



Short Note

Genetic Variability for Grain Iron, Zinc, Protein, Yield and Yield Attributes in Pearl Millet [*Pennisetum glaucum* (L.) R. Br.]

V.P. Chaudhary, K.K. Dhedhi, H.J. Joshi and J.S. Sorathiya

Pearl millet Research Station, Junagadh Agricultural University,
Jamnagar-361 006, (Gujarat), India

A set of 60 genotypes comprising of 45 hybrids, five male sterile lines, nine pollinators and one standard check hybrid (GHB-744) were studied for genetic variability, heritability and genetic advance of grain Fe, Zn, protein, grain yield and its five other component traits in pearl millet, at Jamnagar (Gujarat) during *Kharif* 2011-12. The analysis of variance revealed, highly significant differences among the genotypes for all the nine characters studied. The higher estimates of genotypic variance over environmental variance in all the characters under study except length of protogyny and days to maturity revealed that the variation among the genotypes had a genetic basis. The variability analysis revealed that grain Fe, Zn content, plant height and grain yield per plant had high magnitude of phenotypic range, genotypic coefficient of variation, phenotypic co-efficient of variation, heritability and genetic advance per cent of mean, suggesting the importance of additive gene action. Hence, these characters can be improved through simple selection process.

Key words: Pearl millet, GCV, PCV, Heritability, Genetic advance

Pearl millet has significant potential as a food, feed and fodder crop in subsistence farming in the semi-arid tropics of Africa and Asia. It has the ability to produce grains with high nutritive value even under hot, dry conditions on infertile soils of low water holding capacity, where other cereal crops fail to grow (Khairwal and Yadav, 2005). The pearl millet grains have high biological food value (Rai *et al.*, 1999). Nutritionally, the grains are rich source of protein (12%), fat (5%), carbohydrates (67%), high energy value (>360 Kcal per 100 g) and high Ca, Fe and Zn compared to other cereals (Rai *et al.*, 1999; Devos *et al.*, 2006; Velu, 2006). Thus, pearl millet is the cheapest source not only for energy and protein, but also for micronutrients such as Fe and Zn (Parthasarathy Rao *et al.*, 2006). A recent study showed a large genetic variability for these micronutrients among pearl millet germplasm accessions, breeding lines and improved populations, and identified some of the commercial open-pollinated varieties and hybrid parents with high levels of grain Fe and Zn contents (Velu *et al.*, 2007). Crop improvement depends on the magnitude of genetic variability and the extent to which the desirable characters are heritable. To improve yield, Fe, Zn and protein contents in grain, information on genetic variability and heritability existing in these characters is necessary. The nutritive value of pearl millet crop has not received extensive attention and as a result the data available are limited. Therefore, the present investigation was undertaken to examine the extent of variability, heritability and genetic advance for grain Fe, Zn,

protein, grain yield and its component traits in pearl millet during *Kharif* 2011-12.

Materials and Methods

The seeds of five cytoplasmic-geneic male sterile lines (ICMA-98444, JMSA-20081, JMSA-20091, ICMA-65550, ICMA-841) and nine diverse restorer lines (J-2340, J-2405, J-2433, J-2480, J-2482, J-2495, J-2496, J-2507, J-2526) of pearl millet were sown during summer -2011 at Pearl millet Research Station, Junagadh Agricultural University, Jamnagar, (Gujarat). These female and male lines were crossed in a line x tester mating design to generate 45 hybrids. The resultant 45 hybrids along with fertile counter parts of five male sterile lines, nine testers and one standard check hybrid (GHB-744) were evaluated in a randomized complete block design (RCBD) with three replications at Pearl millet Research Station, Junagadh Agricultural University, Jamnagar, Gujarat, during *Kharif* 2011-12. The experiment was conducted in medium black soil with the applied fertilizer levels of 80 kg/ha nitrogen (50 % basal in the form of diammonium phosphate (DAP) and 50 % top dressed at 20 days after sowing in the form of Urea) and 40 kg/ha phosphorous. Each genotype was grown in a single row of 5.0 m length each with inter and intra row spacing of 60 x 15 cm. The recommended agronomic practices and plant protection measures whenever necessary were adopted for raising the good crop. Observations were recorded on days to 50 % flowering and days to

