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ANALYSIS OF VARIABILITY PARAMETERS IN RESTORER LINES OF PEARL MILLET [*PENNISETUM GLAUCUM* (L.) R.BR.]

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ABSTRACT

Thirty restorer lines of pearl millet [*Pennisetum glaucum* (L.) R. Br.] obtained from Rajasthan Agricultural Research Institute, Durgapura, Jaipur were evaluated in Randomized Block Design with three replications at Research Farm, S.K.N. College of Agriculture, Jobner (Jaipur) Rajasthan during *Kharif,* 2022. The data were recorded on fourteen characters *viz.,* days to 50% flowering, days to maturity, plant height (cm), effective tillers per plant, ear head length (cm), ear head girth (cm), test weight (g), biological yield per plant (g), harvest index (%), grain yield per plant (g), protein content (%), zinc content (ppm), iron content (ppm) and chlorophyll content (SPAD) and subjected to standard statistical analysis to estimate variability, heritability (broad sense), genetic advance as percentage of mean and genetic divergence for yield and yield attributing characters. The analysis of variance in restorer lines revealed the presence of high and significant genetic variability among restorer lines for all the characters studied. The estimation of GCV, PCV, heritability and genetic advance as percentage of mean was high with regard to grain yield per plant, iron content and zinc content. The high heritability (broad sense) was seen for days to flowering, days to maturity, plant height (cm), ear head length (cm), test weight (g), grain yield per plant (g), chlorophyll content (SPAD) protein content (%), zinc content (ppm) and iron content (ppm). High to moderate heritability coupled with high to moderate genetic advance as percentage of mean were detected for all the studied characters except ear head girth. Genetic advance as percentage of mean was high for iron content, zinc content, grain yield per plant, protein content, test weight, plant height and ear head length.

Introduction

Pearl millet (*Pennisetum glaucum* (L.) R. Br.) is an important coarse cereal having high nutritional quality and is significant source of zinc and iron. In order to bring millets into the mainstream for exploitation of their nutritionally rich characteristics and promotion of their production the United Nations General Assembly (UNGA) declared 2023 the International Year of Millets on March 5, 2021. It is a well-known tropical C_4 small-grained cereal crop with high photosynthetic efficacy and dry matter production capacities. It is generally grown in agro-climatically adverse areas where other grains, like sorghum and maize, cannot produce yields.

It is being cultivated in the arid and semi-arid regions of Sub-Sahara Africa, South Asia, mainly India and in North and South America. Pearl millet has the fourth-highest production with 9.62 mt and acreage with 6.7 mha in India (Anonymous, 2021-22a). In terms of both planted area (3.74 mha) and production (3.75 mt) of pearl millet, Rajasthan leads the nation (Anonymous, 2021-22b). Grain yield is a complex trait, and direct selection for grain yield is difficult. As a result, improvements in grain yield are made by improving contributing features such as number of tillers per plant, ear head length, ear head girth, 1000-grain weight, and so on, in addition to yield (Arya *et al*., 2009). Variability in existing available genetic material is necessary in order to have appropriate choice of characters for selection of desirable genotypes under planned breeding programme for yield enhancement.

The estimations of yield variability, yield-contributing traits, and their heritable components in the materials are more crucial for any crop improvement programme. The efficiency of character choice is more heavily influenced by heritability in combination with genetic advancement. As a result, 30 restorer lines were used in the current study to evaluate the variability, heritability and predicted genetic advance as percentage of mean for various quantitative traits.

Materials and Methods

The studied experimental material consists of 30 restorer lines collected from AICRP on Pearl millet RARI, Durgapura, Jaipur (Rajasthan). The experiment was laid out in Randomized Block Design (RBD) with three replications. Each genotype in each replication consisted of two rows each of 3.0 m length with 45 cm of spacing, where plant to plant distance was kept 15 cm. All recommended package of practices were followed to raise a good and healthy crop. Observations such as days of 50% flowering, days to maturity, plant height (cm), effective tillers per plant, ear head length (cm), ear head girth(cm), biological yield per plant (g), test weight (g), harvest index (%), grain yield per plant (g), chlorophyll content (SPAD meter) at 45 DAS, zinc content (ppm), iron content (ppm) and protein content (%) were recorded on 10 randomly selected plants in each of genotype from each replication. The mean data for all the studied characters were subjected to analysis of variance following the method suggested by Panse and Sukhatme (1985).

