

**Guidelines
for the Conduct of Test for
Distinctiveness, Uniformity and Stability**

On

Sorghum
(*Sorghum bicolor* (L.) Moench)



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

Government of India

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I. Subject

These test guidelines shall apply to all varieties, hybrids and parental lines of Sorghum (*Sorghum bicolor* (L.) Moench)

II. Seed 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 are required for testing a variety denomination applied for registration under the Protection of Plant Variety and Farmers' Rights (PPV & FR) Act, 2001. Applicants submitting such 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 the seed to be provided by the applicant shall be 3000 gram in the case of the candidate variety or hybrid and 1500 gram for each of the parental line of the hybrid. Each of these seed lots shall be packed and sealed in ten equal weighing packets and submitted in one lot. If requested by the competent authority in addition 100 panicles shall be submitted.
2. The seeds submitted shall have the following standards for germination capacity, moisture content and physical purity.
 - a. Germination capacity
 - i. Inbred lines and single cross hybrids : 80% (minimum)
 - ii. Varieties and double cross hybrids : 90% (minimum)
 - b. Moisture content : 10-12 % (maximum)
 - c. Physical purity : 98% (minimum)
3. 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. It also shall possess the highest genetic purity, uniformity, sanitary and phyto-sanitary standards.
4. The seed material shall not have been subjected to any chemical or bio-physical treatment.

III. Conduct of tests

1. The minimum duration of the DUS tests shall normally be at least two independent similar growing seasons.
2. The test shall normally be conducted at least 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.
3. The field tests shall be carried out under conditions favouring normal growth and expression of all test characteristics. The size of the plots 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 about 900 plants in the plot size and planting space specified below across four replications. Separate plots for observation and 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:

Number of rows	:	6
Row length	:	6 m
Row to row distance	:	60 cm
Plant to plant distance	:	15 cm
Number of replications	:	4

5. Observations shall not be recorded on plants in border rows.
6. Additional tests 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, inbred lines and hybrids for their DUS.
2. For the assessment of Distinctiveness and Stability, observations shall be made on 40 plants or parts of 40 plants, which shall be divided among 4 replications (10 plants in each replication).
3. For the 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 plants), the number of aberrant plants or parts of plants shall not exceed 6 in 100.
4. For the assessment of Uniformity of characteristics on single ear-rows, plants or parts of plants (visual assessment by observations of a number of individual ear-rows, plants or parts of plants) the number of aberrant ear-rows, plants or parts of plants shall not exceed 6 in 100.
5. For the assessment of colour characteristics, the latest Royal Horticultural Society (RHS) colour chart shall be used.

V. Grouping of varieties

1. The candidate varieties for DUS testing shall be divided into groups to facilitate the assessment of distinctness. 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 sorghum varieties:
 - a) Kharif or rabi adaptation
 - b) Plant: Time of panicle emergence (50% of the plants with complete panicle emergence) (Characteristics 4)
 - c) Plant: Total height at maturity (Characteristics 18)
 - d) Panicle: Shape (Characteristics 27)
 - e) Caryopsis : Colour after threshing (Characteristics 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. Note (1 to 9) shall be used to describe the state of each character for the purpose of digital data processing.
3. Legend:
 - (*) Characteristics that shall be observed during every growing period 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 stage of plant growth for assessment of each characteristic is given in the sixth column.
5. 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 observation of individual plants or parts of plants

VII. Table of characteristics

S.No	Characteristics	States	Note	Example variety/line	Stage of observation	Type of assessment
1	2	3	4	5	6	7
1 (+)	Seedling : Anthocyanin colouration of coleoptile	Yellow green (RHS 144-144N) Grayed purple (RHS 183-187)	1 2	AKMS 14B M 35-1, AKR 150	Seedling 7-8 days after sowing	VS
2 (*)	Leaf sheath: Anthocyanin colouration	Yellow green (RHS 144-144N) Grayed purple (RHS 183-187)	1 2	AKMS 14B, Pant Chari 4	5 leaf	VS
3	Leaf: Mid rib colour (5th fully developed leaf)	White RHS 155-N 155 Yellow green (RHS 144-N 144) Grayed yellow (RHS 162) Grayed purple (RHS 183-187)	1 2 3 4	SPV462, JJ 1041 CS 3541 - -	5th leaf	VS
4 (*)	Plant: Time of panicle emergence (50% of the plants with 50% anthesis)	Very early (<56 days) Early (56-65 days) Medium (66-75 days) Late (76-85 days) Very late (>85 days)	1 3 5 7 9	GFS 4 CSH 14 CSH 16 Pant Chari 5 SSV 84	Panicle emergence	VG
5	Plant: Natural height of plant up to base of flag leaf	Very short (<76 cm) Short (76-150 cm) Medium (151-225 cm) Tall (226-300 cm) Very tall (>300 cm)	1 3 5 7 9	- 296B RS 29 Pant chari 3 -	Panicle emergence	MS
6 (*)	Flag leaf: Yellow colouration of midrib	ABSENT PRESENT	1 5	CS 3541 27B	Panicle emergence	VS
7 (*)	Lemma: Arista formation	Absent Present	1 5	CS 3541 296B	Flowering	VS

