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Research Note

Assessment of genetic diversity in germplasm collections of Browntop millet (*Brachiaria ramosa (L.)* Stapf.) using morphological traits

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Abstract
Browntop millet (*Brachiaria ramose* (L.) Stapf.), is an important small millet crop. It can thrive in variety of climates, uses limited amount of water for growth and development and has high minerals and fibre. As the genetic diversity in any crop species is crucial for crop improvement, present study was aimed at evaluating the diversity present in the germplasm accessions by measuring 13 morphological traits across 27 accessions of browntop millet. The data revealed significant variations between the accessions for each of the traits that were examined. GCV and PCV were observed to be more for the trait panicle width and it was found less in case of days to maturity. The difference in GCV and PCV was very narrow for panicle width indicating least influence of surrounding environment which was further supported by high value of broad sense heritability. While grain yield per plant recorded highest heritability with GAM. Grain yield per plant showed significant positive correlation with plant height, number of panicles per plant, panicle length, peduncle length, flag leaf width and flag leaf length. Principal component analysis revealed 88.73 per cent of total variation was from grain yield per plant, total panicle weight per plant, panicle width and flag leaf length comprising the accessions *viz*., namely IC617956, IC613546, VBT 002, TNBr 016 and IIMR BTL. The study identified best accessions for different traits based on correlation and multivariate analysis that could be of further use in the browntop millet breeding programmes.

Keywords: Browntop millet, *Brachiaria ramosa*, Genetic variability, Heritability, PCA

Brown top millet (*Brachiariaramosa .L*), often known as signal grass, is a tetraploid member of the *Poaceae* family with chromosome number of 2n=32 and base chromosome number of 8 (4x=32) (Basappa *et al*., 1987). The crop is used as traditional food in few parts of Southern India and also as a crop for human use and animal fodder (Kimata *et al*., 2000). It used to be a significant staple crop and was spread across much larger areas previously (Fuller, *et al*., 2004). Brown top millet is rich in fibre, iron, calcium, potassium, magnesium and many other important minerals. Browntop millet eases constipation and helps in detoxifying the body. It helps to control high blood pressure and acts as a probiotic for respiratory disorders. It is also recommended for skin and arthritis problems (Sujata *et al.,* 2018). Due to its high fibre content, it has now growing in popularity with the public as a grain that is nutritious. As there is raising interest, the government sector that works on small millets decided to add browntop millet to the AICRP system of small millets during 2018 to conduct extensive research to develop varieties.Browntop millet is mostly grown in Karnataka, Andhra Pradesh, and to a lesser extent Tamil Nadu in India and used by people from economically weaker section for food purposes (Kumar *et al*., 2021). It is grown in a variety of soils and climates. It can be cultivated in deteriorated soils with limited water supplies and is tolerant of heat and drought. It can be

included into any cropping system and is especially useful as a cover crop since it spreads like grass and sets roots wherever it comes into contact with the soil, covering it and keeping the soil in place to avoid soil erosion. The crop cycle takes 75-100 days with rapid forage production with duration of 50 days. The crop is popular in this region in terms of cultivation and consumption.

Improvement programme in any crop requires the knowledge of existing genetic variation across the germplasm and the assessment of their relationships is crucial in designing the breeding strategies. Cluster analysis serves as potential tools in evaluating the phenotypic diversity. The studies evaluating the morphological and agronomic traits are important in creation of the adaptive and productive cultivars with better adaptation to biotic and abiotic stress factors and high yield potential. Therefore, the objective of the present study was to assess the diversity of browntop millet accessions using morphological traits to quantify genetic variation.

