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Morphological Characterization of Sorghum Accessions

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A B S T R A C T

Field experiment was conducted at directorate of sorghum research, Rajendranagar hyderabad during *Rabi*, 2011 to study the characterization of sixty seven sorghum accessions for various morphological traits both qualitative (Seedling anthocynin colouration of coleoptiles, leaf sheath anthocynin colouration, leaf midrib colour flag leaf yellow colouration of midrib, lemma arista formation, stigma anthocynini colouration, stigma yellow colouration, panicle density, panicle shape, caryosiss colour after threshing, grain shape in profile view, grain size of mark of germ, grain texture of endosperm, grain colour of vitreous albumen, grain lustre) and quantitative (plant natural height, plant total height, stem diameter, grain weight of 1000 grains) based on National DUS guidelines. All the genotypes were grouped based on variations by using DUS descriptors.

Introduction

Sorghum (*Sorghum bicolor* (L.) moench) is a self pollinated crop belongs to Graminae family with diploid chromosome number 20 (2n = 2x = 20). Grain is mostly used for food purposes (55 %), consumed in the form of flat breads and porridges (thick or thin). In Asia, stover is an important source of dry season maintenance rations for livestock. Sorghum is annual or short-term perennial, sessile spikelets with 4 - 6 mm long. It has adapted to a wide range of soils, from deep sands of Goz to heavy black cracking clays of the Gedaref, Sudan. Morphological features have been a major component of varietal identification for certification. The genetic improvement of crop plants has resulted in increased demand for seeking Intellectual Property Rights (IPR) over the products of research. This has led to the introduction of plant variety protection legislation in India. In general, the Protection of Plant Varieties & Farmers Rights (PPV&FR) Act requires registration of plant varieties/hybrids for which protection is sought. The four essential parameters for granting protection to varieties/hybrids are Novelty (N), Distinctiveness (D), Uniformity (U) and Stability (S).

The variety deemed to be Novel if it is not previously known publicly or not commercially exploited prior to a specific period at the time of seeking protection under the act. Distinctiveness refers to the characters of the variety that differentiates it from the

other varieties. Uniformity indicates the absence of the intra-genotypic differences within a variety rendering it to be uniform. Stability denotes the consistent performance of the variety for the traits when tested from season to season, and at different locations. For granting protection to any new variety/ hybrid under the PPV&FR Act, testing for the three parameters, Distinctness, Uniformity and Stability are essential and it is designated as the DUS testing procedure.

Materials and Methods

A total of 67 sorghum accessions *viz*., were evaluated during Rabi 2011season at DSR, Hyderabad in a completely randomized block design with four replications. Sorghum accessions were evaluated for 19 characters *viz*., anthocyanin colouration of coleoptile at seedling, leaf sheath anthocyanin colouration and midrib colour at 5th leaf stage, flag leaf yellow coloration of midrib at panicle emergence stage. Plant natural height of plant observed at the time of panicle emergence stage. Lemma arista formation, stigma anthocynin colouration, stigma yellow colouration observed during flowering stage.

During physiological maturity stage, a total of four characters *viz*., plant total height, stem diameter, panicle density at maturity and panicle shape will be observed. And after threshing stage, seven characters such as caryopsis colour, weight of 1000 grains, grain shape in profile view, size of mark of germ, texture of endosperm, colour of vitreous albumen and grain luster can be observed.

The observations were recorded on 10 randomly selected plants in each replication at specified stages of crop growth period when the characters under study had full expression and as per the national guidelines[1] to conduct tests for DUS.

