

Research Article**Studies On Genetic Distance Between The Diverse Germplasm In Pearl Millet For Fodder Characters (*Pennisetum glaucum* (L.) R. Br.)****K.Veena Priya, R.Usha kumari, R.Suguna, and K.S .Usharani****Abstract**

Sixty nine pearl millet germplasm entries of diverse origin were evaluated for seven quantitative characters and three qualitative characters for their *per se* performance, variability and genetic divergence. Wider variability was observed for fodder yield and its associating characters along with crude protein content. The GCV estimates were observed to be high for number of leaves per plant, number of tillers per plant, leaf area and green fodder yield. Heritability estimates were high for all the characters. Genetic advance as percentage of mean was high for number of leaves per plant followed by plant height, number of tillers per plant, leaf area, green fodder yield, dry fodder yield, crude protein content, crude fibre content and calcium content. By D^2 analysis, the genotypes were grouped into fifteen clusters. The character plant height contributed maximum to the genetic divergence. Cluster eleven with ten entries forms the largest cluster. Based on the average intercluster distance (D) the clusters V and XV were found to be highly divergent from the other clusters. Selecting parents from these clusters and crossing them in a breeding programme might lead to creation of a wide spectrum of variation in the segregating population.

Key words: Pearlmillet, Variability and Genetic divergence, Fodder character

Introduction

Considerable success has been achieved in the improvement of food and cash crops. The total area under fodder cultivation in India is 8.3 million ha. Tamil Nadu occupies 2 lakh ha area of fodder crops comprising mainly cereal forages (SCRT, 2002). The livestock population in India comprises of about 209.08 million numbers of cattle and 92.19 million numbers of buffaloes contributing about 15% of world cattle population and 57% of world buffalo population respectively. Pearlmillet is one of the most suitable dual purpose, drought resistant green fodder crop. In India large numbers of pearlmillet hybrids are being developed, tested and selected every year for general cultivation. However, hybrids with good fodder quality are not given equal importance in most cases. In order to realize substantial production and varietal improvement in this allogamous crop, systematic research efforts should be made for its genetic improvement. It is preferred to that of sorghum because of the absence of HCN content and it can be fed to cattle without harm at any stage of its growth. It

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is also reported that oxalic acid content is also within the safer limit. comprising both grain and fodder types is sown to more than 72 hybrids and improvement in the quantity and the nutritional quality of the fodder of these hybrids could make tremendous impact on livestock productivity in the region (Blummel and Rai, 2003).

Materials and Methods

Sixty nine germplasm entries were raised during Rabi 2004 in a randomized block design with two replications under irrigated conditions at the Research Block, Department of Plant Breeding and Genetics, Agricultural College and Research Institute, Madurai. Each entry was raised in two rows of 2 m length spaced at 25 cm between rows and 10 cm between plants in each replication. The recommended agronomic practices and plant protection measures were adopted uniformly. Border rows were grown on all the sides of the experimental plot.

The observations were recorded on five randomly selected plants at 50 per cent flowering in each replication and the average was worked out and used for statistical analysis. Seven quantitative characters and three qualitative characters (Table 3) were

studied. The total nitrogen content was estimated by Humphrie's (1956) micro kjeldahl method and the crude protein content was calculated by multiplying the total nitrogen content by the factor 6.25 and was expressed in percentage. The crude fibre content was estimated by the method given by Goering and Vansoest (1970) and was expressed in percentage. The calcium content was determined by versanate titration method using triple acid extract (Jackson, 1973). Genetic divergence was estimated for each of the environment using Mahalanobis D² (1936) the significance of V-stat was done by X² test using Wilk's criteria. The intra and inter cluster distances were also estimated following Tocher's (Rao, 1952).

