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PEARL MILLET GERMPLASM VARIABILITY FOR YIELD AND ITS ATTRIBUTING TRAITS UNDER RAINFED CONDITIONS

VINAY KUMAR[1]*, ASHOK KUMAR DEHINWAL[2], DEV VART[1], AMIT[1], RAJAT SHARMA[1] AND RENU RANI[1]

Department of Genetics and Plant Breeding,
[1]CCS Haryana Agricultural University, Hisar-125 004 (Haryana), India
[2]CCSHAU RRS Bawal-123 501, Rewari (Haryana), India
**(e-mail : kumar.vinay51012@gmail.com)*

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SUMMARY

The present research investigation comprised of 50 germplasm lines of pearl millet genotypes (comprising of designated B and Rlines) were carried out at Regional Research Station, Bawal, CCS Haryana AgriculturalUniversity, Hisar, Haryana during *Kharif* 2020. High estimates of GCV, PCV, heritability and high genetic advance as per cent of meanwere recorded for panicle length,panicle diameter, productive tillers (no/plant), 1000-seedweight, dry fodder yield per plant and grain yield per plant implyingthat these traits were predominantly under control of additive gene action and geneticimprovement can be achieved through simple selection. The combined analysis of correlation coefficient analysis and path coefficient analysis revealed that the traits, mainly, dry fodder yield, plant height and 1000-seedweight (gm) were the major yield attributing traits and hence; emphasis should be given to this traits while programming any plant breeding programme.

Key words : Pearl millet, GCV, PCV, heritability, genetic advance, correlation

Pearl millet [*Pennisetum glaucum* (L.) R. Br.] is highly nutritious major cereal grown primarily for grain production on more than 28 million ha in most of marginal arid and semi-arid tropical environments of Asia and Africa (Yadav *et al.,* 2011) with 25% of rainfall regime as against the rainfall demanded by other cereals like paddy.It has in-built resistance to diseases and tolerance to climatic stresses such as drought and heat (Arya *et al.,* 2010 & 2014). Millets are nutritionally comparable and evensuperior to major cereals in terms of energy value, proteins, fat and macro & micro nutrient (Arya *et al.,* 2013). The success of any crop improvement programme depends on amount of genetic diversity and heritability present in the source material. GCV and PCV, which provide information on the comparative amount of variation in different characters, are used to determine the range of variability (Nguyen *et al.,* 2019). Heritability, in combination with genetic advance, plays a significant role in improving the efficacy of character selection. Yield is a complex polygenic character that is severely affected by environmental changes (Arya *et al.,* 2008; Bikash *et al.,* 2013). The information on character association is very essential and important as the selection for one character may bring about the change in other character too (Arya *et al.,* 2008). The enormously intricate inter relationship between components traits that are related to the dependent trait is not taken into account by simple correlation. Thus, a more accurate analysis is desirable, and path coefficient analysis could be used to understand the direct and indirect contributions of many attributes to grain yield (Kant *et al.,* 2011; Bikash *et al.,* 2013).

MATERIALS AND METHODS

The present experiment was carried out at Regional Research Station, Bawal, CCS Haryana Agricultural University, Hisar, Haryana during *Kharif* season of 2020-21. 47 early maturity pearl millet genotypes (comprising of designated B lines and R lines) were evaluated in RBD with two replications. Each genotype having row to row distance 45cm and plant to plant distance 10-12 cm and 4m row length. Geographically, Bawal is situated in arid and semi-arid region at 28°08' N latitude and 76°.58' E longitude at an elevation of 266 meter above mean sea level having loamy-sand soil by nature. The observations were recorded about morphological traits for days to 50% flower, plant length, panicle diameter, productive tillers, plant height, grain yield/plant, dry fodder yield/plant and 1000 seed weight. Genotypic and Phenotypic coefficients of variation were estimated byfollowing formulas proposed by (Burton and Devane1953). Heritability was expressed in the form of percentage were estimated by following formulas proposed by (Hanson *et al.,*1956).Genetic advance for each character was also calculated as per the formula proposed by (Allard 1960) at 5% selection intensity. Phenotypic and genotypic coefficients of correlation between two traits were estimated as per the formula proposed by (Al-Jibouri *et al*., 1958). Path coefficients were estimated by utilizing the genotypic correlation values of yield contributing traits (independent traits) on yield (dependent trait) as per the formula recommended by (Wright 1921)and further illustrated by (Dewey and Lu 1959) in this study.

RESULTS AND DISCUSSION

Results of analysis of variance, mean sum of square for different characters were highly significant which revealed that for all the morphological traits under study showedthere were prevalence of ample variation in the germplasm accessions under study (Table 1). The data based on the cumulative mean and range for each character (Table 2) revealedwide range was found for most of the characters *viz.* days to 50 per cent flowering ranged from 44-55 days, panicle length ranged from 14.25-34.09cm, panicle diameter ranged from 1.58 to 3.85cm,Productive tillers (no. / plant) ranged from 1.00-3.3, plant height ranged from 83.50-221.67cm, dry fodder yield per plant ranged from 6.25-38.52g, 1000-grain weight ranged from 3.18-10.55 g, grain yield per plant ranged from 2.05-11.17g. Likewise, Bikash *et al.,* 2013 also variability in pearl millet.

