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GENETIC VARIABILITY AND CORRELATION COEFFICIENT IN PEARL-MILLET [*PENNISETUM GLAUCUM* (L.) R. BR. EMEND STUNTZ]

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SUMMARY

The present investigation was carried out to estimate genetic variability and correlation among 30 genotypes of pearlmillet for 11 characters. These hybrids were evaluated in RBD during **kharif** 2012 at ARS, Bikaner. Analysis of variance indicated presence of considerable variability for all the 11 characters. Number of effective tillers/plant and biological yield/plant had high estimate of GCV and PCV. It also had high heritability associated with high genetic advance as per cent of mean. Thus, these should be given due emphasis while making a direct selection through these traits. Harvest index and seed yield/plant had moderate estimates of GCV, PCV, heritability and genetic advance. Therefore, selection for these characters would also be effective.The result from character association indicated that grain yield per plant had significant and positive correlation with earhead length (cm), number of effective tillers/plant and biological yield/plant (g) at phenotypic level.

Key words : Genetic variability, estimates of GCV and PCV, character association, pearlmillet

Pearlmillet [*Pennisetum glaucum* (L.) R. Br.], locally known as *bajra, bari, sajja, combo, ganti* or *kambam*, is an allogamous crop having protogynous nature and belongs to the family Poaceae. It originated in West Africa and from there was introduced in India. Pearlmillet is grown all over the world, while Nigeria, Pakistan, Sudan, Saudi Abrabia are the major pearlmillet growing countries in the world including India. Pearlmillet is an important coarse grain cereal crop of dryland agriculture. It can be grown on light textured soil under low moisture condition. It is most important and probably most potential crop among the millets. It is extensively cultivated as a dual purpose crop under large areas in Africa, Asia and Australia while grown as forage crop only in sub-tropics of USA. Globally it ranks 6th cereal crop in importance followed by wheat, rice, maize, barley and sorghum, while in India it is fourth most important cereal after crops like rice, wheat and sorghum. India is the largest producer of pearlmillet with an annual production of 8.01 million tonnes from an area of 9.34 million hactares (Anonymous, 2011) with productivity being 8.50 q/ha. Pearlmillet is traditionally grown as rainfed crop mostly under low fertility and rainfall condition. However, it also responses well to irrigation and improved management conditions. Pearlmillet is mainly grown in Rajasthan, Uttar Pradesh, Gujarat, Maharashtra, Haryana, Karnataka, Tamil Nadu, Madhya Pradesh and Andhra Pradesh states of the country. Rajasthan occupies first position in area and production of pearlmillet in India. In Rajasthan, it is cultivated on 39.55 lac hectares area with the production of 38.39 lac tonnes and productivity 971 kg/ha (Anonymous, 2012). Major pearlmillet producing districts of Rajasthan are Alwar, Sikar, Bharatpur, Karoli, Jaipur, Dausa, Dholpur, Jhunjhunu, Swai Madhopur and Churu. The grains of pearlmillet are very nutritious and form the staple diet of approximately 10 per cent of the population in India. It is rich in protein with slightly superior amino acid profile. It is a good source of protein (5.8-20.9%), fat (4.1-6.4%), carbohydrate (59.8-78.2%) and also has good amount of minerals, particularly phosphorus and iron (2.8%). It also contains higher amount of carotene which is the pre-cursor of vit. A, thiamine (vit. B_1), riboflavin (vit. B_2) and niacin (vit. B_4).

MATERIALS AND METHODS

The experimental material for the present investigation comprised 30 genotypes including hybrids and check varieties of pearlmillet [*Pennisetum glaucum*

(L.) R. Br.] obtained from AICRP on Pearlmillet Scheme, ARS, Bikaner.The experimental material was laid out in a randomized block design (RBD) with two replications during **kharif** 2012. Each plot consisted of four rows each of 4.5 meter length. The spacing between row to row was 50 cm and between plant to plant was 15 cm. Normal and uniform cultural operations were followed during the crop season to raise a good crop. The experiment was sown on 20/7/12. The observations were recorded on individual plant basis on 10 randomly selected plants from each replication for 8 characters viz., plant height, earhead diameter, ear length, number of effective tillers per plant, 1000-seed weight, biological yield per plant, harvest index (%), and seed yield per plant, while two characters, namely, days to 50 per cent flowering and days to maturity were recorded on whole plot basis.

