Biological Forum – An International Journal **14(2): 662-666(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Genetic Variability Parameters and Inter-relationship among Yield and its Attributes in Pearl Millet (*Pennisetum glaucum*) Hybrids

Mukesh Kumar Yadav*, Sanjay Kumar Sanadya, Anil Kumar, Amit Kumar, Ravindra Kumar and P.C. Gupta
Department of Genetics and Plant Breeding,
Swami Keshwanand Rajasthan Agricultural University, Bikaner (Rajasthan), India.

(Corresponding author: Mukesh Kumar Yadav)*
(Received 07 February 2022, Accepted 23 April, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: The pearl millet (*Pennisetum glaucum* (L.) R. Br.) is an important crop in Africa and India's semi-arid tropics. The purpose of this study was to assess the magnitude of variability in pearl millet genotypes and to comprehend the heritable component of variation in biometrical character. A field trial was conducted to determine genetic variability, correlation, and path analysis for ten characters in 45 pearl millet hybrids. The hybrids were tested in RBD at SKRAU's Experimental Farm in Bikaner during the *kharif* of 2018. The presence of significant variability for most of the characters was revealed by analysis of variance, which revealed a significant difference among all hybrids. High or moderate heritability coupled with high or moderate genetic advance as per cent of mean was reported in plant height among hybrids that can be utilized for direct selection and other traits were low heritable and low genetic advance could be improvised using recurrent selection. Direct selection for higher values of harvest index, plant height, biological yield per plant, and number of effective tillers per plant will improve seed yield per plant, according to correlation. At the genotypic level, harvest index, ear head diameter, plant height, days to 50% flowering, and biological yield per plant had the highest direct positive effect on seed yield per plant, while days to 50% maturity, ear head length, number of tillers per plant, and 1000 grain weight had the greatest direct negative effect. This implied that seed yield was primarily determined by attributing traits with direct and indirect effects.

Keywords: Bajra, Breeding program, Hybrids, Selection, Variability.

INTRODUCTION

Pearl millet (*Pennisetum glaucum*) is a diploid (2n=2x=14) cereal widely known as "Bajra" in the Poaceae family. It was first found in West Africa and then spread to India. Pearl millet is a common coarse grain cereal crop grown in dry and semi-arid climates. It may be cultivated in light textured soil with little rainfall. Among the millets, it is the most significant and perhaps most promising crop. It is widely farmed as a dual-purpose crop in Africa, Asia, and Australia, but it is exclusively planted as a feed crop in the subtropics of the United States. Pearl millet grains are high in nutrients and are consumed by around 10% of India's population as a staple food. In Zone 1C (Hyper Arid Partially Irrigated Western Plains), which includes Bikaner, Jaisalmer, and three tehsils in Churu district, pearl millet production is exceptionally low (325 kg/ha). Because arable land is a valuable and limited resource, increasing cropping intensity and maximizing the use of current resources appears to be a more valid option than expanding the area under cultivation. As a result, there is an urgent need to increase grain yield per unit area. Its inflorescence is a panicle, which is a complex terminal spike. Because of its protogynous nature, pearl millet is a highly cross-pollinated species. A caryopsis is a type of millet seed. Its root system is typical of monocotyledonous plants, with seminal or main roots, adventitious roots, and crown or collar roots.

The correlation coefficient into the direct and indirect effects of various traits on a dependent trait (El-Din *et al.*, 2012). Direct effects are where a trait directly affects another without being influenced by other traits whereas indirect effects occur when the relationship between two traits is mediated by one or more traits (Tyagi and Lal 2007). Knowledge of the associations between yield and its component traits and among the component traits themselves would allow for more effective selection for yield. In finger millet, grain yield has been reported to be highly directly associated with: panicle mass and straw yield per plant (Sonnad *et al.*, 2008); productive tillers and 1000 grain mass

(Bezaweletaw *et al.* 2006); biomass yield, finger length and number of fingers per panicle (Ganapathy *et al.* 2011; Wolie and Dessalegn 2011); and basal tillers, flag leaf blade length, and panicle length and width (Bharathi 2011). Studies which have generated such information on finger millet in east Africa are limited.

