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SUDIES ON ESTIMATES OF GENETIC VARIABILITY AND CHARACTER ASSOCIATION OF YIELD COMPONENTS AND PROTEIN CONTENT IN PEARLMILLET

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SUMMARY

Fifty genotypes of pearlmillet (including 3 checks viz. Raj-171, ICTP-3616, ICTP 8203) were evaluated for genetic variability and character association between grain yield and its different morphological characters in Randomized Block Design during **kharif** season, 2007. The analysis of variance indicated significant variability among genotypes for all the characters studied. The association analysis revealed that grain yield per plot had significant positive correlation at phenotypic level with plant height, productive tillers per plant, ear girth, dry fodder yield per plant, test weight, harvest index and grain yield per plant. The grain yield per plant also significantly and positively associated with these traits and these traits were also associated significantly and positively among themselves. However, days to heading was negatively associated with grain yield per plot, grain yield per plant, test weight, dry fodder yield per plant, ear girth and plant height and dry fodder yield per plant also negatively associated with harvest index. suggested that in breeding programme, major emphasis should be given to plant height, productive tillers per plant, ear girth, dry fodder yield per plant, test weight and harvest index(%) as they had positive correlation coefficients with grain yield with high direct effect and they also had high genetic variability. The path analysis revealed that dry fodder yield/plant and harvest index is the major contributors towards the grain yield/plant. Hence, main emphasis should be given in breeding programme.

Key words : Genetic variability, GCV, PCV, heritability, genetic advance, character association, pearl millet

Pearlmillet [*Pennisetum glaucum* (L.) R. Br. emend Stuntz] having chromosome no. 2n=14 is an annual allogamous crop belonging to the family Graminae. It is robust and quick growing rainy season cereal crop with large stem, leaves, heads, tall and vigours, with very high grain yield potential. In semi-arid tropical regions, it is cultivated as dual purpose crop when grown in a mono crop system. Whereas, mature ears are harvested for grain and stover for bovine feed. In India pearl millet, is grown in Rajasthan, Western part of Gujarat, Haryana and Western Uttar Pradesh.

In the world, pearl millet ranks sixth in importance following wheat, rice, maize, barley and sorghum. It is extensively cultivated as dual purpose crop over large part in Africa, Asia and Australia. India and Africa together account 92.3% of world pearlmillet production. Production and productivity of pearlmillet in India are increasing inspite of reduction in area planted to this crop. It is the fourth most important food crop mostly grown in the arid and semi arid regions, particularly in the north western parts of the country (Anonymous, 2007).

As a food crop, pearl millet grain possesses the highest amount of calories per 100 g (Burton *et al.*,1972) which is mainly supplied by carbohydrates, fats and proteins (Flech, 1981).Its mineral content is also comparable with other cereals.Even though pearl millet grain is considered good for human diet, it has an anti-

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nutritonal compound phytate phosphorous called as myo-inositol hexakisphosphate and which is the most important storage form of phosphorous in cereal grains constituting about 60-80 percent of seed total phosphorous (Common, 1940).

The estimates of variability are very useful for devising suitable selection strategy for evolving high yielding genotypes. The estimates of genotypic and phenotypic correlation coefficients of grain yield/plant with its component characters indicated some interesting relationship, which would help in formulation of selection scheme for further improvement. Keeping the above facts in view, the proposed study was undertaken.

MATERIALS AND METHODS

The experimental material for the present study consisted of 50 genotypes of diverse origin obtained from ICRISAT, Hydrabad including three checks namely Raj-171, ICTP-3616, ICTP 8203 collected from Agricultural Research Station, Durgapura, Jaipur. All the fifty genotypes including checks were evaluated during ***kharif*** of year 2007 in Randomized Block Design with three replications at Horticulture Research Farm, Asalpur-Jobner. In each replication every genotype was sown in 4 m row spaced at 45 cm apart. Plant to plant distance 15 cm was maintained by thinning/transplanting at 3 leaf stage. The crop was raised with recommended package of practices. Ten plants were randomly selected from each genotype in each replication avoiding border plants. Every care was taken to select only competitive plants. Plants were tagged before initiation of ear emergence for recording the observations on the following morphological characters at maturity except the days to heading.

