Guidelines for the conduct of test for Distinctiveness, Uniformity and Stability

on

Vegetable Amaranth
(*Amaranthus tricolor L.*)

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

Government of India

New Delhi-110012

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Vegetable Amaranth (*Amaranthus tricolor L.*)

I. Subject

These test guidelines shall apply to all varieties of Vegetable Amaranth (*Amaranthus tricolor* L), and also to other main vegetable species viz., *Amaranthus dubius* Mart exThell, *Amaranthus lividus L.*, *Amaranthus blitum L.*, *Amaranthus tristis* L., *Amaranthus spinosus* L. and *Amaranthus viridis 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 the variety, is to be delivered. Applicants submitting material from a country other than India shall make sure that all customs and phytosanitory formalities are complied with.

2. The minimum quantity of seed to be supplied by the applicant shall be:

   Varieties : 150 g (in one submission only).

3. The seed material shall meet the minimum germination percentage (80%), moisture content (<8%), physical purity (98%) and genetic purity (100%) as prescribed for seed certification in India. Especially for storage, which requires a higher standard, the applicant shall state the actual germination percentage, which shall be as high as possible.

4. The planting material must not have undergone any treatment unless the competent authority allow or reject such treatment. If it has been treated, full details of the treatment must be given.

III. Conduct of tests

1. The minimum duration of tests shall normally be two independent but similar growing seasons with reference to the ecosystem of the variety submitted for DUS testing.

2. The test shall normally be conducted at two test locations. If any essential characteristic of the variety cannot be observed at these places, the variety may be tested at an additional place.

3. The test shall be carried out under conditions ensuring normal growth. The size of the plot shall be such that plants or parts of plant may be removed for measuring and counting without prejudice to the observations which must be made up to the end of the growing period. Each test shall include a minimum of 150 plants, which should be divided among 3 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

Number of rows	:	5
Row length	:	2 m
Plant to plant distance	:	20 cm
Row to Row distance		50 cm
Number of replications	:	3

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

6. Observation shall be recorded from 10 plants from each replication.

IV. Methods and observations

1. The characteristics described in the table of characteristics (see Section VII) shall be used for the testing of varieties for DUS

2. For the assessment of distinctiveness and stability, observation shall be made on 30 plants or parts of plants, which shall be divided among 3 replications (10 plants in each replication).

3. For the assessment of Uniformity of characteristics in the plot as a whole (visual assessment by a single observation of 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 case of a sample size of 150 plants, the number of off-types should not exceed 2.

4. For the assessment of all colour characteristics, Royal Horticultural Society (RHS) Colour Chart shall be used.

5. All the leaf characters shall be made on 8^{th} fully opened leaf from the top.

6. Stage of recording observation on specific characteristic shall be as follows

Description	**Code**
a. Cotyledons completely unfolded	10
b. Active vegetative phase	20
c. Leaves attaining harvestable maturity	30
d. 50% of the flowering stage	40
e. Full seed maturity	50

V. Grouping of varieties

1. The selected varieties to be grown in the trial shall be divided into groups to facilitate the assessment of distinctness. Characteristics, which are suitable for grouping purpose, are those which are known from experience not to vary, or to vary only to lesser extent,

within a variety. The states of expression (even produced at different locations) shall be fairly and evenly distributed throughout the collection.

2. It is recommended that the competent authorities use the following characteristics for grouping of Vegetable Amaranth varieties.

    a. Leaf : Leaf blade: main color (characteristic 11)
    b. Leaf : Leaf blade: presence of blotch (characteristic 12)
    c. Petiole : Petiole: anthocyanin coloration (characteristic 16)
    d. Stem : Stem: color (characteristic 17)
    e. Stem : Stem: shape in cross section (characteristic 20)
    f. Plant : Plant: days to 50% flowering (characteristic 22)

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 for the purpose of recording and electronic processing of data. Each state of expression is allotted a corresponding numerical note (1-9) for the different characteristics.