MATERIALS AND METHODS

The study was conducted at Agricultural Research Station, SKRAU, Bikaner, during *Kharif* season which is falls under Agro-Climate Zone IC of Rajasthan where average rainfall is about 260 mm, mostly received during July-September. The experimental material for the studies consisting 45 hybrids developed by three male sterile lines (A line) and the fifteen restorers lines (R line) through Line × Tester approach. The experimental material was laid out in a Randomized Block Design with three replications during *Kharif*-2018 with 60 cm × 15 cm plant geometry. Normal and uniform cultural operations were followed during the crop season to raise a good crop.

Individual plant observations were made on ten randomly selected plants from each replication for ten traits: plant height, number of effective tillers per plant, ear head diameter, ear head length, 1000 grain weight, biological yield per plant, harvest index, and seed yield per plant, while whole plot observations were made on two characters: days to 50% flowering and days to 50% maturity. Panse and Sukhtame performed analysis of variance on all treatments (1961). Burton's suggested genetic variability parameters were calculated (1958). According to Searle, the phenotypic and genotypic correlation coefficients were calculated from the phenotypic and genotypic variance and covariance (1961). Path coefficient analysis was used to estimate the direct and indirect effects, as suggested by Wright (1921) and elaborated by Dewey and Lu (1959).

RESULTS AND DISCUSSION

The experimental material, which consisted of 45 pearl millet hybrids, was laid out in a three-replication randomized block design. For the purpose of experimental design, the values of all characters were subjected to analysis of variance. Table 1 shows the mean square values for the characters analyzed. The analysis of variance found substantial variations between the hybrids for all traits except the number of effective tillers per plant, showing that pearl millet hybrids have a lot of variability. A wide range of variability for various traits has been observed earlier by Kumari *et al*. (2018a); Kumari *et al.* (2018b); Kumar *et al.* (2020a); Kumar *et al.* (2020b).

Table 1: Analysis of variance among studied traits in pearl millet hybrids.

Characters	Mean square		
	Replication	**Genotype**	**Error**
Degree of freedom	2	44	88
Days to 50 % flowering	59.36**	17.34**	4.75
Days to maturity	59.47**	17.16**	4.68
Plant height	25.24	518.73**	65.93
Number of effective tillers per plant	0.28	0.27	0.18
Ear head length	53.47*	24.75**	13.76
Ear head diameter	45.30**	8.21**	3.55
Test weight	2.34**	2.33**	0.77
Biological yield per plant	3684.50**	461.10**	172.80
Harvest index	101.36**	41.78**	17.08
Seed yield per plant	304.01**	26.87**	13.43

Table 2 shows the mean, range, coefficients of variation, heritability, and genetic advance (as a percentage of the mean). The estimates of genotypic coefficient of variation (GCV) for biological yield per plant were high (>20%), while harvest index and number of effective tillers per plant were moderate (10-20%). For days to 50% flowering, days to 50% maturity, plant height, ear head length, 1000 grain weight, and ear head diameter, it was low (less than 10%). For number of effective tillers per plant, ear head length, biological yield per plant, and seed yield per plant, the phenotypic coefficient of variation (PCV) was high (>20%), but moderate (10-20%) for plant height, 1000 grain weight, and harvest index. For days to 50% flowering, days to 50% maturity, and ear head diameter, it was low (less than 10%). For plant height, heritability estimates were moderate (50-70 percent). Days to 50% flowering, days to 50% maturity, number of effective tillers per plant, plant height, ear head length, 1000 grain weight, ear head diameter, biological yield per plant, and seed yield per plant were all low (below 50%). For the characters of biological yield per plant and seed yield per plant, genetic advance (as a percentage of mean) was high (>20 percent), whereas for plant height, 1000 grain weight, and harvest index, it was moderate (10-20 percent). Days to 50% flowering, low genetic advance (as a percentage of the mean) (less than 10%) was observed.

