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Dipak Kahate
Department Agricultural Botany, College of Agriculture, VNMKV, Parbhani, Maharashtra, India

AB Bagade
National Agricultural Research Project, VNMKV, Parbhani, Maharashtra, India

SB Pawar
National Agricultural Research Project, VNMKV, Parbhani, Maharashtra, India

Mahesh Akhare
Department Agricultural Botany, College of Agriculture, VNMKV, Parbhani, Maharashtra, India

Vishal Bhakad
Department Agricultural Botany, College of Agriculture, VNMKV, Parbhani, Maharashtra, India

Corresponding Author:
Dipak Kahate
Department Agricultural Botany, College of Agriculture, VNMKV, Parbhani, Maharashtra, India

Genetic variability analysis for yield and its contributing characters in pearlmillet (*Pennisetum glaucum* L.)

Dipak Kahate, AB Bagade, SB Pawar, Mahesh Akhare and Vishal Bhakad

Abstract
The present investigation entitled “Genetic Variability Analysis for Yield and its Contributing Characters in Pearl Millet (*Pennisetum glaucum* L.)” was undertaken during *kharif* 2021 at National Agricultural Research Project, Aurangabad. (MH), Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. Analysis of variance in 32 genotypes of pearl millet indicated the presence of high and significant variability among genotypes. From results of variability parameters it was concluded that high genotypic (GCV) and phenotypic (PCV) coefficient of variations for maximum were observed for grain yield per plant, grain yield per plot, green fodder yield per plant and green fodder yield per plot. Indicating that more emphasize would be given on these traits for improvement of grain yield. 1000-grain weight showed minimum differences between GCV and PCV were noted for 1 000-grain weight, indicated the reflection of genotype into phenotype and emphasize given on this traits to improve grain yield. High heritability with high genetic advance as per cent of means were observed for 1000- grain weight, panicle length, grain yield per plant, grain yield per plot, green fodder yield, iron content, iron content and zinc content. Thus, selection of such characters will be useful for varietal improvement.

Keywords: Variability, GCV, PCV, heritability

Introduction
Pearl millet (*Pennisetum glaucum* (L.) R. Br.) is the most important cereal crop subsequent to rice, wheat, maize and sorghum. It is staple food of 90 million poor people and widely grown on 30 million ha in the arid and semi-arid tropical region of Asia and Africa accounting for half of the global millet production. Nutritional value of pearl millet is much superior than the most widely consumed cereals like wheat, rice, maize, and sorghum. It is a highly nutritious, non acid forming, non-glutions food having several neutraceutical and beneficial health properties. Genetic variability defined as the formation of individuals differing in genotype, or the presence of genotypically different individuals, in contrast to environmentally induced differences which, as a rule, cause only temporary, non heritable changes of the phenotype. The possibility of achieving improvement in any crop plants depends on the magnitude of genetic variability.

Heritability specifies the proportion of the genotypic variance to the total phenotypic variance. It is a good index for the transmission of characters from parents to the offspring’s (Falconer, 1960) [2].

Genetic advance is the difference between the mean genotypic value of progeny of selected lines and mean genotypic value of parental population (original population before selection). The study of genetic advance is equally important as it measures the genetic gain based on the selection in a particular character. High genetic advance coupled with high heritability estimates offers the most suitable condition for selection (Johnson *et al*., 1955) [4]. Therefore, for any crop improvement programme through selection, the study of genetic variability and heritability together with genetic advance will be more useful.

Materials and Methods
The thirty two genotypes of pearl mill*et al*ong with two checks ABPC 4-3 and AIMP-92901 were grown in a randomized block design with three replications during *Kharif* 2021-22. Each genotype was sown in a four row of 1.5 m length with spacing of 45 cm between rows and 15 cm between plants.

Observations were recorded on five plants basis. The observations were recorded on days to 50% flowering, days to maturity, plant height (cm), No of productive tillers per plant, Panicle length (cm), Panicle girth (cm), 1000 - grain weight (g), Grain yield per plant (g), Grain yield per plot (kg/plot), Green fodder yield per plant (g), Green fodder yield per plot (kg/plot), Harvest index (%),Seed set under bagging (%), Fe content (ppm), Zn content (ppm).

Statistical Analysis

The data collected on individual characters were subjected to the method of analysis of variance commonly applicable to the randomized block design according to Panse and Sukhatme (1985) [8].