A total of 25 germplasm accessions (**Table 1**), obtained from The Project Coordinating unit, ICAR-AICRP on Small Millets, ZARS, UAS, Bengaluru and ZARS, V.C. Farm, Mandya were sown in randomized complete block design (RCBD) with three replications during *kharif* 2021 at Department of Plant Biotechnology, University of Agricultural Sciences, GKVK, Bengaluru. The experimental site was located at 13^0 05" N latitude and 77^0 34" E longitude, at an altitude of 924 meters above the mean sea level, with a mean annual rainfall of 915.8 mm. Each genotype was sown in five rows per replication adopting a spacing of 45 × 10 cm per and all

Table 1. List of browntop millet germplasmaccessions used

S. No.	Accessions Decode	Code	Location	Type of Panicle	Status of sample
1	IC617961	IC617961	Tumkur, Karnataka	Compact type	Germplasm
2	IC613353	IC613353	Chitradurga, Karnataka	Open type	Germplasm
3	IC617956	IC617956	Chitradurga, Karnataka	Compact type	Germplasm
4	IC613554	IC613554	Haveri, Karnataka	Compact type	Germplasm
5	IC617954	IC617954	Chitradurga, Karnataka	Open type	Germplasm
6	IC613547	IC613547	Chitradurga, Karnataka	Open type	Germplasm
7	IC613551	IC613551	Chitradurga, Karnataka	Compact type	Germplasm
8	IC613552	IC613552	Chitradurga, Karnataka	Compact type	Germplasm
9	IC617959	IC617959	Chitradurga, Karnataka	Compact type	Germplasm
10	IC613556	IC613556	Tumkur, Karnataka	Compact type	Germplasm
11	IC617953	IC617953	Chitradurga, Karnataka	Compact type	Germplasm
12	IC613557	IC613557	Tumkur, Karnataka	Compact type	Germplasm
13	IC613559	IC613559	Anantpur, Andhra Pradesh	Compact type	Germplasm
14	IC613550	IC613550	Chitradurga, Karnataka	Compact type	Germplasm
15	IC613546	IC613546	Tumkur, Karnataka	Open type	Germplasm
16	GPUBT-2	GPUBT-2	Tumkur, Karnataka	Compact type	ABL
17	VBT 005	KH-21 BIAVT-5010	Vizianagaram, Andhra Pradesh	Compact type	ABL
18	VBT 002	KH-21 BIAVT-5002	Vizianagaram,Andhra Pradesh	Open type	ABL
19	GPUBT 2	KH-21 BIAVT-5001	Local check, Karnataka	Compact type	ABL
20	TNBr 016	KH-21 BIAVT-1-5003	Athiyandal, Tamil Nadu	Open type	ABL
21	IIMR BTL	KH-21 BIAVT-5009	IIMR, Hyderabad	Open type	ABL
22	DHBT-11-5	KH-21 BIAVT-5005	Dharwad, Karnataka	Compact type	ABL
23	IIMR BTC	KH-21 BIAVT-5011	IIMR, Hyderabad	Compact type	ABL
24	TNBr 015	KH-21 BIAVT-5006	Athiyandal, Tamil Nadu	Compact type	ABL
25	GPUBT 6	KH-21 BIAVT-5008	Bengaluru, Karnataka	Compact type	ABL
26	GPUBT 9	KH-21 BIAVT-2-5007	Bengaluru, Karnataka	Compact type	ABL
27	DHBT-13-7	KH-21 BIAVT-4-5004	Dharwad, Karnataka	Compact type	ABL

*ABL – advanced breeding lines;

recommended package of practices were followed for better crop stand. Observations on 13 morphological traits namely days to 50% flowering, plant height (cm), No. of tillers/plant, panicle length (cm), panicle width (cm), peduncle length (cm), flag leaf length (cm), flag leaf width (cm), days to maturity, grain yield per plant (g), main panicle length (cm), panicle weight per plant and number of panicles per plant were recorded in five randomly selected plants. Analysis of variance and summary statistics were calculated as per Panse and Sukathme (1967). The components of variation such as genotypic coefficients of variation (GCV) and phenotypic coefficients of variation (PCV) were computed as per Burton and Devane (1953) and heritability in broad sense was computed as per Allard (1960). The morphological data was normalized before using for estimation of genetic similarity. Multivariate analysis like principal component analysis was performed to estimate the contribution of various characters to total variation. The collected data were analyzed with WINDOSTAT software. An Unweighted Pair-Group Method of the Arithmetic Average (UPGMA) clustering procedure using Euclidean distance was employed to construct dendrogram was constructed for quantitative characters for twenty-seven accessions on UPGMA clustering using PAST 4.06 software.