Genotypic and phenotypic variance was estimated using the formula proposed by Burton (1952) and Johnson *et al.* (1955). The PCV and GCV estimates for all the fourteen characters were estimated according to Burton and De Vane (1953) and can be grouped into three classes as high (>20%), medium (10-20%) and low (<10%).

$$\text{Genotypic coefficient of variation (GCV)} = \frac{\sigma_g}{\overline{X}} \times 100$$

$$\text{Phenotypic coefficient of variation (PCV)} = \frac{\sigma_p}{\overline{X}} \times 100$$

Heritability in broad sense was calculated according to the formula suggested by Johnson *et al.* (1956) for each character. It can be divided in different categories like high (>60%), medium (30-60%) and low (<30%).

$$h^2 = \frac{\sigma_g^2}{\sigma_p^2} \times 100$$

Estimates of appropriate components were substituted for the parameters to predict expected genetic gain as suggested by Johnson *et al.* (1955). The genetic advance as percentage of mean (GAM) can also be categorized into three classes *viz.,* high (>20%), medium (10-20%) and low (<10 %) as suggested by Johnson *et al.* (1955). The expected genetic advance was calculated at 5 per cent selection intensity for each character as:

$$\text{Genetic advance (as percentage of mean)} = \frac{K.\sigma_p.h^2}{\overline{X}} \times 100$$

Where,

K is selection differential expressed in terms of phenotypic standard deviation. The value of selection intensity (k) is equal to 2.06.

σ_p = Phenotypic standard deviation

h^2 = Heritability in broad sense, and

$\overline{X}$ = Mean value for that character over all the genotypes.

Results and Discussion

Analysis of variance for the experiment involving 30 pearl millet restorer lines for 14 quantitative characters revealed that mean sum of squares was highly significant for all the traits studied, indicating presence of significant variability in the genotypes which can be exploited through selection (Table 1). The extent of variability with respect to all the studied characters in different genotypes measured in terms of mean, range, genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV) along with the amount of heritability (h), expected genetic advance and genetic advance as per cent of mean (GAM) are presented in (Table 2). The genetic potential range of 30 genotypes for different traits was recorded, that is, days to 50% flowering 43.33 to 59.67 days, days to maturity from 69.67 to 90.00 days, plant height from 103.56 to 192.56 cm, effective tillers from 1.15 to 2.24, ear head length from 15.69 to 25.95 cm, ear head girth from 5.93 to 7.32 cm, biological yield per plant from 30.75 to 47.86 g, test weight from 3.55 to 8.82 g, harvest index from 34.38 to 55.21%, grain yield per plant from 10.00 to 27.12 g, chlorophyll content from 39.12 to 65.41 SPAD, zinc content from 24.66 to 71.14 ppm, iron content from 31.15 to 103 ppm and protein content from 7.03 to 14.10% . The phenotypic coefficient of variation (PCV) in general was higher than genotypic coefficient of variation (GCV) for most of the characters studied, indicating the influence of environment on the manifestation of these characters. High PCV was found for iron content (34.07%), zinc content (28.47%) and grain yield per plant (24.72%). Moderate PCV observed for protein content (20.00%), test weight (18.82%), effective tillers per plant (15.91%), biological yield per plant (15.02%), plant height (14.94%), ear head length (13.99%), harvest index (13.77%) and chlorophyll content (13.04%). Whereas, the low values of PCV were noted for days to 50% flowering (9.48%), days to maturity (7.73%) and ear head girth (7.43 %). These outcomes were also supported by Shanmuganathan *et al.* (2006), Govindaraj *et al.* (2010), Bind *et al.* (2015) in pearl millet. High magnitude of GCV was observed for iron content (33.21%), zinc content (27.49 %) and grain yield per plant (22.47%), while the medium GCV was depicted by protein content (19.26%), test weight (18.12%), effective tillers per plant (10.65%), plant height (13.08%), ear head length (11.94%), biological yield per plant (10.97%) and chlorophyll content (10.89%).The low values of GCV were noted for harvest index (9.40%), days to 50% flowering (7.99%), days to maturity (7.05%) and ear head girth (2.00%), which reveal low variability for these characters. High genotypic coefficient of variation for iron content has been reported by Badigannavar *et al.* (2016) in sorghum. However, the difference between PCV and GCV was less for the characters days to 50 % flowering, days to maturity, plant height (cm), ear head length (cm), grain yield per plant (g), test weight (g), chlorophyll content (SPAD) and protein content (%) indicated low environmental influence and predominance of genetic factors controlling variability in these traits. In the present investigation, high heritability (broad sense) estimates were noted for iron content (95.15%), zinc content (93.25%), protein content (92.74%), test weight (92.70%), days to maturity (83.24%), grain yield per plant (82.64%), plant height (76.62%), ear head length (72.86%), days to 50% flowering (71.04%) and chlorophyll content (69.76%). It was found medium for biological yield per plant (53.30%), effective tillers per plant (44.77%) and harvest index (46.54%) and lowest for ear head girth (7.20%). The high degree of heritability estimates for characters may be due to additive gene effects; hence, these characters are likely to respond to individual plant selection. Similar findings were earlier also reported by Kulkarni *et al.* 2000 and Solanki *et al.* (2002). Genetic advance as percentage of mean ranged from 1.10 (ear head girth) to 66.74 per cent (iron content). It was high for iron content (66.78%), zinc content (54.68%), grain yield per plant (42.08), protein content (38.21%), test weight (35.95%), plant height (23.59%) and ear head length (21.00%) and moderate for chlorophyll content (18.74%), biological yield per plant (16.50%), effective tillers per plant (14.68%), days to 50% flowering (13.87%), days to maturity (13.25%) and harvest index (13.21%). For ear head girth (1.10%), the low genetic advance as a percentage of mean was noted.