The data on days to heading were recorded on whole plot basis. The mean value of ten plants for each character was computed and recorded as plot mean value for days to heading, plant height (cm), productive tillers per plant, ear length (cm), ear girth (cm), grain yield per plant(g),grain yield per plot (kg), harvest index (%), dry fodder yield per plant (g), test weight (g), and protein content (%). Statistical analysis of data was carried out for each character as described by Panse and Sukhatme (1967). The correlation coefficient analysis was done by using formula of Al-Jibouri *et al.* (1958). Path coefficients analysis was carried out according Dewey and Lu (1959). Genotypic nd phenotypic coefficient of variation was estimated as suggested by Burton (1952).

RESULT AND DISCUSSION

A breeding programme depends on proper management of genetic variability present in the basic breeding material. The high magnitude of variability in a population provides the opportunity of selection to evolve a genotype having desirable characters. The phenotypic variability seen in individuals is composed of genotypic and environmental components. In fact, the genotypic components are ultimately useful in utilizing this variability in breeding programme.

Genetic Variation

Mean performance along standard error and range is the basic criteria for selection of diverse

TABLE 1
Mean, range, genotypic and phenotypic coefficient of variation, heritability (bs) and genetic advance as percentage of mean for different characters in pearl millet

Character	Mean	Range	Genotypic variance	Phenotypic variance	GCV (%)	PCV (%)	Heritability (%)	GA	GAM
Days to heading	64.31	56.67-75.33	18.99	26.136	6.776	7.949	72.657	7.652	11.898
Plant height (cm)	132.52	94.00-180.57	336.16	395.365	13.835	15.004	85.026	34.827	26.280
Productive tiller /plant	2.43	1.34-3.13	0.26	0.274	20.894	21.565	93.877	1.013	41.704
Ear length (cm)	21.28	17.57-30.07	7.31	8.972	12.708	14.077	81.492	5.028	23.632
Ear girth (cm)	6.59	5.70-8.50	0.21	0.521	6.990	10.951	40.749	0.606	9.192
Grain yield / plant (g)	27.28	19.00-39.20	21.86	24.365	17.141	18.096	89.724	9.124	33.447
Grain yield /plot (kg)	0.660	0.413-0.997	0.02	0.018	19.306	20.226	91.104	0.249	37.959
Dry fodder yield / plant (g)	73.16	45.26-95.95	195.60	211.638	19.118	19.886	92.424	27.698	37.862
Test weight (g)	7.21	3.68-12.56	5.36	5.562	32.119	32.718	96.371	4.682	64.953
Harvest index	27.38	21.54-35.43	10.03	11.818	11.568	12.554	84.914	6.013	21.960
Protein content (%)	10.37	9.17-11.92	0.43	0.714	6.360	8.150	60.906	1.060	10.225

TABLE 2

Genotypic and phenotypic correlation coefficient matrix for different characters of pearl millet

Character		Plant height (cm)	Productive tillers/ plant	Ear length (cm)	Ear girth (cm)	Dry fodder yield/plant (g)	Test weight	Harvest index	Protein content (%)	Grain yield/ plant (g)	Grain yield/ plot (kg)
Days to heading	G	-0.376	-0.164	0.023	-0.297	-0.432	-0.486	-0.010	-0.021	-0.524	-0.516
	P	-0.310**	-0.132	0.005	-0.172*	-0.346**	-0.410**	-0.027	-0.016	-0.427**	-0.419**
Plant height (cm)	G		0.045	0.438	0.140	0.230	0.309	0.031	-0.120	0.312	0.346
	P		0.030	0.356**	0.180*	0.204*	0.287**	0.033	-0.096	0.274**	0.306**
Productive tillers per plant	G			0.079	0.082	0.153	0.246	0.050	0.019	0.226	0.226
	P			0.063	0.051	0.184*	0.233**	0.028	0.022	0.236**	0.241**
Ear length (cm)	G				-0.156	0.143	-0.003	-0.130	-0.091	0.014	0.038
	P				-0.083	0.132	-0.008	-0.121	-0.018	0.002	0.007
Ear girth (cm)	G					0.021	0.331	0.258	0.078	0.277	0.222
	P					0.036	0.215**	0.140	0.050	0.176*	0.178*
Dry fodder yield per plant (g)	G						0.615	-0.577	0.219	0.620	0.551
	P						0.590**	-0.566**	0.165*	0.591**	0.536**
Test weight	G							0.300	0.129	1.000	0.960
	P							0.243**	0.109	0.930**	0.902**
Harvest index	G								-0.131	0.273	0.328
	P								-0.068	0.318**	0.287**
Protein content (%)	G									0.137	0.122
	P									0.123	0.093
Grain yield per plant (g)	G										0.979
	P										0.912**