The observations recorded were analyzed and are summarized in **Table 2, Table 3 and Table 4**. The data indicates the presence of considerable amount of variation with respect to 13 morphological characters measured across accessions. Panicle width, no. of panicles per plant, grain yield per plant, per plant panicle weight and panicle length are the most variable characters while the characters with least variation were days to 50% flowering and days to maturity.

Mean value of growth and yield related traits of all 27 browntop millet genotypes are given in **Table 2** and **Table 3** respectively. Observations on growth related traits indicated highest plant height in IIMR BTL (90.039 cm) and lowest in IC613556 (57.953 cm). Early flowering was recorded in IC613546 (58 days) and late flowering was observed in IC613556 (70 days). Highest number of tillers was recorded in IIMR BTL (18.6) and lowest was recorded in TNBr 015 (8.6). Highest peduncle length was recorded in VBT 002 (12.47 cm) and lowest peduncle length was recorded in IIMR BTC (9.133 cm). Highest flag leaf length was recorded in IIMR BTL (20.307 cm) and lowest was recorded in IC613556 (14.167 cm). Highest flag leaf width was recorded in IIMR BTL (3.287 cm) and lowest was recorded in GPUBT 2 (2.387 cm). For yield related traits, highest number of panicle per plant was recorded in VBT 002 (11.733) and lowest was recorded in TNBr 015 (3.267). Highest panicle length was recorded in IIMR BTL (20.973 cm) and lowest panicle length was recorded in TNBr 015 (9.713 cm). Highest grain yield per plant was recorded in IC617956 (13.307g) and lowest was observed in TNBr 015 (3.207g). Highest total panicle weight per plant was recorded in IC617956 (16.487g) and lowest was recorded in GPUBT 2 (4.267g). Highest main panicle length was recorded in Kh-21 BIAVT-5002 (21.907 cm) and lowest was recorded in TNBr 015 (10.54 cm). Early maturity was recorded in IC617954 (94 days) and late maturity was recorded in IC613556 (105 days). Highest panicle width was recorded in IIMR BTL (14.54 cm) and lowest was recorded in TNBr 015 (2.38 cm). Genotypes identified with higher grain yield, more number of tillers, higher panicle length, and more number of panicles could be further used for selections and can be used as parents in the crossing programme. Similar wide range for morphological traits in browntop millet has been reported by Priya *et al*. (2022) and Anuradha *et al*. (2020).

Genetic variability parameter for 13 traits are depicted in **Table 4**. The highest PCV was recorded for panicle width (80.73) followed by number of panicle per plant (38.07) and the lowest PCV was recorded for days to maturity (4.01). The highest GCV was recorded for panicle width (80.68) followed by grain yield per plant (33.13) and the lowest GCV was recorded for days to maturity (2.73). The high values of GCV and PCV suggested that there is a possibility of improvement through direct selection for the traits. The PCV and GCV estimates were relatively high for grain yield per plant, per plant panicle weight and number of panicles per plant this suggests that presence of considerable variation for these traits. Hence these accessions can be further used to select some good genotypes with early, dwarf and high yielding types in Browntop millet. The findings were in line with the previous studies of Priya *et al.* (2022) and Anuradha *et al*. (2019) in browntop millet.

The heritability estimates provide information on transmission of trait (s) from parents to offsprings. Such estimates facilitate the evaluation of genetic and environmental effects, aiding in selection. Estimates of heritability can also be used to predict genetic advance under selection, so that the plant breeder can anticipate improvement from different types and intensities of selection. Highest heritability was recorded for panicle width (99.88) followed by grain yield per plant (92.42) and the lowest heritability was recorded for peduncle length (46.27). The highest GA was recorded for plant height (11.85) followed by panicle width (10.32) and the lowest GA was recorded for flag leaf width (0.46). Highest GAM was recorded for panicle width followed by total panicle weight per plant (61.77) and the lowest was recorded for days to maturity (3.83). Moreover, as the value of broad sense heritability becomes high it is used as an indicator of the ease of phenotype-based selection particularly when it is accompanied by a relatively high variability and genetic advance. Hence, in the present study for characters grain yield per plant, panicle width and number of panicle per plant showed high heritability coupled with GAM indicating direct phenotypic selection can be followed in further breeding programme.

