



## Assessment of Genetic Diversity in *Rabi* Sorghum Genotypes (*Sorghum bicolor* L. Moench)

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### ABSTRACT

Mahalanobis's  $D^2$  statistics was applied to assess the divergence among the 25 cultivars of *rabi* sorghum. The analysis of variance revealed significant differences among the genotypes for all the ten traits studied. The 25 genotypes were grouped into 10 clusters where, cluster I was largest containing 13 genotypes followed by cluster II with 4 genotypes and cluster III to X were solitary. The inter cluster distance was maximum between cluster VI and VIII followed by cluster VII and VIII and cluster V and II. Based on the inter cluster distance and the per se performance, the genotype CSV-23 in the cluster VIII can be utilized in further breeding programme as a parent. Harvest index contributed maximum to divergence (32.33%) followed by seed yield per plant (15.33%), panicle length and stover yield per plant (12.67), 100-seed weight (8.00%), plant height (7.00%) and number of primaries per panicle (5.33%).

**Key words :** Dendrogram, Divergence and *rabi* sorghum

*Rabi* sorghum is an important food and feed crop in the semi-arid regions of India where it is grown under residual and rain fed conditions. The area under *rabi* sorghum is fairly consistent over many years but the progress in productivity is much slower compared to *kharif* season. Hybridization involving genetically diverse parents is known to provide an opportunity for bringing together gene constellations resulting in desirable transgressive segregants in advanced generations. However, postulation of rational criteria for identification of such parents is still a live problem in plant breeding. To consider geographic diversity among the parents as an index of genetic diversity has been acclaimed and equally disclaimed in numerous reports. However, reports on genetic diversity among the *rabi* sorghum is very limited. In the present study,  $D^2$  analysis has been applied to assess the diversity among 25 *rabi* sorghum genotypes, to identify the divergent types suitable for hybridization programme.

### MATERIAL AND METHODS

The material for the present study comprised of 25 *rabi* sorghum genotypes. These genotypes were maintaining at Millet Scheme of

Regional Agricultural Research Station (ANGRAU), Nandyal. The present study was carried out at RARS, Nandyal during *rabi* 2011-12. The experiment was laid out in a randomized block design with 3 replications. Each accession was sown in 3 rows of 4 m. length with a spacing of 45 cm between the rows and 15 cm. within the row. Recommended package of practices were followed for raising a normal crop. In each accession, five plants were selected randomly and used for collecting data on days to 50% flowering, plant height (cm), panicle length (cm), panicle weight (g), 100-seed weight (g), dead heart percentage for screening to shootfly, fodder yield (kg/ha), harvest index and seed yield (kg/ha). The data was subjected to statistical analysis using (Mahalanobis, 1936)  $D^2$  statistics and Tocher's method as described by Rao (1952) for determining group constellation. Average intra and inter cluster distances were estimated as per the procedure outlined by Singh and Choudhary (1977).

### RESULTS AND DISCUSSION

The analysis of variance revealed significant differences among the genotypes studied. Based on  $D^2$  statistics and Tocher's method, the

Table 1 . Cluster composition of twenty five genotypes of *rabi Sorghum (Sorghum bicolor L.Moench)* (Tocher's method).

Cluster Number	No. of genotypes	Name of the Genotypes
Cluster I	13	N-7-1, N-38-1, N-13, N-72B, N-2605, N-48, CMS-1, HAGARI, 53A X 3, CSM-13, N-33B-4, N-33B2, NTJ-1
Cluster II	4	NTJ-3, NTJ-4, M35-1, CSV-17
Cluster III	1	C-43
Cluster IV	1	ICSV-702
Cluster V	1	PVK-801
Cluster VI	1	GD-65028
Cluster VII	1	KKLT-4
Cluster VIII	1	CSV-23
Cluster IX	1	M35-1-19
Cluster X	1	NTJ-2

Table 2. Intra cluster (diagonal) and inter-cluster distances for ten clusters in *rabi Sorghum (Sorghum bicolor L.Moench)*.

