

Characterization and Evaluation of Sorghum [*Sorghum bicolor* (L.) Moench] Germplasm from Andhra Pradesh, India

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This paper discusses results of the preliminary characterization and evaluation of 95 accessions of sorghum germplasm collected from Andhra Pradesh under the National Agricultural Technology Project (Mission Mode-Plant Biodiversity). A total of 28 agro-morphological and one biochemical character were studied. The accessions exhibited good variability in both qualitative and quantitative traits. In qualitative traits, maximum diversity was observed in earhead compactness, glume colour, seed size, and seed colour. The days to 50% flowering (60–121), plant height (103–270 cm), earhead length (8.96–39.65 cm), stem fresh weight (50–940 g), stem dry weight (30–290 g) and grain yield (14–83 g) showed good variability in quantitative traits. The correlation coefficients of the quantitative traits were also analysed.

Key words: Characterization, Evaluation, Germplasm, Sorghum

Sorghum, [*Sorghum bicolor* (L.) Moench] also known as Jowar was originated and domesticated in Africa about 5000–8000 years ago (De Candolle 1890; Zeven and Zhukovsky 1975). The Indian subcontinent is the secondary centre of origin of this most important cereal. The diversity in sorghum is distributed throughout India. Appa Rao *et al.* (1999) and Elangovan (2004) indicated that the racial diversity of sorghum is maximum in the state of Andhra Pradesh followed by Maharashtra.

Though a number of surveys were conducted earlier leading to a collection of about 1,100 accessions earlier, to re-collect the landrace diversity from unsurveyed and under-surveyed areas, four explorations were undertaken during 2002–2003 in Andhra Pradesh under the National Agricultural Technological project (Mission Mode-Plant Biodiversity). A total of 95 accessions were collected by National Research Centre for Sorghum (NRCS), Hyderabad, Andhra Pradesh.

Characterization and evaluation of germplasm are the pre-requisites for the utilization of the available diversity in the crop improvement programme. Hence, the accessions were characterized to assess the variability and identify the promising accessions for different traits.

Materials and Methods

The preliminary characterization and evaluation of 95 accessions of sorghum were carried out at the National Research Centre for Sorghum (NRCS), Rajendranagar, Hyderabad and Solapur during *rabi* 2002–03 and 2003–04. The centres are located at 17°19' N latitude and 78°24' E longitude and at an altitude of 538 m above MSL and 17°04' N latitude and 75°54' E longitude

respectively with temperature varying from 10° C to a maximum of 30° C during the cropping season. The soil type was of red sandy. The accessions were raised in an Augmented Randomized Block Design (ARBD) with check varieties (M35-1, Swati and CSV-15) in each block. The accessions were grown in 4 m rows with a row spacing of 60 cm and plant to plant spacing of 10 cm. Standard agronomic and plant protection practices were followed during the cropping season. The data on qualitative and quantitative descriptors were recorded using minimal descriptor developed by NBPGR (Mahajan *et al.*, 2000) and list of sorghum descriptors released by IBPGR/ICRISAT (1980, 1993). Five representative plants in each accession were tagged for recording the qualitative and quantitative characters. Brix percentage of each accession was estimated by refractometer. The quantitative data were analysed statistically.

Results and Discussion

The 95 accessions of sorghum accessions were characterized and evaluated for 28 agro-morphological and one biochemical character. Wide range of variability was recorded in both qualitative and quantitative characters. Majority of the accessions showed tan type, dark green leaf colour, erect leaf orientation, and stay green types (non-senescence). However, variation was observed in seedling vigour, midrib colour, earhead shape, earhead compactness, glume colour, glume covering, seed size, seed colour, and races. Sorghum landraces are consistent for morphological characters, the importance of the midrib color, grain color, grain

size, glume color, glume hairiness, and grain shape were used by the farmers in naming the sorghum landraces (Teshome *et al.*, 1997). Twenty-two sorghum genotypes evaluated for grain mould response showed that harder grain, higher levels of seed phenols, and darker glumes contributed to grain mould resistance (Audilakshmi *et al.*, 1999). The variability of glume colour available in the present study may be utilized for screening for grain mold resistance in sorghum.

The quantitative characters also showed wide variation in the evaluated sorghum germplasm. The results of descriptive statistical analysis are presented in Table 1. The characters of days to 50% flowering (60–121), plant height (103–270 cm), earhead length (8.96–39.65 cm), stem fresh weight (50–940 g), stem dry weight (30–290 g) and grain yield (14–83 g) are the highly variable based on the variance. The brix

percentage ranged from 6–22. The chance of deriving sweet stalk sorghum may be possible from the high brix accessions. The variability presents in the leaf length, plant height, stem fresh weight and stem dry weight can be used to derive fodder sorghum.

Evaluated was done for over 4000 accessions from 11 major sorghum growing states in India for morphological and agronomical characters Appa Rao *et al.*, (1999). Characters as days to flowering, plant height, panicle length, erect and compact panicles were more frequent. Racial diversity was maximal in the state of Andhra Pradesh followed by Maharashtra state. The present study also observed similar variability in days to 50 % flowering and plant height. Analysis of variance (Table 2) revealed significant differences among the characters within a location and across the locations.