Table 2: Estimates of genetic variability parameters for ten traits in pearl millet hybrids.

Characters	Range	GCV	PCV	Heritability	Genetic advance	Genetic advance as % of mean
DF	47.0-62.0	3.76	5.49	46.91	2.89	5.31
DM	67.0-81.0	2.74	3.99	47.06	2.88	3.87
PH	116.2-180.6	8.53	10.22	69.60	21.11	14.65
ET	1.00-3.60	10.83	28.34	14.60	0.14	8.52
EHL	15.60-61.40	9.21	20.09	21.04	1.81	8.71
EHD	17.76-35.18	5.19	9.40	30.48	1.42	5.91
TW	6.55-13.00	8.31	13.14	40.05	0.94	10.84
HI	12-46.02	11.29	19.80	32.52	3.37	13.27
BYP	13.73-136.11	23.40	39.14	35.73	12.07	28.81
GYP	2.71-27.78	19.89	39.78	25.01	2.18	20.50

At both the genotypic and phenotypic levels, character association was calculated for various pairs of agronomic attributes, including grain yield per plant (Table 3). For all of the characters, the genotypic correlation estimates were lower than the phenotypic condition coefficient. Days to maturity were positively and significantly correlated with days to 50% flowering (0.999**), plant height (0.198**), and 1000 grain weight (0.346**), while harvest index (-0.405**), seed yield per plant (-0.484**), and biological yield per plant (-0.314**) were significant and negative phenotypic correlations. The number of effective tillers per plant (0.622**), plant height (0.330**), harvest index (0.382**), and biological yield per plant at the phenotypic level (0.869**) all had positive and significant correlations with seed yield per plant. At the phenotypic level, this character was negatively and significantly correlated with days to 50% flowering (-0.484**) and days to 50% maturity (-0.483**). Grain yield per plant was positively and significantly correlated with characters such as number of effective tillers per plant (0.945**), biological yield per plant (0.851**), plant height (0.374*), and ear head length (0.767**) at the genotypic level, but was negatively and significantly correlated with days to 50% flowering (-0.393**) and days to 50% maturity (-0.402**) at the genotypic level. These characters need due consideration during any selection programmes. Similar findings of positive and significant correlation had been reported by number of workers for grain yield per plant with biological yield per plant, number of effective tillers per plant by Izge *et al.* (2006); Bikash *et al.* (2013); Kumar *et al.* (2020b). Negative and significantly correlation of grain yield per plant with days to 50 per cent flowering and days to 50 per cent maturity reported by Nehra *et al.* (2017); Kumar *et al.* (2020a).

Table 3: Estimates of genotypic (lower diagonal) and phenotypic (upper diagonal) correlation in pearl millet hybrids.

	DF	DM	PH	ET	EHL	EHD	TW	HI	BYP	GYP
DF	1	0.999**	0.198*	-0.164	-0.068	-0.131	0.346**	-0.405**	-0.314**	-0.484**
DM	0.998 **	1	0.196*	-0.164	-0.068	-0.130	-0.344**	-0.401**	-0.314**	-0.483**
PH	0.662**	0.658**	1	0.181*	0.384**	-0.149	-0.123	-0.083	0.395**	0.330**
ET	0.049	0.043	0.152	1	0.022	0.041	0.0398	0.028	0.484**	0.442**
EHL	0.071	0.068	0.603**	-0.145	1	-0.123	0.051	0.115	0.121	0.168
EHD	0.059	0.059	-0.480**	0.279	-0.184	1	0.347**	0.138	0.001	0.060
TW	-0.269	-0.268	-0.512**	-0.084	-0.023	0.368*	1	0.360**	-0.012	0.158
HI	-0.418**	-0.415**	-0.422**	-0.244	0.268	0.246	0.655**	1	-0.088	0.382**
BYP	-0.166	-0.176	0.524**	0.890**	0.463**	-0.176	-0.341*	-0.309*	1	0.869**
GYP	-0.393**	-0.402**	0.374*	0.945**	0.767**	-0.111	-0.070	0.245	0.851**	1