Table 2. Characterization of browntop millet genotypes for growth related traits

S.No.	ENTRIES	PH (cm)	DTF	NTPP	PDL (cm)	FLL (cm)	FLW (cm)
1	IC617961	66.9	60.66	11.73	10.29	16.30	2.73
2	IC613353	68.88	68.66	13.26	11.92	17.58	3.06
3	IC617956	83.44	64	18.13	11.75	19.83	3.12
4	IC613554	87.72	67.33	17.73	9.79	19.86	3.16
5	IC617954	64.46	60.66	9.26	11.96	17.18	2.62
6	IC613547	64.38	62.66	12.46	11.85	17.48	2.56
7	IC613551	84.2	68.66	16.86	10.80	19.16	3.03
8	IC613552	64.38	69.33	11.8	10.33	14.90	2.47
9	IC617959	69.08	69.33	13.46	10.56	15.71	2.7
10	IC613556	57.95	70.66	8.6	10.32	14.16	2.38
11	IC617953	64.80	61.33	9.73	10.35	17.24	2.7
12	IC613557	80.99	67	15.6	10.91	17.6	2.8
13	IC613559	87.16	68.66	18.26	10.64	20.01	3.18
14	IC613550	74.31	70	14.46	10.36	15.82	2.42
15	IC613546	75.24	58.66	15.4	11.96	16.98	2.80
16	GPUBT-2	66.72	60.66	11.46	10.39	16.73	2.76
17	VBT 005	71.12	68	11	10.54	16.26	2.5
18	VBT 002	80	64.66	16.86	12.47	18.72	3.25
19	GPUBT 2	60.02	62	9	10.36	15.68	2.38
20	TNBr 016	85.76	68.66	15.93	12.01	20.15	3.13
21	IIMR BTL	90.09	62.66	18.6	11.74	20.30	3.28
22	DHBT-11-5	79.42	68.66	16.13	9.78	18.45	2.77
23	IIMR BTC	87.70	60.66	18.33	9.13	20.19	3.18
24	TNBr 015	59.26	69.33	8.2	9.38	14.9	2.54
25	GPUBT 6	75.60	68	15.2	9.88	18.53	2.84
26	GPUBT 9	68.28	70	10.93	9.67	14.96	2.51
27	DHBT-13-7	72.14	60.66	12.53	9.13	16.02	2.47
	Replications	41.23	0.45	4.72	6.73**	0.96	0.03
	Treatments	286.73**	45.14**	18.47**	2.77**	10.63**	0.26**
	Error	77.38	2.97	3.29	2.91	2.36	0.04
	CV (%)	11.93	2.62	18.78	8.23	8.80	6.83
	CD (5%)	14.41	2.82	4.22	1.44	2.51	0.31
	CD (1%)	19.20	3.76	5.63	1.92	3.35	0.41

PH: plant height, DTF: days to 50% flowering, NTTP: number of tillers per plant, PDL: peduncle length, FLL: flag leaf length, FLW: flag leaf width

Correlation analysis: Knowledge on the association between single plant yield and their biometrical traits and among the component traits help in improving the efficiency of selection. The idea about the nature of association will be useful to identify the key characters for which selection can be successfully made. In the present study, correlation coefficient among the 13 yield contributing traits was calculated and the same is depicted in **Table 5**. Grain yield per plant showed significant positive association with plant height, panicle length, number of productive tillers per plant, flag leaf width and flag leaf length this indicating that improvement in these characters will lead to improvement in yield. Days to 50 per cent flowering showed significant positive correlation with days to maturity and days to maturity was negatively correlated with peduncle length and panicle weight. Number of panicle per plant, panicle length, flag leaf length, flag leaf width, grain yield per plant, panicle weight per plant, main panicle length and number of tillers per plants showed positive correlation. Panicle width showed positive correlation with peduncle length, flag leaf length, flag leaf width, grain yield per plant, total panicle

