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STUDIES ON GENETIC VARIABILITY FOR DIFFERENT BIOMETRICAL TRAITS IN PEARL MILLET [*PENNISETUM GLAUCUM* (L.) R. BR.]

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ABSTRACT
The present investigation was carried out to study genetic variability for different biometrical traits in pearl millet. The experimental material was comprised of 100 advance inbred lines grown in RBD in two replications during *kharif* 2012. The results on genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) of various characters revealed that highest GCV value was expressed in case of dry fodder yield (40.40) followed by grain yield (34.20), ear weight (31.11), total tillers/plant (24.55) and effective tillers/plant (24.36). On the other hand, the highest PCV values were shown by dry fodder yield (40.71) followed by grain yield (35.56), ear weight (32.09), effective tillers/plant (26.99) and total tillers/plant (26.65).The estimates of heritability were very high (>90%) for plant height, spike length, leaf length, ear weight, 1000-grain weight, dry fodder yield and grain yield. Genetic advance expressed as percent of mean was highest for dry fodder yield (82.58) followed by grain yield (67.76) and ear weight (62.11). Inbreds 12-0125 [1660 (M.T.)], 12-0069 (IPS 98-2) and 12-0107 (H 08/004) were found better not only for grain yield but also for its attributing traits.

INTRODUCTION

Pearl millet (*Pennisetum glaucum (L.) R. Br.)* has wide genetic diversity which is of little value unless it is characterized, evaluated and documented properly to enhance its utilization in crop improvement. In order to effectively utilize the available genetic diversity, the material must be properly characterized and catalogued. Progress in any crop improvement venture depends mainly on the magnitude of genetic variability and heritability present in the source material. Genetic variability studies provide basic information regarding the genetic properties of the population based on which breeding methods are formulated for further improvement of the crop. The extent of variability is measured by GCV and PCV which provides information about relative amount of variation in different characters. These studies are also helpful to know about the nature and extent of variability that can be attributed to different causes, sensitive nature of the crop to environmental influences, heritability of the characters and genetic advance that can be realized in practical breeding. Highly diverse genotypes or accessions can be utilized as parents in hybridization programmes to produce superior varieties/ hybrids. Therefore, there is a need to evaluate available genotypes for their genetic diversity. Genetic variability for agronomic traits is the key component of breeding programmes for broadening the gene pool of crops. However, the genetic variability for many traits is limited in cultivated germplasm (Sabu *et al*., 2009). The overall performance of a genotype may vary due to changes in the environment. If the heritability for the traits is higher, the selection process will be simpler and the response to selection will be greater ((Larik *et al*., 1997; Larik *et al*., 2000; Soomro *et al*., 2008). In the present study, variability and other genetic parameters were studied.

MATERIALS AND METHODS

A set of 100 inbreds was sown in randomized block design (RBD) with two replications at the experimental area of the Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar during *kharif*-2012 under irrigated conditions. The plot size was one row of 4m length and spacing between rows was kept at 50 cm and within rows at 12 cm. Normal cultural practices were followed to raise the crop. Observations were recorded for five randomly selected competitive plants for different quantitative characters [Days to 50 percent flowering (days), plant height (cm), spike length (cm), spike girth (cm), number of total tillers per plant, number of effective tillers per plant, leaf length (cm), leaf width (cm), ear weight (g/plant), grain yield (g/plant), dry fodder yield (g/ plot), weight of 1000-grains (g)]. The analysis of variance for randomized block design was carried out for individual characters to test the significance of difference among the genotypes following the method as suggested by Panse and Sukhatme (1967). The averages data recorded were subjected to statistical analysis for estimating parameters of variability, phenotypic and genotypic coefficient of variance using

techniques as per Burton and Devane (1953). The broad sense heritability (H^2) was calculated for all characters using the formula of Hanson *et al*. (1956). The expected genetic advance was calculated for all the traits according to Johnson *et al*. (1955).