3. Legend

(*) Characteristics that shall be used every growing season for the examination of all the varieties and shall always be included in the description of the variety, except when the states of expression of any of these characters is rendered impossible by a preceding 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 Characteristic in Section VIII

4. Type of assessment of characteristics indicated in column 7 of Table of Characteristics is as follows

    MG: Measurement by a single observation on a group of plants or parts of plants
    MS: Measurement on a number of 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 observation on individual plant or parts of plants

VII. Table of Characteristics

Sl.No	Trait	States	Note	Example Varieties	Stage of observation	Type of assessment
1	**2**	**3**	**4**	**5**	**6**	**7**
1. (*)	Cotyledon: anthocyanin coloration	Absent	1	Arka Suguna, Arka Varna, Pusa Kirti, Pusa Kiran, Co-1, Co-2, Co-3, Co-5, Renushree, RNA-1	10	VG
		Present	9	Arka Arunima, Pusa Lal Chawlai, Arun		
2. (*)	Seedling: anthocyanin coloration of hypocotyls	Absent	1	Arka Suguna, Pusa Kiran, Pusa Kirti, RNA-1	10	VG
		Present	9	Arka Arunima, Arka Samraksha, Arka Varna, Pusa Lal Chawlai, Co-1, Co-3, Co-5, Renushree, Arun		
3.	Young leaf: length (cm)	Short (<10)	3	Co-3	20	MS
		Medium (10.1-13)	5	Arka Arunima, Arka Suguna, Pusa Lal Chawlai, Pusa Kirti, RNA-1, Co-1, Co-5		
		Long(>13)	7	Arka Samraksha, Pusa Kiran, IIHR-109-1		
4.	Young leaf: width (cm)	Narow (<6)	3	*Amaranthus blitum* L.	20	MS
		Medium(6.1-8)	5	Pusa Kiran		
		Broad (>8)	7	Arka Samraksha, Arka Suguna, Arka Varna, Pusa Kirti, Co-1		
5. (+)	Young leaf: position of broadest part	In middle or slightly towards base	1	Pusa Kirti	20	VG
		Moderately towards base	2	Arka Samraksha, Pusa Kiran, IIHR-109-1		
		Strongly towards base	3	Co-1, RNA-1		
6.	Young leaf: prominence of veins	Weak	3	----	20	VG
		Medium	5	Pusa Lal Chawlai, IIHR-109-1, RNA-1, Arka Suguna, Pusa Kirti		
		Strong	7	----		
7.	Young leaf:	Light green	1	Arka Suguna, Co-4	20	VG

	main color on upper side	Medium green	2	Arka Samraksha, Arka Varna, Co-2, Co-3, Co-5		
		Dark green	3	Co-1		
		Red	4	Arka Arunima, Pusa Lal Chawlai		
		Purple	5	----		
8.	Young leaf: distribution of secondary color on upper side	Colored basal area	1	----	20	VG
		Central blotch	2	----		
		Colored margin and Veins	3	Arka Varna, Co-5, Renushree		
9.	Young leaf: color on the lower side	Green	1	Arka Samraksha, Arka Suguna, Arka Varna, Pusa Kiran, Pusa Kirti, Co-1, Co-2, Co-3, RNA-1, IIHR-109-1, Renushree	20	VG
		Red	2	Arka Arunima, Pusa Lal Chawlai		
		Purple	3	----		
10. (+)	Leaf: margin	Entire	1	Pusa Kiran, Pusa Kirti, Pusa Lal Chawlai, Renushree	30	VG
		Sinuate	2	Arka Arunima, Arka Suguna, Arka Varna		
11. (*)	Leaf blade: main color	Light green	1	Arka Suguna	30	VG
		Medium green	2	Arka Samraksha, Arka Varna, Pusa Kiran, Pusa Kirti, Co-2, IIHR-109-1		
		Dark green	3	Co-1		
		Red	4	Arka Arunima, Pusa Lal Chawlai, Arun		
12. (*) (+)	Leaf blade: presence of blotch	Absent	1	Arka Samraksha, Arka Suguna, Pusa Kiran, Pusa Kirti, Co-1	30	VG
		Present	9	----		
13. (+)	Leaf blade: size of blotch in relation to blade	Small	3	----	30	VG
		Medium	5	----		
		Large	7	----		
14.	Leaf blade: color of blotch	Green	1	----	30	VG
		Silvery	2	----		
		Red	3	----		
		Purple	4	----		
15.	Leaf blade:	Ovoid	1	----	30	VS