Result and Discussion

D² statistics is a very useful tool to assess the genetic diversity in crop plants. The observations on seven quantitative characters in 69 genotypes of pearl millet were analysed for genetic diversity. The available divergence between the genotypes was tested by Wilk's lambda criteria and it was found to be significant. The mean values of the 69 genotypes were transformed into standardized uncorrelated mean values. The D² values corresponding to all possible combinations among the sixty nine genotypes were computed. By the application of clustering technique, the 69 types were grouped into 15 different clusters (Table 1). The clustering pattern revealed that the distribution of types into different clusters was at random with regard to their geographical origin. Among the 15 clusters, it was observed that the cluster XI was the largest with ten genotypes followed by cluster VII, X and XIV each with nine genotypes in each. The cluster II, III, IV, V, VIII and IX are recorded to be the smallest clusters with two genotypes in each. The inter and intra cluster D² and D values among 15 clusters are presented in Table 2. The minimum intra cluster distance was recorded in cluster II (3.69) where as maximum was recorded in cluster XIV (47.43). Similarly the least inter cluster distance was observed between I and III (9.12) and maximum between V and XV (78.7).

Variability, heritability and genetic advance

The range, grand mean, phenotypic and genotypic variances and phenotypic and genotypic coefficient of variation, heritability and genetic advance as per cent of mean for all the ten traits are presented in the Table 3. Analysis of variance for different traits involving 69 diverse accessions of pearl millet are presented in Table 4.

The number of days taken for 50 per cent flowering in the genotypes ranged from 40.00 to 52.00 days with a general mean of 44.10. The estimates of phenotypic

and genotypic variance were 4.58 and 4.01 respectively. The coefficient of variation due to phenotypic and genotypic was 4.85 and 4.54 per cent respectively. The trait had a heritability estimate of 87.00 per cent along with low genetic advance of 8.76 per cent of mean. The plant height showed a wide range of variability ranged from 47.90 cm to 117.95 cm with a grand mean of 76.14 cm. This trait recorded moderate phenotypic (19.95) and genotypic (19.94) co-efficient of variation and the phenotypic variance and genotypic variance were 230.94 and 230.64 respectively. The plant height showed a high heritability estimate of 99.00 per cent along with genetic advance of 41.05 per cent of mean.

The number of tillers per plant showed a range of variability from 3.10 to 14.50 with a grand mean of 6.58. The phenotypic coefficient of variation is 30.21 and the genotypic coefficient of variation is 27.45 respectively. The phenotypic variance and genotypic variance are 3.96 and 3.27 respectively indicating less influence by the environment. This trait recorded heritability of 82.00 per cent along with moderate genetic advance as per cent of mean (51.40). The number of leaves showed a wide range of variability from 5.00 to 31.55 with a grand mean of 9.93. The phenotypic variance is 27.77 and the genotypic variance is 26.86, indicating less influence of the trait by the environment. This trait also recorded high phenotypic and genotypic coefficient of variance of 53.04 and 52.16 respectively. Heritability and genetic advance as percent of mean for this trait were 96.00 per cent and 105.67 per cent respectively.

This trait combined high heritability along with high genetic advance as per cent of mean. The leaf area showed a range of variability between 77.47 cm² to 261.55 cm² with a grand mean of 140.08 cm². This trait had the phenotypic and genotypic variability of 1199.11 and 1198.11 respectively with a narrow difference between them. However, this trait showed moderate phenotypic coefficient of variation (15.95) and genotypic coefficient of variation (15.94) values. This trait was found to possess high heritability of 99.00 per cent along with moderate genetic advance as per cent of mean (32.84).

The range of green fodder yield showed a wide range of variability from 84.00 g to 248.90 g with a grand mean of 130.29 g. The phenotypic variance and genotypic variance are 8.69 and 3.94 respectively. The phenotypic coefficient of variance and genotypic coefficient of variance are found to be 21.82 and 21.76 respectively. Heritability estimate for this trait was high as 99.00 per cent with moderate genetic

advance as per cent of mean (44.69). Dry fodder yield for the genotypes showed a range of variability between 44.40 g to 114.35 g with a grand mean of 66.37 g. The estimates of phenotypic variance and genotypic variance are 142.41 and 140.51. The coefficient of variation due to phenotypic and genotypic is 17.97 and 17.85 respectively. This trait recorded high heritability estimate of 98.00 per cent. However it had only moderate genetic advance as per cent of mean (36.54).

