Original Research Article

Association Study of Grain Yield and Nutritional Quality Traits in Pearl Millet [*Pennisetum glaucum* (L.) R. Br.] Hybrids

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A B S T R A C T

Genetics of quality parameters and their associations with grain yield and its component traits have a direct bearing on devising effective strategies for breeding biofortified crop cultivars. A newly developed 54 hybrids of pearl millet showed large genetic variability for yield and nutritional traits. Correlation studies revealed that single plant yield has positive significant correlation with the agronomic traits *viz.*, plant height, number of productive tillers, test weight, single head grain weight and quality traits *viz.*, crude fiber, beta carotene and iron whereas the trait days to fifty per cent flowering alone was recorded negatively significant correlation with single plant yield. It is therefore inferred that simple selection will be effective against positively correlated characters. There is no correlation between grain zinc and yield which suggests that, there is possibility of selection for increased grain zinc content without reducing the grain yield. Maximum direct effect on grain yield was contributed by single head grain weight which is positive and highly significant followed by single head grain weight and number of productive tillers. Results of this present study put forward the way to the development of biofortified cultivars.

Introduction

Pearl millet is an important coarse grain cereal adapted to the arid and semi-arid tropical areas of Africa and the Indian subcontinent with 200-800 mm annual rainfall, where no other cereal crop can be grown successfully. India is one of the largest producers in Asia. Pearl millet [*Pennisetum glaucum* (L.) R. Br.] belongs to the family Poaceae (graminae) and genus *Pennisetum*. It is a highly cross-pollinated crop with protogynous flowering and wind borne pollination mechanism, which

fulfils the essential biological requirement for hybrid development. Pearl millet remains as the major source of nutritious food for poorest people in semi-arid regions of tropical and sub-tropical countries. The ultimate aim of the plant breeding programs is improvement of productivity which measured in terms of yield per unit area. The complex nature of yield is associated with yield contributing characters which are interrelated among them. Such interdependence of the contributory features often affects their direct relationship with yield, thereby making correlation coefficients

unpredictable as selection indices (Khairwal *et al.,* 1999).

Materials and Methods

The trial was carried out in randomized block design (RBD) with three replications under the prevailing environmental conditions at department of millets, TNAU, Coimbatore, lies between 11° North latitude and 77° East longitude. Each genotype was represented by 3 rows of 5 m length with 45 cm between rows and 15 cm between plants. Till the harvesting, all the recommended inputs and cultural practices including fertilizer, irrigation, hoeing and pest control were followed. The genetic material used in this study was received from Department of Millets, TNAU. A total of fifty four newly developed hybrids were utilized for the present study. Variability analysis was carried out for the newly developed fifty four hybrids for thirteen characters which include eight biometric and five quality traits *viz.*, days to fifty per cent flowering, plant height, number of productive tillers/plant, earhead length, earhead girth, test weight, single head grain weight, single plant yield, crude protein, crude fiber, beta carotene, iron and zinc. The observation was recorded for nutritional traits *viz.*, protein content (N x 6.25) using microkjeldahl method (Jackson 1973). The zinc and iron contents were determined by using Atomic absorption spectrophotometer (Humphries 1956) at the department of environmental sciences, TNAU, Coimbatore. Crude protein and crude fiber content were estimated at the Department of Forage crops, Centre for Plant Breeding and Genetics. All the statistical analysis was done by using TNAUSTAT statistical software.

Results and Discussion

Results of phenotypic and genotypic correlation for yield and nutritional traits were presented in the table 1. Phenotypic correlation was higher than genotypic correlation for all the characters studied, which shows that environment also plays an important roles for the trait expression.

The traits plant height (0.2379), number of productive tillers per plant (0.6308), test weight (0.8792) and single head grain weight (0.8401) were significantly positive correlation with single plant yield. These results were conformity with the earlier results of Hepziba *et al.,* (1993), Tomer *et al.,* (1995), Poongodi and Palanisamy (1995), Anarase *et al.,* (2001), Khan *et al.,* (2002) and Govindaraj *et al.,* (2009).

