)	Absent	1	ACS 2000-2	40	VG
		Present	9	Phule Jyoti Byadagi Dabbi		
10 (+)	Stem: Intensity of pubescence (hairiness)	Sparse	3	Khasi Sindhuri Chilli Japani Longi	40	VG
		Medium	5	Arka Khyati Utkal Yellow		
		Strong	7	Byadagi Dabbi Phule Jyoti		
11	Stem: Shape	Round	3	Arka Suphal Arka Abhir	40	VG
		Angled	5	Chilli Japani Longi Utkal Yellow		
		Flat	7	------		
12	Leaf: Length of blade (measured from leaf base to leaf tip in cm)	Short (<4)	3	------	40	MS
		Medium (4.01-8)	5	Arka Lohit Khasi Sindhuri		
		Long (>8)	7	Arka Mohini Pusa Sadabahar		
13	Leaf: Width of blade (measured on the widest part of the leaf in cm)	Narrow (<3)	3	Kashi Anmol (KA2) PC-2062	40	MS
		Medium (3.01-5)	5	Arka Abhir Phule Jyoti		
		Broad (>5)	7	Pusa Sadabahar Arka Mohini		
14	Leaf: Colour	Green	3	Arka Suphal Pusa Sadabahar	40	VG
		Purple	5	--------		
		Green with purple tinge	7	--------		
		Purple with green tinge	9	--------		
15	Leaf: Intensity of green colour	Light	3	ACS 2000-2 Arka Basant	40	VG
		Medium	5	Arka Abhir Lam 353		
		Dark	7	Arka Meghana Pusa Sadabahar		
16	Leaf: Intensity of purple colour	Light	3	---------	40	VG
		Medium	5	---------		
		Dark	7	---------		

S. No.	Characteristics	States	Note	Example variety/ varieties	Stage of observation	Type of assessment
17 (+)	Leaf: Shape	Lanceolate	3	Arka Khyati LCA 333	40	VG
		Ovate	5	Arka Suphal Prasanth		
		Broad elliptic	7	Arka Mohini Kashi Sindhuri		
18	Leaf: Undulation of margin	Weak	3	Arka Mohini Arka Suphal	40	VG
		Medium	5	Arka Abhir Byadagi Dabbi		
		Strong	7	Hungarian Yellow Wax Arka Khyati		
19	Leaf: pubescence (hairiness)	Absent	1	Arka Sweta	40	VG
		Present	9	Pusa Sadabahar Byadagi Dabbi		
20	Leaf: Intensity of pubescence (hairiness)	Sparse	3	Arka Meghana California Wonder	40	VG
		Medium	5	Phule Mukta IVPBC-535		
		Strong	7	Byadagi Dabbi Byadagi Kaddi		
21 (*)	Flower: Petal colour	White	3	Arka Suphal Arka Mohini	30	VG
		Yellowish green	5	PC-2062 Ajeet-3		
		Purple	7	--------		
		Others (specify)	9	--------		
22	Flower: Anther colour	Yellow	3	Bhaskar K-1	30	VG
		Pale blue	5	Arka Suphal Arka Mohini		
		Purple	7	Pant Chilli-3 Ajeet-1		
		Others (specify)	9	------		
23 (*)	Flower: Days to 50% flowering (from the date of sowing)	Early(<70 days)	3	Arka Meghana Kashi Anmol	30	MS
		Medium (70-90)	5	Arka Mohini Kashi Sindhuri		
		Late (>90)	7	Arka Lohit Bhagyalakshmi		