RESULTS AND DISCUSSION

Variability

The analysis of variance (Tables 1 and 2) exhibited highly significant differences among the genotypes for all the 11 characters indicating thereby considerable amount of genetic variability for all the characters. In the present investigation, high range was observed for most of the characters viz., days to 50 per cent flowering, days to maturity, plant height (cm), earhead length (cm), earhead diameter (cm), biological yield per plant (g), test weight, harvest index, seed yield/ plant and protein content. Comparatively narrow range was observed for number of effective tillers per plant only. Similarly, considerably high amount of variability was reported earlier by many workers for different characters. Bhoite *et al*. (2008) reported significant variability for the characters days to 50 per cent flowering, plant height, number of tillers/plant, earhead length and days to maturity. Considerable variability was found for days to 50 per cent flowering, number of tillers/plant, grain yield per plant (g) and test weight (g). Variability was observed for days to 50 per cent flowering, plant height and grain yield per plant (g).

Wide range of differences for GCV was observed which varied from 5.29 for days to maturity to 35.70 for number of effective tillers/plant indicating considerable amount of variability present among the genotypes. In general, the phenotypic coefficient of variation (PCV) was higher than their corresponding genotypic coefficient of variation (GCV). This suggested the role of environment in the expression of these characters. High estimates of PCV and GCV were observed for characters like number of effective tillers/ plant (35.70 and 36.73), biological yield/plant (25.78 and 28.62), seed yield/plant (25.50 and 29.95) and harvest index (20.87 and 24.68). Selection based on these characters would facilitate successful isolation of desirable pearlmillet genotypes. The difference between estimates of PCV and GCV was also indicative of heritability since the characters with low difference between PCV and GCV like days to 50 per cent flowering, days to maturity, plant height, earhead diameter, number of effective tillers/plant, test weight and protein content would be useful.

TABLE 1
Analysis of variance for different characters of pearlmillet hybrids

Character	Replications (1)	Treatments (29)	Error (29)
Days to 50% flowering	4.81*	20.56**	0.81
Days to maturity	52.28**	29.80**	4.16
Plant height (cm)	2.75	383.33**	18.18
Earhead diameter (cm)	0.008	0.17**	0.003
Earhead length (cm)	4.00	19.64**	8.16
No. of effective tillers/plant	0.05	0.66**	0.01
Test weight (g)	1.83**	2.61**	0.21
Biological yield /plant (g)	366.53	1237.82**	128.85
Harvest index (%)	70.60	133.06**	22.09
Seed yield/ plant	16.53	56.40**	9.00
Protein content (%)	0.66**	3.11**	0.05

*,**Significant at P=0.05 and P=0.01 level, respectively.

TABLE 2
Estimates of range, genotypic and phenotypic coefficient of variation, heritability (broad sense %) and genetic advance of different characters of pearlmillet hybrids

Character	Mean	Range	G. C. V.	P. C. V.	Heritability (%)	Genetic advance	Genetic advance (% of mean)
Days to 50% flowering	51.55	45.00-57.00	6.10	6.34	92.40	6.22	12.06
Days to maturity	67.66	61.50-76.50	5.29	6.09	75.50	6.41	9.47
Plant height (cm)	181.00	142.35-204.95	7.47	7.83	90.90	26.54	14.66
Earhead diameter (cm)	2.60	2.13-3.08	11.09	11.35	95.60	0.58	22.30
Earhead length (cm)	21.70	12.95-28.35	11.04	17.18	41.30	3.17	14.60
No. of effective tillers/plant	1.59	1.00-2.80	35.70	36.73	94.50	1.14	71.69
Test weight (g)	10.28	7.70-12.25	10.65	11.55	84.90	2.08	20.23
Biological yield/plant (g)	91.34	53.00-153.00	25.78	28.62	81.10	43.70	47.84
Harvest index (%)	35.69	23.69-53.45	20.87	24.68	71.50	12.98	36.36
Seed yield/plant (g)	19.09	11.25-38.00	25.50	29.95	72.50	8.54	44.73
Protein content (%)	11.90	9.95-17.70	10.40	10.57	96.70	2.51	21.09

Heritability

The heritability estimates were high for the characters like protein content (96.70), earhead diameter (95.60), number of effective tillers/plant (94.50), days to 50 per cent flowering (92.40), plant height (90.90), test weight (84.90) and biological yield/plant (81.10). Similar results have been reported for number of effective tillers per plant and test weight. Similar results were noticed for earhead diameter, earhead length, number of effective tillers/plant and plant height in pearlmillet, but low heritability was recorded for earhead length (41.30). Similar results were reported by Subi and Idris (2013) for earhead length. High heritability values were also obtained by Tomer *et al*. (1995), Bhoite *et al.* (2008), and Govindaraj *et al*. (2011) in pearlmillet for majority of the above mentioned traits. Thus, based on the present study, characters like protein content, earhead diameter, number of effective tillers/plant, days to 50 per cent flowering, plant height and test weight will aid in a selection programme owing to their high heritability value.

