

**Guidelines for the conduct of tests
for Distinctiveness, Uniformity and Stability**

**Grain Amaranth (*Amaranthus L.* excluding
ornamental or vegetable varieties)**



**Protection of Plant varieties and Farmer's Rights Authority
Government of India**

Contents

	Particulars	Page
I.	Subject	
II.	Seed Material Required	
III.	Conduct of Test	
IV.	Methods of Observations	
V.	Grouping of Varieties	
VI.	Characteristics and Symbols	
VII.	Table of Characteristics	
VIII.	Explanation on the Table of Characteristics	
IX.	Working Group Details	
X.	DUS Testing Centers	

Grain Amaranth

I. Subject

These test guidelines will be applied to all varieties of Grain Amaranth grown for grain production. Grain amaranth has four major cultivated species, that are, *Amaranthus hypocondricus*, *A. cruentus*, *A. caudatus* and *A. edulis*.

II. Seed Material Required

1. The Protection of Plant Variety and Farmers' Right Authority (PPV&FRA) shall decide when, where and in what quantity and quality the seed material required for testing of the variety for registration under 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 relevant national legislations and regulations are complied with. The minimum quantity of seed to be supplied by the applicant shall be 50 gram.
2. The seed material should meet the minimum germination percentage (80%), moisture content (not more than 10%), physical purity (98%) and highest genetic purity as prescribed for seed certification in India. The applicant shall also submit along with the seed, a certified data on germination test made not more than one month prior to the date of submission.
3. The seed material shall not have undergone any treatment unless the competent authority 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 DUS tests should normally be at least two independent but similar growing seasons.
2. The test should normally be conducted at two test locations. If any essential characteristic of the candidate variety is not expressed for visual observation at one place, the variety may be tested at another test site.
3. The field test shall be carried out under conditions ensuring normal growth. The size of the plot should be such that plants or parts of plant may be removed for measuring and counting without prejudicing of the observations on standing crop plants or parts of plants until the end of the growing period. Each test should 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. All the replications shall be sharing similar environmental conditions of the test location.

4. Test Plot Design

Details of experimental plan	For Hills	For Plain
Number of rows	6	4
Row length	2 m	3m
Plant to plant distance	20 cm	20 cm
Row to Row distance	60 cm	50 cm
Number of replications	3	3

5. Observations should not be recorded on plants in border rows.
6. Observation should be recorded from 10 plants from each replication.
7. 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 shall be used for the testing of varieties for DUS (Section VII).
2. For the assessment of distinctiveness, uniformity and stability, observation should be made on 30 plants or parts of plants, which should be divided among 3 replications (10 plants in each replication).
3. For assessment of uniformity of characteristics on the plot as a whole (visual assessment by a single observation of a group of plants or parts of plant), 30 plants (a population standard of 5% with an acceptance probability of at least 95% should be applied) are considered for observations and any other observations should be made on all plants in the test. In the case of a sample size of 100 plants, five off-types are allowed.
4. For the assessment of colour characteristics, Royal Horticulture Society (RHS) colour chart be used.

V. Grouping of varieties

Grouping characteristics are those, which are known from experience not to vary, or to vary only to lesser extent, within a variety, can be used to divide the candidate varieties for DUS testing into different groups to facilitate the examination of Distinctiveness. The states of expression (even produced at different locations) should be fairly and evenly distributed throughout the collection.

The following will be the useful grouping characteristics for grain amaranth:

- (a) Seedling: anthocyanin coloration of hypocotyls (characteristic 1)
- (b) Leaf blade: presence of blotch (characteristic 4)
- (c) Inflorescence: colour (characteristic 7)
- (d) Inflorescence: shape (characteristic 13)
- (e) Seed: colour (characteristic 18)

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) should be used.
2. Notes (1 to 9) which are given against the states of the different characteristics at column 4 shall be used to describe the state of each character for the purpose of electronic data processing.
3. Legend
 - (*) Characteristics that shall be observed during every growing period for the examination of all the varieties and shall always be included in the description of the variety, except when the state of expression of a preceding characteristic or regional environmental conditions render this impossible.

(+) See Explanation on the Table of Characteristic in Section VIII B.

(a)- (f) See Explanations on the Table of Characteristics in Chapter VIII A.