Results and Discussion

The qualitative and quantitative morphological characters of sorghum accessions studied by the visual of assessment and measurement of single or group of plant or part of plant and results are furnished in Tables 1 and 2. Sixty seven accessions of sorghum were characterized with 19 morphological DUS descriptors as prescribed by DUS guidelines. The seedling anthocynin colouration there was considerable variation among the sorghum accessions for seedling anthocynin colouration of coleoptiles observed. The accessions were classified into following different groups. Sixty-three accessions were grayed purple (EP1) and four accessions were yellow green (EC 11). The leaf sheath anthocynin colouration there was clearly identifiable difference among the sorghum accessions for leaf sheath anthocynin coloration. All sixty seven accessions were grayed purple (PEC 2) none was yellow green. The midrib color (5th fully developed leaf) there was a considerable variation in the midrib colour of the sorghum accessions studied. Seven accessions were white and sixty accessions were yellow green. None observed as grayed yellow and grayed purple. Similarly Kumar *et al.,* (1993) observed midrib colour in pearl millet. Natural height of the plant up to base of flag leaf nine, medium and fifty eight tall (EP 45) were observed. Flag leaf yellow colouration of midrib, there was considerable variation among the studied sorghum accessions for flag leaf yellow coloration of midrib. Nineteen accessions showed flag leaf midrib colour (EP 16), forty eight accessions were absence of flag leaf midrib colour (EP 103). These findings were in conformity with Kumar *et al.,* (1993) in pearl millet. The lemma - arista formation considerable difference was observed among the sorghum genotype for the DUS trait lemma–arista formation Lemma-arista formation was

present in sixty three accessions (EP 17) and four accessions were with absence of lemma-arista formation (EC 34). The stigma anthocynin colouration stigma yellow colouration was present in four accessions (CSV 25) and sixty three accessions were with absence of the stigma yellow colouration (EP 52). Under the study of stigma yellow coloration, presence of stigma yellow colouration was in five accessions (EA 11) and the absence of stigma yellow colouration was observed in sixty two accessions (EP 68). Under plant total height, Four medium and fifty four accessions were with long plant height (EP 41) and nine accessions were very tall (EP 104). Similarly study in terms of plant total height was done for varietal identification by Reddy *et al.,* (2009).

Table.1 Frequency distribution of DUS traits in sorghum parental lines

DUS#	Plant descriptors	Range in expression	No. of parental lines
1	Seeding: Anthocyanin coloration of coleoptile	Yellow green (RHS 144-144N)	4
		Grayed purple (RHS 183-187)	63
2	Leaf sheath: Anthocyanin coloration	Yellow green (RHS 144-)	0
		Grayed purple (RHS 183-187)	67
3	Leaf Mid rib color (5th fully developed leaf)	White RHS 155-N 155	7
		Yellow green (RHS 144-144N)	60
		Grayed yellow(RHS 162)	0
		Grayed purple (RHS 183-187)	0
4	Plant: Natural height of plant up to base of flag leaf	Very short (<76 cm)	0
		short (76-150 cm)	16
		Medium (151-225 cm)	55
		Tall (226-300 cm)	0
		Very tall (>300 cm)	0
5	Flag leaf: Yellow coloration of midrib	Absent	48
		Present	19
6	Lemma: Arista formation	Absent	4
		Present	63
7	Stigma: Anthocyanin coloration	Absent	63
		Present	4
8	Stigma: Yellow coloration	Absent	62
		Present	5
9	Plant: Total height	Very short(< 76 cm)	0
		Short (76-150 cm)	0
		Medium(151-225 cm)	4
		Long(226-300 cm)	54
		Very long (> 300 cm)	9
10	Stem: Diameter (at lower one third height of plant)	Small (<2 cm)	50
		Medium (2-4 cm)	17
		Large (> 4 cm)	0
11	Panicle: Density at	Very loose	0

	maturity (ear head compactness)	Loose	0
		Semi loose	16
		Semi compact	32
		Compact	19
12	Panicle: Shape	Reversed Pyramid	0
		Panicle broader in upper part	0
		Symmetric	0
		Panicle broader in lower part	65
		Pyramidal	2
13	Caryopsis: Color after threshing	White 155	17
		Grayed white 156	0
		Yellow white 158	49
		Yellow orange 14-20	0
		Grayed orange 200	1
14	Grain: Weight of 1000 grains	Very low (< 16 g)	0
		Low (16-25 g)	0
		Medium (26-35 g)	3
		High (36-45 g)	0
		Very high (> 45 g)	64
15	Grain: Shape in profile view	Narrow elliptic	63
		Elliptic	4
		Circular	0
16	Grain: Size of mark of germ	Very small	0
		Small	0
		Medium	3
		Large	64
		Very large	0
17	Grain: Texture of endosperm (in longitudinal section)	Fully vitreous(100% corneous)	0
		3/4 vitreous (75% corneous)	12
		Half vitreous (50% corneous)	55
		3/4 farinaceous (25% corneous)	0
		Fully farinaceous (0 % corneous)	0
18	Grain : Colour of vitreous albumen	Grayed yellow RHS 160-162	65
		Grayed orange RHS 166	0
		Grayed purple RHS N 187	2
19	Grain: Lustre	Non-lustrous	2
		Lustrous	45