8 (* (*)	Stigma: Anthocyanin colouration	Absent	1	CS 3541	Upper portion of the panicle at the end of flowering	VS
		Present	5	SSG 59-3		
9 (* (*)	Stigma: Yellow colouration	Absent	1	CS 3541	Flowering	VS
		Present	5	27B		
10	Stigma: Length	Short (<1mm)	3	AKMS 14	Flowering	MS
		Medium (1-2mm)	5	BIMS 9B		
		Long (>2mm)	9	MAN T1		
11 (+ (+)	Flower with pedicel: Length of flower	Very short	1	-	Flowering	MS
		Short	3	-		
		Medium	5	CS 3541		
		Long	7	27B		
		Very long	9	SSG 59-3		
12	Anther: Length	Short (<3mm)	3	C 43	Flowering	MS
		Medium (3-4mm)	5	27B		
		Long (>4mm)	7	-		
13	Anther: Colour of dry anther	Yellow orange (RHS 14-23)	1	2219B	End of flowering	VG
		Orange (RHS 24-29)	2	CS 3541		
		Orange red (RHS 30-35)	3	-		
		Grayed orange (RHS 163-177)	4	CSH 16		
14 (* (+)	Glume : Colour	Green white (RHS 157)	1	-	Physio- logical maturity of grain	VG
		Yellow white (RHS 158)	2	2077B		
		Grayed yellow (RHS 160-162)	3	Pant chari 5		
		Grayed orange (RHS 163-177)	4	UPMC 503		
		Grayed red (RHS 178-182)	5	-		
		Grayed purple (RHS 183- N 187)	6	Pant chari 4		
15 (* (*)	Plant: Total height	Very short (< 76 cm)	1	-	Physio- logical maturity	MS
		Short (76-150 cm)	3	2219 B		
		Medium (151-225 cm)	5	RS 673		
		Long (226-300 cm)	7	GJ 39		
		Very long (> 300 cm)	9	-		

16	Stem : Diameter (at lower one third height of plant)	Small (<2 cm) Medium (2 - 4 cm) Large (> 4 cm)	3 5 7	CS 3541 2077B -	Physio-logical maturity	MS
17	Leaf: Length of blade (the third leaf from top including flag leaf)	Short (< 41 cm) Medium (41 - 60 cm) Long (61- 80 cm) Very long (> 80 cm)	3 5 7 9	- 2219B CS 3541 CSH 18	Physio-logical maturity	MS
18	Leaf: Width of blade(the third leaf from top including flag leaf)	Narrow (< 4.1 cm) Medium (4.1 - 6.0 cm) Broad (6.1 - 8.0 cm) Very broad (> 8.0 cm)	3 5 7 9	GFS 4 - CSV 17 CSH 16	Physio-logical maturity	MS
19 (*)	Panicle : Length without peduncle	Very short (<11 cm) Short (11 - 20 cm) Medium (21 - 30 cm) Long (31 - 40 cm) Very long (> 40 cm)	1 3 5 7 9	- SSV 84 CS 3541 IMS 9B SSG 59-3	Physio-logical maturity	MS
20	Panicle : Length of branches (middle third of panicle)	Short (<5.1 cm) Medium (5.1-10 cm) Long (10.1-15 cm) Very long (>15 cm)	3 5 7 9	- CS 3541 2077B SSG 59-3	Physio-logical maturity	MS
21 (*)	Panicle : Density at maturity (ear head compactness)	Very loose Loose Semi loose Semi compact Compact	1 3 5 7 9	SSG 59-3 Pant Chari 4 CSH 16 C 43 Surat 1	Physio-logical maturity	VG
22 (*) (+)	Panicle : Shape	Reversed pyramid Panicle broader in upper part Symmetric Panicle broader in lower part Pyramidal	1 2 3 4 5	- JJ 741 CSH 9 MAN T1 SSG 59-3	Physio-logical maturity	VG