Results and Discussion

Analysis of variance for randomized block design was carried out to assess the variations in selected genotypes for fifteen characters under study. The data on the values of different characters and the analysis of variance showed significant differences among genotypes for all fifteen characters indicating that the material has adequate variability to support the breeding programme for improving the grain yield of pearl millet (Table 1).

Coefficient of variation measures the amount of genetic variation present in a population. Genotypic coefficient of variation (GCV) indicates the extent of genetic variability available in a crop species at gene level whereas the phenotypic coefficient of variation (PCV) of a character is the manifestation of genotypes, environment and interaction between the genotypes and environment. Therefore, to know the true breeding nature of the particular character, the total variation should be partitioned into heritable and non-heritable components. Lesser difference between the magnitude of GCV and PCV indicates the presence of a substantial amount of genetic variability in the population and indicates the little effect of the environment on the expression of the character. In all the characters studied in the present investigation, the PCV was slightly higher in magnitude than the corresponding GCV.

High values of PCV and GCV were recorded for grain yield per plot (38.91%, 37.95%) followed by grain yield per plant (37.41%, 35.33%) and zinc content (29.72%, 29.69%). These results are accordance with the result reported by Priyanka *et al*. (2019) [9] for the trait grain yield per plot and zinc content, Kumar *et al*. (2014) [5] for grain yield per plant.

The present investigation reported moderate GCV and PCV for green fodder yield per plot (19.49%, 16.71%), green fodder yield per plant (18.87%, 14.91%), harvest index (16.21%, 11.22%), panicle length (16.09%,14.85%), plant height (15.36%, 14.33%), 1000 grain weight (14.50%, 14.10%), iron content (13.61%, 13.58%) and days to 50% flowering (10.79%, 10.46%). Similar results were observed by Vidhyadar *et al*. (2007) [12] for days to 50% flowering and panicle length, Kumar *et al*. (2014) [5] for plant height, Ramya *et al* (2018) [10] for 1000 grain weight, Singh *et al* (2018) [11] for plant height, Priyanka *et al* (2019) [9] for harvest index, Pallavi *et al*. (2020) [7] for days to 50% flowering, plant height and panicle length, Narasimhulu *et al* (2021) [6] for 1000 grain weight.

On the contrary, low GCV and PCV were reported for Panicle girth (9.56%, 7.70%), no of productive tiller per plant (9.48%, 3.20%), days to maturity (8.58%, 8.30%) and seed setting under bagging (5.15%, 3.29%). This indicate that selection of these character might not be effective. Similar works were reported by Priyanka *et al*. (2019) [9] for days to maturity, Pallavi *et al*. (2020) [7] for days to maturity, Narasimhulu *et al* (2021) [6] for days to maturity (Table 2; Fig. 1).

The knowledge of heritability estimate of a quantitative character is very important as phenotypic expression of a genotype may be altered by the environment at various stages of development. Heritability indicates the effectiveness with which selection for genotypes can be done on the basis of its phenotypic variation. The heritability estimates serve as a useful guide to the breeder because selection would be fairly easy for the characters with high heritability. Thus, there would be a close correspondence between the genotypes and phenotypes due to a relatively smaller contribution of the environment on phenotype. But for a character with low heritability, selection may not be effective due to the masking effect of the environment on genotypic effect. Heritability in broad sense and genetic advance as per cent of mean are direct selection parameters, which provide index of transmissibility of traits that gives an indication about the effectiveness of selection in improving the characters. By studying the heritability, the value of a character can be assessed for formulating a breeding programme.

High heritability estimates were recorded for traits *viz*., zinc content (99.78%), iron content (99.59%), grain yield per plot (95.12%), 1000 grain weight (94.54%), days 50% flowering (93.94%), days to maturity (93.63%),grain yield per plant (89.22%), plant height (87.08%), panicle length (85.25%), green fodder yield per plot (73.50%), panicle girth (64.76%) and green fodder yield per plant (62.39%). Similar results were also observed by Anuradha *et al*. (2018) [1] and Govindraj *et al*., (2011) [3] for grain related traits, days 50% flowering and micronutrients, Priyanka *et al*. (2019) [9] for days to maturity, plant height, panicle length, panicle girth, 1000 grain weight, grain yield plant, grain yield plot, iron content and zinc content. The high heritability observed for these traits in the present investigation indicated that the influence of environment on expression of these traits is relatively low. Therefore, for improving these traits the selection would be more effective in early generation on the basis of performance of these traits.

