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Study of genetic variability in pearl millet [*Pennisetum glaucum* (L.) R. Br.] hybrids for grain yield and quality parameters

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ABSTRACT

Pearl millet (*Pennisetum glaucum* (L.) R. Br.) is an important millet crop of semi-arid regions in India and Africa. To study the genetic variability present among the newly effected fifty four hybrids an experiment was conducted in randomized block design with three replication. Yield parameters *viz.*, days to fifty per cent flowering, plant height, number of productive tillers, ear head length, ear head girth, test weight, single head grain weight, single plant yield and quality traits such as crude protein, crude fibre, beta carotene, iron and zinc were studied. The phenotypic coefficient of variation (PCV) was greater than genotypic coefficient of variation (GCV) for all the characters studied which shows the little influence of environment. High phenotypic (PCV) and genotypic variability (GCV) was obtained for plant height, single plant yield, single head grain weight, crude fibre, beta carotene content, iron and zinc. Highest heritability (h^2) conjunction with genetic advance (GA) was observed for all the characters studied and moderate for number of productive tillers per plant and earhead girth Therefore, the presence of high variability among the genotypes can be utilized for nutritional enrichment in future millet breeding programs.

Key words: Gentic variability, Nutritional traits, Quality parameters, Yield parameters.

INTRODUCTION

Pearl millet is one of the major cereals grown, primarily for grain production, on more than 29 million ha in the arid and semi-arid tropical regions of Asia and Africa. India is the largest producer of this crop in Asia. Pearl millet [*Pennisetum glaucum* (L.) R. Br.] belongs to the family Poaceae (graminae) and genus *Pennisetum*. It is a highly cross-pollinated crop with protogynous flowering and wind borne pollination mechanism, one of the essential biological requirements for hybrid development. Pearl millet remains as the major source of nutritious food for poorest people in semi-arid regions of tropical and sub-tropical countries. It has high protein content with balanced amino acids, carbohydrate and fat. It is also rich in many micronutrients such as calcium, iron and zinc and is free from anti nutritional compounds like tannins (Malhotra and Dhindsa 1984). A wide range of genetic variability has been reported in grain for Fe (30.1–75.7 mg kg^{-1}) and Zn (24.5–64.8 mg kg^{-1}) content in breeding lines and the necessary crop improvement measures are also being carried out to develop bio-fortified lines. The foremost pre-requisite in crop breeding is, exploitation of genetic variability existing in the crop for yield and related traits. This leads to the utilization for the development of a better variety which can address the growing demand for increasing population.

MATERIALS AND METHODS

The genetic material used in this study was received from Department of Millets, TNAU. A total of fifty four newly developed hybrids were utilized for the present study. The trial was carried out in randomized block design (RBD) with three replications under the prevailing environmental conditions at department of millets, TNAU, Coimbatore, lies between 11° North latitude and 77° East longitude. Each genotype was represented by 3 rows of 5 m length with 45 cm between rows to row and 15 cm between plants to plant distance. Till the harvesting, all the recommended inputs and cultural practices were followed. Variability analysis was carried out for the newly developed fifty four hybrids for thirteen characters which include eight biometric and five quality traits. The observation was recorded for nutritional traits *viz.*, protein content (N x 6.25) using microkjeldahl method (Jackson 1973). The zinc and iron contents were determined by using Atomic absorption spectrophotometer (Sahrawat *et al*., 2002). crude fiber content was estimated by the procedure given by Maynard (1970). Phenotypic and

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genotypic components of traits were worked out based on formula given by Goulden (1952). Water Soluble n-Butanol (WSB) method was adopted for beta carotene estimation (Sathya *et. al*. 2014). Heritability in broad sense was worked out as per Allard (1960) and genetic advance as per cent of mean (GAM) according to Johnson *et al*. (1955). All the statistical analysis was done by using TNAUSTAT statistical software (2014 version).

RESULTS AND DISCUSSION

Analysis of variance exhibited significant differences among the studied traits, which revealed that sufficient variability was observed among the hybrids (Table 1). Mean performance and the range for each trait are depicted in the Table 2. Change in population mean due to selection is depends on heritability nature of the characters, phenotypic variation and selection pressure. Huge variation was observed among the hybrids which will be useful for the selection of parents and hybrids. In general, the PCV values for most of the traits were closer to the corresponding GCV values. High phenotypic variability, which includes genotypic, environmental and G x E interaction components, was evident from the range of values for different characters. High PCV and GCV values were obtained for plant height (28.20, 28.05), earhead length (22.07, 21.70), single plant yield (47.95, 47.38), single head grain weight (38.59, 37.75), crude fibre (52.18, 49.97), crude protein (26.32, 25.23), beta carotene content (80.27, 78.58), iron (45.95, 45.70) and zinc (33.12, 32.88). Moderate PCV and GCV values were recorded for days to fifty per cent flowering (10.67, 10.53), number of productive tillers per plant (18.23, 12.41), test weight (18.11, 17.69) and whereas, Moderate PCV coupled with low GCV observed for the trait earhead girth (11.26, 8.44) and these results has similarity with Sowmiya *et al.* (2016), Sumathi *et al.* (2016).

