Plant Archives Vol. 26, No. 2, 2026 pp. 1883-1886 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org

DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2026.v26.no.2.258

GENETIC DIVERSITY ANALYSIS FOR YIELD AND YIELD CONTRIBUTING TRAITS IN *RABI* SORGHUM (*Sorghum bicolor* L. Moench)

S.U. Bote[1]*, A.M. Dethe[1], A.W. More[2], H.V. Kalpande[1], S.G. Shinde[1], J.D. Deshmukh[1], M.M. Suryawanshi[1], S.L. Shinde[1] and K.S. Ingle

[1]Department of Genetics and Plant Breeding, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani - 431 402, Maharashtra, India.

[2]Sorghum Research Station, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani - 431 402, Maharashtra, India.

*Corresponding author E-mail : sauravbote1@gmail.com

(Date of Receiving-17-07-2026; Date of Revision-19-09-2026; Date of Acceptance-29-09-2026)

ABSTRACT

The present investigation assessed genetic diversity and divergence among 50 *rabi* sorghum (*Sorghum bicolor* (L.) Moench) genotypes, including three checks (Parbhani Moti, CSV-22R and CSV-29R), evaluated during *rabi*, 2025-2026 at Sorghum Research Station, VNMKV, Parbhani (MS), India. Nine quantitative traits were analysed using Mahalanobis D^2 Statistics and Tocher's method. The genotypes were grouped into nine clusters, with Clusters I and II containing highest 16 genotypes each; while Clusters VII, VIII and IX were solitary. The maximum inter-cluster distance was observed between Clusters IV and V (40.5). Cluster VIII recorded the highest mean grain yield per plant (63.51 g) and fodder yield per plant (124.94 g). Plant height contributed most to genetic divergence (59.92%), followed by fodder yield per plant (24.33%) and days to 50 per cent flowering (9.63%). The study revealed substantial genetic divergence, indicating scope for selecting diverse parents for further *rabi* sorghum improvement.

Key words : *Rabi* sorghum, Genetic diversity, Genetic divergence, Mahalanobis D^2, Tocher's method, Cluster analysis.

Introduction

Sorghum (*Sorghum bicolor* (L.) Moench) is an important cereal crop cultivated under diverse agro-climatic conditions for grain and fodder production. The crop exhibits considerable variability for morphological, yield and yield-contributing traits, providing opportunities for genetic improvement. Genetic diversity is essential for crop breeding, as diverse parents offer greater scope for obtaining desirable recombinants and useful variability. Assessment of genetic divergence helps identify distinct groups and suitable parents for hybridization. Mahalanobis D^2 Statistics followed by Tocher's method is an effective multivariate approach for assessing genetic divergence based on multiple quantitative traits. Therefore, the present investigation was undertaken to assess genetic diversity among *rabi* sorghum germplasm lines and identify genetically diverse groups and promising genotypes for future breeding programmes.

Materials and Methods

The experiment was conducted during the *Rabi* season of 2025-2026 at Sorghum Research Station, Vasantrao Naik Marathwada Krishi Vidyapeeth (VNMKV), Parbhani, Maharashtra, India. Fifty *rabi* sorghum germplasm genotypes, including three checks *viz*., Parbhani Moti, CSV-22R and CSV-29R were evaluated in a Randomized Block Design (RBD) with three replications. The genotypes were sown by the hand-dibbling method in two-row plots with a spacing of 45 cm between rows and 15 cm between plants. The crop was raised using the recommended agronomic practices.

Observations were recorded on five randomly selected plants from each plot in every replication. Data were recorded for nine quantitative characters, namely days to 50 per cent flowering, plant height (cm), panicle length (cm), panicle breadth (cm), number of primaries

per panicle, number of grains per primary, 100-seed weight (g), grain yield per plant (g) and fodder yield per plant (g). The replication-wise mean values were used for assessment of genetic diversity among the genotypes.

Genetic divergence among the 50 *rabi* sorghum genotypes was assessed using Mahalanobis D^2 S1tatistics as described by Mahalanobis (1936) and suggested by Rao (1952). The correlated variables were transformed into uncorrelated variables prior to computation of D^2 values. Based on the magnitude of genetic distances, the genotypes were grouped into different clusters following Tocher's method. Intra-cluster and inter-cluster distances were calculated to determine the extent of genetic divergence among and within the clusters. Cluster-wise mean values for all the quantitative characters were estimated to characterize the performance of different clusters. The relative contribution of individual characters towards total genetic divergence was also determined.