Table.2 Description of sorghum parental lines on DUS traits

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
VAR	Seeding: Anthocyanin coloration of coleoptile	Leaf sheath: Anthocyanin coloration	Leaf Mid rib color (5th fully developed leaf)	Plant: Natural height of plant up to base of flag leaf	Flag leaf: Yellow coloration of midrib	Lemma: Arista formation	Stigma: Anthocyanin coloration	Stigma: Yellow coloration	Plant: Total height	Stem: Diameter (at lower one third height of plant)	Panicle: Density at maturity (ear head compactness)	Panicle: Shape	Caryopsis: Color after threshing	Grain: Weight of 1000 grains	Grain: Shape in profile view	Grain: Size of mark of germ	Grain: Texture of endosperm (in longitudinal section)	Grain : Color of vitreous albumen	Grain: Lustre
EP-1	2	2	2	5	5	5	1	1	7	5	7	4	1	9	1	7	5	1	2
EP-9	2	2	2	5	5	5	1	1	7	3	9	4	1	9	1	7	5	1	2
EP-11	2	2	2	5	5	5	1	1	7	3	7	4	1	9	1	7	5	1	2
EP-12	2	2	2	1	1	5	1	1	7	3	7	4	1	9	1	7	5	1	2
Ep-13	2	2	2	5	5	5	1	1	7	3	7	4	1	9	1	7	5	1	2
EP-14	2	2	2	5	5	5	1	1	7	3	7	4	1	9	1	7	5	1	2
EP-16	2	2	2	5	5	5	1	1	7	3	7	4	1	9	1	7	5	1	2
EP-17	2	2	2	1	1	5	1	1	7	3	9	4	1	9	1	7	5	1	2
EP-22	2	2	2	5	5	5	5	1	7	3	9	4	1	9	1	7	5	1	2
EP-23	2	2	2	1	1	5	1	1	9	3	9	4	1	9	1	7	5	1	2
EP-24	2	2	2	5	5	5	1	1	7	3	9	4	1	9	1	7	5	1	2
EP-37	2	2	2	5	5	5	1	1	7	3	7	4	1	9	1	7	5	1	2
EP-41	2	2	2	1	1	5	1	1	7	3	5	4	3	5	1	5	5	1	2
EP-42	2	2	2	1	1	5	1	1	7	3	7	4	1	9	1	5	7	1	2
EP-45	2	2	2	1	1	5	1	1	7	3	7	4	3	9	1	7	7	1	2
EP-46	2	2	2	1	1	5	1	1	7	3	9	4	1	9	1	7	5	1	2
EP-52	2	2	2	1	1	5	1	1	7	3	9	4		9	1	7	5	1	2
SEVS-2	2	2	2	5	5	5	1	1	7	3	9	4	1	9	1	7	7	1	2
SEVS-3	2	2	2	5	5	5	1	1	7	3	9	4	1	9	1	7	7	1	1
SEVS-20	2	2	2	5	5	5	1	1	5	3	9	4	1	9	1	5	5	1	1
EC-1	2	2	1	1	1	5	1	5	5	3	7	4	1	9	1	7	5	1	2
EC-11	1	2	2	1	1	5	1	1	7	3	9	4	1	9	1	7	5	1	2
EC-12	2	2	2	1	1	5	1	1	7	3	9	4	5	9	1	7	5	1	1
EC-21	2	2	2	1	1	1	5	1	7	3	9	4	1	9	1	7	7	1	2
EC-33	2	2	2	1	1	5	1	1	7	3	9	4	3	9	1	7	5	1	2
EC-34	2	2	1	1	1	1	1	1	7	5	9	4	1	9	1	7	7	1	2
EA-6	1	2	2	5	5	1	1	1	7	3	5	4	1	5	2	7	5	1	2
EA-10	2	2	1	5	5	5	1	1	7	3	5	4	1	5	2	7	5	1	2
EA-11	2	2	1	5	5	1	5	5	7	3	5	4	1	9	2	7	5	1	2
EP-54	2	2	2	1	1	5	1	1	7	3	5	4	1	9	1	7	5	1	2
EP-55	2	2	2	1	1	5	1	1	7	3	5	4	3	9	1	7	7	1	2
EP-57	2	2	2	1	1	5	1	1	7	3	5	4	3	9	1	7	7	1	2
EP-59	2	2	2	1	1	5	1	1	7	3	7	4	3	9	1	7	7	1	2
EP-64	1	2	2	1	1	5	1	1	7	3		4	3	9	1	7	7	1	2
EP-65	1	2	2	1	1	5	1	1	7	3	7	4	3	9	1	7	5	1	2
EP-68	2	2	2	1	1	5	5	1	7	3	7	4	3	9	1	7	5	1	2
EP-78	2	2	2	1	1	5	1	5	7	3	7	4	3	9	1	7	5	1	2
EP-80	2	2	2	1	1	5	1	1	7	3	7	4	3	9	1	7	5	1	2