Table 3. Characterization of browntop millet genotypes for yield related traits

S. No.	ENTRIES	NPPP	PL (cm)	GYPP (g)	TWPP (g)	MPL (cms)	DTM	PW
1	IC617961	6.13	16.38	5.97	7.57	17.8	96.66	2.90
2	IC613353	8.33	16.42	9.07	11.79	17.88	102.33	13.88
3	IC617956	11	20.69	13.30	16.48	21.4	100	13.92
4	IC613554	8.53	19.96	7.99	9.82	20.95	100.33	3.22
5	IC617954	4.66	12.72	6.3	7.73	13.34	94.33	12.8
6	IC613547	6.66	15.22	7.52	9.14	16.41	97.66	13.55
7	IC613551	10	19.56	7.47	10.3	20.45	102.66	3.1
8	IC613552	6.26	17.96	6.35	6.75	19.5	104.33	3.20
9	IC617959	7.46	18.66	6.05	7.73	19.19	103	3.19
10	IC613556	3.46	10.49	3.38	4.37	10.91	105.66	2.75
11	IC617953	3.8	16.23	3.69	5.09	17.33	99.66	2.92
12	IC613557	8.8	20.82	6.92	10.15	21.60	101.66	3.26
13	IC613559	11.4	19.07	7.43	12.11	19.78	101	3.19
14	IC613550	8.4	19.12	6.49	9.1	20.09	105	3.24
15	IC613546	8.4	18.70	8.33	10.53	20.36	94.66	13.19
16	GPUBT-2	6.73	11.28	6.5	10.98	11.59	95.66	2.47
17	VBT 005	6.8	16.12	3.44	5.11	17.04	102	3.04
18	VBT 002	11.73	20.24	9.22	12.95	21.90	97.66	14.2
19	GPUBT 2	4	12.55	3.83	4.267	13.44	97	3.02
20	TNBr 016	8.8	20.3	10.25	10.63	20.74	102.66	14.17
21	IIMR BTL	10.26	20.97	10.25	13.31	21.38	96.33	14.54
22	DHBT-11-5	8	17.76	7.052	10.1	19.00	102.66	2.97
23	IIMR BTC	11.6	20.59	8.08	13.22	20.74	98.33	3.29
24	TNBr 015	3.26	9.71	3.20	4.82	10.54	103.66	2.38
25	GPUBT 6	7.93	20.67	6.43	9.33	21.16	103	3.33
26	GPUBT 9	5.73	16.4	5.61	6.69	17.67	102.66	3.23
27	DHBT-13-7	6.73	19.49	7.49	8.41	20.06	101.33	2.82
	Replications	2.76	13.14*	0.05	0.052	17.00*	6.25	0.03
	Treatments	33.09**	34.40**	16.34**	16.34**	35.20**	31.41**	75.52**
	Error	8.75	2.91	0.43	1.56	3.60	8.75	0.03
	CV (%)	23.90	9.84	9.48	13.56	10.41	2.94	2.73
	CD (5%)	2.97	2.79	1.08	2.04	3.11	4.84	0.27
	CD (1%)	3.96	3.72	1.43	2.72	4.14	6.45	0.37

NPPP: number of panicle per plant, PL: panicle length, GYPP: grain yield per plant, TPWPP: total panicle weight per plant, MPL: main panicle length, DTM: days to maturity, PW: panicle width

weight per plant. Supported related findings were found in the studies of Priya *et al*. (2022) and Anuradha *et al*. (2019) in browntop millet. Association of these characters suggests that individual plant selection can be practiced for plants with higher plant height, panicle length, number of panicles, flag leaf width and flag leaf length which ultimately could lead to improvement in grain yield per plant.

PCA analysis revealed the importance of the first two principal components in discriminating the entire set of Browntop millet germplasm. The percentage of variation explained by the first two principal components and the vector loadings for each agronomic character and principal components are shown in **table 6**. The percentage of total variation explained by two principal components was 85.75 %. The PC1 was observed to be the most important coordinate accounting for 68.95 % of total variation. PC1 was observed to separate accessions based on four traits namely plant height, no. of tillers per plant, panicle length and per plant panicle weight. Plane height (0.81) and No. of tillers per plant (0.27) contributes more to the