RESULTS AND DISCUSSION

The results on analysis of variance for different characters are presented in Table 1. It was evident from the analysis of variance that mean sum of squares were highly significant for all the characters. This indicated the material is diverse for all the characters and the data can be further used for calculating the variability. The utilization of diverse breeding material in the development of these designated inbred lines has resulted into a wide range of variability. For instance, days to 50 per cent flowering ranged from 41 to 59 days, plant height ranged from 117.5 to 228.7 cm, spike length ranged from 13.3 to 28.8 cm, spike girth ranged from 4.7 to 9.3 cm, total tillers per plant ranged from 1.1 to 3.3, effective tillers per plant ranged from 1.0 to 3.3, leaf length ranged from 40.1 to 80.7 cm, leaf width ranged from 1.8 to 4.5 cm, ear weight ranged from 12.8 to 68.5 g, grain yield ranged from 9.0 to 34.5 g, dry fodder yield per plot ranged from 525 to 3962 g and 1000-grain weight ranged from 2.5 to 11.5 g. There were only 3 genotypes, which had more than 3 tillers per plant while most of the remaining had 2-3 effective tillers per plant. Thus immense variability shown among these inbred lines provides ample opportunity to breed hybrid for specific requirement of different agro climatic zones in pearl millet. There were close correspondence between phenotypic and genotypic coefficient of variation in almost all the characters. This indicated that environment had little effect to impact genetic potential of trait expression in most cases. The results revealed by Borkhataria *et al*. (2005), Kumari and Nagarajan (2008), Govindaraj *et al*. (2010) and Dapke et al. (2014) indicated presence of enough variability for various traits in pearl millet confirming the results of this study.

The results on genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) of various characters presented in Table 2 revealed that highest GCV value was expressed in case of dry fodder yield (40.40) followed by grain yield (34.20), ear weight (31.11), total tillers/plant (24.55) and effective tillers/plant (24.36). On the other hand, the highest PCV values were shown by dry fodder yield (40.71) followed by grain yield (35.56), ear weight (32.09), effective tillers/plant (26.99) and total tillers/plant (26.65). Lowest values of GCV were expressed by days to 50% flowering (7.73), spike girth (13.71) and plant height (13.78) In case of PCV lowest values were expressed by days to 50% flowering (8.20), plant height (14.15) and spike girth (14.51).Genotypic coefficient of variation for dry fodder yield, grain yield, ear weight, total tillers/plant and effective tillers/plant were of higher magnitude. It showed that the material possessed sufficient genetic variability. It was obvious that for this reason the selection of better genotypes could be done based on their phenotype. These observations were similar as reported earlier by Kulkarni *et al*. (2000), Sachan and Singh (2001), Solanki *et al*. (2002), Patil and Jadeja (2006) and Arun kumar et al. (2013).

The estimates of heritability were very high (>90%) for plant height, spike length, leaf length, ear weight, 1000-grain weight, dry fodder yield and grain yield. Heritability estimates were higher (80-90 %) for days to 50% flowering, spike girth, total tillers, effective tillers and leaf width. Genetic advance expressed as per cent of mean was highest for dry fodder yield (82.58) followed by grain yield (67.76) and ear weight (62.11). Genetic advance for other traits namely days to 50 % flowering (15.0), plant height (27.63), spike girth (26.68) and leaf length (27.69) have low values. Broad sense heritability estimates determine the importance of genetic effects that may be passed on to the offspring. It was concluded that heritability estimate along with genetic advance is usually more helpful than heritability alone. These observations on heritability (broad sense) across the environments were similar as reported by Kulkarni *et al*. (2000), Lakshmana *et al*. (2003) and Solanki *et al*. (2002).

