Indian J. Genet., **54** (1): 89–93 (1994)

GENETIC DIVERGENCE IN PEARL MILLET ACCESSIONS OF INDIAN AND EXOTIC ORIGIN

O. P. YADAV

Central Arid Zone Research Institute, Jodhpur 342003

(Received: July 15, 1993; accepted: December 22, 1993)

ABSTRACT

Fifty two pearl millet accessions of Indian and exotic origin were evaluated for genetic divergence. The accessions were grouped in ten clusters. Cluster I had approximately half of all the accessions. The genotypes in cluster I were early and had higher threshing ratio and seed weight, while those in clusters IV and V showed quick early growth. The clustering pattern indicated that the geographic diversity was not necessarily related with genetic diversity. Seedling vigour, productive tillers and plant height have been identified as potent variables which can be used as parameters while selecting diverse parents for hybridization programmes.

Key words: *Pennisetum glaucum*, pearl millet, D^2 analysis, geographical diversity, genetic diversity.

Genetic diversity is the basic requirement for successful breeding programme. The more diverse the parents, greater are the chances of increased spectrum of variability. However, major difficulty is encountered in the measurement of such variability so as to utilize it fruitfully in breeding programmes. Mahalanobis' D^2 statistics is a powerful tool in quantifying the degree of variability at genotypic level and has been used previously in many crops including pearl millet [1, 2]. The present investigation aims to determine (i) the genetic diversity in 52 accessions of pearl millet (*Pennisetum glaucum* (L.) R. Br.) of Indian and African origin and (ii) whether differences in geographic origin can be used as an index of genetic diversity.

MATERIALS AND METHODS

Fifty two accessions of pearl millet were evaluated: 17 from India and 33 from seven African countries, viz. Togo, Ghana, Burkino Faso, Senegal, Nigeria, Niger, Somalia, and one each from ICRISAT and Yemen. These accessions were grown in randomized block design with two replications at the Central Arid Zone Research Institute, Jodhpur in kharif.

The plant-to-plant distance of 15 cm was maintained within rows which were spaced at 60 cm. The data were recorded for early seedling vigour on 1 (most vigorous) to 5 (least vigorous) scale [3], days to flowering (when stigma emerged in the main shoot panicles of 50% plants in a plot), plant height (cm), panicle length (cm), panicle bearing tillers, grain yield (g/plot), dry fodder weight (g/plot), panicle weight (g/plot), 500-grain weight (g), and threshing percentage (grain yield as percentage of panicle weight). Mahalanobis' D^2 statistic was used to assess genetic divergence. The accessions were grouped on the basis of minimum generalized distances using the Tocher's method [4].

RESULTS AND DISCUSSION

Analysis of variance indicated significant variability in the accessions for all the characters. The simultaneous test of significance based on Wilk's criterion for the pooled effect of all the characters also showed significant differences among accessions (χ^2 value = 1386.81 for 510 d.f.).

Based on the relative magnitude of D^2 values, the 52 accessions were grouped into ten clusters so that the genotypes within the cluster had smaller D^2 values among themselves than those belonging to different clusters (Table 1). As many as 27 accessions were

Table 1. Distribution of 52 pearl millet accessions in different clusters and their origin

Cluster	No. of accessions	Accessions	Origin or source
I	27	IP 9476, IP 9506, IP 11341, IP 3840, IP 9503, IP 17549, IP 9495, IP 9265, IP 9551, IP 9536, IP 17800, IP 8042, IP 9273, IP 9447, IP 17552, IP 8955, IP 9526, IP 9524, IP 9445, IP 13904, IP 9409, IP 4138, IP 5842, IP 4188, IP 9379, IP 9457, IP 3146	Ghana, Burkino Faso, India, Togo, Yemen, Senegal
II	6	IP 3285, IP 3127, IP 3043, IP 11871, IP 3061, IP 3071	India
III	5	IP 11005, IP 5203, IP 3096, IP 10344, IP 6107	Nigeria, India, Niger
IV	4	IP 17725, IP 17502, IP 13297, IP 5050	Togo, Somalia, Nigeria
V	2	IP 3394, IP 3116	India (Rajasthan)
VI	2	IP 5842, IP 12144	Senegal, Nigeria
VII	2	IP 5744, IP 9360	Nigeria, Ghana
VIII	2	IP 9263, IP 12674	India (ICRISAT)
IX	1	IP 11787	India (A.P.)
X	1	IP 11871	India (A.P.)

accommodated in cluster I, 6 in II, 5 in III, 4 in IV, 2 each in V, VI, VII and VIII, and 1 each in IX and X. Out of the 14 accessions from Ghana, all but one (IP 9360) were included in cluster I indicating greater genetic similarity in the accessions originating from Ghana. On the other hand, the 17 accessions from India were spread over seven clusters. Likewise, four accessions of Nigerian origin fell in four different clusters. Further, 27 accessions originating from Ghana, Burkino Faso, India, Togo, Yemen and Senegal were grouped into one cluster. These results show that geographic diversity is not necessarily a direct cause of genetic diversity. The geographic diversity has been disproved to be an index of genetic diversity in pearl millet [1, 2] and several other crops [5–7]. Genetic drift and selection in different environments could cause greater diversity among genotypes than their geographic distances [8]. Frequent exchange of breeding materials from one place to other and further selection may also be responsible for distribution of gene complexes over distant geographical locations. Thus, it is more appropriate to select accessions for hybridization based on genetic diversity rather than geographic distances.