Table 4. Genetic parameters of 27 browntop millet genotype

	Mean ± SE	RANGE		PCV	GCV	h2	GA	GAM
		Min	Max					
Days to 50% flowering	65.61 ± 0.995	58.66	70.66	6.28	5.71	82.56	7.01	10.69
Days to maturity	100.44 ± 1.707	94.33	105.66	4.01	2.73	46.34	3.85	3.83
Plant height	73.7 ± 5.079	57.95	90.09	16.45	11.33	47.42	11.85	16.07
No. of panicle per plant	7.59 ± 1.048	3.267	11.73	38.07	29.63	60.57	3.60	47.51
Panicle length	17.33 ± 1.39	9.713	20.973	21.11	18.68	78.28	5.90	34.05
Peduncle length	10.68 ± 0.508	9.133	12.47	11.24	7.64	46.27	1.14	10.71
Flag leaf width	2.79 ± 0.11	2.387	3.28	11.92	9.76	67.15	0.46	16.49
Flag leaf length	17.43 ± 0.88	14.16	20.30	12.97	9.52	53.95	2.51	14.41
Grain yield per plant	6.95 ± 0.38	3.207	13.30	34.46	33.13	92.42	4.56	65.61
Per plant panicle weight	9.20 ± 0.721	4.267	16.48	35.21	32.49	85.16	5.68	61.77
Main panicle length	18.23 ± 1.096	10.54	21.90	20.62	17.79	74.50	5.77	31.65
Panicle width	6.21 ± 0.098	2.38	14.54	80.73	80.68	99.88	10.32	166.1
No. tillers per plant	13.74 ± 1.49	8.2	18.6	28.62	21.60	56.95	4.61	33.58

Table 5. Phenotypic correlation of 13 parameters recorded from 27 browntop millet genotypes

	DF	DM	PH	NP	PL	PEDL	FLW	FLL	GYP	PWP	MPL	PW
DM	0.88**											
PH	0.02	-0.06										
NP	0.003	-0.09	0.89**									
PL	0.03	0.07	0.83**	0.80**								
PDL	-0.16	-0.39*	0.15	0.30	0.14							
FLW	-0.09	-0.25	0.82**	0.80**	0.60**	0.37*						
FLL	-0.15	-0.27	0.88**	0.79**	0.65**	0.31	0.90**					
GYP	-0.16	-0.23	0.71**	0.78**	0.66**	0.52**	0.73**	0.72**				
PWP	-0.18	-0.27	0.77**	0.89**	0.64**	0.41*	0.81**	0.79**	0.92**			
MPL	0.04	0.06	0.79**	0.79**	0.99**	0.18	0.58**	0.61**	0.66**	0.62**		
PW	-0.27	-0.43*	0.23	0.34	0.21	0.88**	0.45*	0.41*	0.69**	0.53**	0.23	
TLP	0.02	-0.06	0.95**	0.94**	0.85**	0.21	0.82**	0.85**	0.78**	0.86**	0.83**	0.29

PH: plant height, DTF: days to 50% flowering, NTTP: number of tillers per plant, PDL: peduncle length, FLL: flag leaf length, FLW: flag leaf width, NPPP: number of panicle per plant, PL: panicle length, GYPP: grain yield per plant, TPWPP: total panicle weight per plant, MPL: main panicle length, DTM: days to maturity, PW: panicle width

variation followed by panicle length (0.25) and per plant panicle weight (0.22) which had the highest loadings in PC1 indicating their importance for these components. The second principal component (PC2) which included days to 50 % flowering and days to maturity, contributed 16.8 percent to the total variation. Four traits namely, days to 50% flowering, plant height, days to maturity and no. of tillers per plant, explained more variance in the first two principal components, indicating their importance for the characterization of Browntop millet germplasm accessions . Such characters with high variability are expected to provide high level of transgressive segregation in breeding populations. This is important for breeders to investigate high yielding, early maturing and dwarf varieties through conventional breeding.