S. No.	Characteristics	States	Note	Example variety/ varieties	Stage of observation	Type of assessment
24 (+)	Flower/ Fruit: Orientation	Drooping	3	Arka Suphal Pusa Jwala	30/40	VG
		Semi drooping	5	Phule Mukta Hungarian Yellow Wax		
		Erect	7	Pusa Sadabahar Utkal Yellow		
25	Fruit: Bearing habit (No. of fruits/ node)	1 (Solitary)	3	Arka Suphal Pusa Jwala	40	VG
		2-3	5	------		
		>3 (Cluster)	7	Pusa Sadabahar Punjab Gucchedhar		
26 (*)	Fruit: Colour (at mature unripe stage)	White	3	------	40	VG
		Cream	5	Arka Basant		
		Green	7	Arka Suphal Pusa Jwala		
		Purple	9	------		
27	Fruit: Intensity of colour (at mature unripe stage)	Light	3	Arka Sweta Pusa Jwala	40	VG
		Medium	5	Pusa Sadabahar Arka Suphal		
		Dark	7	Arka Meghana Utkal Yellow		
28a (*)	Fruit: Length (cm) (hot pepper and paprika)	Very short (<2)	1	------	40	MS
		Short (2.01-5.0)	3	Pusa Sadabahar Phule Mukta		
		Medium (5.01-10)	5	Arka Suphal Arka Harita		
		Long (10.01-15)	7	Arka Khyati Byadagi Dabbi		
		Very long (>15)	9	Byadagi Kaddi		
28b (*)	Fruit: Length (cm) (bell pepper)	Short (<3)	3	-------	40	MS
		Medium (3.01-6)	5	Solan Bharpur Kandaghat Selection-9		
		Long (>6)	7	Arka Mohini California Wonder		
29a (*)	Fruit: Diameter (fruits measured at the widest point in cm) [hot pepper and paprika]	Narrow (<0.8)	3	Byadagi Kaddi Pusa Jwala	40	MS
		Medium (0.81-1.5)	5	Arka Harita Lam 353		
		Broad (>1.5)	7	Byadagi Dabbi KTPL-19		

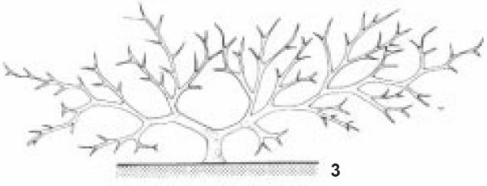
S. No.	Characteristics	States	Note	Example variety/ varieties	Stage of observation	Type of assessment
29b (*)	Fruit: Diameter (fruits measured at the widest point in cm) [bell pepper]	Narrow (<3)	3	Solan Bharpur	40	MS
		Medium (3.01-5)	5	KT-1 (Katrain) Arka Basant		
		Broad (>5)	7	Arka Mohini California Wonder		
30 (*) (+)	Fruit: Shape in longitudinal section	Oblate	1	-------	40	VG
		Circular	2	-------		
		Cordate	3	Solan Bharpur		
		Square	4	Arka Mohini California Wonder		
		Rectangular	5	Arka Basant		
		Trapezoidal	6	Arka Gaurav		
		Moderately triangular	7	Byadagi Dabbi KTPL-19		
		Narrowly triangular	8	Pusa Jwala Byadagi Kaddi		
		Horn shaped	9	Prasanth Anugraha		
		Others (specify)	10	-------		
31 (+)	Fruit: Curvature	Absent	1	Arka Suphal	40	VG
		Present	9	Pusa Jwala		
32 (+)	Fruit: Curvature intensity	Low	3	Kashi Sindhuri	40	VG
		Medium	5	Pusa Jwala		
		High	7	Byadagi Kaddi		
33 (+)	Fruit: Neck at basal end	Absent	1	Arka Suphal Arka Sweta	40	VG
		Present	9	Kashi Sindhuri		
34 (*) (+)	Fruit: Cross sectional corrugation (at level of placenta)	Round	3	Phule Mukta Punjab Gucchedhar	40	VG
		Slightly corrugated	5	Arka Lohit Prasanth		
		Strongly corrugated	7	Byadagi Dabbi Byadagi Kaddi		
35 (*) (+)	Fruit: Sinuation of pericarp	Weak	3	Arka Suphal Hungarian Yellow Wax	40	VG
		Medium	5	Arka Lohit Prasanth		
		Strong	7	Byadagi Dabbi Arka Abhir		
36 (*)	Fruit: Texture of surface	Smooth	3	Arka Sweta Arka Suphal	40	VG
		Slightly rough	5	Arka Abhir Arka Meghana		
		Rough	7	Byadagi Dabbi Byadagi Kaddi		

