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Research article

GENETIC VARIABILITY AND INTER-RELATIONSHIP AMONG MORPHO-ECONOMIC TRAITS OF PEARL MILLET (*Pennisetum glaucum* (L.)R. Br.,) AND THEIR IMPLICATIONS IN SELECTION

Kumari Vinodhana, N*, P. Sumathi and M.Sathya

Department of Millets, Centre for Plant Breeding and Genetics
Tamil Nadu Agricultural University, Coimbatore 641003, Tamil Nadu, India.
Email: soundhini@yahoo.co.in

ABSTRACT: A field experiment was conducted with fifty pearl millet genotypes raised in a randomized block design with two replications at Department of Millets, Tamil Nadu Agricultural University, Coimbatore and the observation was recorded for ten morpho-economic characters. High magnitude of variation in the experimental material of this study was reflected by high values of mean and range for almost all the characters. The results indicated that the genotypes 15010 recorded early flowering (38 days), ICTP 8203 recorded highest mean value for thousand seed weight (14.50g) and seed yield potential (6.50), 5713 for panicle length (53.50 cm) and panicle thickness (10.25mm), 6510 for plant height (330.50cm) and green fodder yield potential (6.50), 18116 for total number of tillers (6.50) and productive tillers (5.00) and 18780 for spikelet density (7.50) which indicated that these genotypes can be selected as a parents in pearl millet improvement programme for the development of elite varieties/hybrids. The PCV and GCV estimates were found to be high for seed yield potential followed by green fodder yield potential, panicle length, spikelet density, thousand seed weight and total number of tillers which suggests that there is enough scope for selection based on these characters. The high heritability combined with high genetic advance was observed for plant height, total number of tillers, panicle length, panicle thickness, spikelet density, 1000 seed weight, green fodder yield potential and seed yield potential which showed that these characters were controlled by additive gene effects and phenotypic selection for these characters were likely to be effective. A perusal of the results obtained in correlation analysis revealed that panicle length, panicle thickness, spikelet density, thousand seed weight and green fodder yield potential had positive correlation with seed yield potential. Hence, selection towards these components will lead to development of dual purpose pearl millet varieties/hybrids.
Key words: Pearl millet, selection, variability, correlation, dual purpose

INTRODUCTION

Pearl Millet [*Pennisetum glaucum* (L.) R. Br.] known as bulrush or cattail millet is a hardy crop that can be grown in very diverse environments from sea level to about 2000 meters at elevation, and is the staple cereal crop for the hottest, most arid regions where dry land agriculture is practiced. It is basically cultivated as a rainfed crop, largely under marginal environment and with no or little external inputs where grain yields vary mostly between 400 and 900 kg ha^{-1} [1]. India, China, Myanmar, Pakistan, and Yemen in Asia, Nigeria, Niger, Burkina Faso, Mali, Sudan, Chad, and Tanzania in Africa are the top countries in each region producing pearl millet grain. In India, It is mainly cultivated in the states of Rajasthan, Maharashtra, Gujarath, Madhya Pradesh, Karnataka, Andhra Pradesh, Uttar Pradesh and Tamil Nadu on a total area of 9.3 million hectare with the production of 9.5 million tonnes. The national average productivity is 1044 kg/ha [2]. Looking to the present situation there is need to increase productivity of pearl millet by utilizing variability and heritability present in genotypes to develop high yielding varieties and hybrids. This is essential for planned heterosis breeding programme to give due weightage to the characters responsible for increased seed yield of hybrids. Also, knowledge of the presence of association among the supplementary characters assumes an unique prominence as the basis for selecting desirable genotypes with high grain yield potential. The characters selected based on their variability parameters and their inter correlation among the morpho-economic traits in pearl millet suggests that simultaneous improvement of both fodder and grain type some extent is possible. Efforts were thus made to get a better picture of the contribution of each component trait in building up the total genetic architecture of complex characters such as seed yield and fodder yield obtained through variability and association analysis.