The range was wide from 4.09 to 8.34 per cent with a grand mean of 6.33 per cent. The phenotypic coefficient of variation and genotypic coefficient of variation of 17.20 and 16.13 respectively were obtained for this trait. It also recorded low phenotypic (1.18) and genotypic (1.04) variance. The estimate of heritability and genetic advance as percent of mean are 87.00 per cent and 31.17 per cent respectively. The crude fibre content of the genotypes ranged from 18.60 to 51.30 per cent with a grand mean value of 28.67 per cent. This trait showed phenotypic coefficient of variation and genotypic coefficient of variance of 20.66 and 20.51 respectively. Phenotypic variance and genotypic variance for this trait are 35.11 and 34.60 respectively. High heritability estimate of 98.00 per cent along with moderate genetic advance as per cent of mean (41.95) was recorded for this trait. The range for this trait was from 0.22 to 0.36 per cent with a grand mean of 0.28 per cent.

The phenotypic coefficient of variation and genotypic coefficient of variation for this trait was 14.15 and 13.71 per cent respectively. Heritability and genetic advance as per cent of mean are 93.00 per cent and 27.38 respectively. This trait combined high heritability along with moderate genetic advance as per cent of mean.

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Table 1. Composition of D² clusters in pearl millet germplasm

Cluster	Number of genotypes	Name of the genotypes		
I	3	MP236	DRSB 2	IP 8660
II	2	FMH 2	NDFD 103	
III	2	HES 4	IP 14706	
IV	2	DRSB 3	IP 15344	
V	2	IP 20339	IP 20350	
VI	5	MP 216	GP 15072	GK 1006
		IP 3585	UCC 23	
VII	9	TNSC 6	PCB 154	FD 1905
		FD 1915	TNFC 9903	ICMU 8111
		APFB 2	IP 8650	IP 8652
VIII	2	PT 5627	IP 20440	
IX	2	IP 3603	CO 8	
X	9	AFB 6	PT 1890	PT 4450
		PT 4870	PT 4891	PT 4978
		PT 4993	IP 20329	IP 20376
XI	10	PT 5048	PT 5058	PT 5085
		PT 5826	IP 3088	IP 3559
		IP 8600	IP 8532	IP 3629
		IP 15255		
XII	6	IP 8637	IP 15307	IP 15321
		IP 15341	IP 15343	IP 19575
XIII	3	IP 15369	UCC 17	VELLAMALAI
XIV	9	IP 20230	IP20233	IP 20338
		IP 20345	IP 20346	IP 20348
		IP 20379	IP20386	CO 7
XV	3	UUJ 72	UUJ4M	THINDIVANAM