Dendrogram based on UGPMA clustering was constructed based on the 13 morphological traits (**Fig. 2**). It revealed that the 25 accessions were divided into two major clusters. The cluster I was sub divided into two sub clusters. Sub cluster I consisted of eight accessions and sub cluster II consisted of five accessions namely IC513546, IIMR BTL, IC617956, VBT002 and TNBr 016 are observed to have higher grain yield per plant. Cluster II was also divided into two sub clusters. Sub cluster I consisted of two accessions namely IC613556 and TNBr 015 which were late maturing and late flowering. Sub cluster II consisted of 12 accessions. Diverse accessions belonging to different clusters can be utilized for hybridization to get transgressive segregants for that trait, which could be used for developing superior

Table 6. Vector loadings and percentage variation explained by first two principal components in Browntop millet germplasm

	PC 1	PC 2
Eigeon value	142.14	34.63
Variance Explained (%)	68.95	16.8
Cumulative variance explained (%)	68.95	85.75
Eigeon vectors		
Days to 50% flowering	-0.01	0.49
Days to maturity	-0.03	0.45
Plant height (cms)	0.81	0.18
No. of panicle per plant	0.19	-0.01
Panicle length (cms)	0.25	0.08
Peduncle length (cms)	0.02	-0.11
Flag leaf width (cms)	0.02	-0.01
Flag leaf length (cms)	0.14	-0.05
Grain yield per plant (g)	0.16	-0.16
Per plant panicle weight (g)	0.22	-0.16
Main panicle length (cms)	0.24	0.07
Panicle width (cms)	0.15	-0.67
No. tillers per plant	0.27	0.03

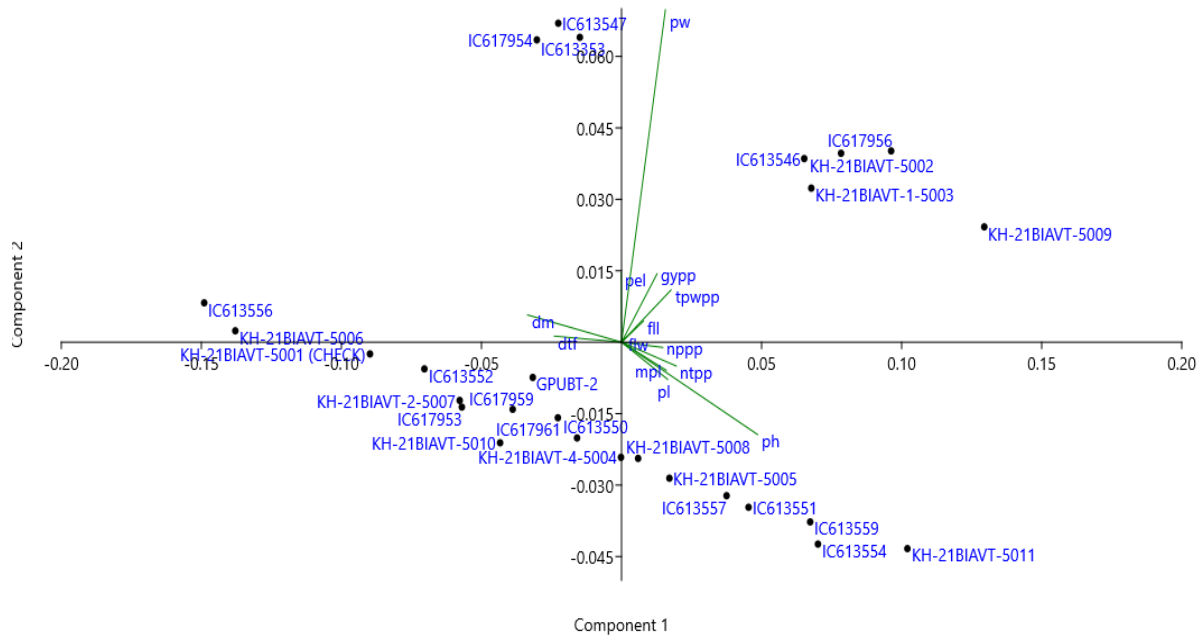

Fig. 1. Principle component analysis: Scatter biplot showing distribution of different browntop millet accessions

high yielding varieties. Supported related findings were found in the studies by Priya *et al*. (2022) in browntop millet.