At the genotypic level, harvest index (0.838) had the greatest direct positive effect on seed yield per plant, followed by ear head diameter (0.622), plant height (1.528), days to 50% flowering (24.202), and biological yield per plant (0.949), while days to 50% maturity (-25.062), ear head length (-0.800), number of tillers per plant (-0.508), and 1000 grain weight had the greatest direct negative effect (-0.023). The study's low residual effect at the genotypic (0.018) level indicated that all of the characters contributed significantly to seed yield per plant. This research backs up the findings of and Bikash *et al.* (2013); Kumari *et al.* (2018a); Kumari *et al.* (2018b); Kumar *et al.* (2020a).

Table 3: Estimates of genotypic (upper diagonal) and phenotypic (lower diagonal) path coefficient analysis in pearl millet hybrids.

0.018	DF	DM	PH	ET	EHL	EHD	TW	HI	BYP	GYP
DF	**24.202**	-25.062	1.012	-0.025	-0.057	0.037	0.006	-0.350	-0.158	-0.484**
DM	24.202	**-25.062**	1.005	-0.022	-0.054	0.037	0.006	-0.348	-0.167	-0.483**
PH	16.032	-16.483	**1.528**	-0.077	-0.483	-0.298	0.012	-0.354	0.497	0.330**
ET	1.176	-1.075	0.233	**-0.508**	0.116	0.173	0.002	-0.205	1.033	0.442**
EHL	1.721	-1.699	0.922	0.074	**-0.800**	-0.114	0.001	0.225	0.439	0.168
EHD	1.440	-1.476	-0.733	-0.142	0.147	**0.622**	-0.009	0.206	-0.167	0.060
TW	-6.501	6.722	-0.782	0.042	0.018	0.229	**-0.023**	0.549	-0.324	0.158
HI	-10.105	10.405	-0.646	0.124	-0.215	0.153	-0.015	**0.838**	-0.293	0.382**
BYP	-4.023	4.409	0.801	-0.553	-0.370	-0.110	0.008	-0.259	**0.949**	0.869**

CONCLUSION

The resource for seed yield and its components had significant genetic variation, indicating that seed yield may be improved. All of these hybrids could be used in a breeding programme because they performed well in the desired direction for component characters that are directly related to seed yield. When GCV, heritability estimates, and high genetic advancement were combined, it was clear that non-additive gene action and environmental factors were in responsible of the majority of the traits. As a result, in segregating generation, direct selection for these characters will be ineffective. Direct selection for higher values of harvest index, plant height, biological yield per plant, and number of effective tillers per plant will improve seed yield per plant, according to correlation. The strong direct influence of other traits on seed yield per plant was also owing to the high positive relationship of these characters with seed yield per plant. This suggested that seed yield was mostly a result of attributing traits with direct and indirect effects.

Conflicts of interest. None.

REFERENCES

Bezaweletaw, K., Sripichitt, P., Wongyai, W., & Hongtrakul, V. (2006). Genetic variation, heritability and path-analysis in Ethiopian finger millet [*Eleusine coracana* (L.) Gaertn] landraces. *Agriculture and Natural Resources*, *40*(2): 322-334.

Bikash, A., Yadav, I. S. & Arya R. K. (2013). Variability, correlation and path analysis in pearl millet. *Journal of Plant Science and Research, 39*(3): 134-139.

Burton, G. W. (1952). Quantitative inheritance in pearl millet (*Pennisetum glaucum*). *Agronomy Journal, 43*: 409-417.

Burton, G. W. (1958). Cytoplasmic male sterility in pearl millet. *Agronomy Journal, 50*: 230.

Dewey, D. R. & Lu, K. H. (1959). A correlation and path coefficient analysis of components of erasted wheat grass production. *Agronomy Journal, 7*: 179-188.

