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Research Note

Genetic variability study in pearl millet germplasm (*Pennisetum glaucum* (L.) R.Br.) for yield and its component traits

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Abstract
The study was undertaken to determine genetic variability of yield and its components traits in pearl millet germplasm. A set of 376 germplasm was evaluated in Augmented Block Design (ABD) without replications under irrigated conditions during *summer* 2017 season. Observations were recorded on 10 yield and yield contributing traits. A notable amount of variation was found in material under study. Wide range of variation, were recorded for the traits *viz*., days to 50 per cent flowering, plant height, number of productive tillers per plant, leaf sheath length, leaf blade length, leaf blade width, spike length, spike girth, 1000 seed weight, single plant yield. The characters *viz.,* single plant yield, number of productive tillers per plant, spike length, leaf blade width and spike girth showed high phenotypic and genotypic coefficients of variance. Higher estimates of heritability along with high genetic advance as per cent of mean were observed for number of productive tillers per plant and leaf blade width. Therefore, selection for these characters in the given set of germplasm will be more effective.

Key words
Pearl millet, genetic variability, heritability, genetic advance

Pearl millet [*Pennisetum glaucum* (L.) R. Br.] is an important coarse grain crop and serves as stable diet for the millions of people thriving under hunger. It is a hardy crop grown in arid and semi-arid regions of the world and known for its nutritional value and it can be further enhanced by bio-fortification without any genetic modification by utilization of superior breeding lines having considerable amount of variability in the breeding programme. Presence of variability is essential for successful improvement of any character genetically and hence an insight on the nature of variability is imperative to infer about the genetic potential of the given set of germplasm.

The study and utilization of the existing variability and the presence of differences in the population which will be due to either genetic constitution of the individual plant or the environment they are grown for various morphological traits and yield components will decide the success rate in the crop improvement programme. Germplasm serve as the base population in this study. The **P**henotypic **C**oefficient of Variation (PCV) and **G**enotypic **C**oefficient of **V**ariation (GCV) may provide an idea about the magnitude of variability. The total variation present in the population comprises of genotypic and environmental effects and which may be heritable or non-heritable. Heritability is an important index, which decides the intensity of selection. It is a good index of the transmission of characters from parents to their offspring (Falconer, 1967). Genetic advance is another parameter which indicates the amount of genetic change that would occur due to selection and helps in formulating suitable selection methods.

The experimental material consist a total of 376 germplasm lines of which 121 entries were obtained from Dr.Ramaih Gene Bank, Department of Plant Genetic Resources and the remaining 255 entries and five check varieties were obtained from pearl millet unit, Department of Millets. The entire germplasm accessions of 376 numbers along with five checks were raised during *summer* 2017 in an Augmented Completely Randomized Design (Augmented Design I) during *summer*, 2017. In the Augmented design five checks were replicated six times, randomized throughout the experimental area irrespective of blocks. The 376 genotypes and checks were placed throughout the experimental area randomly with no restriction on blocking. Each genotype was sown in two rows of 4 m length plot and 60 cm apart by adopting a spacing of 60 x 15cm. Normal recommended cultural practices and plant protection measures were followed to maintain the crop stand. The observations were recorded for each genotype for 10 characters *viz*., days to 50 per cent flowering, plant height (cm), number of productive tillers per plant, leaf sheath length (cm), leaf blade length (cm), leaf blade width (cm), spike length (cm), spike girth (cm), 1000 seed weight (g), single plant yield (g). The data were subjected to statistical analysis. The phenotypic and genotypic variances were worked out according to the method suggested by Johnson *et al*., (1955) and these computations also permit estimation of phenotypic and genotypic coefficients of variance as suggested by Burton (1952). The heritability in broad sense was computed as per the methods given by Lush (1940) and genetic advance was estimated according to the method given by Johnson *et al*., (1955) and expressed as percentage of mean.

The analysis of variance revealed the significant variation for all the characters under study indicating considerable amount of genetic variation present in the germplasm. The estimates of variability parameters like genotypic coefficient of variation, heritability and genetic advance are presented in table 1. The analyzed data indicates that the traits, plant height and single plant yield recorded higher phenotypic and genotypic variation than the other characters studied. The variation observed for plant height, single plant yield and spike length was observed to be its maximum and it strongly implies the consideration of these characters during selection and other breeding methods will help in the genetic improvement of the germplasm.