Estimates of heritability were high for all the characters studied and moderate for number of productive tillers per plant and earhead girth. Highest heritability was observed for days to fifty per cent flowering (97.50 %), plant height (97.80 %), earhead length (96.70 %), test weight (95.45 %), single plant yield (97.65 %) followed by single head grain weight (95.70 %), crude protein (91.90 %), crude fibre (91.70 %), beta carotene (95.85 %) iron (98.30 %) and zinc (98.60 %). Moderate heritability was observed for the traits *viz*., number of productive tillers (46.33 %) and earhead girth (56.23 %). High estimates of genetic advance as per cent of mean (GAM) was recorded for plant height (57.48), test weight (35.60), single plant yield (96.46) followed by single head grain weight (76.08) crude protein (39.20), crude fibre (98.58), beta carotene (158.48) and zinc (67.25) while, moderate genetic advance as per cent of mean (GAM) was observed for number of productive tillers per plant (17.40), earhead girth (13.04), crude protein (16.37) and iron (10.53).

Table 1: Analysis of variance for yield and nutritional traits of pearl millet hybrids.

Source	df	MSS												
		DFF	PH (cm)	NPT	EHL (cm)	EHG (cm)	TW (g)	SPY (g)	SHW (g)	CP (g/100g)	CF (g/100g)	BC (ug/g)	FE (mg/100g)	ZN (mg/100g)
Replication	2	0.44	39.75	0.61	1.66	0.28	0.36	60.26	39.20	78.73	0.01	0.01	2.62	0.65
Genotypes	53	81.39**	3228.51**	1.99**	80.17**	4.66**	19.16**	3841.88**	177.48**	303.71**	0.49**	0.77**	66.19**	18.97**
Error	108	1.21	49.89	0.32	4.41	0.49	0.23	54.32	8.86	0.22	0.01	0.01	5.31	1.07

**Significant at $P<0.01$ probability level

DFF: Days to fifty per cent flowering, PH: plant height, NPT: Number of productive tillers, EHL: Ear head length, EHG: Ear head girth, TW: Test weight, SWG: Single head grain weight, CP: Crude protein, CF: Crude fibre, BC: Beta carotene, FE: Iron, ZN: Zinc, SPY: Single plant yield.

Table 2: Variability and genetic parameters for yield and nutritional characters of pearl millet hybrids.

	MEAN	RANGE	PCV	GCV	h^2	GAM
DFF	54.46	38.67 - 63.00	10.67	10.53	97.50	3.73
PH $_{(cm)}$	158.15	67.67 - 176.00	28.20	28.05	97.80	57.48
NPT	4.31	2.00 - 5.33	18.23	12.41	46.33	17.40
EHL$_{(cm)}$	28.70	14.93 - 35.33	22.07	21.70	96.70	8.21
EHG$_{(cm)}$	11.28	7.53 - 14.47	11.26	8.44	56.23	13.04
TW $_{(g)}$	10.99	5.80 - 16.00	18.11	17.69	95.45	35.60
SHW$_{(g)}$	29.12	6.01 - 39.23	38.59	37.75	95.70	76.08
CP $_{(g/100g)}$	12.46	5.75 - 14.85	26.32	25.23	91.90	16.37
CF$_{(g/100g)}$	2.78	0.427 - 5.673	52.18	49.97	91.70	98.58
BC$_{(\mu g/g)}$	1.12	0.135 - 2.412	80.27	78.58	95.85	158.48
IRON$_{(mg/100g)}$	18.44	7.17 - 25.54	45.95	45.70	98.30	10.53
ZINC$_{(mg/100g)}$	10.97	4.11 - 14.98	33.12	32.88	98.60	67.25
SPY$_{(g)}$	110.59	16.03 - 169.30	47.95	47.38	97.65	96.46

DFF: Days to fifty per cent flowering, PH: plant height, NPT: Number of productive tillers, EHL: Ear head length, EHG: Ear head girth, TW: Test weight, SWG: Single head grain weight, CP: Crude protein, CF: Crude fibre, BC: Beta carotene, FE: Iron, ZN: Zinc, SPY: Single plant yield.

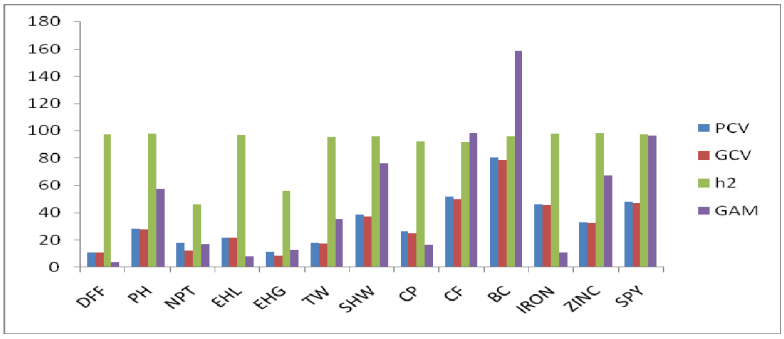


Fig 1: Variability present among various traits of pearl millet hybrids.

DFF: Days to fifty per cent flowering, PH: plant height, NPT: Number of productive tillers, EHL: Ear head length, EHG: Ear head girth, TW: Test weight, SWG: Single head grain weight, CP: Crude protein, CF: Crude fibre, BC: Beta carotene, FE: Iron, ZN: Zinc, SPY: Single plant yield.

Low genetic advance as per cent of mean was observed for the traits *viz.*, days to fifty per cent flowering (20.69) and earhead length (8.21). Similar observations were reported by earlier workers *viz.*, Berwar *et al.* (2001) and Solanki et al. (2002). Additive genetic effect plays a major role for high heritability coupled with high genetics advance which makes selection to be an effective tool in the subsequent segregating generations. Heritability will provide the magnitude of inheritance of characters, while genetic advance is useful to formulate the suitable selection strategies. When the selection is based on both the high heritability combined with high genetic advance for the character will be more consistent. From the present study, a wide range of variation observed in the population would provide a huge chance of exploiting qualitative and quantitative traits for the development of new bio-fortified pearl millet cultivars.

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