QL: Qualitative characteristic
QN: Quantitative characteristic
PQ: Pseudo-qualitative characteristic

4. The optimum stage of plant growth for assessment of each characteristic is given in the column 6 of Table of Characteristic (Section VII).
5. Example Varieties: Where appropriate, example varieties are provided to clarify the states of expression of each characteristic.
6. Type of assessment of characteristics indicated in column 7 of Table of Characteristics (Section VII) 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

7. Characteristics containing the following key in the column 6 of the Table of Characteristics should be examined as indicated below:

Code	Description
10	Observations on the seedling which should be made 3-6 days after emergence (See Ch. 1)
20	Observations on the young plant on 6 to 8 leaves
30	Observations should be made at full flowering: 50% of the plants (see Ch. 5)
40	Observations should be made at physiological maturity (see Ch. 14)
50	Observations should be made on dry seeds at harvest time (see Ch. 17)

VII. Table of Characteristics

S.N	Characteristics	States	Note	Example variety/cultivar	State of observation	Type of assessment
1. (* QL	Seedling: anthocyanin coloration of hypocotyl	Absent	1	Annapurna	10	VG
		Present	9	Suvarna		
2. QN	Leaf blade: length (cm)	Short (<18 cm)	3	IC 21795	30	MS
		Medium (18-22 cm)	5	GA 2		
		Long (>22 cm)	7	Annapurna, Suvarna		
3. (+ QN	Leaf blade width (cm)	Narrow (<10 cm)	3	IC 17936	30	MS
		Medium (10-14 cm)	5	Annapurna, GA1		
		Broad (>16 cm)	7	Durga, Suvarna		
4. (* (+ QL	Leaf blade: presence of blotch	Absent	1	Annapurna	30	VG
		Present	9	GA 2		
5. (* (+ PQ	Leaf blade: Main colour	Green	3	Annapurna, VL101	30	VG
		Purple (<i>Red purple group 67A</i>)	7	GA 2, GA 3		
6. (+ PQ	Petiole length (cm)	Short (<14 cm)	3	BGA 2, GA 1	30	VG
		Medium (14 -17 cm)	5	VL102, Annapurna		
		Long (>17 cm)	7	VL44		
7. (* (+ PQ	Inflorescence colour	Light yellow	1	PRA 1	30	VG
		Yellow (<i>Yellow group 2C, 10 A</i>)	2	BGA 2, VL 102, PRA 1		
		Yellowish green (<i>Yellow green group 145C</i>)	3	Suvarna, GA 1		
		Orange (<i>Orange group 23A, 24A</i>)	4	IC 7941, IC 21925		
		Pink (<i>Red-Purple 61B, N66A, 67A</i>)	5	GA 2, GA 3		

		Pinkish green	6	-		
		Purple	7	-		
		Red (<i>Red group 51B</i>)	8	EC 169657, IC 38129		
		Reddish green	9	-		
		Green	10	-		
		Others (Mottoling)	99	Durga		
8. (* (+ QN	Days to 50% flowering (days)	Early (< 70 days)	3	VL Chua 44	30	MG
		Medium (70-80 days)	5	BGA 2		
		Late (>80 days)	7	Annapurna, PRA 1		
9. (+ QN	Inflorescence: compactness	Lax	3	Durga	30	VG
		Intermediate	5	PRA 1, VL Chua 44		
		Dense	7	BGA 2, GA 1		
10. QN	Inflorescence length (cm)	Short (<40 cm)	3	IC 7918, IC 7920	30	VG/MS
		Medium (40-70 cm)	5	Durga, Suverna		
		Long (>70 cm)	7	PRA 1		
11. (+ QL	Inflorescence spininess	Absent	1	Annapurna, Durga	30	VG
		Present	9	PRA 1, GA 1		
12. (+ QN	Lateral spikelet length (cm)	Short (<10 cm)	3	IC 7920	30	VG/MS
		Medium (10-15 cm)	5	Durga, VL 44		
		Long (>15 cm)	7	Suverna, VL 102		
13. (* (+ QL	Inflorescence: shape	Erect	3	Annapurna, VL Chua 44	40	VG
		Semi erect	5	-		
		Drooping	7	IC 7918		
14. (* (+ QN	Plant height (cm)	Short (<150 cm)	3	BGA 2, VL Chua 44	40	MG
		Medium (150-200)	5	Suverna, GA 1		
		Tall (>200 cm)	7	Annapurna, PRA 2		
15. (* (+ QL	Stem colour	Yellowish green (<i>Yellowish-Green 150C</i>)	3	VL 101, VL 102	40	VG
		Pink (<i>Red-Purple 67A</i>)	5	GA 2, GA 3		
		Red (<i>Red group 54A</i>)	7	IC 38129, IC 42371		
16. (* (+ QL	Stem surface	Smooth	1	Suverna	40	VG
		Ridged	9	GA 3, VL 101		
17. (+ QL	Seed transparency	Translucent	1	IC 95564, EC 150200	50	VG
		Opaque	9	Annapurna		
18. (* (+ PQ	Seed colour	Creamish (<i>White group 155D</i>)	3	VL 101, GA 3	50	VG
		Yellow (<i>Yellow group 4D</i>)	5	VL 102, VL 44, GA 1		
		Pink (<i>Red-Purple 67C, 67D</i>)	7	IC 7918, IC 7920		
19. (* (+ QL	Seed Shape	Ellipsoid	1	Suverna	50	VG
		Discoid	2	EC 150200		
		Opaque	2	Annapurna, Suverna		
20. (* (+ QN	Seed weight (g/10 ml.)	Low (<7 g)	3	VL 101	50	MG
		Medium (7 - 8 g)	5	Suverna		
		High (>8 g)	7	Annapurna, BGA 2		