The intracluster distance ranged from 33.6 (cluster V) to 67.1 (cluster VII), while the intercluster distance was maximum (443.2) between clusters IX and X (Table 2). Cluster I consisting of approximately half of all the accessions was closer to clusters II and X and was widely different from clusters III, VI, VII. Maximum diversity was observed between genotypes of clusters IX and X both of which had one accession each from Andhra Pradesh. This further confirms that geographic origin is not a confirmed indicator of genetic diversity.

Table 2. Intra- (in bold) and intercluster D^2 values in pearl millet

Cluster	I	II	III	IV	V	VI	VII	VIII	IX	X
I	**57.1**	97.5	344.3	140.7	122.4	280.0	294.1	168.0	156.8	93.7
II		**51.7**	265.9	129.0	75.2	180.1	194.7	142.5	123.2	295.0
III			**50.6**	142.9	327.4	151.8	79.8	96.5	333.3	119.3
IV				**55.9**	138.3	106.1	113.7	91.1	288.0	188.2
V					**33.6**	156.5	258.7	155.7	257.6	228.9
VI						**62.6**	90.7	139.6	392.5	125.2
VII							**67.1**	119.5	299.0	154.7
VIII								**48.6**	210.8	112.2
IX									**0.0**	443.2
X										**0.0**

The character means over clusters (Table 3) showed a wide range clusterwise. Genotypes of cluster I were early with higher threshing ratio and seed weight. Genotypes

Table 3. Mean values of ten characters in different clusters of pearl millet

Cluster	Early seedling vigour (scale 1–5)	Days to flowering	Plant height (cm)	Ear length (cm)	Effective tillers	Panicle weight (g)	Grain yield (g/plot)	Threshing ratio (%)	Dry fodder yield (g/plot)	500-grain weight (g)
I	3.2	45.5	189.0	19.0	1.3	652.2	444.8	68.5	991	4.88
II	3.9	49.3	176.0	22.7	2.1	801.7	540.0	68.2	1225	3.17
III	4.3	68.7	212.2	21.7	1.5	388.0	204.0	52.5	1690	3.27
IV	2.9	60.0	216.1	21.5	1.2	805.0	560.0	68.5	1638	4.49
V	3.0	50.8	236.5	37.5	1.3	995.0	625.0	63.8	1375	3.35
VI	3.8	64.3	235.3	29.5	1.1	1005.0	575.0	57.0	2400	2.95
VII	4.5	65.0	230.8	19.0	1.1	565.0	365.0	65.0	2150	3.08
VIII	5.0	62.5	200.5	26.5	1.4	350.0	215.0	62.5	850	3.55
IX	5.0	43.5	157.5	13.5	2.2	220.0	130.0	58.0	550	2.40
X	3.0	68.0	246.0	46.0	1.0	520.0	250.0	48.0	2250	2.90
Grand mean	3.5	52.0	202.5	21.7	1.4	656.8	431.8	65.3	1258	4.16
CV (%)	24.2	3.3	7.5	12.1	24.8	12.8	13.7	8.9	20	8.66

Scale for seedling vigour: 1 (best) to 5 (poorest) in visual observation.

in clusters IV and V showed fast early growth which is considered as highly desirable character under arid areas [9]. Particularly noteworthy are the extreme mean values of six characters, i.e. days to flowering, plant height, early seedling vigour, ear length, effective tillers and dry fodder yield, in clusters IX and X even though both these clusters included entries from Andhra Pradesh within India. This showed that geographic distribution could not be taken to be the sole criterion of genetic diversity. Further, it is possible to collect wide variability even from relatively nearer regions.

The analysis for the relative contribution of characters to total divergence indicated that early seedling vigour, effective tillers and plant height serve as potent variables which can be used as parameters in selecting genetically diverse parents for hybridization.

ACKNOWLEDGEMENTS

Thanks are due to Dr. S. Appa Rao of International Crop Research Institute for the Semi-Arid Tropics, Patancheru for the supply of pearl millet accessions.

REFERENCES

1. M. K. Upadhyay and B. R. Murty. 1970. Genetic divergence in relation to geographical distribution in pearl millet. Indian J. Genet., **30**: 704–715.

2. Y. R. Singh, A. Kumar and B. P. S. Chauhan. 1981. Genetic divergence in pearl millet. Indian J. Genet., **41**: 186–190.

3. R. K. Maiti, P. S. Raju and F. R. Bidinger. 1981. Evaluation of visual scoring for seedling vigour in sorghum. Seed Sci. Technol., **9**: 613–622.

4. C. R. Rao. 1952. Advanced Statistical Methods in Biometrical Research. John Wiley & Sons, Inc. New York.

5. J. Lee and P. J. Kaltsikes. 1973. The application of Mahalanobis' generalized distance to measure genetic divergence in durum wheat. Euphytica, **22**: 124–131.

6. R. P. Golakai and V. G. Makne. 1992. D^2 analysis in virginia runner groundnut genotypes. Indian J. Genet., **52**: 252–256.

7. R. A. Sheriff and G. Shivashankar. 1992. Genetic divergence in foxtail millet (*Setaria italica* B.). Indian J. Genet., **52**: 29–32.

8. B. R. Murty and V. Arunachalam. 1966. The nature of genetic divergence in relation to breeding systems in crop plants. Indian J. Genet., **26A**: 188–198.

9. V. K. Manga and M. B. L. Saxena. 1990. Variability for seedling vigour and its association with yield in pearl millet. Crop Improv., **17**: 83–84.