maturity on plot basis, and 1000-grain weight (based on a
*Corresponding author email: kkdhedhi@rediffmail.com

sample of 500 random grains). The

length of protogyny (days) was calculated by deducting days to stigmatic stage from the days to anthesis. Plant height (cm) and grain yield (g/plant) were measured from five random plants from each plot. Selfed grain samples, produced from harvests at physiological maturity, were analyzed for Fe and Zn in laboratory using the method described by Sahrawat *et al.* (2002). The Fe and Zn in the digests was analyzed using atomic absorption spectrophotometer. Protein content was analyzed using microkjeldahl method in the laboratory (Humphries, 1956). Data of grain Fe, Zn and protein content, grain yield and other component traits were subjected to standard statistical procedures namely, analysis of variance (Panse and Sukhatme, 1985), genotypic and phenotypic co-efficient of variations (Burton, 1952) and heritability and genetic advance

(Johnson *et al.*, 1955). The range of heritability was categorized as suggested by Robinson *et al.* (1949).

Results and Discussion

The analysis of variance (Table 1) revealed highly significant differences among the genotypes for all the nine characters studied. The results indicated that vast genetic variability existed among the genotypes for all the characters under study. The range of phenotypic variability was observed wide phenotypic variation for Fe, Zn content, plant height and grain yield per plant, indicating the possibility of effective selection for these traits. On the other hand, length of protogyny, days to maturity and protein content exhibited narrow range of phenotypic variability. Days to 50 % flowering and 1000-grain weight showed moderate magnitude of phenotypic

Table 1. Analysis of variance showing mean squares, and variability parameters for grain Fe, Zn, protein, yield and its components in pearl millet

Character	Mean sum of squares		Mean	Range of phenotypic variability		Pheno typic variance	Geno typic variance	PCV (%)	GCV (%)	Heritability (h ²)	Genetic Genetic	
	Genotypes (59 df)	Error (118df)		Min.	Max.						advance as % of mean	advance as % of mean
Grain yield /plant (g)	169.28**	10.56	36.39	19.50	50.70	63.47	52.90	21.89	19.99	83.40	13.68	37.59
Days to 50 % flowering	72.18**	4.66	45.32	38.33	62.33	27.17	22.51	11.50	10.47	82.80	8.89	19.63
Length of Protogyny (days)	0.68**	0.32	3.14	2.00	4.00	0.44	0.12	21.12	11.08	27.50	0.38	11.97
Days to maturity	44.41**	15.66	86.47	79.33	95.33	25.24	9.58	5.81	3.58	78.00	3.93	4.54
Plant height(cm)	1022.52**	115.61	126.78	84.00	164.98	417.92	302.29	20.13	18.71	72.30	30.46	24.03
1000-grain weight (g)	5.29**	0.93	9.55	6.71	12.13	2.38	1.45	16.17	12.61	60.90	1.94	20.27
Protein Content (%)	2.85**	0.63	10.64	8.93	13.40	1.37	0.74	10.98	8.09	54.20	1.31	12.26
'Fe' content(mg/kg)	651.15**	17.61	60.47	31.03	90.00	228.79	211.18	25.01	24.03	92.30	28.76	47.56
'Zn' content(mg/kg)	560.12**	33.94	52.56	32.55	82.67	209.34	175.39	27.53	25.20	83.80	24.97	47.51

*, ** P = 0.05 and P = 0.01 levels, respectively. GCV= Genotypic coefficient of variation;

PCV= Phenotypic coefficient of variation.

variability. The wide range of phenotypic variability for grain Fe and Zn content was reported by Velu *et al.* (2007) and Govindaraj (2011) in pearl millet. In the present study, the higher estimates of genotypic variance over environmental variance in all the characters except length of protogyny and days to maturity revealed that the variation among the genotypes had a genetic basis. Similar results were reported by Bhadalia *et al.*, (2011). The estimates of phenotypic and genotypic variances were high for Fe, Zn content, plant height and grain yield per plant. The phenotypic and genotypic variances were moderate for days to 50 % flowering and days to maturity; while, they were low for the remaining characters. Borkhataria *et al.* (2005) and Bhadalia *et al.*, (2011) were also reported high genotypic and phenotypic variances for plant height and grain yield.