Genetic Advance

In the present study the expected genetic advance showed wide range 0.58 for earhead diameter (cm) to 43.70 for biological yield/plant (g) and genetic advance in terms of per cent of mean ranged from 9.47 for days to maturity to 71.69 for number of effective tillers/plant. Genetic advance was highest for biological yield/plant (g) (43.70) and plant height (cm) (26.54). It was low for earhead diameter (cm) (0.58), number of effective tillers/plant (1.14), test weight (g) (2.08) and protein per cent (2.51). Moderate to high genetic advance for majority of these traits was also reported by Tomer *et al*. (1995), Bhoite *et al*. (2008), and Govindaraj *et al*. (2011). High estimates of coefficient of variation along with high heritability and genetic advance as per cent over mean for number of effective tillers per plant and biological yield per plant are indicative of additive gene action for these two characters which are amenable in population improvement programme in pearlmillet. The high heritability with low genetic advance was observed for the characters like earhead diameter, test weight, protein content and days to 50 per cent flowering. It indicated more influence of non-additive gene effects so selection in later generation will be more effective. Harvest index and seed yield /plant had moderate heritability with moderate genetic advance which indicated both additive and non-additive gene effects. In such a case, recurrent selection and diallele selective mating may be followed. High heritability, low genetic advance and low variability were observed for days to 50 per cent flowering indicating more non-additive gene action. Here, high heritability is due to environment rather than the genotype itself. Selection for such traits will not be rewarding. However, selection in later generations might be more effective.

Correlation Coefficient

Seed yield per plant had positive and non-significant phenotypic correlation with protein content (Table 3). While positive and significant correlation was

observed with earhead length (0.402**), number of effective tillers/plant (0.487**) and biological yield/plant (0.594**). Days to 50 per cent flowering had positive and highly significant phenotypic correlation with days to maturity (0.572**) and also had high genotypic correlation (0.634).

Negative and significant phenotypic correlation was obtained for plant height (-0.333*) and test weight (-0.381*) and similarly, also had high value of negative genotypic correlation. Days to maturity had positive and significant phenotypic correlation with harvest index (0.349*) along with high value of positive genotypic correlation. Negative and significant phenotypic correlations of days to maturity were obtained with plant height (-0.348*) and test weight (-0.438**) and genotypic correlations were also high and negative.Similar findings were also reported by Arya *et al*. (2009a, b) and Choudhary *et al.* (2012).

Plant height (cm) had positive and significant phenotypic correlation with number of effective tillers/ plant (0.387*), test weight (0.458**) and genotypic correlations were also high and positive. Negative and significant phenotypic correlation of plant height was obtained with harvest index (-0.389*) and negative genotypic correlation was also high. Earhead diameter had positive and significant phenotypic correlation with test weight (0.311*) and genotypic correlation was also high (0.339) and positive. Earhead length had positive and significant phenotypic correlations with biological yield/plant (0.341*) and seed yield/plant (0.402*) and similarly, had high value of positive genotypic correlation. Number of effective tillers/plant had positive and highly significant phenotypic correlation with biological yield/ plant (0.682**) and seed yield/plant (0.487**) and genotypic correlation was also high, positive but non-significant phenotypic correlation was present with test weight (0.018). Negative and non-significant phenotypic correlation of number of effective tillers/plant was obtained for protein content (-0.029), but negative significant association was present with harvest index (-0.370*).