MATERIALS AND METHODS

The experimental material comprised of fifty germplasm lines collected from various agro-climatic regions of the world were obtained from Department of Millets, Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore, India. The germplasm lines were evaluated in a replicated yield trial with two replications during kharif, 2008 at Department of Millets, Tamil Nadu Agricultural University, Coimbatore. The crop was raised with the row spacing of 45 cm and plant to plant spacing of 15 cm. All the recommended package of practices were carried out. Data was recorded for ten characters *viz.*, days to 50% flowering, plant height (cm), number of productive tillers, total number of tillers, panicle length (cm), panicle thickness (mm), spikelet density (score 1-9), 1000 seed weight (g), green fodder yield potential (score 1-9) and seed yield potential per plant (score 1-9), on five randomly selected plants in each replications. The traits spikelet density, green fodder yield potential and seed yield potential were given the scores from 1-9 as per the descriptors for pearl millet given by IBPGR and ICRISAT [3]. The statistical analysis was carried out for estimating analysis of variance as suggested by [4]. Phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), and heritability in broad sense (h^2) and expected genetic advance (GA) were calculated according to the procedure described by [5]. The genotypic correlation between yield and its component traits and among themselves was worked out as per the methods suggested by [6]. All the data analysis was performed as per the statistical software GENRES.

RESULTS AND DISCUSSSION

Analysis of variation showed mean square due to genotypes was highly significant, indicating that considerable amount of genetic variation existed among the accessions. Large variation among genotypes were found for the traits, days to 50% flowering (38-57 days), plant height (105-330 cm), total number of tillers (2.5-6.5), panicle length (12.5 - 53.5 cm), panicle thickness (4.45-10.25 mm) and 1000 seed weight (2.5 - 15.9 g). This wide range of variation observed for these characters would offer scope of selection for development of desirable genotypes. These significant differences could also be attributed to the composition of the population, which is made up of diverse genotypes in the past. High phenotypic variability, which encompasses genotypic, environmental and G x E interaction components, was evident from the range of values for different characters. Among the fifty genotypes, 15010 recorded early flowering (38 days), ICTP 8203 recorded highest mean value for thousand seed weight (14.50g) and seed yield potential (6.50), 5713 for panicle length (53.50 cm), panicle thickness (10.25mm), 6510 for plant height (330.50cm) and green fodder yield potential (6.50), 11505 and 18116 for total number of tillers (6.50), 18116 for productive tillers (5.00) and 18780 for spikelet density (7.50). These genotypes can be utilized as the parents in the pearl millet improvement program for the development of elite varieties or hybrids.

Genetic variability play a vital role in the improvement of crops since it offers scope for natural and artificial selection to tailor genotypes suitable for diverse agro-ecological conditions. Thus, more the genetic variability in the base material more is the chance of improvement. The variability parameters presented in Table 1, showed highly significant differences among the genotypes for all characters, indicating sufficient variability existed within the genotypes which suggested ample scope for selection of superior genotypes aimed at enhancing genetic yield potential of pearl millet. In this study, the genetic constants for the characters revealed that the magnitude of phenotypic coefficient of variation (PCV) was higher than the genotypic coefficient of variation (GCV) denoting environmental factors influencing their expressions to some degree or other. Narrow difference between PCV and GCV suggested their relative resistance to environmental alteration. It was observed that PCV and GCV were higher for total number of tillers, panicle exertion, panicle length, spikelet density, 1000 seed weight, green fodder yield potential and seed yield potential per plant indicating the possibilities of improving these characters through phenotypic selection for the development of dual purpose hybrids. High amount of GCV and PCV suggested greater scope of selection of superior genotypes for these traits. The determination of heritable portions is not based on only the estimation of PCV and GCV, where the utility of heritability is increased when it is used to estimate genetic advance [8]. The heritability estimates for morpho-economic characters ranged from 45.90 (number of productive tillers) to 98.80 (1000 seed weight). The trait days to 50% flowering exhibited high heritability along with the moderate genetic advance as percent of mean which indicated that the existence of both additive and non-additive genes in equal proportion as indicated by Vidyadhar *et al*. [7]. High heritability (h^2) with high genetic advance indicates the predominance of additive gene action and greater response to phenotypic selection and improvement of such traits could be anticipated [9]. In this study, the high heritability combined with high genetic advance was observed for plant height, total number of tillers, panicle length, panicle thickness, spikelet density, 1000 seed weight, green fodder yield potential and seed yield potential which showed that these characters were controlled by additive gene effects and phenotypic selection for these characters were likely to be effective.