Results and Discussion

Genetic diversity among the 50 *rabi* sorghum genotypes was assessed using Mahalanobis D^2 Statistics followed by Tocher's clustering method. The analysis grouped the fifty genotypes into nine distinct clusters, indicating considerable genetic divergence among the genotypes. Cluster I and Cluster II emerged as the largest, comprising 16 genotypes each, followed by Cluster IV (5 genotypes), Clusters III and V (4 genotypes each), and Cluster VI (2 genotypes); whereas Clusters VII, VIII and IX were solitary.

The cluster-wise mean values revealed substantial differences among the clusters for the characters studied. Cluster I recorded a mean of 77.92 days to 50 per cent flowering, 147.60 cm plant height, 14.74 cm panicle length and 5.72 cm panicle breadth, with mean grain and fodder yields of 48.26 and 94.59 g plant^{-1}, respectively. Cluster II showed 86.08 days to flowering, 132.37 cm plant height and mean grain and fodder yields of 45.16 and 88.35 g plant^{-1}, respectively. Cluster III recorded comparatively lower plant height (99.23 cm), grain yield (29.35 g plant^{-1}) and fodder yield (62.29 g plant^{-1}).

Cluster IV recorded the highest mean 100-seed weight (3.82 g), with 78.47 days to flowering and 145.95 cm plant height. Cluster V showed the highest mean number of grains per primary (48.50), along with 45.35 primaries per panicle and 44.33 g grain yield plant^{-1}. Cluster VI was characterized by late flowering (104.83 days) and tall plants (159.47 cm), with mean grain and fodder yields of 44.16 and 95.28 g plant^{-1}, respectively. Cluster VII recorded the highest mean panicle length (20.43 cm), although its grain yield was comparatively low (32.93 g plant^{-1}).

Cluster VIII exhibited superior performance for several important traits, recording the highest mean grain yield (63.51 g plant^{-1}) and fodder yield (124.94 g plant^{-1}), along with the highest number of primaries per panicle (52.11) and panicle breadth (6.50 cm). Cluster IX recorded the highest mean plant height (203.63 cm) and also showed high grain yield (56.52 g plant^{-1}) and fodder