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

TABLE 3

Direct and indirect effects of component characters on grain yield per plant in pearl millet

Character		Days to heading	Plant height (cm)	Productive tillers/ plant	Ear length (cm)	Ear girth (cm)	Dry fodder yield/plant (g)	Test weight	Harvest index	Protein content (%)	Correlation with grain yield/plant
Days to heading	P	-0.0019	-0.0057	0.0000	-0.0002	0.0025	-0.3393	-0.0597	-0.0232	-0.0001	-0.4277**
	G	0.0352	-0.0197	-0.0023	-0.0016	-0.0069	-0.7040	0.1888	-0.0142	0.0000	-0.5248
Plant height (cm)	P	0.0006	0.0185	0.0000	-0.0114	-0.0026	0.2003	0.0418	0.0279	-0.0005	0.2746**
	G	-0.0133	0.0523	0.0007	-0.0304	0.0033	0.3792	-0.1199	0.0412	-0.0002	0.3127
Productive tiller per plant	P	0.0002	0.0006	0.0002	-0.0020	-0.0007	0.1804	0.0340	0.0237	0.0001	0.2364**
	G	-0.0058	0.0024	0.0142	-0.0055	0.0019	0.2496	-0.0957	0.0657	0.0000	0.2268
Ear length (cm)	P	0.0000	0.0066	0.0000	-0.0319	0.0012	0.1292	-0.0013	-0.1018	-0.0001	0.0020
	G	0.0008	0.0229	0.0011	-0.0695	-0.0036	0.2335	0.0012	-0.1716	-0.0002	0.0146
Ear girth (cm)	P	0.0003	0.0033	0.0000	0.0026	-0.0145	0.0355	0.0314	0.1176	0.0003	0.1766*
	G	-0.0105	0.0073	0.0012	0.0109	0.0233	0.0347	-0.1284	0.3391	0.0002	0.2778
Dry fodder yield per plant (g)	P	0.0006	0.0038	0.0000	-0.0042	-0.0005	0.9786	0.0860	-0.4739	0.0008	0.5913**
	G	-0.0152	0.0122	0.0022	-0.0100	0.0005	1.6286	-0.2385	-0.7596	0.0004	0.6205
Test weight	P	0.0008	0.0053	0.0000	0.0003	-0.0031	0.5776	0.1457	0.2032	0.0006	0.9303**
	G	-0.0171	0.0162	0.0035	0.0002	0.0077	1.0015	-0.3879	0.3946	0.0003	1.0190
Harvest index	P	0.0001	0.0006	0.0000	0.0039	-0.0020	-0.5548	0.0354	0.8359	-0.0003	0.3187**
	G	-0.0004	0.0016	0.0007	0.0091	0.0060	-0.9412	—0.1164	1.3144	-0.0003	0.2735
Protein content (%)	P	0.0000	-0.0018	0.0000	0.0006	-0.0007	0.1618	0.0160	-0.0571	0.0051	0.1239
	G	-0.0008	-0.0063	0.0003	0.0064	0.0018	0.3568	-0.0501	-0.1729	0.0020	0.1371

Residual effect : phenotypic =0.1247 and genotypic =0.1354.

genotypes. Therefore, considering the mean performance of genotypes for different characters studied, the genotypes genotypes IP-506-3, IP-181-1, IP-118-1, IP-460-2 and IP-181-1 were found promising. Similarly, on the basis of grain yield mean performance, Arya *et al.* (2009a) also indentified the top 10 genotypes in a comparative study of pearlmillet genotypes. The analysis of genetic variation indicated significant differences for all the characters studied. The differences in the magnitude genotypic level were negligible for most of the characters. Arya *et al*. (2009b) also reported sufficient genetic variation among pearlmillet genotypes for all the traits.