Table 1. Genetic variation among fifty pearl millet genotypes for ten morpho-economic traits

Entries	DTF	PH	PT	TT	PL	PTI	SD	TSW	GFY	SYP
ICTP8203	44.00	147.50	3.50	4.00	22.00	9.30	4.50	14.50	4.50	6.50
18702	50.00	285.00	3.50	3.00	37.50	9.70	4.50	10.70	3.00	4.50
5713	53.00	294.00	3.00	4.00	53.50	10.25	4.00	11.42	4.50	5.50
6869	57.00	202.50	3.00	4.00	12.50	7.45	3.50	2.50	5.50	3.50
15899	50.00	204.00	4.00	4.00	29.50	7.50	4.00	7.48	2.50	3.50
11384	52.00	198.50	4.00	4.00	28.00	7.95	4.50	9.20	4.50	2.50
18657	53.00	220.50	3.50	4.00	24.00	7.65	5.00	9.50	4.50	2.50
10839	50.00	169.50	4.00	4.00	22.50	7.55	5.50	8.20	2.50	2.50
6882	47.00	255.50	4.00	4.00	23.50	6.65	4.00	6.70	3.50	2.50
18780	47.00	204.00	3.00	4.50	28.00	7.70	7.50	6.70	4.50	2.50
Raj 171	43.00	205.00	4.00	4.50	19.50	7.25	5.50	6.90	3.50	1.50
15010	38.00	145.50	3.50	4.00	19.50	6.25	3.50	5.10	3.00	1.50
17144	39.00	105.00	3.50	5.00	21.00	8.90	4.50	8.50	2.50	3.50
19361	47.00	304.00	4.00	4.50	51.50	10.00	4.50	11.20	4.00	2.50
19243	46.00	287.50	2.50	2.50	42.50	8.75	5.50	10.60	4.50	5.50
19229	51.00	280.50	3.00	4.00	30.50	9.10	3.50	6.90	4.50	1.50
17006	51.00	165.00	3.50	3.50	23.50	7.05	3.00	5.60	2.50	1.50
9618	46.00	186.50	3.50	5.00	18.50	7.65	3.50	10.90	3.50	2.50
5272	50.00	256.50	2.50	3.50	43.50	7.05	6.50	7.70	3.50	3.50
11505	53.00	201.50	4.00	6.50	43.00	7.10	3.50	12.10	4.50	3.50
IP 3616	56.00	239.00	2.50	3.00	17.50	6.35	3.50	6.90	3.50	3.50
12248	53.00	201.00	4.00	4.50	42.50	7.80	4.00	9.60	3.50	3.50
3098	54.00	202.50	2.50	3.00	17.50	4.45	3.50	7.36	3.50	2.50
6396	49.00	205.00	3.50	2.50	31.50	8.05	4.00	8.20	2.00	2.50
11537	47.00	209.00	3.50	2.50	27.00	8.25	2.50	6.90	4.50	3.50
18116	47.00	184.50	5.00	6.00	19.50	6.25	3.50	3.48	2.50	1.50
12570	39.00	171.50	3.00	3.50	21.50	6.65	3.50	7.66	3.00	1.50
17080	49.00	252.50	3.00	4.00	32.50	7.10	4.50	8.50	3.50	2.50
10186	50.00	214.00	3.50	5.00	26.00	6.70	4.50	11.60	4.00	6.00
18157	51.00	219.50	2.50	2.50	16.50	8.35	2.50	15.90	2.50	3.50
9720	57.00	201.00	3.00	3.50	20.50	7.00	3.00	9.60	4.00	2.00
3106	47.00	213.00	4.00	4.50	24.00	6.90	2.50	7.20	4.50	2.50
5816	51.00	209.00	3.50	3.50	30.50	6.70	2.50	7.50	3.50	1.50
18722	54.00	187.50	2.50	2.50	25.50	8.60	2.50	6.90	3.50	3.50
9426	42.00	180.00	2.00	2.50	15.50	7.35	2.50	14.30	2.50	2.50
10912	52.00	204.50	2.00	2.50	20.50	7.95	2.50	9.50	3.00	3.50
13900	47.00	176.00	3.50	2.50	19.00	9.90	2.50	8.90	2.50	4.50
16911	50.00	202.50	2.50	2.50	26.50	7.05	2.50	5.50	1.50	1.50
6510	47.00	330.50	3.50	5.00	26.00	9.95	3.50	8.29	7.50	1.50
8562	50.00	186.00	4.00	4.00	22.00	6.70	2.50	6.00	4.50	1.50
3125	40.00	148.00	3.50	4.50	18.00	7.45	1.50	7.40	2.50	1.50
14918	46.00	220.00	3.00	2.50	20.50	6.55	2.50	5.50	7.50	3.50
11310	51.00	164.50	3.00	4.50	23.00	6.80	4.50	6.50	1.50	1.50
14426	51.00	203.50	3.00	4.00	12.50	6.65	6.50	8.50	2.50	4.50
4759	51.00	223.50	3.00	3.00	22.50	8.80	1.50	7.00	3.50	1.50
14148	51.00	183.50	3.00	3.00	22.00	6.60	2.50	9.60	1.50	2.50
12138	55.00	202.00	3.00	3.00	26.50	6.65	1.50	8.20	2.50	3.50
19160	56.00	269.00	3.00	3.50	31.00	8.45	2.50	10.90	2.50	1.50
17407	55.00	255.00	3.00	3.50	37.00	7.05	3.50	9.48	6.50	4.50
6584	51.00	200.50	3.00	2.50	19.50	7.30	3.50	4.70	1.50	1.50
MEAN	**49.00**	**211.52**	**3.27**	**3.72**	**26.17**	**7.62**	**3.66**	**8.40**	**3.54**	**2.88**

