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Heritability Studies in Pearl Millet (*Pennisetum glaucam* (L.) R. Br) for Grain Yield and other Agronomic Traits

N Anuradha, T S S K Patro, Y Sandhya Rani, U Triveni, P Kranthi Priya, Vikas Khandelwal and C Tara Satyavathi
Agricultural Research Station, ANGRAU, Vizianagaram

ABSTRACT

Pearl millet (*Pennisetum glaucum* (L.) R. Br.) is a quick growing millet crop which forms the staple food in arid and semi arid regions of Indian subcontinent and Africa. The experiment material for the present study comprised of 18 pearl millet released varieties and hybrids which were evaluated during *Kharif*, 2021 to assess genetic variability, heritability and genetic advance for nine yield contributing traits. Analysis of variance revealed significant differences for all the traits included under study indicating ample scope for improvement of yield and various yield attributing characters. High phenotypic coefficient of variation coupled with high genotypic coefficient of variation was observed for number of productive tillers per plant. High heritability coupled with high genetic advance as per cent of mean was observed for plant height, number of productive tillers per plant and panicle diameter indicating preponderance of additive gene action and selection is effective for these traits.

Keywords: *Pearl millet, Variability, Heritability and Genetic advance*

India is a major pearl millet [*Pennisetum glaucum* (L.) R. Br.] producing country in the world and mainly cultivated in the states of Rajasthan, Maharashtra, Gujarat, Madhya Pradesh, Karnataka, Andhra Pradesh, Uttar Pradesh and Tamil Nadu (Kumawat *et al*., 2019, Satyavathi *et al*., 2021). It is an important coarse grain crop having drought tolerance, high temperature tolerance and can grow in less fertile soil.

It is a cross pollinated, diploid (2n=2x=14) and annual C4 crop with protogynous nature (Subbulakshmi *et al.*, 2018, Yan *et al.*, 2023). It is mainly used as dual purpose crop in arid and semi-arid regions of many countries including India. It can thrive under adverse conditions like low rainfall and fertility. The basic aim of any crop improvement programme is to increase yield potential of the concerned crop species.

Among them, pearl millet (*Pennisetum glaucum* L.) is a monocot plant under the grass family (Poaceae), which is considered on sixth position in terms of global food importance after rice, wheat, maize, barley and sorghum. It is an annual cereal crop species, cultivated in arid and semi-arid tropical regions of Africa and Southeast Asia, including India (Jukanti *et al*., 2016). It has the potential to grow in adverse climatic conditions such as high temperature, drought and less fertile soil.

The study of material's variability must be completed as a prerequisite before a varietal development programme can be started. As a result, it is important to examine the type and degree of heritable genetic variation in the sample. A successful breeding programme for increasing yield through phenotypic selection depends largely on the kind and degree of variation in the material available and the role that the environment plays in the expression of plant traits. As a result, it is important to examine the type and extent of heritable genetic variation found in the experimental material.

MATERIAL AND METHODS

The experiment was conducted with eighteen pearl millet genotypes at Agricultural Research Station, Vizianagaram, Andhra Pradesh during *Kharif*, 2021. Genotypes were planted in a randomized complete block design (RCBD) with three replications and a spacing of 50 × 15 cm. per

each entry. Every genotype was grown in 8 lines each of 4 m length. Standard management practices were followed to maintain a healthy crop. Observations were recorded on five plants for plant height (cm), number of productive tillers per plant, panicle length (cm), panicle diameter (cm), 1000 test weight (g). Days to 50% flowering and days to maturity were recorded by visualizing the entire plot. Fodder yield and grain yield were recorded on per plot basis and then converted into per hectare.

Analysis of variance and summary statistics was calculated as per Panse and Sukathme (1967). Phenotypic and genotypic coefficients of variation (PCV and GCV) were computed as per Burton and Devane (1953). Heritability in broad sense was computed as per Allard (1960). Genotypic and phenotypic correlations were calculated according to Falconer (1981). Heritability and genetic advancement were categorized into low, medium and high as per Johnson *et al*. (1955).

RESULTS AND DISCUSSION

Analysis of Variance components (Table 1) revealed significant differences for all the traits included under study indicating presence of adequate amount of variability among different genotypes for the traits.