In the current study, high to moderate heritability coupled with high to moderate genetic advance as percentage of mean were observed for all the characters except ear head girth. Because these features are driven by additive gene effects, there is potential for improvement through selection. Similar findings in pearl millet were also reported by Subi and Idris (2013) and Sumathi *et al.* (2016). Badigannavar *et al.* (2016) reported high estimate of heritability coupled with high genetic advance as percentage of mean for iron content and zinc content in pearl millet. Low heritability coupled with low genetic advance as percentage of mean was found for ear head girth. Hence, direct selection for this trait will not be rewarding.

Table 1: Analysis of variance for yield and yield related characters in R lines of pearl millet

S. No.	Character	Replications (2 df)	Genotypes (29 df)	Error (58 df)
1	Days to 50% flowering	16.03	58.97**	7.06
2	Days to maturity	20.54	105.17**	6.61
3	Plant height (cm)	236.77	1345.37**	124.21
4	Effective tillers per plant	0.05	0.13**	0.04
5	Ear head length (cm)	4.51	18.20**	2.01
6	Ear head girth (cm)	0.49	0.28**	0.23
7	Grain yield per plant (g)	8.02	46.45**	3.04
8	Biological yield per plant (g)	20.68	75.92**	17.16
9	Test weight (g)	0.04	4.02**	0.10
10	Harvest index %	44.09	63.75**	17.65
11	Chlorophyll content(SPAD)	29.86	118.62**	14.97
12	Zinc content (ppm)	25.95	482.33**	11.36
13	Iron content (ppm)	45.51	1193.68**	19.95
14	Protein content %	0.97	12.23**	0.31

** Significant at 1 % level of significance

Table 2: GCV, PCV, Heritability, Genetic Advance and GA as percentage of mean for different characters of Pearl Millet genotypes

S. No.	Characters	Range	Mean	Genotypic coefficient of variation (GCV)	Phenotypic coefficient of variation (PCV)	Heritability (%)	Genetic Advance (GA)	GA as percentage of mean (%)
1.	Days to 50% flowering	43.33-59.67	52.07	7.99	9.48	71.04	7.22	13.87
2.	Days to maturity	69.67-90.00	81.29	7.05	7.73	83.24	10.77	13.25
3.	Plant height (cm)	103.56-192.56	154.23	13.08	14.94	76.62	36.38	23.59
4.	Effective tillers per plant	1.15-2.24	1.65	10.65	15.91	44.77	0.24	14.68
5.	Ear head length (cm)	15.69-25.95	19.45	11.94	13.99	72.86	4.08	21.00
6.	Ear head girth (cm)	5.93-7.32	6.63	2.00	7.43	7.20	0.07	1.10
7.	Grain yield per plant (g)	10.00-27.12	16.93	22.47	24.72	82.64	7.12	42.08
8.	Biological yield per plant (g)	30.75-47.87	40.35	10.97	15.02	53.30	6.66	16.50
9.	Test weight (g)	3.55-8.82	6.31	18.12	18.82	92.70	2.27	35.95
10.	Harvest index %	34.38-55.21	41.72	9.40	13.77	46.54	5.51	13.21
11.	Chlorophyll content (SPAD)	39.12-65.41	53.97	10.89	13.04	69.76	10.11	18.74
12	Zinc content (ppm)	24.66-71.14	45.58	27.49	28.47	93.25	24.92	54.68
13.	Iron content (ppm)	31.15-103	59.56	33.21	34.05	95.15	39.75	66.74
14.	Protein content (%)	7.03-14.10	10.35	19.26	20.00	92.74	3.95	38.21