PH- Plant height (cm), DTF - Days to 50% flowering (days), NPT- Number of productive tillers, TT-Total number of tillers, PL – Panicle length (cm), PTI – panicle thickness (mm), SD – spikelet density (score), TSW – Thousand seed weight (g), GFY – green fodder yield potential (score) , SYP – Seed yield potential (score)

For efficient approach towards improvement of grain yield selected should be exercised on its components. Association of plant characters with grain yield assumes a special importance in determining as to which traits, the selection should be applied to ultimately obtain high yielding hybrids. The genotypic correlation coefficients between morpho-economic traits clearly indicated (Table 2) that seed yield potential had positive and significant correlation with most of the characters viz., panicle length, panicle thickness, spikelet density, thousand seed weight and green fodder yield potential under study. Similarly, other positive and significant correlations were recorded for plant height with panicle length, panicle thickness and green fodder yield.

Plant height and panicle length were also important yield determinant characters because of their positive and highly significant levels of correlations with yield. Number of productive tillers and earhead length had highly significant positive correlation with plant height, which revealed that tall plants could contribute to fodder characters coupled with yield. This was in agreement with the findings of [10]. Correlation of panicle length with panicle thickness, seed density, 1000 seed weight, green fodder yield potential and seed yield potential suggest that these characters may be of merit while making selections for dual purpose pearl millet with high fodder yield and grain yield, indicating selection criteria should be based on these characters for the development of dual purpose hybrids. These results were in tune with the earlier works in pearl millet [11]. Correlation of days to 50% flowering with productive tillers was negative indicating that it is not possible to achieve a significant improvement in both traits, depending on the intensity of linkage or the degree of trade off between the two traits. This investigation therefore suggest that plant height, grain yield/plant, number of seeds/panicle, should be given maximum consideration as the appropriate selection indices in breeding for dual purpose pearl millet hybrids. This was in agreement with the findings of [12]. The study revealed substantial genetic variability among the genotypes and a scope for improvement through selection where the selection procedure should be formulated in such a way that the advance in one component is not jeopardized by the deterioration effect of the other.