EP-81	2	2	2	1	1	5	1	1	7	3	9	4	3	9	1	7	5	1	2
EP-82	2	2	2	1	1	5	1	1	7	3	5	4	3	9	1	7	5	1	2
EP-84	2	2	2	1	1	5	1	1	7	3	5	4	3	9	1	7	5	1	2
EP-87	2	2	2	1	1	5	1	1	7	3	5	4	3	9	1	7	5	1	2
EP-91	2	2	2	1	1	5	1	1	7	3	9	5	3	9	1	7	5	1	2
EP-92	2	2	2	1	1	5	1	1	7	3	7	4	3	9	1	7	5	1	2
EP-93	2	2	2	1	1	5	1	1	7	3	9	4	3	9	1	7	5	1	2
EP-94	2	2	2	1	1	5	1	1	7	5	9	4	3	9	1	7	5	1	2
EP-95	2	2	2	1	1	5	1	1	7	5	9	4	3	9	1	7	5	1	2
EP-97	2	2	2	1	1	5	1	1	7	5	7	4		9	1	7	5	1	2
EP-102	2	2	2	1	1	5	1	1	7	5	5	4	1	9	1	7	5	1	2
EP-103	2	2	2	1	1	5	1	1	7	5	5	4	1	9	1	7	5	1	2
EP-104	2	2	1	1	1	5	1	1	7	5	5	4	3	9	1	7	5	1	2
EP-105	2	2	1	1	1	5	1	1	7	5	5	4	3	9	1	7	5	1	2
EP-107	2	2	1	1	1	5	1	5	7	5	7	4	1	9	1	7	5	1	2
EP-114	2	2	2	1	1	5	1	5	7	5	5	4	1	9	1	7	5	1	2
EP-115	2	2	2	1	1	5	1	1	7	3	5	4	1	9	1	7	5	1	2
EP-117	2	2	2	1	1	5	1	1	7	5	5	4	1	9	1	7	5	1	2
EP-120	2	2	2	1	1	5	1	1	7	3	7	4	1	9	1	7	5	1	2
PEC-2	2	2	2	1	1	5	1	1	7	3	7	4	3	9	1	7	5	1	2
PEC-5	2	2	2	1	1	5	1	1	7	5	7	4	3	9	1	7	5	1	2
Pec-7	2	2	2	1	1	5	1	1	7	5	7	5	3	9	1	7	5	1	2
PEC-15	2	2	2	1	1	5	1	1	7	5	7	4	3	9	1	7	5	1	2
PEC-22	2	2	2	1	1	5	1	1	7	5	7	4	3	9	1	7	5	1	2
PEC-26	2	2	2	1	1	5	1	1	5	5	7	4	3	9	1	7	5	1	2
EP-124	2	2	2	1	1	5	1	1	5	3	7	4	1	9	1	7	5	1	2
EP-127	2	2	2	1	1	5	1	1	7	3	7	5	3	9	1	7	5	1	2
EP-138	2	2	2	1	1	5	1	1	7	3	7	4	3	9	1	7	5	1	2
EP-138	2	2	2	1	1	5	1	1	7	3	7	4	3	9	1	7	5	1	2
State of characteristics according to national test guidelines	1=Yellow green, 2=Grayed purple	1=Yellow green, 2=Grayed purple	1=White, 2=Yellow green, 3=Grayed yellow, 4=Grayed purple	1=Very short, 3=Short, 5=Medium, 7=Tall, 9= Very tall	1=Absent, 5=Present	1=Absent, 5=Present	1=Absent, 5=Present	1=Absent, 5=Present	1=Very short, 3=Short, 5=Medium, 7=Long, 9=Very long	3=Short, 5=Medium, 9=Large	1=Very loose, 3=Loose, 5=Semi loose, 7=Semi compact, 9=Compact	1=Reverse pyramid, 2=Panicle broader in upper part, 3=Symmetric, 4=Panicle broader in lower part, 5=Pyramidal	1=White, 2=Grayed white, 3=Yellow white, 4=Yellow orange, 5=Grayed orange	1=Very low, 3=Low, 5=Medium, 7=High, 9=Very high	1=Narrow elliptic, 2= Elliptic, 3=Circular	1=Very small, 3=Small, 5=Medium, 7=Large, 9=Very large	1=Fully vitreous, 3= 3/4 vitreous, 5=Half vitreous, 7= 3/4 farinaceous, 9=Fully farinaceous	1=Grayed yellow, 2=Grayed orange, 3=Grayed purple	1=Non-lustrous, 5= Lustrous