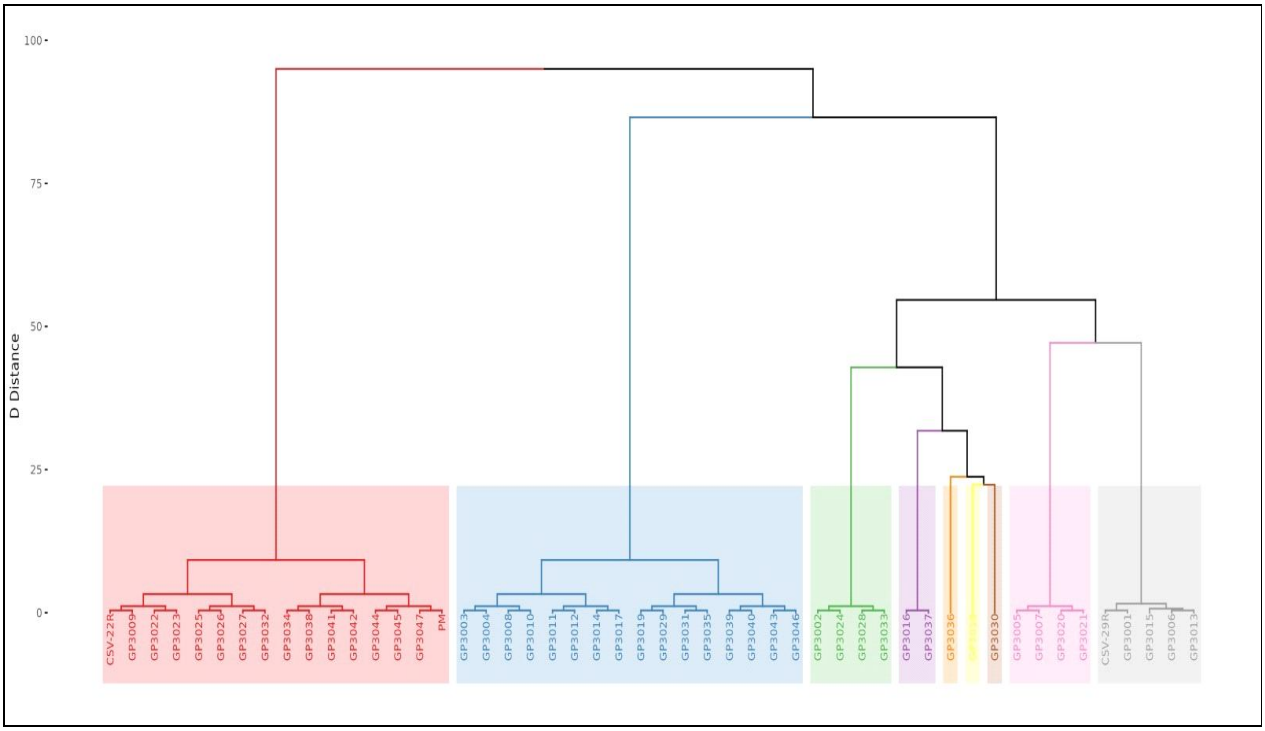


Fig. 1 : Clustering of genotypes by Tocher's method for *rabi* sorghum germplasm.

Table 1 : Composition of fifty *rabi* sorghum genotypes into different clusters by Tocher's method.

Cluster Number	Number of genotypes	Name of genotypes
1	16	GP3009, GP3022, GP3023, GP3025, GP3026, GP3027, GP3032, GP3034, GP3038, GP3041, GP3042, GP3044, GP3045, GP3047, CSV-22R, Parbhani Moti
2	16	GP3003, GP3004, GP3008, GP3010, GP3011, GP3012, GP3014, GP3017, GP3019, GP3029, GP3031, GP3035, GP3039, GP3040, GP3043, GP3046
3	4	GP3005, GP3007, GP3020, GP3021
4	5	CSV-29R, GP3001, GP3006, GP3013, GP3015
5	4	GP3002, GP3024, GP3028, GP3033
6	2	GP3016, GP3037
7	1	GP3018
8	1	GP3030
9	1	GP3036

Table 2 : Average intra- and inter-cluster D^2 values for *rabi* sorghum germplasm.

Clusters	C1	C2	C3	C4	C5	C6	C7	C8	C9
C1	**9.1**	19.1	18.7	15.4	28.8	15.1	27.0	17.5	12.2
C2		**10.3**	13.9	30.1	14.7	16.1	15.4	14.5	19.9
C3			**9.0**	27.6	19.4	20.4	16.4	21.1	23.8
C4				**9.8**	40.5	23.0	36.3	28.4	19.7
C5					**10.7**	25.0	16.6	20.2	28.9
C6						**9.8**	21.3	15.3	13.4
C7							**0.0**	25.3	28.5
C8								**0.0**	15.8
C9									**0.0**

Table 3 : Per cent contribution of different nine characters to genetic diversity in *rabi* sorghum germplasm.

S. no.	Characters	Times ranked first	Contribution %
1.	Days to 50% flowering	118	9.63
2.	Plant height (cm)	734	59.92
3.	Panicle length (cm)	0	0
4.	Panicle breadth (cm)	0	0
5.	Number of primaries/panicle	14	1.14
6.	Number of grains per primary	45	3.67
7.	100-seed weight (g)	0	0
8.	Fodder yield per plant (g)	298	24.33
9.	Grain yield per plant (g)	16	1.31

yield (124.77 g plant^{-1}). These differences among cluster means indicated the presence of considerable genetic variability and the distinct nature of the genotypes grouped into different clusters.

The relative contribution of individual characters towards total genetic divergence revealed that plant height contributed the maximum (59.92%), followed by fodder yield per plant (24.33%) and days to 50 per cent flowering (9.63%). Number of grains per primary contributed 3.67%; while grain yield per plant and number of primaries per panicle contributed 1.31 and 1.14%, respectively. It was also observed that traits *viz.*, panicle length, panicle breadth and 100-seed weight did not contribute to the observed divergence.

The formation of nine clusters, differences in cluster means and the contribution of individual characters confirmed the presence of substantial genetic diversity among the *rabi* sorghum genotypes. Cluster VIII was particularly promising for grain and fodder yield; whereas Cluster IX represented a distinct source of tall plant stature with high productivity. Similar genetic divergence based on Mahalanobis D^2 and Tocher's method has been reported in sorghum by Ahamed *et al.* (2015), Deep *et al.* (2020), Dalip *et al.* (2022) and Rajappa *et al.* (2024). The diverse and superior-performing genotypes identified in the present study, may therefore be utilized as potential parents in future *rabi* sorghum breeding programmes.

Table 4 : Cluster means of nine characters of *rabi* sorghum genotypes.