In the present study the hybrid, NBH 5061(4505 kg/ha) outyielded all other genotypes with respect to grain yield followed by another hybrid, NBH 4903 (4387 kg/ha) shown in (Table 2). ICMV 221 and Dhanshakti are the early duration varieties with 60 and 61 days of maturity respectively. The early duration genotypes can be used for breeding earliness in pearl millet. AHB 1200 can be used for breeding non-lodging genotypes since it was observed to be the shortest (151.1 cm) among all eighteen genotypes studied followed by Pratap (MH 1642) with 168.1 cm. More number of productive tillers were observed for Kaveri Super Boss. Longer panicle length was observed for AHB 1269 (33.1 cm) followed by Pratap (MH 1642) (32.4 cm). Long panicle length is indicative of getting higher grain yield. Broader panicle diameter was recorded for AHB 1269 (4.6 cm).

The estimates of genotypic coefficient of variation (GCV %) ranged from 5.4 for test weight to 22.5 for number of productive tillers per plant. The corresponding values for phenotypic coefficient of variation (PCV %) ranged from 8.1 to 26.3 respectively (Table 3). Phenotypic coefficient of variability is higher than genotypic coefficient of variability for all the characters indicating that the interaction of genotypes with the environment. In the present study, high values of PCV and GCV were obtained for the traits, number of productive tillers per plant (26.27, 22.54) followed by panicle diameter (22.9, 21.0). Similar results were reported by Singh and Singh (2016) and Talawar *et al*. (2017). High PCV coupled with moderate GCV was recorded for traits like panicle diameter (21.23, 18.83) followed by fodder yield per plant (20.91, 11.56). Moderate PCV and GCV were recorded for days to 50 % flowering, plant height and grain yield per plant. The results were similar with the reports of Sharma *et al*. (2018) and Singh *et al*. (2018). Presence of variability implies possibility of selections. For reliable selection one has to depend on heritability studies. Highly heritable traits are governed by genotypic variances rather than with environmental variance. Hence, there is more chance for success in selection of genotypes based on heritability. However, heritability informs whether the variation is genetic or non genetic while Genetic Advance as per cent Mean (GAM) enlightens the aspect of gene action.

The estimates of heritability ranged from 30.55 for fodder yield per plant to 88.09 for days to 50 % flowering. High heritability was recorded for days to 50 % flowering, days to maturity, plant height, number of productive tillers per plant and panicle diameter whereas moderate heritability was recorded for panicle length, test weight and grain yield per plant. Similar results were reported by Vetriventhan and Nirmalakumari (2007) Ratna babu D and Ravi kumar R L, (2010). Genetic Advance as Per cent of Mean was recorded high for traits plant height, number of productive tillers per plant and panicle diameter. Similar results were reported by Dhedhi *et al*., (2016). Moderate GAM for days to 50 % flowering, days to maturity, grain yield and fodder yield whereas lower GAM was recorded for panicle length and test weight. But, high heritability with high genetic advance as per cent of mean was reported for panicle length by Rajpoot *et al*., (2023). High heritability with high genetic advance as per cent of mean was recorded for plant height, number of productive tillers per plant and panicle diameter. The results were in consonance with the earlier reports of Basavaraj *et al*. (2017), while Rani *et al*. (2022) reported high heritability with

moderate GAM for plant height, number of productive tillers per plant, grain and fodder yield whereas Parmer *et al*. (2022) reported high heritability with high Genetic Advance as Per cent of Mean for plant height, leaf length and dry matter yield per plant. Earlier reports from Pallavi *et al*. (2023), showed high heritability with high GAM for thousand seed weight.

Significant differences for all the traits studied implies scope for improvement of these traits. Further, high to moderate PCV and GCV for number of productive tillers per plant, plant height, panicle diameter, grain yield and fodder yield supports existence of significant variation in the population. In addition, high heritability coupled with high GAM for plant height, number of productive tillers per plant and panicle diameter assures effective selection for these traits through exploitation of additive gene action.

LITERATURE CITED

Allard R W 1960. Principles of Plant Breeding. John Wiley and Sons Inc., New York. 485.

Basavaraj P S, Biradar B D and Sajjanar G M 2017. Genetic variability studies for quantitative traits of restorer (R) Lines in Pearl millet [*Pennisetum glaucum* (L.) R. Br.]. *International Journal of Current Microbiology and Applied Sciences*. 6(8): 3353-3358.

Burton G W and Devane E W 1953. Estimating heritability in tall fescue (*Festuca arundiraceae*) from replicated clonal material. *Agronomy Journal.* 45:478-481.

DasI K, Palanna K B, Patro T S S K, Ganapathy K N, Kannababu N, Kumar S and Tonapi V A 2021. A multilocational evaluation of blast resistance in a diverse panel of finger millet in India. Crop protection. 139:105401

Dhedhi K K, Ansodariya V V, Chaudhari N N, Sanghani J M and Sorathiya J S 2015. Genetic variability and character association for fodder yield and its related traits in pearl millet over locations under rainfed conditions of Gujarat. *International Journal of Forestry and Crop Improvement*.6(2): 110-115.