	Cluster I	Cluster II	Cluster III	Cluster IV	Cluster V	Cluster VI	Cluster VII	Cluster VIII	Cluster IX	Cluster X
Cluster I	6.780 (2.604)	10.760 (3.280)	8.880 (2.980)	8.610 (2.934)	9.200 (3.033)	10.340 (3.216)	9.700 (3.114)	12.520 (3.538)	10.220 (3.197)	10.870 (3.297)
Cluster II		6.420 (2.534)	10.010 (3.164)	11.560 (3.400)	14.540 (3.813)	13.240 (3.639)	12.780 (3.575)	9.230 (3.038)	9.490 (3.081)	9.320 (3.053)
Cluster III			0.000 (0.000)	4.900 (2.214)	8.590 (2.931)	5.910 (2.431)	8.880 (2.980)	11.910 (3.451)	7.720 (2.778)	10.090 (3.176)
Cluster IV				0.000 (0.000)	5.360 (2.315)	5.680 (2.383)	9.800 (3.130)	11.580 (3.403)	9.200 (3.033)	10.110 (3.180)
Cluster V					0.000 (0.000)	9.090 (3.015)	10.020 (3.165)	13.640 (3.693)	11.760 (3.429)	10.850 (3.294)
Cluster VI						0.000 (0.000)	12.380 (3.519)	15.420 (3.927)	11.370 (3.372)	14.260 (3.776)
Cluster VII							0.000 (0.000)	15.130 (3.890)	8.090 (2.844)	11.650 (3.413)
Cluster VIII								0.000 (0.000)	12.370 (3.517)	7.950 (2.820)
Cluster IX									0.000 (0.000)	10.490 (3.239)
Cluster X										0.000 (0.000)

Table 3. Cluster means for ten characters in twenty five *rabi* sorghum (*Sorghum bicolor* L. Moench) genotypes.

	Days to 50 per cent flowering	Dead heart percentage	Plant height (cm)	Panicle length (cm)	Panicle weight (g)	Number of primaries per panicle	100-seed weight (g)	Stover yield per plant (g)	Harvest index	Grain yield per plant (g)
cluster I	64.15	31.44	292.47	14.82	66.43	69.59	2.55	101.14	31.61	47.44
cluster II	63.67	20.52	270.17	24.22	108.95	59.75	3.34	124.90	43.37	91.63
cluster III	65.33	25.93	144.60	30.60	70.50	73.33	1.94	91.32	28.87	37.10
cluster IV	72.00	17.50	205.00	24.60	45.98	73.67	1.78	51.12	41.13	35.82
cluster V	64.00	20.56	231.00	18.99	37.28	61.67	1.40	31.32	43.73	24.32
cluster VI	67.67	17.10	199.00	29.19	33.43	69.33	1.38	55.40	24.67	18.08
cluster VII	72.00	38.64	247.03	23.43	73.50	73.33	1.44	201.24	19.17	47.70
cluster VIII	55.67	10.29	189.33	18.10	112.33	82.00	3.15	44.12	68.77	97.00
cluster IX	65.00	22.86	230.00	27.21	72.43	75.67	3.34	200.12	23.30	60.96
cluster X	60.00	27.91	239.00	27.53	99.57	49.00	3.35	42.12	65.73	81.03
% CTD	0.00%	3.00%	7.00%	12.67%	3.67%	5.33%	8.00%	12.67%	32.33%	15.33%