Top ten inbreds selected on the basis of mean performance of different characters were presented in Table 3. Inbred 12-0125 *i.e.* 1660 (M.T.) was found better for six traits viz., plant height (228.7cm), spike girth (2.67cm), leaf width (4.2cm), ear

Table 1: Analysis of variance for grain yield and its component characters in different Pearl millet inbred lines

Characters Source of variation	Df	Days to 50% flowering	Plant height (cm)	Spike length (cm)	Spike girth (cm)	Total tillers /Plant	Effective tillers/plant
Replication	1	18.58	105.20	0.058	2.21	0.002	0.001
Genotype	99	29.23*	981.83*	27.81*	1.82*	0.588*	0.569*
Error	99	1.73	26.09	0.84	0.10	0.048	0.057
C.D. at 5% level		2.61	10.14	1.82	0.64	0.44	0.47
C.V. (%)		2.74	3.22	4.98	4.75	10.37	11.45

Characters Source of variation	Df	Leaflength (cm)	Leafwidth (cm)	Ear weight (g/plant)	Grain yield (g/plant)	Dry Fodder Yield(g/plot)	1000-grain weight (g)
Replication	1	43.431	0.304	0.30	1.45	10,585.13	0.88
Genotype	99	124.469*	0.599*	258.22*	86.63*	1,070,532.07*	6.24*
Error	99	5.00	0.041	8.05	3.37	8,267.04	0.13
C.D. at 5% level		4.44	0.40	5.63	3.64	8.41	0.72
C.V. (%)		4.05	6.94	7.89	9.74	5.04	5.71

df: Degree of freedom;* Significant at 5% level

Table 2: Estimates of Mean, Range, Genotypic coefficient of variation (GCV), Phenotypic coefficient of variation (PCV), Heritability (broad sense) and Genetic advance (GA) in inbred lines of Pearl millet

Sr. No.	Characters	Mean ± S.E(m)	Range	GCV	PCV	Heritability (Broad sense)	Genetic advance (% Mean)
1	Days to 50 per cent flowering	47.98 ± 0.93	41-59	7.73	8.20	0.89	15.00
2	Plant height (cm)	158.70 ± 3.61	117.5-228.7	13.78	14.15	0.95	27.63
3	Spike length (cm)	18.41 ± 0.65	13.3-28.8	19.95	20.56	0.94	39.87
4	Spike girth (cm)	2.15 ± 0.23	1.5-2.9	13.71	14.51	0.89	26.68
5	Total tillers/ plant	2.12 ± 0.16	1.1-3.3	24.55	26.65	0.85	46.59
6	Effective tillers/ plant	2.08 ± 0.17	1.0-3.3	24.36	26.92	0.82	45.42
7	Leaf length (cm)	55.24 ± 1.58	40.1-80.7	13.99	14.57	0.92	27.69
8	Leaf width (cm)	2.92 ± 0.14	1.8-4.4	18.07	19.36	0.87	34.75
9	Ear weight (g/plant)	35.95 ± 2.01	12.8-68.5	31.11	32.09	0.94	62.11
10	Grain yield (g/plant)	18.87 ± 1.30	9.0-34.5	34.20	35.56	0.93	67.76
11	Dry Fodder Yield (g/plot)	1804.02 ± 64.29	525-3962.5	40.40	40.71	0.99	82.58
12	1000- grains weight(g)	6.37 ± 0.26	2.5-11.7	27.41	28.00	0.96	55.28

Table 3: Best Ten inbreds selected on the basis of mean performance of all characters