Falconer D S 1981. Introduction to Quantitative Genetics. 2nd ed. Longman, London,.

Johnson H W, Robinson H F and Comstock R E 1955. Estimate of genetic and environmental variability in Soybeans. *Agronomy Journal*. 47: 314-318.

Jukanti A K, Gowda C L, Rai K N, Manga V K, and Bhatt R K 2016. Crops that feed the world 11. Pearl Millet (*Pennisetum glaucum* L.): an important source of food security, nutrition and health in the arid and semi-arid tropics. *Food Security*, *8*, 307-329.

Kumawat, Ram K, Sharma N K and Sharma N 2019. Genetic variability and character association analysis in pearl millet single cross hybrids under dry conditions of Rajasthan.*Electronic Journal of Plant Breeding*. 10(3):1067-1070.

Parmar S V, Gohil D P, Suvatar V K and Borkhatariya T H 2022. Genetic Variability, Correlation and Path Analysis in Forage Bajra [*Pennisetum glaucum* (L.) R. Br.]. *Biological Forum – An International Journal* 14(4): 248-252.

Pallavi M, Reddy P S, Ratnavathi C and Krishna K R 2023. Genetic variability and diversity for rancidity and associated characters in pearl millet (*Pennisetum Glaucum* L.). Preprint in Research Square.

Panse V G and Sukathme P V 1967. Statistical Method for Agricultural Workers. ICAR, New Delhi., 381.

Ratna babu D and Ravikumar R L 2010. Parallel responce between gametophyte and Sporophyte for fusariumloilt resistance in the recombinant in bread line of chickpea. Current Science. 513-518.

Rani R, Khandelwal V, Ramesh S J, Singh A and Kumar V 2022. Genetic Variability and Association Analysis for Dry Fodder Yield and its Component Traits in Pearl Millet Inbred. *Forage Research*, *48*(1), 57-61.

Satyavathi C T, Ambawat S, Khandelwal V and Srivastava R K 2021. Pearl millet: a climate-resilient nutricereal for mitigating hidden hunger and provide nutritional security. *Frontiers in Plant Science*, *12*, 659938.

Sharma B, Chugh L K, Sheoran R K Singh V K and Sood M 2018. Study on genetic variability, heritability and correlation in pearl millets germplasm. *Journal of Pharmacognosy and Phytochemistry*. 7(6): 1983-1987.

Table 1: ANOVA of eighteen pearl millet genotypes

Source of Variations	Df	Mean Sum of Squares								
		DFF	DM	PH	NPT	PL	PD	GY	FY	TSW
Treatments	17	49.33**	72.39**	3855.02**	3.81**	20.19**	1.12**	892786**	2538070*	3.79**
Replications	2	3.19	1.69	143.87	0.69	4.31	0.53	425011	2611273	0.65
Error	34	2.13	4.63	237.47	0.41	7.04	0.09	211776	1094108	1.11

**significant at 1% level and *significant at 5%

Note: DFF: Days to 50% flowering; DM: Days to maturity; PH: Plant height (cm); NPT: No. of productive tillers per plant; PL: Panicle length(cm); PD: Panicle Diameter; GY: Grain yield (kg/ha); FY: Fodder yield (kg/ha); TSW: Thousand Seed weight

Table 2: Performance of eighteen pearl millet genotypes

S.No	Entry	DFF	DM	PH	NPT	PL	PD	GY	FY	TSW
1	NBH 5061	36	66	309.7	6	30.4	3	4505	6096	8.4
2	NBH 4903	42	74	268.3	5	29.9	3.7	4387	7168	9.6
3	Kaveri Super Boss	43	75	214.4	6.9	28.5	3.4	4231	7354	7.8
4	AHB 1200	40	69	151.1	5.7	27	3.7	4123	6574	9.1
5	86M64	40	72	209.7	4.4	29.1	2.5	3811	4180	9.2
6	ABV 04	44	76	205.1	4	30.3	3.1	3667	6559	8.7
7	Rai 171	42	73	219.5	5.1	29	2.3	3649	5883	7.8
8	GHB 558	33	62	212.5	5.9	27.1	2.8	3646	5234	8.4
9	86M01	39	69	255.9	6	26.2	3.4	3583	6970	8.7
10	NBH 5767	38	69	241.5	5.1	31.5	2.6	3501	6369	8.4
11	AHB 1269	40	71	190.6	3.9	33.1	4.6	3483	7204	8.5
12	86M88	42	74	235.1	5.4	26.1	3.7	3246	5745	9.1
13	ICMV 221	30	60	203.2	3.1	28.7	3.1	3222	5799	9.8
14	Pratap (MH 1642)	37	67	168.1	3.5	32.4	2.4	3105	4210	9
15	Pusa Comp. 612	36	66	206.7	4.7	25.8	2.7	3081	5919	8.4
16	Dhanshakti	32	61	236.8	3.9	30.5	2.4	2895	5544	8.7
17	86M86	43	74	224.4	2.9	25.7	3.5	2856	5246	9.3
18	ICMV 155	40	71	219.2	3.5	34.3	2.8	2538	5955	8.3
	Mean	**38.7**	**69**	**221**	**4.7**	**29**	**3**	**3529**	**6001**	8.7
	CD (1%)	3.2	4.8	34.3	1.4	5.9	0.7	1025	2330	1.2
	CD (5%)	2.4	3.6	25.6	1.1	4.4	0.5	764	1735	0.9
	CV (%)	3.8	3.1	7	13.5	9.1	9.8	13	17.4	6.1