In the case of nutritional traits *viz.*, crude fiber (0.2343), beta carotene (0.5065) and iron (0.4107) content also recorded positively significant association with single plant yield and it can be improved without harming the yield. Whereas the character days to fifty per cent flowering (-0.2760) recorded significantly negative correlation with single plant yield. This result has conformity with the previous works of Govil *et al.,* (1982), Izge *et al.,* (2006) and Vetriventhan *et al.,* (2007).

The quality traits *viz.*, crude protein and zinc had no correlation with single plant yield and these findings have similarity with Arya *et al.,* (2009). Contrast results also reported by (Virk, 1988 and Choudhary, 2003) as negative significant correlation of grain yield with quality parameters.

In the case of inter correlation resulted that, association between the traits plant height, earhead length, single head grain weight, crude fibre, beta carotene and iron were positively significant and which indicates that selection for these traits in the early generation will work out. The results were in agreement with findings of Azhaguvel (1997) and Latha and Shanmugasundaram (1998).

Table.1 Genotypic correlation analysis for thirteen traits of hybrids

	DFF	PH	NPT	EHL	EHG	TW	SHW	CP	CF	BC	FE	ZN	SPY
DFF		-0.1286	-0.2827*	0.1210	0.0126	-0.2963**	-0.1661	0.0683	-0.1605	-0.1552	-0.3469**	-0.0773	-0.2760*
PH	-0.1175		-0.3129**	0.6929**	0.3814**	0.0917	0.4756**	-0.1789	0.2652*	0.4192**	0.2905*	0.1145	0.2379*
NPT	-0.2239*	-0.2628*		-0.4809**	-0.1796	0.5792**	0.1423	0.0366	0.0285	0.2470*	0.0980	-0.0949	0.6308**
EHL	0.1933	0.6135**	-0.3514**		0.3557**	0.1128	0.5482**	-0.1230	0.2379*	0.3318**	0.1376	0.1762	0.1985
EHG	0.0202	0.3324**	-0.1383	0.3073**		0.0642	0.1534	-0.2571*	0.0166	0.2623*	0.1808	0.0975	0.0950
TW	-0.2797*	0.0858	0.4943**	0.1046	0.0797		0.6902**	0.0033	0.2971**	0.4771**	0.3301**	0.1351	0.8792**
SHW	-0.1485	0.4436**	-0.0344	0.4691**	0.1305	0.6360**		-0.0326	0.2392*	0.3835**	0.4078**	0.2264*	0.8401**
CP	0.0669	-0.1733	0.0301	-0.1102	-0.2190*	0.0016	-0.0313		-0.0973	0.0240	0.0389	0.0685	0.0037
CF	-0.1531	0.2569*	-0.0265	0.2080	0.0037	0.2926*	0.2282*	-0.0964		0.1867	0.1207	0.0952	0.2343*
BC	-0.1506	0.4069**	0.1957	0.2966**	0.2305*	0.4622**	0.3551**	0.0233	0.1838		0.2548*	0.0946	0.5065**
FE	-0.2917*	0.2496*	0.0491	0.1060	0.1322	0.2822*	0.3527**	0.0295	0.1081	0.2282*		0.3609**	0.4107**
ZN	-0.0613	0.0931	-0.0565	0.1295	0.0664	0.1278	0.1864	0.0622	0.0940	0.0951	0.3201**		0.1496
SPY	-0.2616*	0.2270*	0.5575**	0.1827	0.0905	0.8685**	0.7745**	0.0036	0.2295*	0.4893**	0.3588**	0.1389	

** Significant at 1 per cent level; * Significant at 5 per cent level. Upper diagonal indicates genotypic correlation and down diagonal indicates phenotypic correlation
DFF: Days to fifty per cent flowering, PH: plant height, NPT: Number of productive tillers, EHL: Ear head length, EHG: Ear head girth, TW: Test weight, SWG: Single head grain weight, CP: Crude protein, CF: Crude fibre, BC: Beta carotene, FE: Iron, ZN: Zinc, SPY: Single plant yield