The average difference in the mean genotypic and phenotypic values of the genotypes is quantified by genotypic and phenotypic variances, respectively. These parameters cannot be used for a comparative assessment of variation for different characters. To obviate these difficulties, genotypic and phenotypic coefficients of variation (GCV and PCV) were calculated. PCV were higher than GCV for all the characters. This indicated the positive effect of environment in enhancing differences among the genotypes at phenotypic level. The estimates of GCV and PCV were high for test weight, productive tillers per plant, grain yield per plot, dry fodder yield per plant and grain yield per plant. Whereas, plant height, ear length and harvest index have moderate GCV and PCV values. This indicated that selective breeding could lead to appreciable improvement in these traits. These findings were similar to the earlier reports of Sandhu and Phul (1984), Kunjir and Patil (1986), Sastry *et al*. (1987), Saraswathi *et al*. (1995), Berwal and Khairwal (1997) and Bhatnagar *et al*. (1999), Varu *et al.* (2005), Aruselvi *et al*. (2007).

Correlation Coefficient

In general, the estimates of genotypic correlation coefficient were higher for most of the characters then phenotypic correlation coefficient, indicating a strong inherent association among various characters. Grain yield per plot showed significant positive correlation at phenotypic levels with plant height, productive tillers per plant, ear girth, dry fodder yield per plant, test weight, harvest index and grain yield per plant. While, days to heading had negative significant correlation with grain yield per plot. It had non-significant correlation with ear length and protein content. The grain yield per plant showed significant positive correlation at phenotypic level with plant height, productive tillers per plant, ear girth, dry fodder yield per plant, test weight and harvest index. While the days to heading had negative significant correlation with grain yield per plant. Above results were supported by Kulkarni *et al*. (2000), Chaudhary *et al*. (2007), Arya *et al*. (2009b & c), Yadav *et al.* (2012) and Abuali *et al.* (2012).

Among the different pairs of morphological quality characters, it was observed that at phenotypic level, days to heading had negative and significant association with test weight, dry fodder yield per plant, ear girth and plant height. Plant height showed significant positive correlation with test weight, dry fodder yield per plant, ear girth and ear length. Productive tillers per plant showed positive and significant correlation with test weight and dry fodder yield per plant. Ear girth showed positive correlation with test weight only. Dry fodder yield per plant showed positive correlation with protein content and test weight, while, negative significant correlation with harvest index. Test weight showed positive correlation with harvest index only. Kulkarni *et al*. (2000), Chaudhry *et al*. (2003) and Abuali *et al.* (2012).

Path Coefficient Analysis

It is apparent that many of the characters are correlated because of a mutual association, positive or negative with other characters. Path coefficient analysis proved an effective mean of separating direct and indirect causes of association and permits critical evaluation of specific forces acting to produce a given correlation and measure the relative importance of each causal factor.

Path coefficient analysis (Table 3) reflected that dry fodder yield/plant registered the highest direct and positive effect on grain yield/plant and followed by harvest index. However, the test weight exhibited direct negative effect, but contributed positive indirect effect via dry fodder yield/plant. Moreover, plant height and productive tillers/plant was not reflecting any direct effect, but contributing indirectly via dry fodder yield/ plant.

Correlation studies showed a high positive correlation of grain yield/plant with dry fodder yield/ plant, and harvest index. Therefore, selection for the improvement of the grain yield/plant based upon these characters will be effective. Path coefficient analysis further revealed that dry fodder yield/plant, and harvest index had positive direct effect on grain yield. The plant height, productive tillers/plant and test weight were another characters, which had sufficient effect via dry fodder yield/plant. Thus, these characters should be given importance while breeding for higher grain yield.

CONCLUSION

Based on the mean performance of the genotypes IP-506-3, IP-181-1, IP-118-1, IP-460-2 and IP-181-1 were found top yielders. These genotypes may be utilized in further breeding. The grain yield per plot was positively and significant association with plant height, productive tillers per plant, ear girth, dry fodder yield per plant, test weight, harvest index and grain yield per plant The concluded that number of productive tillers per plant, test weight, plant height and ear girth are the important grain yield determiners. Path analysis further revealed that dry fodder yield/plant, and harvest index had positive direct effect on grain yield. As grain yield is a complex character, thus, for genetic improvement understanding of correlation within its contributing characters is highly helpful to develop high yielding desirable genotypes.

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