Table 1. Statistical analysis of quantitative characters in sorghum accessions

Characters	Minimum	Maximum	Mean	SE	SD	Sample Variance
Days to 50% flowering (days)	60	121	83.63	0.97	9.45	89.30
Number of leaves	6	18	9.92	0.21	2.06	4.25
Leaf length (cm)	47.25	91.55	63.00	0.87	8.50	72.31
Leaf width (cm)	3.09	10.20	6.42	0.12	1.12	1.26
Plant height (cm)	103	270	183.47	2.94	28.64	820.24
Earhead length (cm)	8.96	39.65	18.60	0.63	6.15	37.85
Earhead width (cm)	4.45	10.25	7.25	0.12	1.15	1.32
Stem thickness (cm)	1.06	2.90	1.60	0.03	0.32	0.10
Stem fresh weight (g)	50	940	239.95	13.33	127.11	16157.88
Stem dry weight (g)	30	290	126.32	5.32	50.46	2545.89
Brix (%)	6	22	14.36	0.37	3.53	12.43
Grain yield (g)	14	83	41.94	1.81	16.95	287.24
100-seed weight (g)	1.77	4.71	3.06	0.06	0.57	0.32

Table 2. Analysis of variance for different characters

Source of variation	Variance		
	Location I (Solapur)	Location II (Hyderabad)	Pooled over I & II
d.f	12	11	12
Days to 50% flowering (days)	154.84	92.24	89.30
Number of leaves	10.28	2.88	4.25
Leaf length (cm)	137.52	82.79	72.31
Leaf width (cm)	1.45	2.12	1.26
Plant height (cm)	1731.55	1082.07	820.24
Stem thickness (cm)	0.10	NA	0.10
Earhead length (cm)	47.50	32.58	37.85
Earhead width (cm)	1.30	3.10	1.32
Stem fresh weight (g)	403946.90	395951.12	16157.88
Stem dry weight (g)	63835.40	62174.56	2545.89
Brix (%)	13.40	13.57	12.43
Grain yield (g)	378.70	470.16	287.24
Seed weight (g)	0.30	0.30	0.32

* All characters significant at P = 0.05

The correlation coefficients of grain yield/fodder yield vs. some major yield attributing characters were analysed. The grain yield and some minor grain-yield attributing characters *viz.*, number of leaves and leaf width showed positive correlation and 100-seed weight also showed positive correlation with number of leaves and grain yield. The dry fodder (stem dry weight) yield and some major fodder-yield attributing characters showed high positive correlation with stem fresh weight, number of leaves, leaf width, days to flowering, stem thickness. Amsalu Ayana, Endashaw Bekele (2000), also reported similar results. Negative correlation was observed in case of days to 50% flowering with earhead width, brix with leaf width and plant height, grain yield and earhead length, days to maturity with earhead width, and 100-seed weight with brix.

Promising lines identified performing better than the check varieties are listed in Table 3.

Table 3. Promising accessions of sorghum identified from evaluation

Trait	Promising accessions
Days to 50% flowering (=60 days)	IC-347591
Number of leaves (>17)	IC-347576, 347583
Leaf length (>82 cm)	IC-347574, 347576, 347583, 347585, 347591
Leaf width (>8 cm)	IC-347592, 392142, 392147, 392149, 392150, 392159
Plant height (>240 cm)	IC-347517, 347583, 347585
Earhead length (>30 cm)	IC-347581, 347583, 347584, 347585
Earhead width (>9 cm)	IC-369123, 369125, 369130, 347505, 347510, 347514, 347582
Stem thickness (>2 cm)	IC-347574, 347576, 347581, 347582, 347583, 347585
Brix (>19%)	IC-347517, 347522, 347525, 347570, 347576, 347587, 347594, 347595
Grain yield (>70 g)	IC-347505, 347510, 347515, 347519, 347524, 347531, 347569, 392144
100-seed weight (>4 g)	IC-347508, 347509, 347510, 347511, 392141
Days to maturity (=98days)	IC - 347579

Preliminary characterization and evaluation of 95 accessions of sorghum germplasm for 28 agro-morphological and one biochemical characters exhibited good variability in both qualitative and quantitative traits. In qualitative traits, maximum diversity was observed in earhead compactness, glume colour, seed size, and seed colour. The days to 50% flowering (60–121), plant height (103–270 cm), earhead length (8.96–39.65 cm), stem fresh weight (50–940 g), stem dry weight (30–290 g) and grain yield (14–83 g) showed good variability in quantitative traits. Promising accessions identified in the study for various characters will be helpful in sorghum improvement programmes. The high yielding accessions viz., IC Nos.- 347505, 347510, 347515, 347519, 347524, 347531, 347569, 392144 and high brix

percentage lines viz., IC Nos. - 347517, 347522, 347525, 347570, 347576, 347587, 347594, 347595 will be highly useful in the yield and sweet stalk sorghum improvement programmes.

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