El-Din, A. A. T., Hessein, E. M., & Ali, E. A. (2012). Path coefficient and correlation assessment of yield and yield associated traits in sorghum (*Sorghum bicolor* L.) genotypes. *American-Eurasian Journal of Agricultural & Environmental Sciences, 12*, 815-819.

Ganapathy S, Normalakumari A, Muthiah A. R. (2011). Genetic variability and interrelationship analyses for economic traits in finger millet germplasm. *World Journal of Agribusiness Sciences, 7*: 185-188.

Izge, U., Kadams, M. & Gungula, T. (2006). Studies on character association and path analysis of certain quantitative characters among parental line of pearl millet (*Pennisetum glaucum*) and their F_1 hybrids in a diallel cross. *African Journal of Agricultural Research, 1*(5): 194-198.

Kumar R., Gupta, P. C., Sanadya, S. K., Chandel, D., Mamta & Kumar, A. (2020a). Variability and genetic parameters for agronomic traits in the heterotic gene pools of pearl millet. *Journal of Pharmacognosy and Phytochemistry, 9*(2): 319-321

Kumar, R., Sanadya, S. K., Kumar, A., Yadav, M. K., Chandel, D. & Gupta, P.C. (2020b). Estimation of correlation coefficient and path analysis in hybrids of pearl millet [*Pennisetum glaucum* (L.) R.Br.]. *International Journal of Chemical Studies, 8*(1): 1254-1256.

Kumari, N., Sharma, N. K., Kajla, S. L. & Sanadya, S. K. (2018a). Studies on variability, character association and genetic diversity in B-lines of pearl millet. *International Journal of Chemical Studies, 6*(5): 695-699.

Kumari, N., Sharma, N. K., Kajla, S. L. & Sanadya, S. K. (2018b). Studies on variability, character association and genetic diversity in R-lines of pearl millet. *International Journal of Chemical Studies, 6*(5): 700-704.

Nagar, R.P., Singh, D. & Jain, R.K. (2006). Genetic variability in fodder pearl millet. *Range management and Agroforestry, 27*: 55-57.

Nehra, M., Kumar, M., Kaushik, J., Vart, D., Sharma, R. K., & Punia, M. S. (2017). Genetic divergence, character association and path coefficient analysis for yield attributing traits in pearl millet [*Pennisetum Glaucum* (L.) R. Br] inbreds. *Chemical Science Review and Letters, 6*(21): 538-543.

Panse, V. G. & Sukhatme, P. V. (1961). Statistical Methods for Agricultural Workers. ICAR, New Delhi, India.

Rao, C. R. (1952). Advanced Statistical Methods in Biometrical Research (1st edition). John Wiley and Sons, New York, USA.

Sanadya, S. K., Shekhawat, S. S., Sahoo, S. & Kumar, A. (2018). Variability and inter- relationships of quantitative traits in sewan grass (*Lasiurus sindicus*

Henr.) accessions. *International Journal of Chemical Studies, 6*(6): 1843-1846.
Searle, S. R. (1961). Phenotypic, genotypic and environmental correlations. *Biometrics, 17*: 474-480.
Sonnad. S. K., Shanthakumar, G., Salimath, P. M. (2008). Genetic variability and trait association studies in white ragi (*Eleusine coracana Gaertn*). *Karnataka Journal of Agricultural Science, 21*: 572-575.
Tyagi, A. P., and Lal, P. (2007). Correlation and path coefficient analysis in sugarcane (*Saccharum officinarum*). *The South Pacific Journal of Natural Sciences*, 25:1-9.
Wright, S. (1921). Correlation and causation. *Journal of Agricultural Research, 20*: 557-587.

How to cite this article: Mukesh Kumar Yadav, Sanjay Kumar Sanadya, Anil Kumar, Amit Kumar, Ravindra Kumar and P.C. Gupta (2022). Genetic Variability Parameters and Inter-relationship among Yield and its Attributes in Pearl Millet (*Pennisetum glaucum*) Hybrids. *Biological Forum – An International Journal, 14*(2): 662-666.