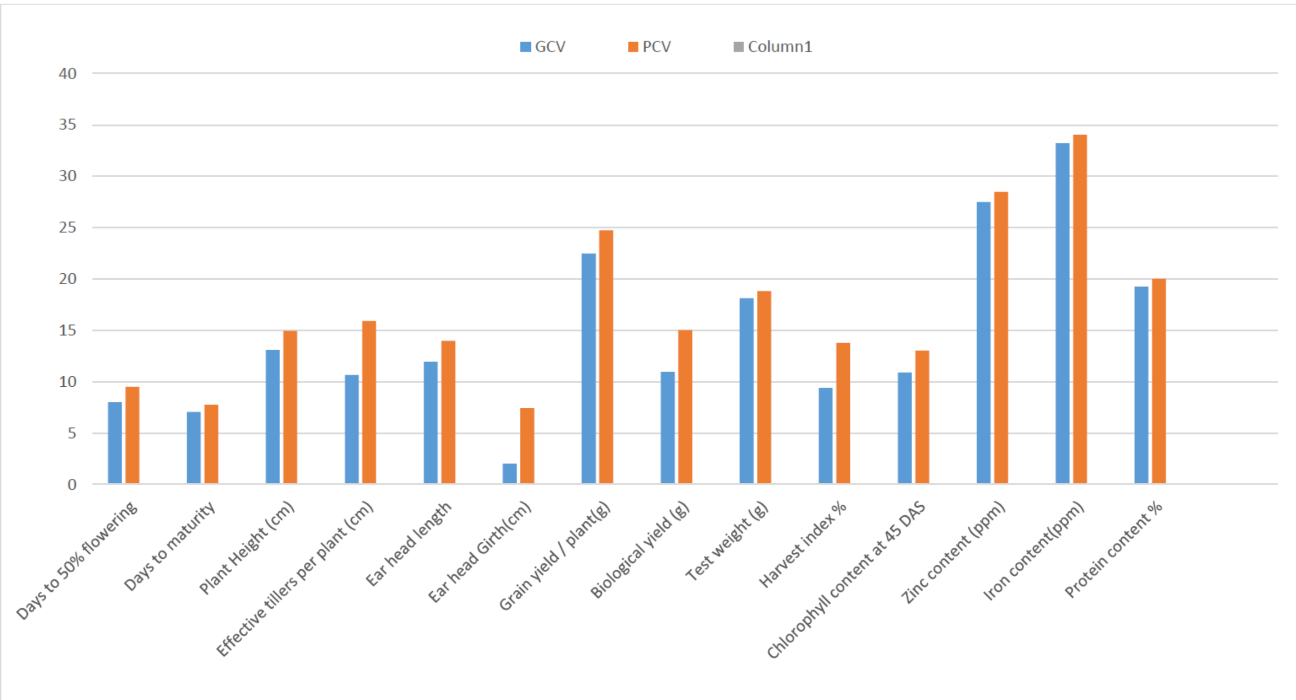

Fig. 1: GCV and PCV for different characters in genotypes of pearl millet

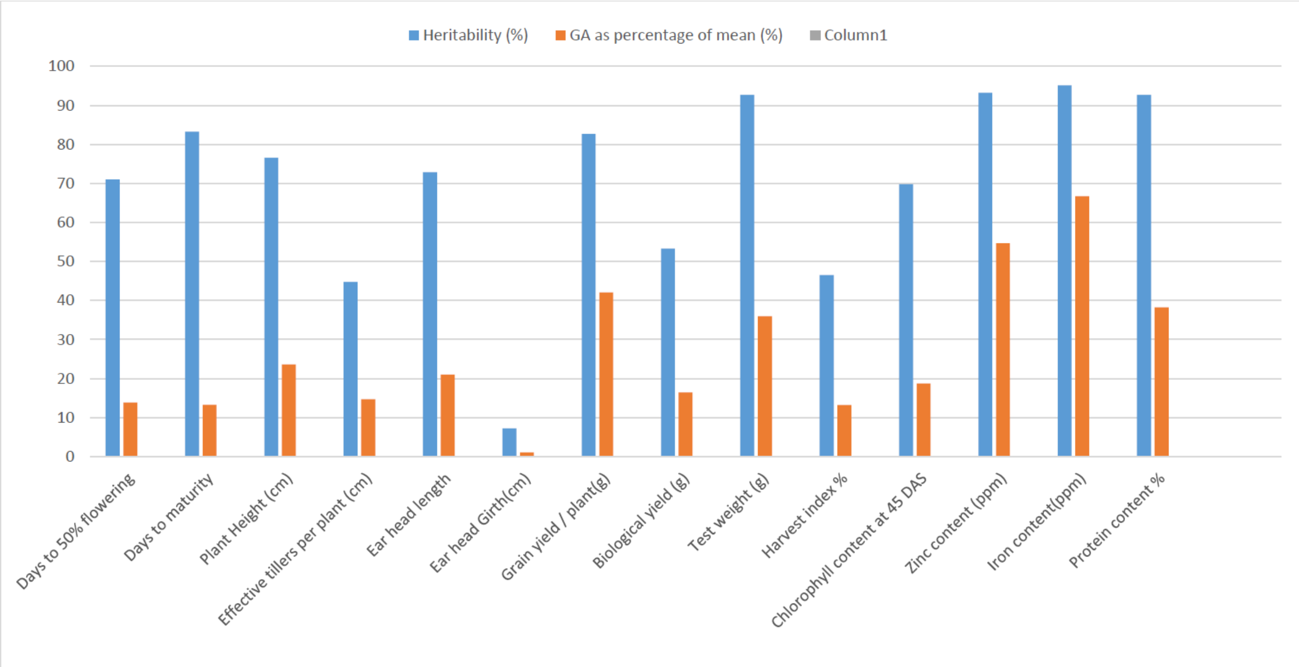

Fig. 2: Heritability and genetic advance as percentage of mean for different characters in genotypes of pearl millet

References

Anonymous (2021-22a) Agricultural Statistics at a Glance 2022-2022.

Anonymous (2021-22b) Agricultural Statistics at a Glance 2022-2022

Badigannavar, A., Girish, G., Ramachandran, V. and Ganapathi, T.R. (2016). Genotypic variation for seed protein and mineral content among post rainy season grown sorghum genotypes, *The Crop Journal*, **4**, 61-67.

Badigannavar, A., Girish, G., Ramachandran, V. and Ganapathi, T.R. (2016). Genotypic variation for seed protein and mineral content among post rainy season grown sorghum genotypes, *The Crop Journal*, **4**, 61-67.

Bind, H., Bharti, B., Kumar, S., Panday, M.K., Kumar, D. and Vishwakarma, D.N. (2015). Studies on genetic variability for fodder yield and its contributing characters in bajra (*Pennisetum glaucum* (L.) R. Br.). *Agricultural Science Digest*, **35**(1), 78-80.

Burton, G.W. (1952). Quantitative inheritance in grasses. *Proceedings of Sixth International Grassland Congress*, **1**, 277-283.