Genetic variability : Traits such as panicle length, panicle diameter, productive tillers (no. /plant), fodder yield per plant, 1000 seed weight and grain yield per plant had higher magnitude of PCV & GCV , which showed significant role of these characters in improvement of breeding plan. These were in conformity with previous reports in pearl millet by Vinodhana *et al.* (2013) & Singh and Singh (2016) for productive tillers per plant, grain yield per plant and panicle length traits, similarly by Bhuri *et al.* (2014) for grain yield per plant. Similar findings were also reported by Nehra *et al.* (2017) for days to 50% flowering. Besides that, the narrow spectrum of difference between PCV and GCV revealed that the environment contribution is least on expression of these traits. Heritability (%) and genetic advance as % of mean (%) estimation for various morphological traits in pearl millet germplasm were presented in Fig. 1.

Heritability : Estimation of heritability coupled with genetic advance is usually more informative than estimation of heritability only. Characters like panicle length, panicle diameter, productive tillers (no. /plant), plant height, fodder yield per plant, 1000 seed weight and grain yield per plant

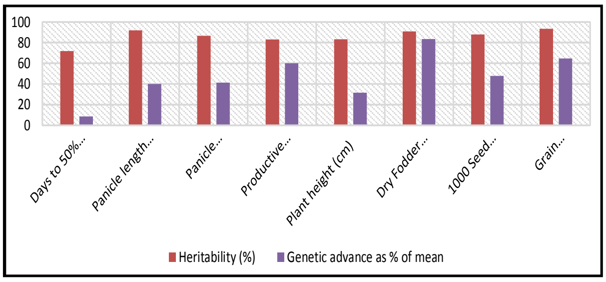

Fig. 1. Heritability (%) and genetic advance as % of mean (%) estimates in pearl millet germplasm lines for grain yield per plant and its component characters in pearl millet germplasm.

TABLE 1
Estimates of parameters of genetic variability for quantitative and biochemical traits

	Mean ± S.E(m)	Range	GCV (%)	PCV (%)	Heritability (h^2) (%)	Genetic advance as % of mean
Days to 50% flowering	50.61 ± 1.10	45-55	4.94	5.82	71.91	8.62
Panicle length (cm)	18.17 ± 0.77	14.25-34.09	20.29	21.16	91.88	40.06
Panicle diameter (cm)	2.37 ± 0.141	1.58-3.85	21.50	23.09	86.68	41.24
Productive tillers (no./plant)	1.8 ± 0.18	1-3.3	31.92	35.01	83.12	59.95
Plant height (cm)	133.85 ± 7.10	83.50-221.67	16.75	18.36	83.27	31.49
Dry Fodder yield/plant(g)	17.35 ± 1.499	6.25-38.52	38.26	40.17	90.75	83.49
1000 Seed weight (g)	6.11 ± 0.39	3.18-10.55	24.71	26.34	87.98	47.74
Grain yield Yield/plant(g)	6.49 ± 0.39	2.05-11.17	32.52	33.64	93.49	64.78

had high heritability along with high genetic advance as a percentage of the mean clearly indicating the relevance of additive gene action and greater response to phenotypic selection and improvement of such traits could be anticipated. This was in conformity with previous reports of Kumari *et al.*(2013), Vinodhana *et al.* (2013) and Bhuri *et al.* (2014). Nevertheless, high heritability coupled with low genetic advance was observed for the traits days to 50% flowering which indicated the existence of non-additive gene action and therefore, simple selection will not contribute to genomic improvement for such trait. As a nutshell, breeder's ability to design a suitable breeding programme is significantly aided by knowledge of PCV, GCV, heritability and genetic advance as a percentage of the mean, in addition to genetic variability.

Correlation coefficient analysis : Direct selection for grain yield is unproductive since this is a complex quantitative traits and severely affected by the environment. If selection is based solely on yield, high genotype and environment interaction will curtail improvement. The correlation coefficient analysis (table 3) revealed that the traits *viz.*, panicle length, panicle diameter, number of productive tillers per plant, plant height, 1000-seed weight and dry fodder yield per plant were positive and significant correlation with grain yield per plant. These findings were similar to the previous studies in pearl millet reported by number of workers on different traits i.e., for the association of grain yield with 1000 grain weight by Vinodhana *et al.* (2013), panicle length by Singh and Singh (2016) and Sharma *et al.*(2018), number of effective tillers per plant by Kale *et al.* (2011), panicle diameter by Bakhit and Elgasim (2015) and Kaushik *et al.*(2018), dry fodder yield per plant Singh *et al.* (2015), plant height by Kanatti *et al.* (2014). The findings of Bhasker *et al.*(2017), Subbulakshmi *et al.*(2018) and Kumawat *et al.*(2019) were also found similar with the current investigation's findings that days to 50% flowering were significantly and negative associated with grain yield per plant.