23 (*)	Neck of panicle : Visible length above sheath	Absent or very short (<5.1 cm)	1	296B	Physio-logical maturity	MS
		Short (5.1-10 cm)	3	JJ 1041		
		Medium (10.1-15 cm)	5	Pant chari 4		
		Long (15.1-20 cm)	7	GJ 37		
		Very long (>20cm)	9	CSH 16		
24 (+)	Glume : Length	Very short (25% of grain covered)	1	CSH 9	Physio-logical maturity	MS
		Short (50% of grain covered)	3	CSV 15		
		Medium (75% of grain covered)	5	2219B		
		Long (100% of grain covered)	7	SSG 59-3		
		Very long (longer than the grain)	9	-		
25 (+)	Grain: Threshability	Freely threshable (<11% unthreshed grain)	1	C 43	Maturity	VG
		Partly threshable (11 - 50% unthreshed grain)	5	MR 750		
		Difficult to thresh (>50% unthreshed grain)	7	SSG 59-3		
26 (*)	Caryopsis: Colour after threshing	White 155	1	MAN T1	After threshing	VG
		Greyed white 156	2	Pant Chari 4		
		Yellow white 158	3	Pant Chari 5		
		Yellow orange 14-20	4	27B		
		Greyed orange 200	5	UPMS 503		
27	Grain : Weight of 1000 grains	Very low (< 16 g)	1	SSG 59-3	After threshing	MG
		Low (16-25 g)	3	2219B		
		Medium (26-35 g)	5	C 43		
		High (36-45 g)	7	-		
		Very high (> 45 g)	9	-		
28 (+)	Grain: Shape (in dorsal view)	Narrow elliptic	1	SSG 59-3	After threshing	VG
		Elliptic	2	2219B		
		Circular	3	27B		

29 (+)	Grain: Shape in profile view	Narrow elliptic Elliptic Circular	1 2 3	SSG 59-3 2219B 27B	After threshing	VG
30 (+)	Grain: Size of mark of germ	Very small Small Medium Large Very large	1 3 5 7 9	- RS 29 296B C 43 DSV 4	After threshing	VG
31 (*)	Grain: Texture of endosperm (in longitudinal section)	Fully vitreous (100% corneous) $\frac{3}{4}$ vitreous (75% corneous) Half vitreous (50% corneous) $\frac{3}{4}$ farinaceous (25% corneous) Fully farinaceous (0% corneous)	1 3 5 7 9	- - AKMS 14B 296B -	After threshing	VG
32	Grain: Colour of vitreous albumen	Grayed yellow 160-162 Grayed orange rhs 166 Grayed purple RHS N 187	1 2 3	AKMS 14B SSG 59-3, UPMC 503 Pant Chari 4	After threshing	VG
33 (*)	Grain : Lustre	Non-lustrous Lustrous	1 5	296B CS 3541, M 35-1	After threshing	VG

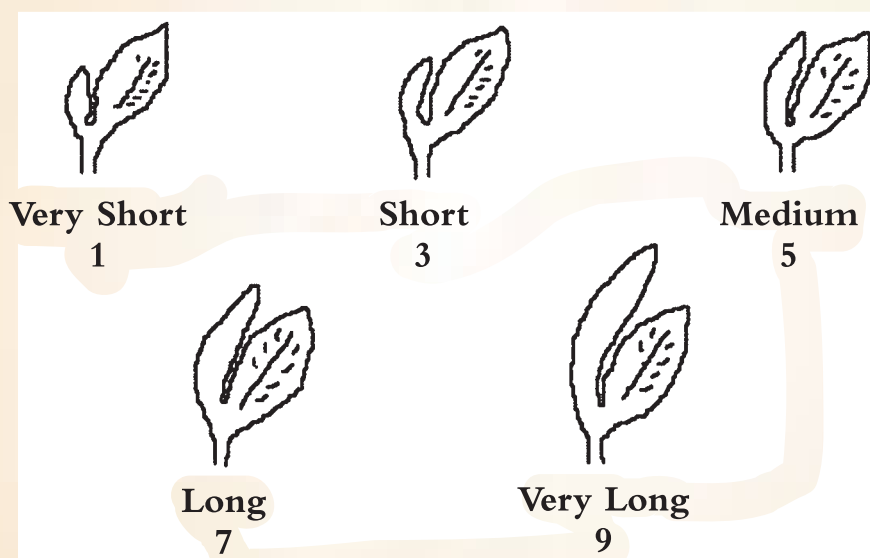
VIII. Explanations on the Table of characteristics

Characteristic 1. Seedlings : Anthocyanin colouration of coleoptile

Cultivation for production of seedlings of sorghum under controlled conditions as per Payne *et al.*, 1980.