Among all small millets Browntop millet is one of the important small millet crop grown for food and fodder purpose. Research work carried out in this crop is very limited. This study provides basic details about the diversity that exists in this crop for different traits like grain yield, number of panicle per plant, panicle length, peduncle length, flag leaf width and flag leaf length. This will help breeders to execute selections. In the present study sufficient genetic variation was found among the twenty-seven browntop millet accessions for the thirteen

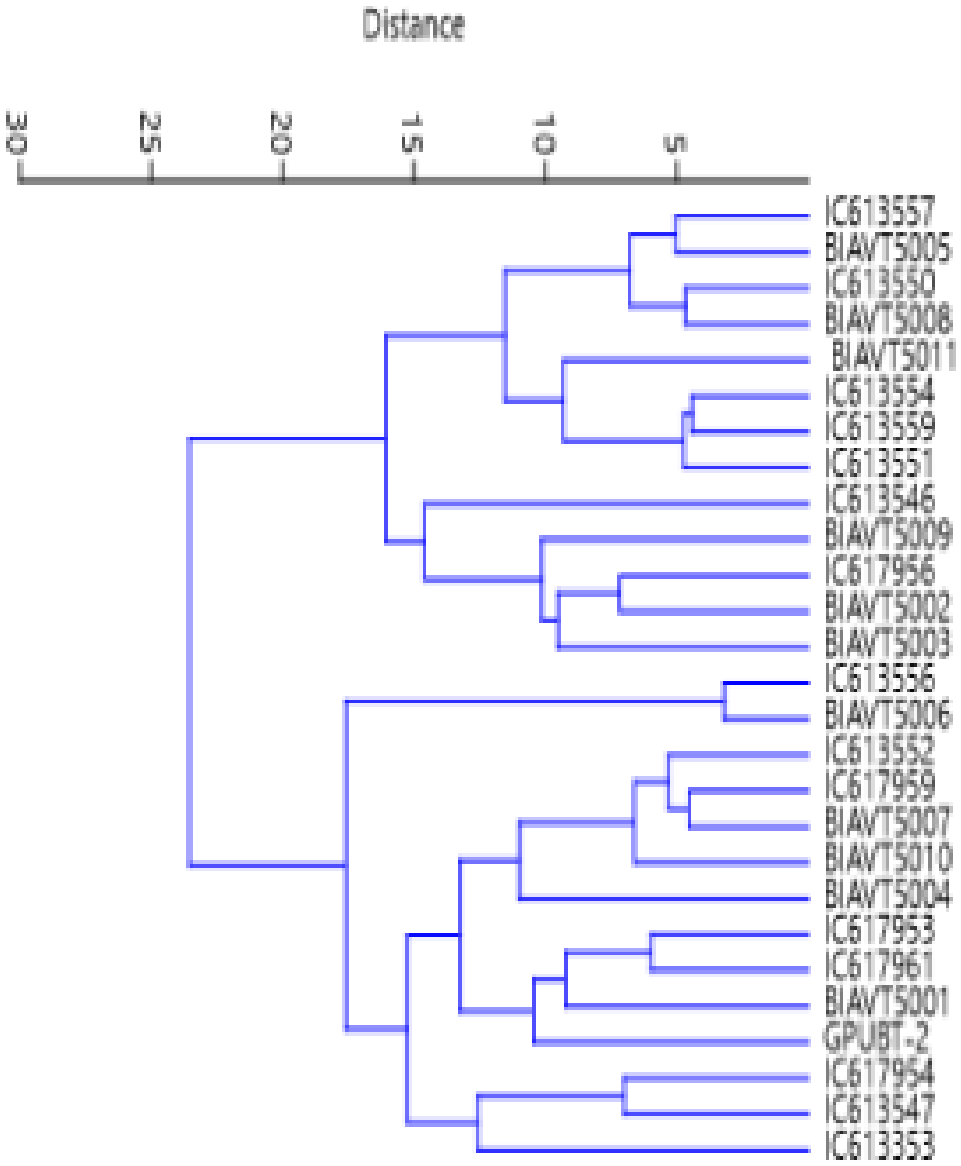

Fig. 2. Hierarchical cluster based dendrogram displaying the genetic relationship among 27 browntop millet accessions

traits evaluated. Grain yield per plant showed to be positively correlated with number of panicle per plant, panicle length, peduncle length, flag leaf width and flag leaf length. Genotypes identified with higher grain yield, more number of tillers, higher panicle length, and more number of panicles could be further used for selections and can be used as parents in the crossing programme.

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