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Research Note

Genetic diversity study in germplasm lines of foxtail millet (*Setaria italica* (L.) Beauv)

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Abstract

The present investigation was carried out with the objective to find out the extent of genetic variability for six yield component traits in 49 indigenous genotypes of foxtail millet. Analysis of variance showed highly significant differences for all the characters studied. Based on the D^2 analysis, the genotypes were grouped into five clusters. Maximum number of genotypes were grouped in cluster I (28 genotypes) followed by cluster III (11 genotypes) whereas the remaining genotypes fall under cluster IV (6 genotypes) and cluster II and V had two genotypes each. The maximum inter cluster distance was observed between the cluster III and IV (27.96) followed by cluster I and III (24.39). The intra cluster distance was maximum in cluster V (17.59) followed by cluster III (16.18) which indicated that hybridization involving genotypes within the same clusters might result in good cross combinations. Regarding the cluster means for six characters, cluster III had the maximum cluster mean for plant height (104.68), ear width (1.06) and yield (2493.03) followed by the cluster II for the number of tillers (19.67) and the number of productive tillers per plant (16.50). The results revealed that the maximum contribution of quantitative traits towards genetic divergence was single plant yield (93.62 %) followed by the number of tillers per plant (2.23 %) and ear head length (1.45 %). Therefore, these yield component traits might be considered during the selection process and adjudged as important criteria for the selection of parents during hybridization programme.

Keywords

Foxtail millet, genetic diversity, cluster analysis, D^2 statistic, yield

Foxtail millet is one of the world's traditionally oldest cultivated crops. Its domestication and cultivation is estimated to have occurred over 4000 years ago (Chang, 1968). It is generally raised as a rainfed crop in India. Foxtail millet with a short growing period is grown extensively in diverge agro-climatic regions for grain and fodder. It is also grown in nutrient deficient soils and possesses tolerance to pests and diseases. Foxtail millet was not merely food; the ancient indigenous people cultivated it for various purposes, including for use in festivals and marriages. These varying landraces of foxtail millets have resulted from a long – standing selection for various objectives in different indigenous tribes. Nutrient quality is similar to common millet, 11 % of protein, 4% of oil and 7% of crude fibre. Matured grain has higher content of essential amino acids and vitamins (thiamine, riboflavin and niacin). As reported by Deb (2009), maintaining crop diversity can ensure agricultural sustainability and food security. Assessing the genetic diversity that exists in the foxtail millet germplasm is important not only for providing genetic resources and aiding in conservation but also for practical applications, such as broadening the genetic base and manipulation for heterosis. Expansion of genetic base is vital in species in which inbreeding has resulted in a decline in genetic diversity.

The materials of the present study comprised of forty nine indigenous accessions originated from the different geographical regions of India received from ICRISAT, Hyderabad. These accessions were grown in a randomized block design with two replications during summer 2016 and subsequently during *Rabi* 2016. Eighteen days old seedlings of each accession were transplanted in four rows, each of 4 m length rows and 15 cm within row. All the recommended package of practices was adopted to raise a healthy crop. Observations were recorded for grain yield per plant and yield component traits *viz*., plant height, the number of tillers per plant, the number of productive tillers per plant, ear head length, ear head width, single plant yield and plot yield. The observations were recorded for five randomly selected plants for each entry in each replication. The data obtained were then subjected to standard statistical procedures. Genetic diversity in the material was analyzed by using Mahalanobis D^2 statistics described by Rao (1952) and the accessions were grouped into different clusters according to Tocher's method.