Stem diameter, seventeen accessions were with medium stem thickness and fifty accessions with small stem thickness. Anita (1995) studied sunflower and reported that stem diameter was a key diagnostic character for varietal identification. Panicle density at maturity sixteen accession were semi loose (EP 24), thirty two with semi compact (EP 37) and nineteen with compact panicle density (EC 11). Similar findings were reported by Elangovan *et al.,* (2007) in sorghum. There was marked difference in shape of panicle. The panicle shape two with pyramidal (EP 91) and sixty five were with the border in lower part in shape of panicle (EP 105). There was marked difference in caryopsis colour after threshing. The caryopsis colour after threshing, seventeen accessions were white (EP 41), forty nine accessions with yellow white (EP 1) and single accession grayed orange (EC-1). The weight of 1000 grains, three accessions were medium (EP 41) sixty four accessions were with very high grain weight (EP 17). Similar study in terms of 1000-grain weight was done for varietal identification by (Reddy *et al.*, (2009) in sorghum. There was marked difference in grain shape in profile view. The grain shape in profile view four were elliptic (EA 6), sixty three were with the narrow elliptic grain shape (EP 24). Considerable difference was observed for grain size of mark of germ. The size of mark of germ, three accessions was medium size (EP 41) and sixty four accessions were large size (EP 16). Similarly size of mark of germ, texture of endosperm, colour of vitreous albumen, grain luster were studied as a tool for varietal identification by Thangavel *et al.,* (2005) in sorghum. Considerable difference was observed for grain texture of endosperm. The texture of endosperm twelve, with ¾ vitreous (EP 42), Fifty five accessions with half vitreous (EP 16) and none was fully vitreous and farinaceous. Considerable difference was observed in the sorghum germplasm for grain colour of vitreous albumen. The colour of vitreous albumen two accessions with grayed purple (EC 21), sixty five accessions were observed with grayed yellow (SEVS 3). Considerable difference was observed for grain luster. The grain luster, all sixty seven accessions were observed with luster (EC 34).

The variation in morphological characters among the accession was helpful in identification of DUS traits in Rabi sorghum accessions by visual assessment or measurement of plant or part of plants. Varietal identification is an important component of seed technology. The results of present study clearly indicated that the genotypes of sorghum examined can be distinguished and identified plant, seed characters. DUS (Distinctness, Uniformity and Stability) is imperative for protection of plant breeders rights (PBR) and plant varieties under PPV&FRA. One of the objectives of DUS testing is to provide an official description of the variety which must be clearly distinguishable in one/more important characteristics from other genotypes. In this context, information on morphological characterization would be highly useful in identification of the genotypes studied.

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