Forage Res., **39** (4) : pp. 175-178 (2014) **http://forageresearch.in**

STUDIES ON VARIABILITY AND CHARACTER ASSOCIATION UNDER RAINFED CONDITIONS IN PEARL MILLET (*PENNISETUM GLAUCUM* L.) HYBRIDS

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(Received : 21 February 2014; Accepted : 27 March 2014)

SUMMARY

A set of 26 pearl millet hybrids was evaluated in randomized block design (RBD) with three replications during **kharif** 2012 at CCSHAU Regional Research Station, Bawal under rainfed conditions. The objectives of the investigation were to estimate the genetic parameters, correlation and path coefficient analysis for yield and its component traits viz., days to 50 per cent flowering, days to maturity, plant height (cm), ear length (cm), ear girth (cm), 1000-seed weight (g), productive tillers per plant, plant population per plot, dry fodder yield (kg/plot) and grain yield (kg/plot). Significant differences were observed among the hybrids for all the characters studied. Phenotypic and genotypic coefficients of variation were recorded highest in dry fodder yield followed by productive tillers per plant, grain yield and 1000-seed weight. Estimates of heritability in broad sense ranged from 26 per cent for plant population to 99 per cent for 1000-seed weight, while grain yield showed 75 per cent heritability. Moderate to high heritability coupled with high genetic advance as per cent of mean was observed for 1000-seed weight, grain yield, dry fodder yield, plant height, productive tillers per plant and ear length indicating the importance of these traits in selection and crop improvement. Correlation studies revealed that the traits, namely, plant height, ear length, productive tillers per plant and dry fodder yield exhibited significant positive phenotypic correlation with grain yield. Dry fodder yield, productive tillers per plant and ear length showed highest positive direct effect on grain yield at phenotypic level. Hence, main emphasis should be given to these traits in breeding programme for development of high yielding pearl millet hybrids under rainfed conditions.

Key words : Genetic variability, correlation coefficient, path analysis, pearl millet

Pearl millet [*Pennisetum glaucum* (L.) R. Br.] is a major warm season cereal crop of rainfed region. It is not only important as a grain crop, but is an indispensable source of dry fodder in dry tracts of South-Western Haryana, Gujarat and Rajasthan. It can withstand drought to a great extent and also responds well to good management and high fertility levels. Pearl millet is generally grown in area where environmental conditions, especially rainfall, temperature and soil fertility, are too harsh to grow other cereals. Globally it ranks 6th cereal crop in importance after wheat, rice, maize, barley and sorghum, while in India, it is fourth most important cereal crop after rice, wheat and sorghum. In India, pearl millet occupied an area of 7.95 mha with production and productivity of 8.79 mt and 1106 kg/ha, respectively (Anonymous, 2014). The grains of pearl millet 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, fat, carbohydrate and also has good amount of minerals, particularly phosphorus and iron. Its fodder is free from dhurrin, the cyanogenic glycoside found in sorghum and hence can be fed at all stages of crop growth.

Genetic reconstruction of a plant type is required for developing high yielding genotypes by incorporating and improving yield components. Therefore, evaluation of genotypes for genetic variability is essential for present

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as well as for future crop improvement programmes. Moreover, proper utilization of genotypes requires testing of genetic potential under targeted environment for which the breeding programme is aimed. Thus, keeping in view the above, the present investigation was undertaken to study genetic variability, correlation and path analysis in pearl millet hybrids under rainfed conditions.

MATERIALS AND METHODS

Twenty-six pearl millet hybrids including three checks, namely, HHB-67 Improved, HHB-197 and HHB-226 were evaluated in randomized block design with three replications at CCSHAU Regional Research Station, Bawal (28.1° N, 76.5°E and 266 m ASL) during **kharif** 2012 under rainfed conditions. Each hybrid was sown by hand plough in four rows with a plot size of 4 x 1.8 m^2. All the recommended package of practices for pearl millet were followed as per rainfed conditions to raise a healthy crop. Observations were recorded on five randomly selected competitive plants of each hybrid from each replication for yield and its component traits viz., days to 50 per cent flowering, days to maturity, plant height (cm), ear length (cm), ear girth (cm), 1000-seed weight (g), productive tillers per plant, plant population per plot, dry fodder yield (kg/plot) and grain yield (kg/plot).