Table 2. Estimation of variability parameters for different morpho-economic traits in pearl millet

Traits	GCV (%)	PCV (%)	ECV (%)	Heritability Broad sense (%)	Genetic advance as % of mean (5%)
Days to 50% flowering (days)	8.98	9.78	3.87	84.20	16.98
Plant height (cm)	19.41	22.30	10.97	75.79	34.82
Number of productive tillers	14.33	21.15	15.56	45.88	19.99
Total number of tillers	22.52	28.41	17.32	62.82	36.77
Panicle length (cm)	35.39	35.72	4.83	98.17	72.24
Panicle thickness (mm)	15.22	15.58	3.35	95.38	30.62
Spikelet density (score)	33.31	37.15	16.44	80.40	61.53
1000 seed weight (g)	31.43	31.61	3.35	98.88	64.39
Green fodder yield potential (score)	35.73	39.83	17.59	80.50	66.04
Seed yield potential (score)	44.98	47.02	13.70	91.50	88.63

Table 3. Correlation of fifty genotypes among ten morpho-economic traits in pearl millet

	PH	PT	TT	PL	PTI	SD	TSW	GFY	SYP
DTF	0.363**	-0.319**	-0.217	0.185	-0.099	-0.089	-0.027	0.129	0.108
PH		-0.268*	-0.068	0.635**	0.434**	0.183	0.181	0.484**	0.138
PT			0.983**	0.217	0.078	0.135	-0.186	0.066	-0.163
TT				0.172	-0.061	0.349**	-0.034	0.186	-0.12
PL					0.408**	0.273*	0.285*	0.239*	0.275*
PTI						0.053	0.393**	0.125	0.279*
SD							0.05	0.05	0.287*
SW								-0.005	0.499**
GFY									0.263*

*Significant at 5%; ** Significant at 1%

PH- Plant height, DTF - Days to 50% flowering, NPT- Number of productive tillers, TT-Total number of tillers, PL – Panicle length, PTI – panicle thickness, SD – spikelet density, TSW – Thousand seed weight, GFY – green fodder yield potential, SYP – Seed yield potential

REFERENCES

[1] Mula R P, Rai K N, Dangaria C J and Kulkarni M P. 2009. Pearl millet as a post-rainy cool season crop: Case Studies from Gujarat and Maharashtra. Indian. Journal of SAT Agricultural Research, 7: 1-7.

[2] AICPMIP Workshop, Project Coordinator Review. Hisar. 12-14 March. 2011.

[3] IBPGR and ICRISAT. 1993. Descriptors for pearl millet [Pennisetum glaucum (L.) R. Br.]. International Board for Plant Genetic Resources, Rome Italy; International Crops Research Instiute for Semi Arid Tropics, Patencheru, India

[4] Panse V G. and Sukhatme P V. 1964. Statistical methods for agricultural workers. 2nd Ed. ICAR., New Delhi.

[5] Singh R K and Chaudhary BD. 1977. Biometrical methods in quantitative genetic analysis. Kalyani publishers, New Delhi, pp: 85-87

[6] Johnson H W, Robinson H F and Comstock R E. 1955. Estimation of genetic variability and environmental variability in soybean. Agronomy Journal 47: 314 - 318.

[7] Vidyadhar B, Chand P and Devi I S. 2006. Genetic variability and character association for yield trails in pearl millet (Pennisetum sp.) germplasm. Journal of Research, ANGRAU., 34: 114-117.

[8] Govindaraj M, Shanmugasundaram P and Muthiah A R. 2010. Estimates of genetic parameters for yield and yield attributes in elite lines and popular cultivars of India's pearl millet. African Journal of Agricultural Research, 5: 3060-3064.

[9] Sumathi P, Madineni S and Veerabadhiran P. 2010. Genetic variability for different biometrical traits in pearl millet genotypes [Pennisetum glaucum (L.) R. Br.]. Electronic Journal of Plant Breeding, 1: 437- 440

[10] Satish P. 2002. Correlation and path analysis in pearl millet (Pennisetum glaucum L) R.Br). Research on Crops 3: 75-77

[11] Salunke P, Dumbre A D and Rajput S D. 2006. Correlation and path analysis in germplasm of pearl millet. (Pennisetum glaucum (L.). Journal of Maharashtra Agricultural University, 3: 16-18.

[12] Yadav O P, Bidinger F R and Singh D V. 2009. Utility of pearl millet landraces in breeding dual-purpose hybrids for arid zone environments of India. Euphytica, 166: 239-247.