Soil:	1/3 compost + 2/3 sand
Temperature:	24°C
Lighting:	Continuous light at 24000 lux
Duration of test:	About 14 days with the day of sowing included
Actual observation:	2 times on 25 seedlings

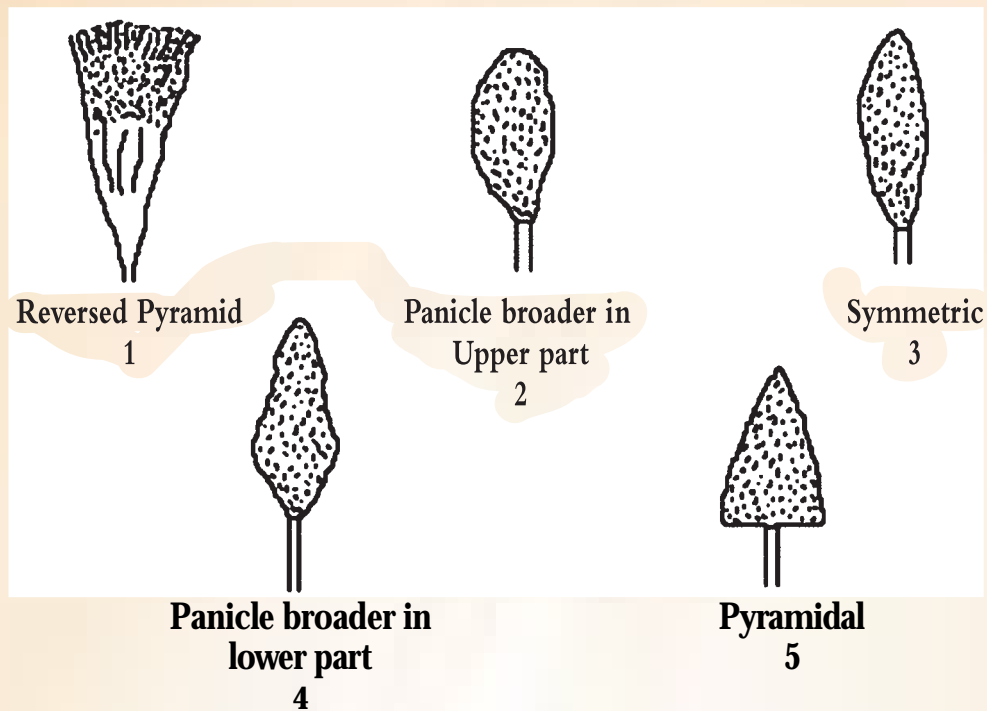
Characteristic 11. Flower with pedicel: Length of flower (at flowering)



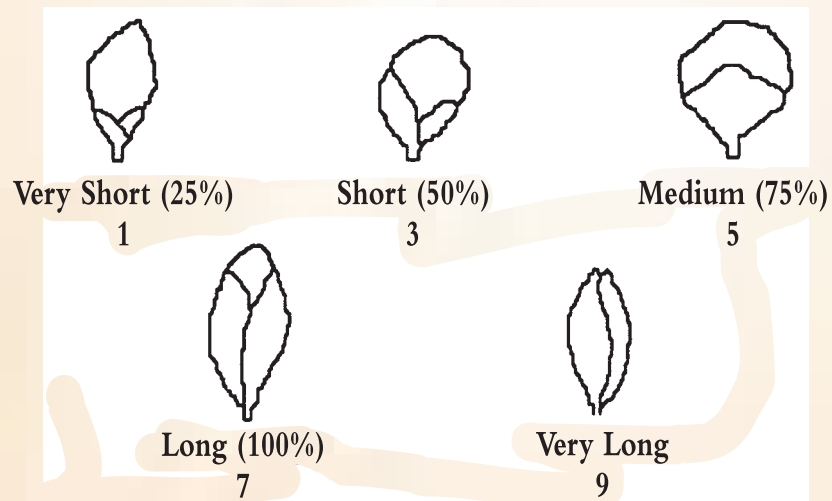
Characteristics 14. Glume: Colour

Glume colour is to be recorded at the time of physiological maturity i.e., when the black layer is formed on the base of the grain.