The relative amount of variation expressed by different traits was judged through estimates of phenotypic and genotypic co-efficient of variation. The characters like Fe, Zn content, plant height and grain yield per plant exhibited high magnitude of GCV and PCV indicating the presence of wide genetic variability for these traits and chances for improvement in these characters are fairly high. The low values of GCV and PCV were observed for days to maturity. The remaining characters showed

moderate magnitude of GCV and PCV. Results also revealed that the estimate of PCV value was slightly higher than their corresponding GCV value for all the characters under study except length of protogyny, which showed that these traits were less affected by environment. These results are in conformity with the report of Borkhataria *et al.*, (2005) and Bhadalia *et al.*, (2011).

Partitioning of total phenotypic variation into heritable and non-heritable components is very useful because only heritable portion of variation is exploitable through selection. The estimates of heritability (broad sense) ranged from 27.50 % (length of protogyny) to 92.30 % (Fe content). High heritability estimates were recorded for the traits like Fe, Zn content, plant height, days to 50 % flowering, days to maturity, 1000-grain weight and grain yield per plant suggesting the usefulness of selection based on phenotypic observations. High heritability may be due to additive gene effects; hence these traits are likely to respond to direct selection. Moderate heritability estimate was observed for protein content. Length of protogyny recorded low heritability. The results achieved in the present study are in akin with Borkhataria *et al.*, (2005) and Bhadalia *et al.*, (2011). Genotypic coefficient of variability along with heritability

estimates provides a better picture for the amount of genetic gain expected to be obtained from phenotypic selection (Burton, 1952). It was interesting to note that high GCV was accompanied with high heritability estimates for Fe, Zn content, plant height and grain yield per plant in the present material, which further revealed that selection, could be more effective to improve these traits.

The estimates of genetic advance ranged from 0.38 (length of protogyny) to 30.46 (plant height). The estimates of genetic advance did not project the actual genetic gain that has been attained in relation to the *per se* performance which is obviously not uniform in different populations and even in the same population under different environments. Therefore, the expected genetic gain as per cent of mean was computed. The estimates of genetic advance as per cent of mean ranged from 4.54 (days to maturity) to 47.56 (Fe content). Heritability in coupled with genetic gain was more useful than the heritability values alone in the prediction of the resultant effect for selecting the best individual genotypes (Johnson *et al.*, 1955).

Genetic gain gives an indication of expected genetic progress for a particular trait under suitable selection pressure. In the present study, the characters like Fe, Zn content, plant height, 1000-grain weight, days to 50 % flowering and grain yield per plant exhibited high heritability coupled with high genetic advance expressed as per cent of mean. This indicates the predominance of additive gene action governing the traits and their suitability of selection for further improvement among the genotypes studied.

The results are in accordance with those of Borkhataria *et al.*, (2005). Moderate heritability estimates with low to medium genetic gain was manifested for days to maturity and protein content which might be due to preponderance of non-additive gene effects. Hence, it could be suggested that the improvement of these characters might be difficult through simple selection. Length of protogyny showed low heritability and genetic advance as per cent of mean, which indicates the predominance of additive and non-additive gene action in controlling this trait. Hence, direct selection for length of protogyny is not rewarding. Thus, the characters like Fe, Zn content, plant height and grain yield per plant had high magnitude of phenotypic range, heritability, PCV, GCV, genetic advance and genetic advance as per cent of mean indicates that the selection for these traits could be effective.

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