S. No.	Characteristics	States	Note	Example variety/ varieties	Stage of observation	Type of assessment
37 (*)	Fruit: Colour (at ripe maturity)	Yellow	1	Utkal Yellow Arka Gaurav	50	VG
		Orange	2	Arka Basant		
		Red	3	Arka Suphal Arka Mohini		
		Brown	4	-------		
		Others (specify)	5	-------		
38	Fruit: Intensity of colour (at maturity)	Light	3	Pusa Jwala (Red)	50	VG
		Medium	5	Arka Lohit (Red) Phule Jyoti (Red)		
		Dark	7	Arka Abhir (Red) Byadagi Dabbi (Red)		
39	Fruit: Color transition	One stage	3	Pusa Jwala	50	VG
		Two stages	5	Byadagi Dabbi Arka Basant		
		>Two stages	7	------		
40	Fruit: Glossiness	Weak	3	Kashi Sindhuri	40	VG
		Medium	5	KTPL-19 Byadagi Dabbi		
		Strong	7	Arka Suphal Lam 353		
41 (*) (+)	Fruit: Shape at the base	Acute	3	Arka Lohit Prasanth	40	VG
		Round	5	Arka Abhir KTPL-19		
		Sunken	7	Arka Mohini California Wonder		
42 (+)	Fruit: Shape of apex	Acute	1	Arka Lohit Prasanth	40	VG
		Blunt	3	Hungarian Yellow Wax KTPL-19		
		Depressed	5	Arka Mohini		
		Depressed & Acute	7	Arka Gaurav		
		Others (specify)	9	-------		
43 (*)	Fruit: Number of Locules/ lobes (bell pepper)	2	1	-------	40	MG
		2-3	2	KT-1 (Katrain) Kandaghat Selection-1		
		3	3	--------		
		3-4	4	Arka Mohini California Wonder		
		>4	5	---------		
44 (*)	***Fruit:*** Pericarp thickness (at physiological mature stage)	Very thin (<1)	1	Arka Lohit Prasanth	40	MS
		Thin (1.01-2)	3	Arka Suphal Byadagi Kaddi		
		Medium (2.01-3)	5	Byadagi Dabbi Arka Abhir		
		Thick (3.01-4)	7	Hungarian Yellow Wax Arka Sweta		
		Very thick (>4)	9	Arka Mohini California Wonder		

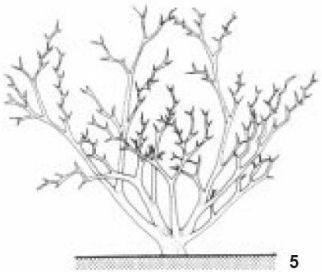
S. No.	Characteristics	States	Note	Example variety/ varieties	Stage of observation	Type of assessment
45	Fruit: Stalk Length (cm)	Very short (<1.5)	1	Kashi Anmol Kandaghat Selection-1	40	MS
		Short (1.6-2.5)	3	Byadagi Dabbi KT-1 (Katrain)		
		Medium (2.6-3.5)	5	Arka Abhir Arka Suphal		
		Long (3.6-4.5)	7	California Wonder Lam 353		
		Very long (>4.5)	9	HDC-75 PC-56		
46 (+)	Fruit: Calyx Cover	Non-enveloping	1	Byadagi Dabbi Arka Basant	40	VG
		Enveloping	9	Arka Lohit Prasanth		
47 (+)	Fruit: Calyx Margin	Smooth	1	Punjab Surkh LCA 333	40	VG
		Dented	9	Pusa Jwala Prasanth		
48 (+)	Fruit: Calyx Constriction	Absent	1	Arka Suphal Pusa Sadabahar	40	VG
		Present	9	Kashi Sindhuri Jayanti		
49	Fruit: Pedicel attachment	Weak	1	Arka Sweta	40	VG
		Strong	9	Arka Lohit		
50 (+)	Fruit: Blossom end appendage	Absent	1	Arka Mohini	50	VG
		Present	9	Arka Gaurav		
51	Fruit: Days to 50% ripening (from the date of sowing)	Early (<100days)	3	Arka Meghana MI-2	50	MS
		Medium(101-120days)	5	Arka Khyati Prasanth		
		Late (>120 days)	7	Arka Harita Arka Lohit		
52	Seed: 1000 seed weight (g)	Low (<4)	3	Pusa Sadabahar Hungarian Yellow Wax	60	MS
		Medium (4.01-6)	5	Arka Suphal Prasanth		
		High (>6)	7	Arka Lohit K-1		
53	Seed: Recovery (%)	Low (<30)	3	Arka Khyati Pusa Jwala	60	MS
		Medium (30.1-50)	5	Arka Suphal Utkal Yellow		
		High (>50)	7	Chilli Japani Longi Pusa Sadabahar		
54	Seed: Colour	Light yellow	3	Arka Sweta Arka Basant	60	MG
		Yellow	5	Arka Suphal Utkal Yellw		
		Orange yellow	7	Pusa Sadabahar Prasanth		
		Others (specify)	9	------		

VIII. Explanations for the Table of Characteristics:

Characteristic # 2: Plant: Habit



3
Spreading

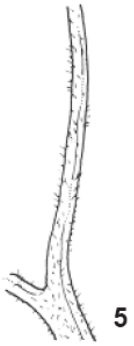


5
Semi-upright

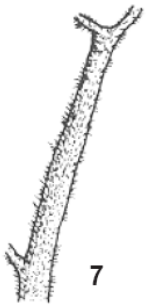
7
Upright

Characteristic # 10: Stem: Intensity of pubescence (hairiness)