The maximum genetic advance was registered for green fodder yield plot (1736.59) followed by grain yield per plot (1163.23), plant height (42.52), zinc content (30.69), iron content (29.63) and grain yield per plant (27.70). Moderate genetic advance was observed for days to maturity (14.22), days to 50% flowering (11.86). These results were also conformity with findings Priyanka *et al*. (2019) [9] for days to maturity and plant height. Govindraj *et al*. (2011) [3] for panicle length and panicle girth.

In the present study, high heritability coupled with high genetic advanceas per cent of mean was recorded for plant height, panicle length, 1000 grain weight, grain yield per plant, grain yield per plot, fodder yield per plot, ergot disease, doweny mildew disease, rust disease, blast disease, iron content and zinc content indicating the preponderance of additive gene action and hence simple selection would be more effective for improvement for these character. Similarly, high heritability coupled with moderate genetic advance as per cent of mean was recorded for days to maturity which might be controlled by both additive and non additive gene effects. Recurrent selection would be more effective to improve this trait. Priyanka *et al*. (2019) [9] also reported such results (Table 2; Fig. 1).

Table 1: Analysis of variance for yield and yield contributing characters in pearl millet.

Source of Variation	df	MSS							
		Days to 50% Flowering	Days to Maturity	Plant Height (cm)	Panicle Length (cm)	Panicle Girth (cm)	1000 Grain weight (g)	No. of productive tiller	Grain Yield Per Plot (kg/plot)
Replication	2	6.89	13.14	1.03	0.25	0.00	0.11	0.06	42044
Genotypes (**)	31	72.87**	5.28**	51.14**	0.81**	0.12**	2.87**	0.09**	21316525**
Error	62	2.28	3.46	72.62	1.66	0.03	0.08	0.07	533109

Source of Variation	df	MSS						
		Green Fodder Yield Per Plant (g)	Green Fodder Yield Per Plot (kg/plot)	Harvest Index (%)	Seed setting under Bagging (%)	Fe Content (ppm)	Zn content (ppm)	Grain yield per plant (g)
Replication	2	47.15	49204	0.47	5.94	0.23	0.71	45.80
Genotypes (**)	31	1441.74**	2282134**	50.20**	28.44**	416.25**	445.61**	429.81**
Error	62	333.86	348496	17.66	11.96	0.86	0.50	24.50

*, ** denotes significance at 5% and 1% respectively.

Table 2: Parameters of genetic variability for yield and yield contributing characters in pearl millet

Characters	Mean	Genotypic Variance	Phenotypic Variance	Genotypic Coefficient of Variance	Phenotypic Coefficient of Variation	Heritability (bs) (%)	Genetic Advance (%)	Genetic Advance as percentage of mean
Days to Flowering	56.78	35.29	37.57	10.46	10.79	93.94	11.86	20.89
Days to Maturity	85.94	50.91	54.37	8.30	8.58	93.63	14.22	16.55
Plant Height (cm)	154.31	489.26	561.88	14.33	15.36	87.08	42.52	27.55
Panicle Length (cm)	20.84	9.58	11.24	14.85	16.09	85.25	5.89	28.25
Panicle Girth (cm)	2.80	0.04	0.07	7.70	9.56	64.76	0.36	12.76
Test Weight (g)	8.38	1.40	1.48	14.10	14.50	94.54	2.37	28.23
No. of productive tillers per plant	2.99	0.01	0.08	3.20	9.48	11.41	0.06	2.23
Grain Yield Per Plot (kg/plot)	1.074	335216.39	352413.44	37.95	38.91	95.12	1163.23	76.24
Green Fodder Yield Per Plant (g)	157.87	553.94	887.80	14.91	18.87	62.39	38.30	24.26
Green Fodder Yield Per Plot (kg/plot)	5.885	966818.91	1315315.12	16.71	19.49	73.50	1736.59	29.51
Harvest Index (%)	35.94	16.27	33.93	11.22	16.21	47.95	5.75	16.01
Seed Setting under Bagging (%)	87.31	8.24	20.20	3.29	5.15	40.78	3.78	4.32
Fe Content (ppm)	106.15	207.69	208.55	13.58	13.61	99.59	29.63	27.91
Zn Content (ppm)	50.24	222.56	223.06	29.69	29.72	99.78	30.69	61.10
Grain Yield Per Plant (g)	40.30	202.66	227.15	35.33	37.41	89.22	27.70	68.75