(*)(+)	shape of blotch	"V" shaped	2	----		
16. (*)	Petiole: anthocyanin coloration	Absent	1	Arka Samraksha, Arka Suguna, Pusa Kiran, Pusa Kirti, Co-2, Co-3, IIHR-109-1, RNA-1	30	VG
		Present	9	Arka Arunima, Arka Varna, Pusa Lal Chawlai, Renushree		
17. (*)	Stem: color	Green	1	Arka Samraksha, Arka Suguna, Pusa Kiran, Pusa Kirti, Co-1, Co-2, Co-3, RNA-1	30	VG
		Pink	2	----		
		Red	3	Arka Arunima, Arka Varna, Pusa Lal Chawlai, Renushree		
		Purple	4	-		
		White	5	IIHR-109-1		
18.	Plant: height (cm)	Short(<50)	3	Co-4, Co-5, Arka Suguna	30	MS
		Medium (50.1-80)	5	Arka Arunima, Co-3		
		Tall (>80)	7	Arka Samraksha, Pusa Kirti, Pusa Kiran, Pusa Lal Chawlai		
19. (*)	Stem: anthocyanin coloration of base	Absent	1	Arka Suguna, Pusa Kiran, Pusa Kirti, Co-2, RNA-1	30	VG
		Present	9	Arka Arunima, Arka Samraksha, Arka Varna, Pusa Lal Chawlai, Renushree		
20. (*) (+)	Stem: shape in cross section	Circular	1	Pusa Lal Chawlai, Arun, Co-5	30	VS
		Undulated	2	Arka Samraksha, Arka Suguna, Pusa Kiran, Co-1, RNA-1		
21. (*)	Plant : type of harvesting	Pulling type	1	Arka Samraksha, Arka Varna	30	VG
		Cutting type	2	Arka Suguna, Arka Arunima, Co-3, Pusa Kiran		
22. (+)	Days to 50% flowering	Early (<40)	3	Arka Samraksha, Arka Varna, Co-2, Co-3	40	MS
		Medium (40.1-50)	5	Arka Arunima, RNA-1, IIHR-109-1		
		Late(>50)	7	Arka Suguna, Pusa Lal		

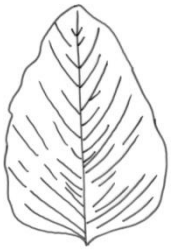
				Chawlai, Pusa Kiran, Co-5		
23. (*)	Inflorescence: color	Green	1	Arka Samraksha, Arka Suguna, Pusa Kirti, Pusa Kiran, Renushree, RNA-1	40	VG
		Pink	2	Arka Varna		
		Red	3	Arka Arunima, Pusa Lal Chawlai		
		Purple	4	----		
24. (*)	Plant growth habit	Determinate	1	Arka Arunima, Arka Samraksha, Pusa Kirti, Pusa Kiran, Pusa Lal Chawlai	40	VG
		Indeterminate	2	----		
25. (*)	Seed: color	Brown	1	----	50	VG
		Black	2	Arka Arunima, Arka Samraksha, Arka Suguna, Arka Varna, Pusa Kirti, Pusa Kiran, Pusa Lal Chawlai, Co-1, Co-2, Co-3, Co-5, Renushree, RNA-1, IIHR-109-1		
26. (*) (+)	Seed: shape	Ellipsoid	1	Pusa Kiran, RNA-1	50	VG
		Discoid	2	Arka Arunima, Arka Samraksha, Arka Suguna, Arka Varna, Renushree		
27. (+)	1000 Seed weight (g)	Low (0.6)	3	Co-1	50	MG
		Medium(0.61-0.8)	5	Arka Varna, Pusa Kirti, Co-2, Co-4, IIHR-109-1		
		High (>0.8)	7	Co-3		