Note: DFF: Days to 50% flowering; DM: Days to maturity; PH: Plant height (cm); NPT: No. of productive tillers per plant; PL: Panicle length(cm); PD: Panicle Diameter; GY: Grain yield (kg/ha); FY: Fodder yield (kg/ha); TSW: Thousand Seed weight

Table 3: Genetic parameters of eighteen pearl millet genotypes

S.No	Parameter	DFF	DM	PH	NPT	PL	PD	GY	FY	TSW
1	**Mean**	38.7	69.4	220.7	4.7	29.2	3.1	3529.4	6000.5	17.4
2	**Minimum**	30	59.7	151.1	2.9	25.7	2.3	2537.5	4180.2	15.5
3	**Maximum**	44	76.3	309.7	6.9	34.3	4.6	4504.5	7354.3	19.6
4	**GCV**	10.2	6.8	15.7	22.5	7.2	18.8	13.5	11.6	5.4
5	**PCV**	10.9	7.5	17.2	26.3	11.6	21.2	18.8	20.9	8.1
6	**ECV**	3.8	3.1	7	13.5	9.1	9.8	13	17.4	6.1
7	**H (B)**	88.1	83	83.5	73.6	38.4	78.6	51.7	30.6	44.5
8	**Genetic Advance**	7.7	8.9	65.4	1.9	2.7	1.1	706	790	1.3
9	**GAM**	19.8	12.8	29.6	39.9	9.1	34.4	20	13.2	7.5

Note: DFF: Days to 50% flowering; DM: Days to maturity; PH: Plant height (cm); NPT: No. of productive tillers per plant; PL: Panicle length(cm); PD: Panicle Diameter; GY: Grain yield (kg/ha); FY: Fodder yield (kg/ha); TSW: Thousand Seed weight

GCV: Genotypic Coefficient of Variance, PCV: Phenotypic Coefficient of Variance; ECV: Environmental Coefficient of Variance; H (B): Heritability in Broad sense; GAM: Genetic Advance as Per cent Mean

Singh O V and Singh A K 2016. Analysis of genetic variability and correlation among traits in exotic germplasm of pearl millet [*Pennisetum glaucum* (L.) R. Br.]. *Indian Journal of Agricultural Research*. 50(1): 76-79.

Singh O V, Gowthami R, Singh K and Shekhawat N 2018. Assessment of inter-characters associations in the germplasm of pearl millet *Pennisetum glaucum* (L.) R. Br.] over five years in hot arid climate of Rajasthan, India. *International Journal of Current Microbiology and Applied Sciences*. 7(1): 3133-3149.

Subbulakshmi K, Ravikesavan R, Babu C and Iyanar K 2018. Study of genetic variability in pearl millet [*Pennisetumglaucum* (L.) R. Br.] hybrids for grain yield and quality parameters. *Agricultural Science Digest*. 38(4): 289-292.

Talawar A M, Girish G, Channabasavanna A S and M S Kitturmath A S 2017. Studies on genetic variability, correlation and path analysis in pearl millet (*Pennisetum glaucum* L.) germplasm lines. *Agricultural Science Digest*.37(1): 75-77.

Vetriventhan M and Nirmalakumari A 2007. Studies on variability parameters in pearl millet (*Pennisetum glaucum* (L.) R. Br.). *Madras Agricultural Journal*. 94 (6):118-120.

Yan H, Sun M, Zhang Z, Jin Y, Zhang A, Lin C and Huang L 2023. Pangenomic analysis identifies structural variation associated with heat tolerance in pearl millet. *Nature Genetics 55*(3): 507-518.

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