TABLE 2

Estimates of phenotypic (below diagonal) and genotypic (above diagonal) correlation coefficients

	Days to 50% flowering	Panicle length (cm)	Panicle diameter (cm)	Productive tillers (No./plant)	Plant height (cm)	Dry fodder yield/ plant (g)	1000-Seed weight (g)	Grain yield/ plant (g)
Days to 50% flowering	1	0.2	0.206*	-0.301**	-0.085	-0.023	-0.332**	-0.275**
Panicle length (cm)	0.162	1	0.432**	-0.235*	0.786**	0.311**	0.358**	0.364**
Panicle diameter (cm)	0.168	0.407**	1	-0.425**	0.381**	0.194	0.203*	0.225*
Productive tillers (No. /plant)	-0.283**	-0.203	-0.368**	1	-0.038	0.284**	-0.019	0.212*
Plant height (cm)	-0.07	0.713**	0.362**	-0.034	1	0.501**	0.300**	0.562**
Dry fodder yield/plant (g)	-0.031	0.300**	0.153	0.280**	0.459**	1	0.07	0.803**
1000 seed weight (g)	-0.258*	0.355**	0.188	-0.003	0.272**	0.087	1	0.296**
Grain yield /plant (g)	-0.224*	0.343**	0.194	0.206*	0.490**	0.796**	0.292**	1

* Significant at p= 0.05, ** Significant at p= 0.01.

TABLE 3

Estimates of direct and indirect effect of grain yield per plant on its component characters

	Days to 50% flowering	Panicle length (cm)	Panicle diameter (cm)	Productive tillers (No./plant)	Plant height (cm)	Dry fodder yield/ plant (g)	1000-Seed weight (g)	Grain yield/ plant (g)
Days to 50% flowering	-0.246	0.012	0.009	0.010	-0.006	-0.017	-0.036	0.275**
Panicle length (cm)	-0.049	0.061	0.018	0.008	0.059	0.228	0.039	0.364**
Panicle diameter (cm)	-0.051	0.026	0.042	0.014	0.029	0.142	0.022	0.225*
Productive tillers (No. /plant)	0.074	-0.014	-0.018	-0.034	-0.003	0.209	-0.002	0.212*
Plant height (cm)	0.021	0.048	0.016	0.001	0.075	0.368	0.033	0.562**
Dry fodder yield/plant (g)	0.006	0.019	0.008	-0.010	0.038	0.734	0.008	0.803**
1000 seed weight (g)	0.082	0.022	0.009	0.001	0.023	0.052	0.109	0.296**

Residual effect (0.243).

Path coefficient analysis : Path coefficient analysis (Wright, 1921; Dewey & Lu, 1959) quantifies the direct and indirect causes of association and shows the relative importance of each factor that contributes to the final product viz., yield. The maximum direct effect on grain yield was exhibited by dry fodder yield per plot followed by1000 seed weight, plant height, panicle diameter at genotypic level which further supported by the finding of Bhasker*et al.* (2017) for fodder yield per plant, plant height; Choudhury *et al.* (2012) for 1000 seed weight; Talawar*et al.*(2017) for panicle diameter. Direct selection for these traits may be very effective for increasing grain yield per plant in pearl millet. Negative direct effect on grain yield / plant, on the other hand by days for 50% flowering and no. of productive tillers. Similar results were reported by Ezeaku *et al.* (2015) for days for 50% flowering; Talawar*et al.* (2017) for number of productive tillers. Indirect effects of independent traits divulged that plant height had highest indirect effect on grain yield per plant via dry fodder per plant (Table 4).

The residual effect calculated the impact of potential independent variables that were not included in the study on the dependent variable. The residual effect in the present study was 0.2436, indicating that all the characters under study contributed for grain yield.

CONCLUSION

High estimates of GCV, PCV, heritability and high genetic advance as per cent of mean were recorded for panicle length,panicle diameter, productive tillers (no/plant), 1000-seed weight, dry fodder yield per plant, and grain yield per plant implying that these traits were predominantly under the control of additive gene action and genetic improvement can be achieved through simple selection in these germplasm lines of pearl millet for these traits. Most of traits indicating strong inherent association among characters *viz*. dry fodder yield per plant, plant height, panicle diameter, productive tillers, panicle length and 1000-seed weight and with grain yield per plant. So, it would be rewarding that these traits must be chosen as selection criterion for developing high yielding cultivars.Path coefficient analysis revealed that high and direct contribution towards the grain yield per plant by a number of traits *viz*. dry fodder yield per plant, 1000 seed weight,plant height and panicle diameter,which indicated the true relationship with grain yield per plant.

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