VIII. Explanations on the Table of Characteristics

Characteristic 5. Young leaf: Position of broadest part

1
In middle or slightly towards base

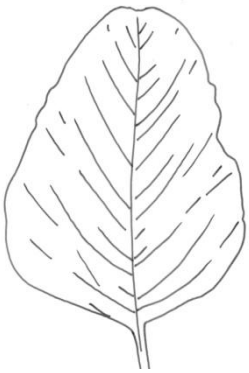
2
Moderately towards base



3
Strongly towards base

Characteristic 10. Leaf: Margin

1
Entire



2
Sinuate

Characteristic 12. Leaf Blade: Presence of blotch

1
Absent

9
Present

Characteristic 13. Leaf blade: Size of blotch in relation to blade

3
Small

5
Medium

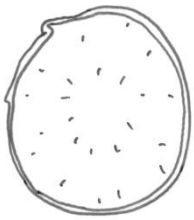
7
Large

Characteristic 15. Leaf Blade: Shape of blotch

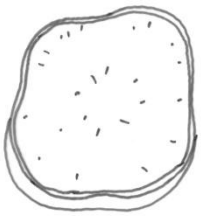
1
Ovoid

2
"V" Shaped

Characteristic 20. Stem: Shape in cross section



1
Circular



2
Undulated

Characteristic 22. Days to 50% flowering:

This is when 50 % of the plants have a panicle approximately 5 cm long, showing open flowers in its middle parts with separate stamens and with the stigma completely visible.

Characteristic 26. Seed: Shape

1
Ellipsoid

2
Discoid

Characteristic 27: 1000 seed weight:
The seed weight shall be measured on three samples of 1000 seeds, at moisture of 10%.

IX. Working Group Details

The Test Guidelines developed by the IIHR, Bangalore was finalized by the following Task Force Committee (10/2014) constituted by the PPV & FR Authority.

The Members of the Task Force (10/2014)

1.	**Dr. D.L. Maheswar** Vice-Chancellor, University of Horticultural Sciences, Udyanagiri, Near Seemekeri Cross, Hubli Bypass Road, Navanagar, Bagalkot-587103	**Chairman**
2.	**Dr. B. Singh** Director, & Project Coordinator (Vegetables) Indian Institute of Vegetable Research, Post Box No. 1, P.O. Jakhini, Varanasi- 221005	**Member**
3.	**Dr. P. S. Sirohi** Ex-Head, Division of Vegetable Science, IARI, EA-172, Near Arya Samaj Mandir, Inderpuri, New Delhi-110012	**Member**
4.	**Dr. B. Varalakshmi** Principal Scientist & PI, Nodal Centre, Division of Vegetable crops, Indian Institute of Horticultural Research, Hessaraghatta Lake Post, Bangalore-560089	**Member**
5.	**Dr. N. K. Biradar Patil** Prof. & Head (Seed Science & Technology) and Special Officer(Seeds), UAS, Dharwad- 580005, Karnataka	**Special Invitee**
6.	**Dr. T. R. Shashidhar** Assistant Prof. (Seed Science & Technology) Prof. of Horticulture, UAS, Dharwad- 580005, Karnataka	**Special Invitee**
7.	**Dr. Revanappa** Professor &Head, Dept. of Vegetable Science, UHS, Bagalkot-587103	**Special Invitee**
8.	**Dr. Ravi Prakash** Registrar, PPV & FRA, New Delhi	**Member Secretary**

Nodal Officer

Dr B. Varalakshmi, Principal Scientist (Hort.), Division of Vegetable Crops, Indian Institute of Horticultural Research, Hessarghatta, Lake Post, Bengaluru-560089 (Karnataka).

Co-Nodal Officer

Dr T. K. Behera, Principal Scientist (Hort.), Division of Vegetable Science, Indian Agricultural Research Institute, Pusa, New Delhi-110012

IX. DUS testing centers

Nodal Centre	**Other Centre**
Dr B. Varalakshmi Indian Institute of Horticultural Research, Hessarghatta Lake Post, Bengaluru-560089 (Karnataka).	Dr T. K. Behera Indian Agricultural Research Institute, Pusa, New Delhi-110012