The mean performance of each hybrid was subjected for statistical analysis. Genotypic and phenotype coefficients of variation (GCV and PCV) were calculated by formula given by Burton (1952), heritability in broad sense by Burton and Vane (1953) and genetic advance given by Johnson *et al.* (1955). Correlation coefficients between different characters and path coefficients were calculated as per Al-Jibouri *et al.* (1958) and Dewey and Lu (1959), respectively.

RESULTS AND DISCUSSION

Estimates of Variability

The estimates of variability parameters for yield and its component traits in 26 pearl millet hybrids are presented in Table 1. The analysis of variance for all the characters under study revealed significant differences thereby indicating presence of substantial genetic variation among the hybrids. Phenotypic and genotypic coefficients of variation were recorded highest in dry fodder yield followed by productive tillers per plant, grain yield, 1000-seed weight, plant height and ear length, indicating availability of sufficient variation and thus exhibited scope for genetic improvement through selection for all these traits. However, days to flowering and maturity exhibited least phenotypic and genotypic coefficients of variation. Similar findings were also reported by Lakshmana *et al.* (2010) and Chaudhary *et al*. (2012) in pearl millet. These values alone are not helpful in determining the heritable portion of variation. The proportion of genetic variability which is transmitted from parents to offspring is reflected by heritability. Estimates of heritability in broad sense ranged from 26 per cent for plant population to 99 per cent for 1000-seed weight, while grain yield showed 75 per cent

TABLE 1
Estimates of variability parameters for different characters in pearl millet

Character	Mean±SE (d)	Range	Coefficients of variation (%)		Heritability (bs) (%)	Genetic advance (% of mean)
			PCV	GCV		
Days to 50% flowering	43.62±0.63	38.67-49.67	6.10	5.84	92	11.52
Days to maturity	66.82±0.89	62.00-72.00	3.66	3.28	80	6.04
Plant height (cm)	189.03±9.63	147.00-250.67	12.76	11.13	76	19.99
Ear length (cm)	20.62±0.93	17.67-29.22	11.19	9.74	76	17.46
Ear girth (cm)	9.65±0.37	8.55-11.72	8.79	7.42	71	12.89
1000-seed weight (g)	9.92±0.13	7.27-13.47	15.57	15.48	99	31.73
Productive tillers/plant	1.79±0.18	1.33-2.33	17.91	13.00	53	19.44
Plant population/plot	79.53±5.96	65.67-91.67	10.71	5.51	26	5.84
Dry fodder yield (kg/plot)	4.05±0.39	3.17-5.50	18.75	14.66	61	23.60
Grain yield (kg/plot)	2.53±0.18	1.71-3.42	17.52	15.15	75	26.97

heritability. Moderate to high heritability coupled with high genetic advance as per cent of mean was observed for 1000-seed weight, grain yield, dry fodder yield, plant height, productive tillers per plant and ear length indicating predominance of additive gene action in the inheritance of these characters. The present findings corroborate the earlier report of Choudhary *et al*. (2012) in a study on variability and character association in pearl millet. Lakshmana *et al*. (2010) reported high heritability for 1000-seed weight with high genetic advance in pearl millet.

Correlation Coefficient

Correlation coefficient analysis measures natural relation between various plant traits and determines the component characters on which selection can be used for genetic improvement in yield. Phenotypic correlation coefficients between studied traits are depicted in Table 2. The results revealed that traits, namely, plant height, ear length, productive tillers per plant and dry fodder yield exhibited significant positive correlation with grain yield. The positive correlation of grain yield with these characters implies that improving one or more of these traits could result in higher grain yield for pearl millet.