% CTD: Percent contribution towards divergence

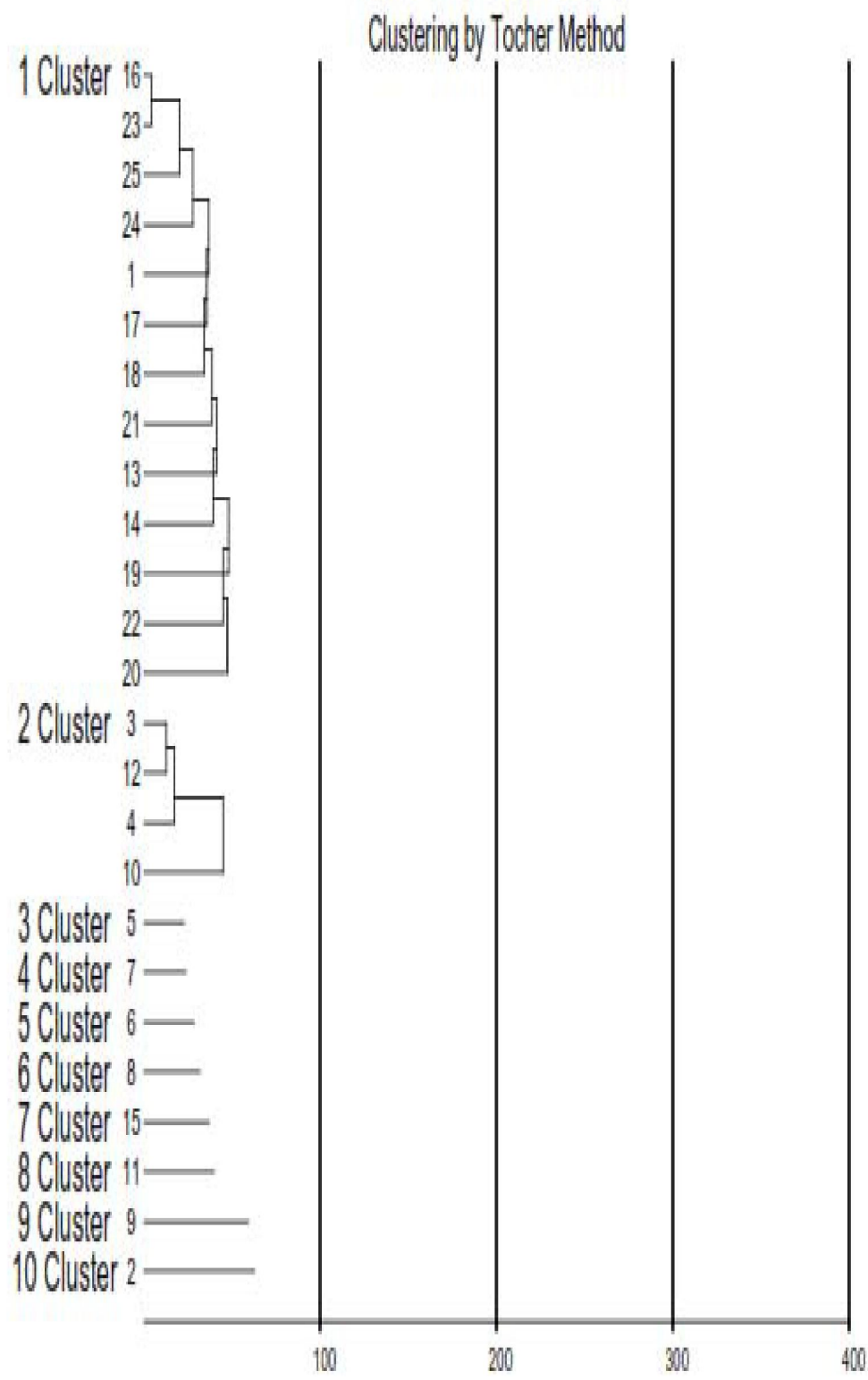
25 accessions were grouped into 10 clusters however, with variable number of entries in each cluster revealing considerable amount of genetic diversity in the material (Table 1). It was observed that cluster 1 had maximum number of genotypes of 13 followed by cluster II with 4 genotypes. The eight clusters III to X were solitary.

Average intra and inter cluster  $D^2$  values among 25 genotypes (Table 2) revealed that cluster I has the maximum intra cluster value (6.78) indicating that genotypes within the cluster were similar. The inter cluster  $D^2$  values ranged from 4.90 to 15.42. Minimum inter cluster  $D^2$  values (4.90) were observed between the clusters IV and III indicating the close relationship among the genotypes included in these clusters. Maximum inter cluster value (15.42) was observed between cluster VI and cluster VIII followed by (15.13) cluster VII and VIII and (14.54) cluster II and V which indicates that genotypes included in these clusters are genetically diverse and may give rise to high heterotic response.

The cluster means and contribution of each trait towards genetic divergence are presented in Table 3. The data revealed considerable differences among the clusters for most of the characters studied. The cluster VIII recorded the highest seed yield per plant, panicle weight, number of primaries per panicle and harvest index and also the cluster VIII recorded the lowest dead heart percentage and early flowering (CSV-23). Whereas, cluster III (C 43) recorded the highest mean for panicle length followed by the other highest mean values recorded in cluster I for plant height (292.47 cm), cluster VII for stover yield per plant (201.24 gm) and cluster X for 100-seed weight (3.35 gm).

The data on inter cluster distances and *per se* performance of genotypes were used to select genetically diverse and agronomically superior genotypes. The genotypes, exceptionally good with respect to one or more characters were desirable. On that basis, the genotype CSV-23 was distinct and diverse and can be selected as a promising donor for different characters. Intercrossing of divergent groups would lead to wide genetic base in the base population and greater opportunities for crossing over to occur, which in turn may release hidden variability by breaking close linkage

Fig.1. Dendrogram depicting the special position of twenty five *rabi* sorghum genotypes.



(Thody, 1960). The progenies derived from such crosses are expected to show wide variability, providing greater scope for isolating transgressive sergeants in the advanced generations. Hence, these genotypes may be used repeatedly in the crossing programmes to recover transgressive segregants, which can be either released as a variety or can be utilized in the genetic enhancement of sorghum crop.