For all the traits studied, the PCV was higher than the GCV which is presented graphically in Figure 1.The high PCV was recorded for single plant yield, spike length, leaf blade width, number of productive tillers per plant, spike girth, while moderate PCV was observed for the traits *viz*., 1000 seed weight, plant height, leaf blade length, leaf sheath length and days to 50 per cent flowering expressed low PCV value. The highest genotypic coefficient of variation was observed for single plant yield, spike length, leaf blade width, spike girth, number of productive tillers per plant, and while moderate GCV was observed for the traits *viz*., 1000 seed weight, plant height, leaf blade length, leaf sheath length and days to 50 per cent flowering expressed low GCV value. The magnitude of genotypic and phenotypic coefficients of variance shows that there is a greater scope of selection of superior germplasm entries for these traits and its effective utilization in the breeding programme. Similar reports for high PCV and GCV was made by Sumathi *et al*., (2017) for single plant yield, Talawar *et al*., (2017) for number of productive tillers per plant spike length and spike girth and Anuradha *et al*., (2018) for number of productive tillers per plant and single plant grain yield. Moderate PCV and GCV were obtained by Talawar *et al*., (2017) for the characters 1000 seed weight and Anuradha *et al*., (2018) for 1000 seed weight and plant height. Low PCV and GCV were obtained by Sumathi *et al*., (2017) for days to 50 per cent flowering and Bhasker *et al*., (2017) for days to 50 per cent flowering.

The heritable portions is determined based on not only the estimation of phenotypic and genotypic coefficients of variation, it also depends on heritability and genetic advance (Govindaraj *et al*., 2010). The highest heritability was found for the trait plant height, 1000 seed weight, single plant yield, leaf blade length, spike length, leaf blade width, days to 50 per cent flowering, leaf sheath length, spike girth and number of productive tillers. The heritability per cent ranged between 67.47 per cent to 93.43 per cent. The estimate of genetic advance as per cent of mean was ranged from 1.30 per cent to 49.14 per cent. High genetic advance as per cent of mean was observed for leaf blade width, number of productive tillers. Moderate genetic advance as per cent of mean was observed for spike girth, 1000 seed weight and leaf sheath length. The traits like spike length, days to 50 per cent flowering, single plant yield and plant height recorded low genetic advance as per cent of mean. The heritability (broad sense) and genetic advance as per cent of mean were presented graphically in Figure 2.

High heritability combined with high genetic advance as per cent of mean was observed for the characters number of productive tillers per plant and leaf blade width and indicates the prevalence of additive gene action in their inheritance. Similar results were reported for number of productive tillers per plant by Talawar *et al*., (2017), Sumathi *et al*., (2017) and Anuradha *et al*., (2018). High heritability with moderate genetic advance as per cent of mean was recorded for leaf sheath length, spike girth and 1000 seed weight indicating that these characters were governed by additive gene action. Similar results were reported by Lakshmana *et al*., (2009) and Prabha *et al*. (2010) for 1000 seed weight. High heritability with low genetic advance as per cent of mean was recorded for days to 50 per cent flowering, plant height, leaf blade length, spike length and single plant yield indicating non-additive gene action for these traits. Similar results were observed for days to 50 per cent flowering by Vetriventhan and Nirmalakumari *et al*., (2007) and for plant height Govindaraj *et al*., (2010).

Based on heritability estimates alone, efficient selection cannot be made, since, it does not give a correct measurement of the genotypic variation and should be observed along with the genetic advance as per cent of mean. Higher estimates of heritability combined with high genetic advance as per cent of mean was observed for number of productive tillers per plant and leaf blade width. This indicates the presence of lesser influence of environment in expression of these characters and prevalence of additive gene action in their inheritance, hence amenable for simple selection. The characters which expressed high heritability and low genetic advance showed non additive gene action. Hence heterosis breeding would be recommended for these traits.

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Table 1. Estimates of variability parameters for different biometrical characters in pearl millet