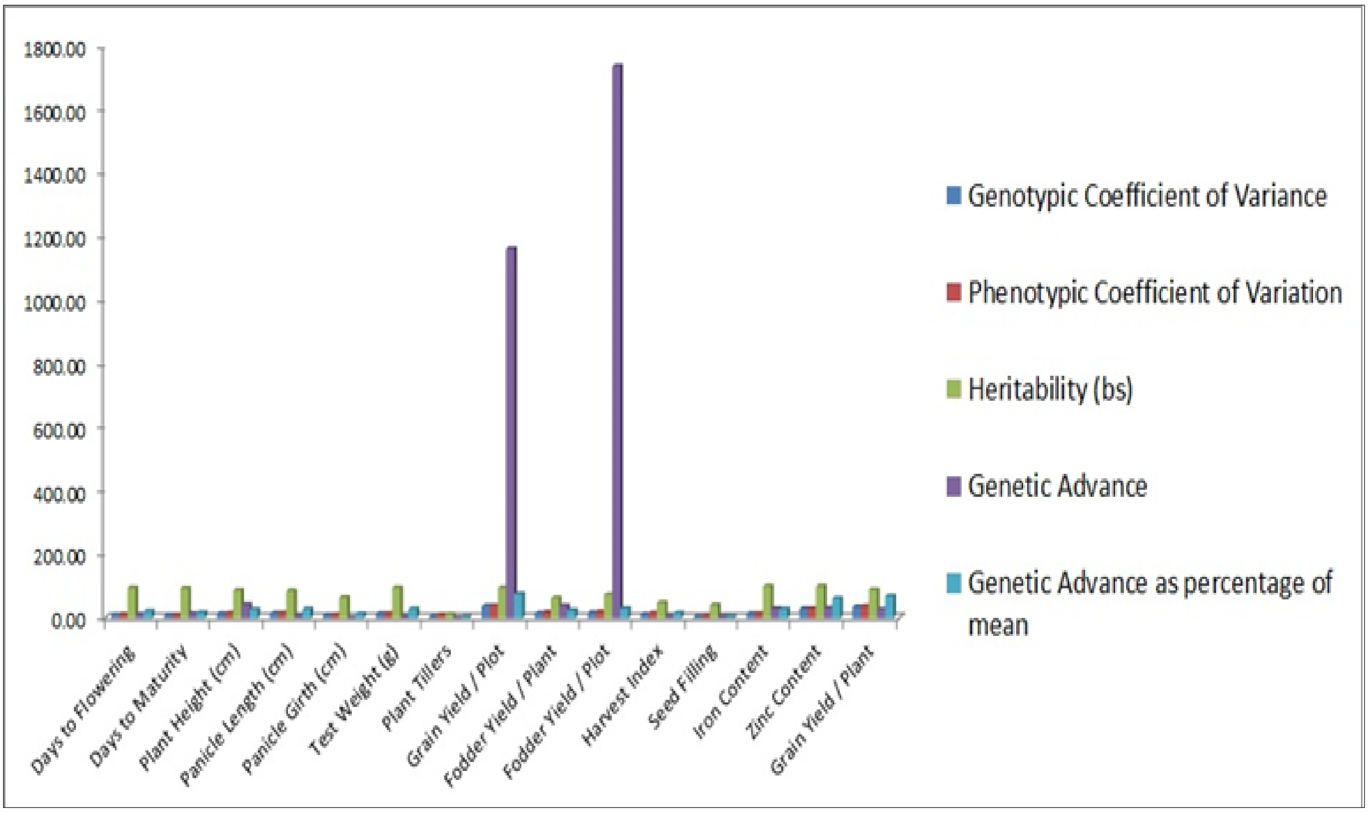

Fig 1: Genetic Variability in Pearlmillet

Conclusion

From results of variability parameters it was concluded that high genotypic (GCV) and phenotypic (PCV) coefficient of variations for the maximum were observed for grain yield per plant, grain yield per plot, green fodder yield per plant and green fodder yield per plot. indicating that more emphasize would be given on these traits for improvement of grain yield.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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