Characteristic 22. Panicle: Shape (at maturity)



Characteristic 24. Glume: Length (at maturity)



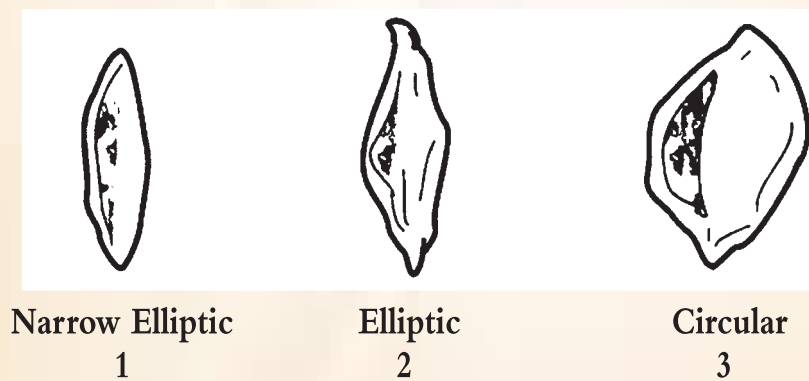
Characteristic 25. Grain: Threshability

Three primary branches each from top, middle and bottom portions (total 9 primary branches) of the panicle shall be selected after one week of physiological maturity and hand threshed. Ten panicles per replication shall be randomly selected for this purpose.

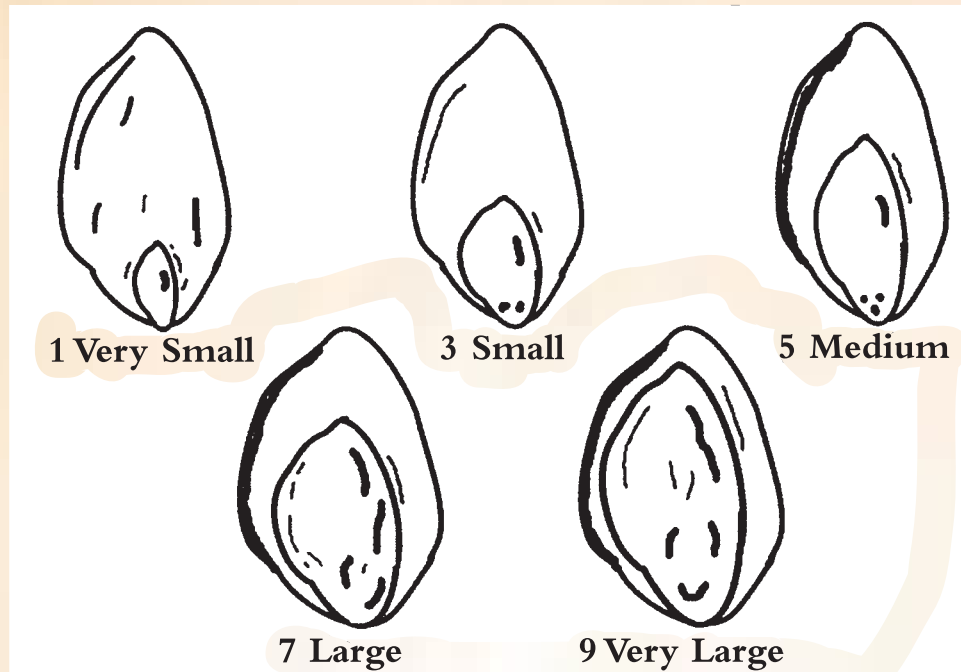
Characteristic 28. Grain: shape in dorsal view



Characteristic 29. Grain: Shape in profile view



Characteristic 30. Grain: Size of mark of germ



IX. Literature

1. UPOV (1989), TG/122/3 Guidelines for the conduct of tests for distinctness, homogeneity and stability in Sorghum.
2. IBPGR and ICRISAT, 1984, "Revised Sorghum Descriptors".
3. IBPGR and ICRISAT, 1993, "Descriptors for Sorghum (*Sorghum bicolor* (L.) Moench) 99
4. Payne, R.C., Koszykolowski, T.U. Morris, L. P., 1980: "Differentiation of Sorghum, Sudan grass and Sorghum x Sudan Grass Cultivars by seedling pigmentation patterns," Journal of Seed Technology Nr 1.

X. Working Group details

The Test Guideline developed by the National Core Committee in consultation with the Director, National Research Centre for Sorghum (NRCS), Hyderabad, the Nodal Officer, DUS Testing, NRCS, Hyderabad and the Task Force (1/2005) constituted by the PPV & FR Authority

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