VIII. Explanations on the Table of Characteristics

Characteristic 3: Leaf: width



3
Narrow



5
Medium



7
Broad



Narrow (3)



Medium (5)



Broad (7)

Characteristic 4: Leaf blade: presence of blotch



1
Absent



9
Present



Absent (1)



Present (9)

Characteristic 5: Leaf blade: Main colour



Green (3)



Purple (7)

Characteristic 6: Petiole length (cm)



Short (3)



Medium (5)



Long (7)

Characteristic 7: Inflorescence colour



Light Yellow(1)



YellowishGreen(3)



Orange(4)



Pink (5)



Red (8)



Mottling (99)

Characteristic 8: Days to 50% flowering

The time of flowering 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 9: Inflorescence: compactness



3

Lax



5

Intermediate



7

Dense



Lax (3)



Intermediate (5)



Dense (7)

Characteristic 11: Inflorescence spinness



Absent (1)



Present (9)

Characteristic 12: Lateral spikelet length (cm)



Short (3)

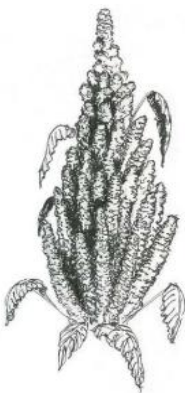


Medium (5)



Long (7)

Characteristic 13: Inflorescence: Shape



**1
Globose**



**2
Semi drooping**



**3
Completely drooping**



**4
Straight**



Globose (1)



Semi Drooping (2)



Completely Drooping (3)



Straight (4)

Characteristic 14: Plant height

To be measured from the base of the plant to the tip of the inflorescence.

Characteristic 15: Stem colour



Yellowish Green (2)



Pink (4)



Red (5)

Characteristic 16: Stem: Surface



1

Smooth



9

Ridged



Smooth (1)

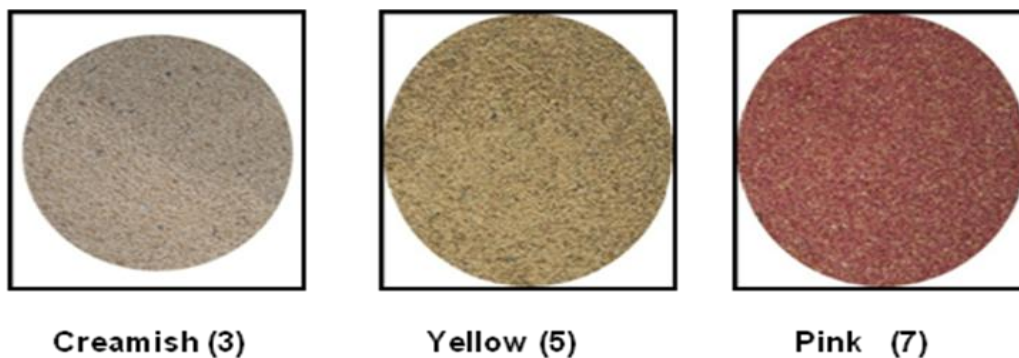


Ridged (9)

Characteristic 17: Seed: Transparency

The type of seed should be observed by placing the seed on glass lid: if the light is transmitted through the seed, it is translucent type seed; if the light is not transmitted, it is opaque type seed.

Characteristic 18: Seed colour



Characteristic 19: Seed: shape



Ellipsoid



Discoid

Characteristic 20: Seed weight

The seed weight should be measured on volume/weight basis (g/10 ml), at moisture of 10%.

IX. Working Group details:

These guidelines developed by the National Core Committee in consultation with the Project Coordinator (Underutilized Crops), the Nodal Officer, DUS testing, NBPGR, New Delhi and the Task Force (4-10/12) constituted by the PPV&FR Authority.

The Members of the Task Force:

Prem N Mathur
(Chairman)

M Dutta
(Member)

J C Rana
(Member)

B S Phogat
(Member)

Rashmi Yadav
(Nodal Officer)

Dipal Roy Chaudhury
(Member Secretary)

X. Name of DUS Test Centre(s):

Nodal DUS Centre	Other DUS Centre(s)
National Bureau of Plant Genetic Resources, New Delhi-110012	NBPGR, Regional Station, Phagli, Shimla (H.P.)