Biological yield/plant (g) had positive and non-significant phenotypic correlation with protein content (0.033), positive and highly significant phenotypic correlation was present with seed yield/plant (0.594**) and genotypic correlation was also high (730). Negative

TABLE 3
Estimation of phenotypic (P) and genotypic (G) correlation coefficients for 11 characters in pearlmillet hybrids

Characters		1	2	3	4	5	6	7	8	9	10	11
1. Days to 50% flowering	P	1.000	0.572**	-0.333*	0.071	0.094	0.070	-0.381*	0.079	-0.018	0.138	0.237
	G	1.000	0.634	-0.363	0.087	0.082	0.076	-0.452	0.084	-0.036	0.174	0.253
2. Days to maturity	P		1.000	-0.348*	-0.263	-0.209	0.060	-0.438**	-0.183	0.349*	0.108	-0.049
	G		1.000	-0.383	-0.279	-0.121	0.053	-0.529	-0.279	0.477	0.119	-0.077
3. Plant height (cm)	P			1.000	0.048	0.251	0.387*	0.458**	0.290	-0.389*	0.003	-0.156
	G			1.000	0.096	0.336	0.406	0.516	0.330	-0.440	0.011	-0.176
4. Earhead diameter (cm)	P				1.000	0.138	-0.012	0.311*	0.202	-0.084	0.30	0.062
	G				1.000	0.209	-0.007	0.339	0.247	-0.104	0.369	0.072
5. Earhead length (cm)	P					1.000	0.231	0.262	0.341*	-0.164	0.402*	-0.129
	G					1.000	0.471	0.413	0.533	-0.157	0.765	-0.172
6. No. of effective tillers/plant	P						1.000	0.018	0.682**	-0.370*	0.487**	-0.029
	G						1.000	0.009	0.755	-0.420	0.534	-0.037
7. Test weight (g)	P							1.000	0.087	-0.156	0.068	-0.218
	G							1.000	0.174	-0.178	0.069	-0.251
8. Biological yield/plant (g)	P								1.000	-0.502**	0.594**	0.033
	G								1.000	-0.594	0.730	0.049
9. Harvest index (%)	P									1.000	0.109	-0.088
	G									1.000	0.203	-0.080
10. Seed yield/ plant (g)	P										1.000	0.005
	G										1.000	0.022
11. Protein content (%)	P											1.000
	G											1.000

*,**Significant at P=0.05 and P=0.01 levels, respectively.

and highly significant phenotypic correlation of biological yield/plant was obtained with harvest index (-0.502**) and genotypic correlation was also high. Harvest index had positive and non-significant phenotypic correlation with seed yield/plant (0.109), while negative and non-significant phenotypic correlation was obtained with protein content (-0.088). Above results were supported by Arya *et al.* (2099a, b).

CONCLUSION

On the basis of foregoing discussion, it can be concluded that the characters like biological yield per plant and number of tillers per plant had high estimate of GCV and PCV. It also had high heritability associated with high genetic advance. These also exhibited a strong positive correlation with seed yield. Thus, these should be given due emphasis while making a direct selection through these traits. However, harvest index and seed yield per plant had moderate estimates of GCV, PCV, heritability and genetic advance. Therefore, selection for these characters would also be helpful. In crop improvement, only genetic component of variation is important since only this component is transmitted to the next generation. Genetic coefficient of variation as such does not give the idea of total variation that is heritable. The relative amount of heritable portion of variation can be accessed through heritable estimates. Heritability indicates the effectiveness with which selection for genotypes can be done on the basis of its phenotypic variation. It expresses the extent to which individual phenotypes are determined by their genotypes. These heritability estimates serve as a useful guide to the breeder because selection would be fairly easy for the characters with high heritability.

REFERENCES

Anonymous, 2011 : *Handbook of Agriculture.* ICAR, New Delhi.

Anonymous, 2012 : *Vital Agricultural Statistics.* Directorate of Agriculture, Rajasthan, Jaipur.

Arya, R. K., S. Arya and S. K. Pahuja 2009a : *Forage Res.* **35** : 169-174.

Arya, R. K., H. P. Yadav, Desh Raj, and A. K. Yadav, 2009b : *Agric. Sci. Digest,* **29** : 101-104.

Bhoite, K. D., S. R. Pardeshi, B. M. Mhaske, and M. P. Wagh, 2008 : *Agric. Sci. Digest,* **28** : 115-117.

Choudhary, R., B. L. Jat, R. Anwale, S. R. Dhikwal, and K. C. Sharma, 2012 : *Forage Res.,* **38** : 80-85.

Govindaraj, M., B. Selvi, S. Rajarathinam, and P. Sumathi, 2011 : *Afr. J. Food Agric. Nutr. and Dev.,* **11** (3).

Subi, M. I., and A. E. Idris, 2013 : *British Biotechnol. J.,* **3** : 54-65.

Tomer, N. S., V. S. Kushawaha, and G. P. Singh, 1995 : *J. Soils and Crops,* **5** : 117-120.