Sparse

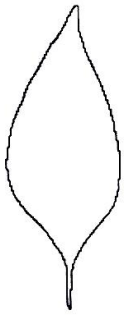


Medium

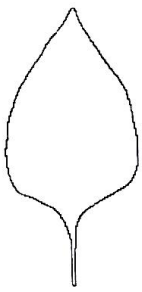


Strong

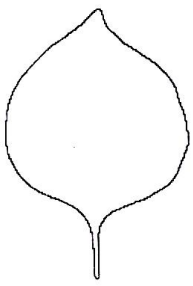
Characteristic # 17: Leaf: shape



1
Lanceolate

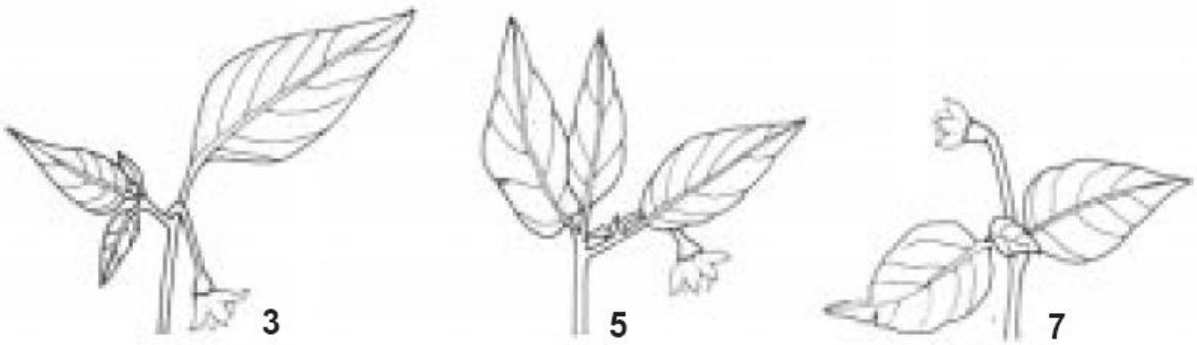


2
Ovate



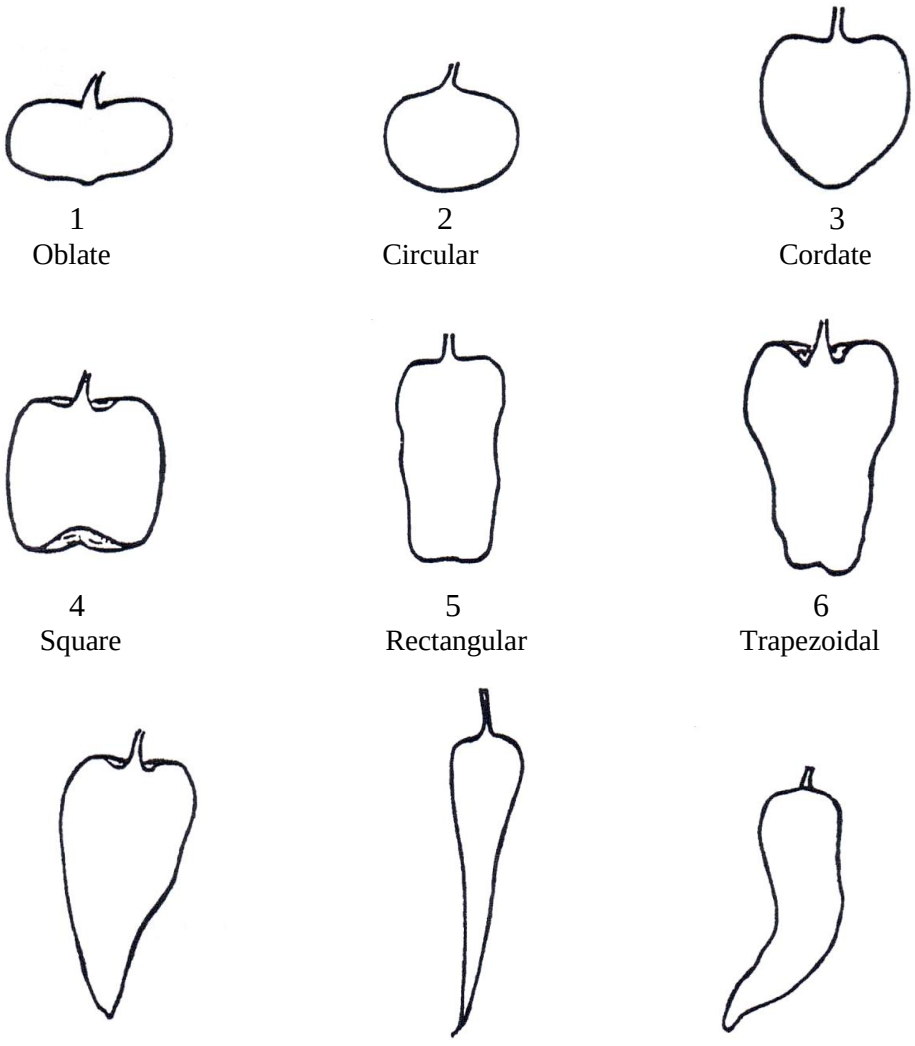
3
Broad elliptic

Characteristic # 24: Flower/ Fruit Orientation



Drooping | Semi-drooping | Erect

Characteristic # 30: Fruit: shape in longitudinal section



1 Oblate | 2 Circular | 3 Cordate

4 Square | 5 Rectangular | 6 Trapezoidal

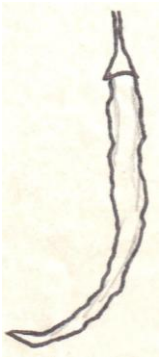
7 Moderately triangular | 8 Narrowly triangular | 9 Horn shaped

Characteristic # 31: Fruit: Curvature

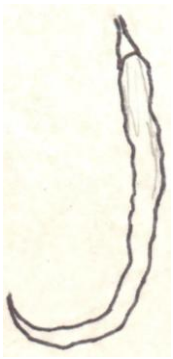
1
Absent

9
Present

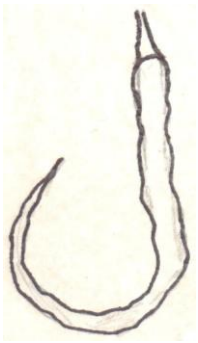
Characteristic # 32: Fruit: Curvature intensity



3
Low



5
Medium



7
High

Characteristic # 33: Fruit: Neck at basal end

1
Absent

9
Present

Characteristic # 34: Fruit: Shape in cross section

3
Round

5
Slightly corrugated

7
Strongly corrugated

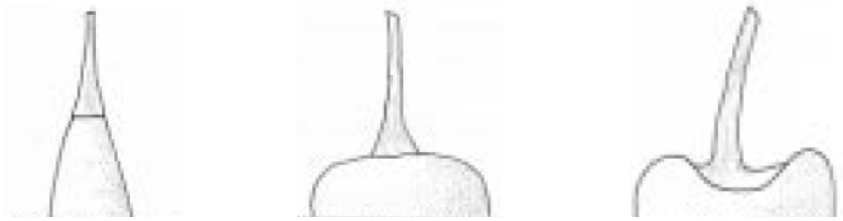
Characteristic # 35: Fruit: Sinuation of pericarp

3
Weak

5
Medium

7
Strong

Characteristic # 41: Fruit: Shape at base



3
Acute

5
Round