Clusters	DF	PH	PL	PB	NPP	NGP	SW	FYP	GYP
C1	77.92	147.6	14.74	5.72	40.97	36.99	3.37	94.59	48.26
C2	86.08	132.37	15.95	5.21	42.32	42.27	2.49	88.35	45.16
C3	78.75	99.23	14.54	4.86	28.68	43.77	2.42	62.29	29.35
C4	78.47	145.95	13.26	5.17	37.76	30.07	3.82	86.34	41.68
C5	81.50	120.87	16.27	5.02	45.35	48.50	1.97	89.01	44.33
C6	104.83	159.47	13.97	4.96	47.98	32.9	2.82	95.28	44.16
C7	100.67	129.47	20.43	3.73	39.51	43.88	2.02	68.15	32.93
C8	86.00	123.17	14.54	6.50	52.11	41.60	3.11	124.94	63.51
C9	81.33	203.63	15.89	5.88	45.04	40.73	3.44	124.77	56.52

DF-Days to 50% flowering, **PH-** Plant height (cm), **PL-** Panicle length (cm), **PB-** Panicle breadth (cm), **NPP-** Number of primaries per panicle, **NGP-** Number of grains per primary, **SW-** 100-seed weight (g), **FYP-** Fodder yield per plant (g), **GYP-** Grain yield per plant (g).

Conclusion

The study revealed substantial genetic diversity among the 50 *rabi* sorghum genotypes, which were grouped into nine distinct clusters based on Mahalanobis D^2 analysis. Plant height contributed the maximum (59.92%) towards total genetic divergence, followed by fodder yield per plant (24.33%) and days to 50 per cent flowering (9.63%). Among the clusters, Cluster VIII recorded the highest mean grain yield (63.51 g plant^{-1}) and fodder yield (124.94 g plant^{-1}); while Cluster IX exhibited the highest plant height (203.63 cm) along with high grain and fodder yield. Hence, the genetically diverse and superior-performing genotypes identified in the present study could be effectively utilized as potential parents in future *rabi* sorghum breeding programmes.

Acknowledgement

The authors sincerely acknowledge the ICAR–Indian Institute of Millets Research (ICAR-IIMR), Rajendranagar, Hyderabad, India for providing the seed material of germplasm accessions for the said investigation.

References

Ahamed, K.U., Akhter B., Islam M.R., Alam M.K. and Hossain M.M. (2015). An assessment of genetic diversity in sorghum (*Sorghum bicolor* L. Moench) germplasm. *Bull. Inst. Trop. Agricult., Kyushu Univ.*, **38(1)**, 47-54. DOI: 10.11189/bita.38.047.

Dalip, N., Dodiya N.S., Goswami B., Saran R. and Bairwa L.L. (2022). Genetic divergence analysis in sorghum [*Sorghum bicolor* (L.) Moench] genotypes for forage and grain yield attributes. *Range Management and Agroforestry*, **43(2)**, 326-330.

Deep, H., Chakraborty I., Arya S., Lamba P., Pahuja S.K. and Tokas J. (2020). Genetic diversity analysis by D^2 clustering of fodder yield and its related traits in forage sorghum. *Pantnagar J. Res.*, **18(3)**, 203-209.

Doijad, S.B., Bagade A.B. and More A.W. (2016). Evaluation of sorghum germplasm for genetic diversity using D^2 statistics. *Elect. J. Plant Breed.*, **7(4)**, 934-938.

Kavya, P., Rao V.S., Vijayalakshmi B., Sreekanth B., Krishna Y.R. and Umar N. (2019). Genetic divergence study in sorghum (*Sorghum bicolor* L. Moench) using D^2 analysis. *Int. J. Curr. Microbiol. Appl. Sci.*, **8(6)**, 24-31.

Mahalanobis, P.C. (1936). On the generalized distance in Statistics. *Proc. Nat. Inst. Sci. India*, **2**, 49-55.

More, A.W., Kalpande H.V. and Dhutmal R.R. (2018). Genetic divergence studies in sorghum (*Sorghum bicolor* L. Moench) landraces for yield and yield parameters. *Int. J. Curr. Microbiol. Appl. Sci.*, **6**, 393-399.

Prasad, B.H.V. and Biradar B.D. (2017). Genetic diversity studies in minicore collection of *rabi* sorghum using D^2 statistics. *Int. J. Curr. Microbiol. Appl. Sci.*, **6(7)**, 608-611.

Rajappa, P.V., Krishnaraj P.U., Hanamratti N.G., Bagewadi B., Nawalagatti C.M., Anisha A. and Madhusudhana R. (2024). Assessment of genetic diversity in *rabi* sorghum landraces using D^2 statistics. *J. Cereal Res.*, **16(1)**, 92-101. DOI: 10.25174/2582-2675/2024/149894.

Rao, C.R. (1952). *Advanced Statistical Methods in Biometrical Research*. John Wiley and Sons, New York.