Among the 10 characters studied harvest index contributed the most (32.33%) to the genetic divergence followed by grain yield per plant (15.33%), panicle length (12.67%) and stover yield (12.67%), 100-seed weight (8.00%), plant height (7.00%), number of primaries (5.33%), panicle weight (3.67%) and dead heart percentage (3.00%). However days to 50% flowering indicated a narrow range of diversity among the genotypes under study. The traits like harvest index, grain yield per plant, panicle length, stover yield per plant height, 100-seed weight, plant height, number of primaries per panicle, panicle weight and dead heart percentage were found to be important for divergence in *rabi* sorghum genotypes. The results are in accordance with Kamatar *et al.* (2011), Ganeshmurthy *et al.* (2010) and Sameer Kumar *et al.* (2010) for grain yield per plant; Mohanraj *et al.* (2006), Salilkumar and Singhanian (1984) for stover yield per plant; Ganeshmurthy *et al.* (2010) and Umakanth *et al.* (2002) for panicle length; Rohman *et al.* (2004) and Narkhede *et al.* (2000) for 100-seed weight; Kamatar *et al.* (2011), Ganeshmurthy *et al.* (2010) and Sameer Kumar *et al.* (2010) for plant height; Biradar *et al.* (1996), Kukadia *et al.* (1981) and Salilkumar and Singhanian (1984) for number of primaries per panicle; Asthana *et al.* (1998), Biradar *et al.* (1996) and Salilkumar and Singhanian (1984) for panicle weight. Thus, it can be concluded that trait specific parental lines can be selected from distinctly related clusters to secure yield improvement in *rabi* sorghum.

#### LITERATURE CITED

- Asthana O P , Tomar N S, Asthana N and Sharma R C 1998** Genetic divergence studies in exotic sorghum using Mahalanobis concept of generalized distance. *Advances in Plant Sciences*, 11 (2): 69-76.
- Biradar B D, Parameshwarappa R, Patil S S and Goud P P 1997** Genetic diversity among restorers on diverse cytoplasmic male sterility in sorghum. *Mysore Journal of Agricultural Sciences*, 31(2): 105-110.
- Biradar B D, Parameshwarappa R, Patil S S and Parameshwargoud P 1996** Inheritance of seed size in sorghum (*Sorghum bicolor* L. Moench). *Crop Research*, 11 (3): 331-337.
- Ganesamurthy D, Punitha N and Elangovan M 2010** Genetic diversity among the land races of sorghum collected in Tamil Nadu. *Electronic Journal of Plant Breeding*, 1 (6):1375-1379.
- Kamatar M Y, Kotragouda M, Deepak kumar G, Shinde M and Salimath P M 2011** Studies on genetics diversity in F<sub>3</sub> progenies of *kharif* × *rabi* and *rabi* × *rabi* crosses in sorghum (*Sorghum bicolor* L. Moench). *Plant Archives*, 11 (2): 617-620.
- Kukadia M U, Desai K B and Tikka S B S 1981** Genetic diversity in exotic sorghum. *Sorghum Newsletter*, 24: 28-29.
- Mahalanobis P C 1936** On the generalizes distance in statistics. *Proceedings of national Academy of Science*, 12:49-55.
- Mohanraj A, Gopalan and Shanmuganathan M 2006** Genetic diversity in sorghum (*Sorghum bicolor* L. Moench). *The Journal of Agricultural Sciences*, 2 (2): 6-11.
- Narkhede B N, Akade J H and Awari V R 2000** Genetic diversity in *rabi* sorghum local types (*Sorghum bicolor* L. Moench). *Journal of Maharashtra Agriculture University*. 25 (3): 245-248.
- Rao C R 1952** *Advanced statistical methods in Biometrical research*, John Wiley and sons Inc, New York.363.
- Rohman M M, Hakim M A, Sultana N A, Kabir M E, Hasanuzzan M and Ali M 2004** Genetic divergence analysis in sorghum (*Sorghum bicolor*). *Asian Journal of Plant Sciences*, 3 (2): 211-214.

- Salilkumar and Singhania D L 1984** Analysis of genetic divergence in elite lines of grain sorghum. *Sorghum News Letter*, 28: 18.
- Sameer Kumar C V, Shreelakshmi, C H and Shivani D 2010** Genetic diversity analysis in *rabi* sorghum (*Sorghum bicolor* L. Moench) local genotypes. *Electronic Journal of Plant Breeding*, 1 (4): 527-529.
- Singh R K and Choudhary B D 1977** Biometrical Methods in quantitative genetic analysis. *Kalyani Publishers*, New Delhi.304.
- Thody J M 1960** Effects of Disruptive selection-III coupling and repulsion. *Heridity*, 14: 35-39.
- Umakanth A V, Madhusudhana R, Swarnalata K, Rana B S and Kaul S 2002** Genetic diversity studies in sorghum. *International Sorghum and Millets News Letter*, 43: 31-33.

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