Traits	Variance		Mean	PCV (%)	GCV (%)	Heritability(%)	GA	GA as % of mean
	σ^2_g	σ^2_p						
Days to 50 per cent flowering	13.61	11.48	48.82	7.55	6.93	84.37	1.74	3.56
Plant height (cm)	700.04	654.07	145.56	17.90	17.30	93.43	1.92	1.30
No. of productive tillers per plant	1.99	1.34	5.30	26.59	21.84	67.47	1.39	26.21
Leaf sheath length (cm)	1.36	1.09	13.68	8.48	7.59	79.97	1.65	12.00
Leaf blade length (cm)	55.64	48.67	59.71	12.45	11.64	87.47	1.80	3.01
Leaf blade width (cm)	0.92	0.79	3.53	26.67	24.72	85.91	1.77	49.14
Spike length(cm)	42.78	37.28	22.23	28.50	26.60	87.14	1.80	7.82
Spike girth (cm)	5.70	4.54	9.18	25.81	23.04	79.69	1.64	17.74
1000 seed weight (g)	6.47	5.93	13.63	18.63	17.84	91.72	1.89	13.84
Single plant yield (g)	416.16	379.22	55.98	36.57	34.91	91.12	1.88	3.36

σ^2_p= Genotypic variance σ^2_g = Phenotypic variance
h^2 = Heritability GA= Genetic advance

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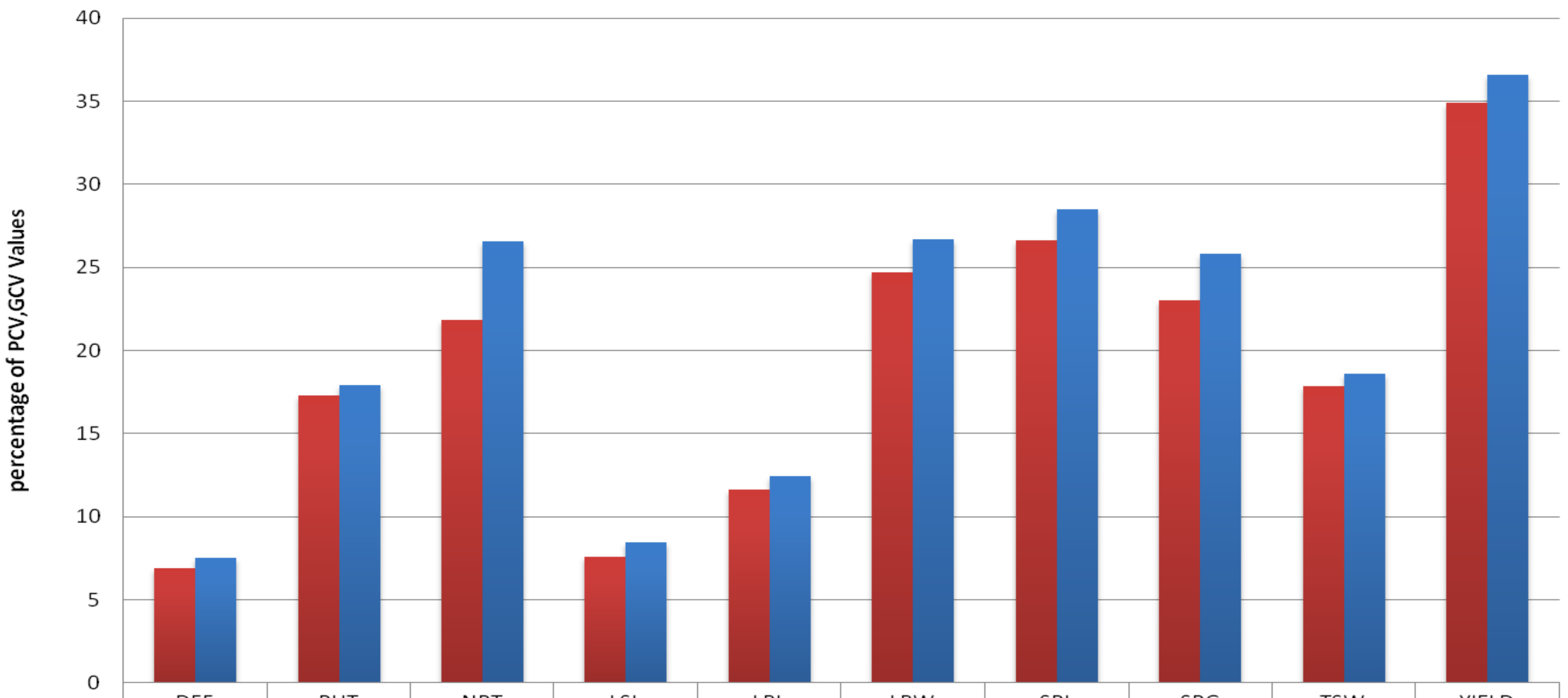

	DFF	PHT	NPT	LSL	LBL	LBW	SPL	SPG	TSW	YIELD
GCV (%)	6.93	17.3	21.84	7.59	11.64	24.72	26.6	23.04	17.84	34.91
PCV (%)	7.55	17.9	26.59	8.48	12.45	26.67	28.5	25.81	18.63	36.57

DFF Days to 50 per cent flowering; PHT Plant height; NPT Number of productive tillers per plant; LSL –Leaf sheath length; LBL – Leaf blade length; LBW – Leaf blade width; SPL – Spike length; SPG – Spike girth; TSW 1000 seed weight; YIELD – Single plant yield.