7
Sunken

Characteristic # 42: Fruit: Shape at apex

1
Acute

3
Blunt

5
Depressed

9
Depressed & acute

Characteristic # 46: Calyx: Cover

1
Non-enveloping

9
Enveloping

Characteristic # 47: Calyx: Margin

1
Smooth

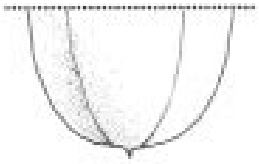
9
Dented

Characteristic # 48: Calyx: Constriction

1
Absent

9
Present

Characteristic # 50: Fruit: Blossom end appendage



1
Absent

9
Present

IX. Literature:

IPGRI, AVRDC and CATIE. 1995. Descriptors for *Capsicum* (*Capsicum* spp.). International Plant Genetic Resources Institute, Rome, Italy; the Asian Vegetable Research and Development Center, Taipei, Taiwan and the Centro Agronómico Tropical de Investigación y Enseñanza, Turrialba, Costa Rica. ISBN 92-9043-216-0. Pp 49.

X. Working Group Details:

The test guidelines were developed by the National Core Committee in consultation with the Director, Indian Institute of Horticultural Research (IIHR), Bangalore, the Nodal Officer, Co-Nodal Officers, DUS testing centers and the Task Force (7/2014) constituted by the PPV&FR Authority.

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XI. DUS test centres

Nodal DUS Centre	Co-Nodal DUS Centre
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