Govindaraj, M., Shanmugasundaram, P. and Muthiah, A.R. (2010). Estimates of genetic parameters for yield and attributes in elite lines and popular cultivars of Pearl millet. *African Journal of Agricultural Research*, **5**(22), 3060-3064.

Johnson, H.W., Robinson, H.F. and Comstock, R.E. (1955). Estimation of genetic variability and environmental variability in soyabean. *Agronomy Journal*, **47**, 314-318.

Kulkarni, V.M., Navale, P.A. and Harinarayana, G. (2000). Variability and path analysis in white grain pearl millet. *Tropical Agriculture*, **77**(2), 131-132.

Panse, V.G. and Sukhatme, P.V. (1985). Statistical methods for agricultural workers. ICAR. New Delhi.

Shanmuganathan, M., Gopalpan, A. and Mohanraj, K. (2006). Genetic Variability and multivariate analysis in pearl millet. *Journal of Agriculture Sciences*, **2**, 1.

Solanki, Y.P.S., Khairwal, I.S. and Bidinger, F.R. (2002). Genetic variability in some productivity traits of pearl millet composites. *Forage Research*, **27**, 273-275.

Subi, M.I.M. and Idris, A.E. (2013). Genetic variability, heritability and genetic advance in pearl millet [*Pennisetum glaucum* [L.] R. Br.) genotypes. *British Biotechnology Journal*, **3**(1), 54-65.