Fig. 1. Phenotypic and Genotypic Coefficients of Variations for quantitative characters of Pearl millet

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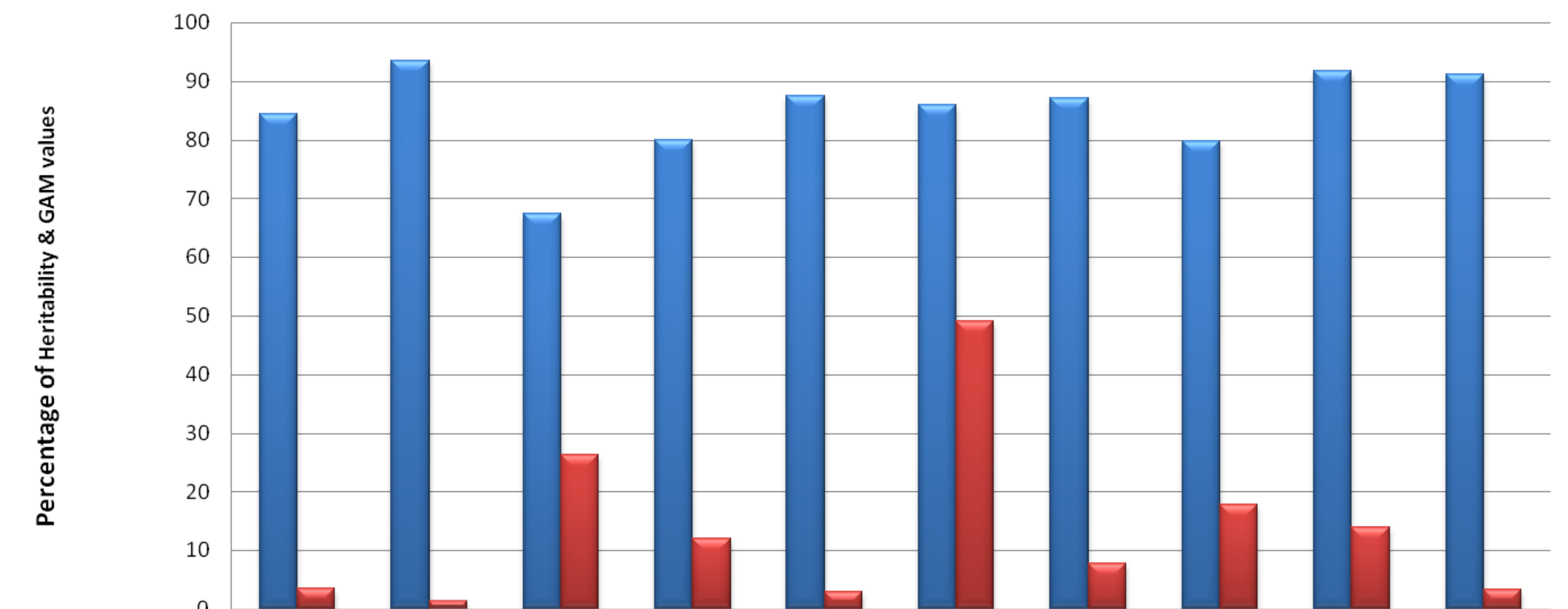

	DFF	PHT	NPT	LSL	LBL	LBW	SPL	SPG	TSW	YIELD
Heritability(%)	84.37	93.43	67.47	79.97	87.47	85.91	87.14	79.69	91.72	91.12
GA as % of mean	3.56	1.3	26.21	12	3.01	49.14	7.82	17.74	13.84	3.36

DFF Days to 50 per cent flowering; PHT Plant height; NPT Number of productive tillers per plant; LSL –Leaf sheath length; LBL – Leaf blade length; LBW – Leaf blade width; SPL – Spike length; SPG – Spike girth; TSW 1000 seed weight; YIELD – Single plant yield.

Fig. 2. Heritability and Genetic advance per mean for ten quantitative characters of Pearl millet