Sr. No.	Characters	Inbreds
1	D.F. (50%)	12-0045(41),12-0068(41),12-0090(41),12-0117(42),12-0112(42),12-0089(42),12-0071(42),12-0047(42), 12-0072(42.5),12-0059(42.5)
2	Plant height (cm)	12-0125(228.7),12-0053(212.2),12-0069(208.1),12-0028(205.5),12-0002(205.3),12-0022(200.3),12-0055 (199.5),12-0080(195.3),12-0056(192.0),12-0091 (191.6)
3	Spike length (cm)	12-0032(28.8),12-0022(28.6),12-0038(27.9)),12-0035(27.5),12-0029(26.3),12-0021(26.1),12-0004(25.5), 12-0031(25.1),12-0020(24.99),12-0019(24.7)
4	Spike girth (cm)	12-0047(2.9),12-0090(2.8),12-0118(2.8)),12-0107(2.8),12-0009(2.8), 12-0012(2.7),12-0125(2.7),12-0048 (2.7),12-0069(2.6),12-0121(2.6)
5	Total tillers/ plant	12-0114(3.3),12-0034(3.3),12-0092(3.1)),12-0011(3.1),12-0107(3.0), 12-0072(3.0),12-0096(3.0),12-0108 (3.0),12-0069(2.9),12-0098(2.9)
6	Effective tillers/ plant	12-0114(3.3),12-0034(3.1),12-0092(3.1)),12-0011(3.0),12-0107(3.0) 12-0096(3.0),12-0108(3.0),12-0069 (2.9),12-0026(2.9),12-0098(2.8)
7	Leaf length (cm)	12-0022(80.7),12-0078(72.7),12-0056(71.6)),12-0029(69.5),12-0054(68.5) 12-0023(68.4),12-0073(68.2), 12-0035(67.4),12-0077(67.3),12-0025(67.3)
8	Leaf width (cm)	12-0036(4.5),12-0038(4.4),12-0125(4.2)),12-0004(4.1),12-0069(4.0) 12-0056(4.0),12-0019(4.0),12-0053 (3.9),12-0022(3.9),12-0035(3.9)
9	Ear weight (g/plant)	12-0125(68.5),12-0118(67.5),12-0120(58.8)),12-0114(56.5),12-0111(55.8) 12-0103(53.8),12-0105(53.2), 12-0116(51.0),12-0053(50.0),12-0108(49.5)
10	Grain yield (g/plant)	12-0103(34.5),12-0116(34.0),12-0111(33.5)),12-0101(33.5),12-0053(32.0) 12-0125(31.0),12-0121(29.5), 12-0080(29.0),12-0078(29.0),12-0047(29.0)
11	DFY (g/plot)	12-0116(3962.5),12-0053(3783),12-0125(3406)),12-0121(3400),12-0078(3325) 12-0047(3262.5),12-0118 (3062.5),12-0111(3042.0),12-0103(3016.0),12-0080(2906.5)
12	Test weight(g)	12-0042(11.7),12-0038(10.9),12-0006(10.4)),12-0063(10.1),12-0008(9.4) 12-0107(9.2),12-0092(9.0),12-0103(9.0),12-0012(8.4),12-0032(8.4)

weight (68.5g), grain yield (31.0g) and dry fodder yield 3406(g/plot). Inbred 12-0069 i.e. IPS 98-2 was also found better for five traits viz., plant height (208.1cm), spike girth (2.67cm), total tillers (2.9), effective tillers (2.9) and leaf width (4.0cm). Inbred 12-0053 *i.e.* H 08/004 was found better for five traits viz., plant height (212.2cm), leaf width (3.9cm), ear weight (50.0g), grain yield (32.0g) and dry fodder yield (3783 g/plot). Inbred 12-0103 i.e. H 08/014 was found better for four traits viz., ear weight (53.8cm), grain yield (34.5g), dry fodder yield (3016g/plot) and 1000-grains weight (9.0g). Inbred 12-0107 i.e. 72-2-2 was found better for three traits viz., spike girth (2.8 cm), total tillers (3.0) and effective tillers (3.0). Based on overall results, it is concluded that Inbreds 12-0125 [1660 (M.T.)], 12-0069 (IPS 98-2) and 12-0107 (H 08/004) were found better not only for grain yield but also for its attributing traits viz., plant height, spike girth, total tillers per plant, effective tillers per plant , leaf width, ear weight and dry fodder yield. These inbreds can be used in further breeding programme to improve grain yield and its component characters in pearl millet.

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