Days to flowering showed positive and significant correlation with days to maturity, plant height, ear length and girth, 1000-seed weight and dry fodder yield. However, it registered significant negative correlation with plant population. Further, the results of correlation coefficient implied the significant positive association for days to maturity with plant height, ear length and girth and 1000-seed weight. Similarly, positive and significant correlation was found for plant height

TABLE 2
Phenotypic correlation coefficients among 10 characters in pearl millet

Characters	Days to 50% flowering	Days to maturity	Plant height (cm)	Ear length (cm)	Ear girth (cm)	1000-seed weight (g)	Productive tillers/ plant	Plant population/ plot	Dry fodder yield (kg/plot)	Grain yield (kg/plot)
Days to 50% flowering	1.000									
Days to maturity	0.676**	1.000								
Plant height (cm)	0.629**	0.539**	1.000							
Ear length (cm)	0.383**	0.510**	0.671**	1.000						
Ear girth (cm)	0.331**	0.235*	0.154	0.138	1.000					
1000-seed weight (g)	0.439**	0.248*	0.306**	0.235*	0.385**	1.000				
Productive tillers/plant	-0.129	0.001	0.080	0.075	-0.048	-0.156	1.000			
Plant population/plot	-0.310**	-0.154	-0.085	-0.047	-0.125	-0.145	0.024	1.000		
Dry fodder yield (kg/plot)	0.319**	0.095	0.417**	0.246*	-0.050	0.101	0.030	0.164	1.000	
Grain yield (kg/plot)	0.108	0.035	0.324**	0.324**	0.101	0.051	0.324**	-0.017	0.439**	1.000

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

TABLE 3
Direct (diagonal) and indirect effects of different characters on grain yield at phenotypic level in pearl millet

Characters	Days to 50% flowering	Days to maturity	Plant height (cm)	Ear length (cm)	Ear girth (cm)	1000-seed weight (g)	Productive tillers/ plant	Plant population/ plot	Dry fodder yield (kg/plot)	rp with grain yield (kg/plot)
Days to 50% flowering	-0.119	-0.098	0.062	0.089	0.051	-0.009	-0.036	0.036	0.132	0.108
Days to maturity	-0.080	-0.145	0.053	0.119	0.036	-0.005	0.000	0.018	0.039	0.035
Plant height (cm)	-0.075	-0.078	0.099	0.156	0.024	-0.006	0.022	0.010	0.172	0.324**
Ear length (cm)	-0.045	-0.074	0.066	0.233	0.021	-0.005	0.021	0.005	0.101	0.324**
Ear girth (cm)	-0.039	-0.034	0.015	0.032	0.154	-0.007	-0.013	0.014	-0.020	0.101
1000-seed weight (g)	-0.052	-0.036	0.030	0.055	0.059	-0.019	-0.043	0.017	0.042	0.051
Productive tillers/plant	0.015	0.000	0.008	0.017	-0.007	0.003	0.278	-0.003	0.012	0.324**
Plant population/plot	0.037	0.022	-0.008	-0.011	-0.019	0.003	0.007	-0.115	0.068	-0.017
Dry fodder yield (kg/plot)	-0.038	-0.014	0.041	0.057	-0.008	-0.002	0.008	-0.019	0.413	0.439**

rp : phenotypic correlation. *, **Significant at P=0.05 and P=0.01 levels, respectively.

and ear length with 1000-seed weight and dry fodder yield; plant height with ear length; ear girth with 1000-seed weight, thereby indicating that these traits may be improved simultaneously. These findings are in accordance with the results of Vidyadhar *et al.* (2007), Choudhary *et al*. (2012) and Dhakar *et al.* (2012).

Path Coefficient

Path coefficient provides an effective way of finding direct and indirect sources of correlation. Direct and indirect effects of these components determined on grain yield at phenotypic level are presented in Table 3. The results of path coefficient analysis revealed that dry fodder yield (0.413) exerted the highest positive direct effect on grain yield followed by productive tillers per plant (0.278), ear length (0.233), ear girth (0.154) and plant height (0.099), which support the findings of Choudhary *et al*. (2012) and Dhakar *et al.* (2012). Therefore, these characters could be considered as main components for selection in a breeding programme for higher grain yield. The positive direct contribution of dry fodder yield, productive tillers and plant height towards grain yield in pearl millet was also reported by Ram *et al.* (2007). Path analysis further revealed that though plant height had low direct effect but it highly contributed to grain yield *via* dry fodder yield and ear length.

The present study thus suggests that besides dry fodder yield, productive tillers per plant and ear length, plant height should be taken into consideration in breeding programmes for higher grain yield in pearl millet under rainfed conditions.

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