Table 1. Distribution of 49 foxtail millet accessions into different clusters

Cluster Number	Number of accessions	Accession identified
I	28	Korra, Kaon, Kaoni, Bhedi, Kangani, Mosu tenai, Vellai tenai, Hirlla navne, Mobbu navne, Navne, Bili navne, Kangni, Kawni, Koni dhan, Tangun, Kangni, Karuvai kepai, KEP 5-1, KEP 6, KEP 16, SAR 2, SAR 1659-1, SAR 1706, SAR 1718, SAR1903, SE 105/1-1
II	2	SE 2482, SE 2994
III	11	A 107/1, A 109/1-1, JNSE 9A, SE 201, SE 480, SE 703, SE 21741, SE 3045, SE 4929, SE 7230/3-1, SE 7261/2-1
IV	6	PR 4722, DT 4675, DT 4682, DT 4688, DT 4696, ISe 249 A; Navne
V	2	ISe 275 A; Kangani, ISe 278 A; Bili

Analysis of variance revealed highly significant differences for grain yield and yield component characters studied, indicating the existence of sufficient variability for effective selection. Further, 49 accessions studied were grouped into five clusters (**Table 1**), based on the relative magnitude of D^2 value. Among the five clusters, cluster I consisted of maximum accessions (28) representing different accession namely Korra, Kaon, Kaoni, Bhedi, Kangani, Mosu tenai, Vellai tenai, Hirlla navne, Mobbu navne, Navne, Bili navne, Kangni, Kawni, Koni dhan, Tangun, Kangni, Karuvai kepai, KEP 5-1, KEP 6, KEP 16, SAR 2, SAR 1659-1, SAR 1706, SAR 1718, SAR1903, SE 105/1-1; while cluster III had 11 accessions and cluster IV had six accessions; while clusters II and V were monogenotypic and comprised of accession identifiers from SE 2482, SE 2994 and ISe 275 A; Kangani, ISe 278 A; Bili, respectively. Minimum inter cluster distance was observed between the cluster I and II (11.25) indicating their close relationship and similarity with regards to the characters studied for most of the accessions in the two clusters. The maximum inter cluster distance were observed between the cluster III and IV (27.96) followed by cluster I and III (24.39). Further, intra cluster distance was observed to be minimum for cluster II (1.69) and maximum for cluster V (17.59). The accessions included in the cluster V exhibited maximum intra cluster distance are inferred to be more divergent than those in other clusters with regards to the characters studied. (**Table 2**). Similar results on cluster studies was reported by earlier workers Sheriff and Shivashankar (1992)), Selvarani and Gomathinayagam (2000), Murugan and Nirmalakumari (2006), Yogheesh *et al*. (2015) and Kavya (2016) in foxtail millet.

Table 2. Average inter and intra cluster distance for 49 foxtail millet accessions

Cluster	I	II	III	IV	V
I	14.44	11.26	24.39	12.95	20.36
II		1.69	18.29	12.12	14.03
III			16.18	27.96	14.74
IV				8.99	23.59
V					17.59

Table 3. Cluster mean for yield and yield characters in 49 foxtail millet accessions

Cluster	Plant height (cm)	Number of tillers per plant	Number of productive tillers per plant	Ear head length (cm)	Ear head width (cm)	Grain yield kg/ha
I	99.14	14.11	11.01	12.85	0.99	1462.04
II	92.93	19.67	16.50	12.92	1.02	1714.67
III	104.68	17.24	14.21	13.17	1.06	2493.03
IV	102.23	17.39	12.89	13.33	0.96	1153.06
V	102.62	10.50	8.00	16.00	1.05	2272.83

Flowering time variation

Variation in panicle architecture

Phenotypic variation with in *Setaria italica* accessions

Table 4. Relative contribution of characters studied towards genetic divergence in foxtail millet

Characters	Times ranked 1st	Per cent contribution
Plant height (cm)	10	0.85
Number of tillers per plant	25	2.23
Number of productive tillers per plant	11	0.94
Ear head length (cm)	17	1.45
Ear head width (cm)	12	1.02
Grain yield kg/ha	1101	93.62

A perusal of the results on cluster means for yield and yield components (**Table 3**) revealed considerable differences between the clusters for all the characters under study. High grain yield, ear head width and plant height were noticed for cluster III, while high number of tillers and the number of productive tillers per plant were noticed for cluster II, indicating the importance of selection of accessions from the corresponding clusters in hybridization programmes for effecting improvement of the respective traits.

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