**Table 2. Inter and intra (diagonal) cluster average of D^2 and D values (in bold)**

Cluster	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV
I	228.90 15.13	426.28 20.67	83.20 9.12	764.61 27.65	1734.89 41.65	1503.16 38.77	798.51 28.25	390.39 19.75	714.77 26.73	1022.37 31.97	1628.10 40.35	1105.97 33.25	1642.25 40.52	1941.84 44.06	1713.62 41.39
II		13.65 3.69	373.57 19.32	214.95 14.66	679.98 26.07	2698.14 51.94	1309.29 36.18	1227.20 35.03	1631.212 40.38	1142.47 33.80	2777.83 52.70	638.93 25.27	3199.60 56.56	1284.24 35.83	3135.31 55.99
III			16.37 4.04	689.63 26.26	1661.07 40.75	1445.67 38.02	737.88 27.16	325.96 18.05	663.87 25.76	971.67 31.17	1560.12 39.49	1051.54 32.42	1565.00 39.56	1871.60 43.26	1661.44 40.76
IV				21.12 4.59	296.64 17.22	3694.77 60.78	1902.92 43.62	1895.88 43.54	2570.06 50.69	1617.79 40.22	3625.35 60.21	666.76 25.82	4119.41 64.18	1074.37 32.77	4273.76 65.37
V					21.45 4.63	5438.22 73.74	3144.77 56.07	3366.39 58.02	4175.76 64.62	2557.7 50.57	5335.80 73.04	1156.49 34.00	6176.10 78.58	1222.61 34.96	6202.59 78.75
VI						1218.27 34.90	1533.69 39.16	692.81 26.32	581.97 24.12	2324.19 48.21	1337.87 36.57	3590.33 59.91	804.33 28.36	4931.65 70.22	746.26 27.31
VII							1348.97 36.72	692.14 26.30	830.36 28.81	1579.25 39.74	1743.06 41.75	2020.52 44.95	1591.52 39.89	3077.17 55.47	1596.76 39.96
VIII								33.79 5.81	115.51 10.74	1256.04 35.44	935.25 30.58	1996.76 44.68	599.45 24.48	3142.13 56.05	641.04 25.31
IX									48.03 6.93	1471.77 38.34	923.59 30.39	2489.86 49.89	531.07 23.04	3809.71 61.72	422.46 20.55
X										1943.04 44.08	2492.27 49.92	1803.53 42.46	2568.67 50.68	2723.70 52.18	2525.18 50.25
XI											1807.86 42.51	3608.22 60.06	1107.51 33.27	4882.48 69.87	1183.49 34.40
XII												1223.49 34.97	4025.54 63.44	1658.63 40.72	4054.05 63.67
XIII													482.59 21.96	5449.60 73.82	508.79 22.55
XIV														2249.79 47.43	5517.60 74.28
XV															552.20 23.49

**Table3. Range, variance, heritability and genetic advance in 69 diverse accessions of pearl millet**

S. No	Characters	Range	Variance		PCV %	GCV %	Heritability (broad sense) %	Genetic Advance as % of mean
			Phenotypic	Genotypic				
1.	Days to 50 per cent flowering	40.00-52.00	4.58	4.01	4.85	4.54	87.0	8.76
2.	Plant height (cm)	47.90-117.95	230.94	230.64	19.95	19.94	99.0	41.05
3.	Number of tillers	3.10-14.50	3.96	3.27	30.21	27.45	82.0	51.40
4.	Number of leaves	5.00-31.55	27.77	26.86	53.04	52.16	96.0	105.67
5.	Leaf area (cm ²)	77.47-261.55	1199.11	1198.11	15.95	15.94	99.00	32.84
6.	Green fodder yield (g)	84.00-248.90	8.69	3.94	21.82	21.76	99.0	44.69
7.	Dry fodder yield (g)	44.40-114.3	142.41	140.51	17.97	17.85	98.0	36.54
8.	Crude protein content (%)	4.09-8.34	1.18	1.04	17.20	16.13	87.0	31.17
9.	Crude fibre content (%)	18.60-51.30	35.11	34.60	20.66	20.51	98.0	41.95
10.	Calcium content (%)	0.22-0.36	0.002	0.001	14.15	13.71	93.0	27.38



Table4. Analysis of variance for different traits involving 69 diverse accessions of pearl millet

S.No	Source	df	Mean sum of squares									
			Days to 50 per cent flowering	Plant height (cm)	No. of tillers/plant	No. of leaves/plant	Leaf area (cm ²)	Green fodder yield (g)	Dry fodder yield (g)	Crude protein content (%)	Crude fibre content (%)	Calcium content (%)
1.	Replication	1	12.17	0.01	0.11	5.89	0.94	0.03	3.08	0.55	0.57	0.57
2.	Genotypes	68	8.50**	461.59**	7.23**	54.63**	2397.64**	1612.53**	282.92**	2.22**	69.71**	69.71**
3.	Error	68	0.56	0.30	0.68	0.91	0.61	4.75	1.90	0.14	0.51	0.51

**Significant at 1% level

*Significant at 5% level