Table.2 Genotypic path analysis with dependent variables

	DFF	PH	NPT	EHL	EHG	TW	SHW	CP	CF	BC	FE	ZN	Genotypic correlation
DFF	**0.0286**	-0.0017	-0.1384	0.0016	0.0007	-0.0327	-0.1043	0.0016	-0.0079	-0.0080	-0.0149	-0.0004	-0.2760*
PH	-0.0037	**0.0132**	-0.1532	0.0090	0.0201	0.0101	0.2986	-0.0041	0.0131	0.0216	0.0125	0.0006	0.2379*
NPT	-0.0081	-0.0041	**0.4897**	-0.0062	-0.0095	0.0639	0.0893	0.0008	-0.0014	0.0127	0.0042	-0.0005	0.6308**
EHL	0.0035	0.0092	-0.2355	**0.0130**	0.0188	0.0124	0.3443	-0.0028	0.0117	0.0171	0.0059	0.0010	0.1985
EHG	0.0004	0.0050	-0.0879	0.0046	**0.0528**	0.0071	0.0963	-0.0059	0.0008	0.0135	0.0078	0.0005	0.0950
TW	-0.0085	0.0012	0.2836	0.0015	0.0034	**0.1103**	0.4335	0.0001	0.0146	0.0246	0.0142	0.0007	0.8792**
SHW	-0.0047	0.0063	0.0697	0.0071	0.0081	0.0761	**0.6280**	-0.0007	0.0118	0.0198	0.0175	0.0012	0.8401**
CP	0.0020	-0.0024	0.0179	-0.0016	-0.0136	0.0004	-0.0205	**0.0229**	-0.0048	0.0012	0.0017	0.0004	0.0037
CF	-0.0046	0.0035	-0.0140	0.0031	0.0009	0.0328	0.1502	-0.0022	**0.0493**	0.0096	0.0052	0.0005	0.2343*
BC	-0.0044	0.0055	0.1209	0.0043	0.0138	0.0526	0.2409	0.0006	0.0092	**0.0516**	0.0110	0.0005	0.5065**
FE	-0.0099	0.0038	0.0480	0.0018	0.0095	0.0364	0.2561	0.0009	0.0059	0.0131	**0.0430**	0.0020	0.4107**
ZN	-0.0022	0.0015	-0.0464	0.0023	0.0051	0.0149	0.1422	0.0016	0.0047	0.0049	0.0155	**0.0055**	0.1496

** Significant at 1 per cent level; * Significant at 5 per cent level. Residual effect = 0.218
DFF: Days to fifty per cent flowering, PH: plant height, NPT: Number of productive tillers, EHL: Ear head length, EHG: Ear head girth, TW: Test weight, SWG: Single head grain weight, CP: Crude protein, CF: Crude fibre, BC: Beta carotene, FE: Iron, ZN: Zinc, SPY: Single plant yield

Results of path coefficient analysis are presented in the table 2. The correlation study measures the relationship between pairs of traits. Whereas, dependent traits are an interaction with mutually associated components. The path analysis takes into account the cause and effect relationship between the variables by partitioning the association into direct and indirect effects through other independent variables. The direct and indirect associations on grain yield were carried out using coefficient of all the traits with grain yield plant per plant. In this study, the response variable grain yield and other twelve variables, path analysis was possible to categorize plant characteristics according to magnitude of their effect on grain yield.

The path analysis revealed that, plant height had moderate positive direct effect followed by crude fiber on grain yield. High positive effect was observed for the traits *viz*., number of productive tillers per plant and single head grain weight its indirect effect through other observed characters were also positive. It was confirmed by Hepziba *et al.,* (1993) and Poongodi and Palanisamy (1995) for the influence of traits like number of productive tillers. Similarly, days to fifty per cent flowering had positive direct effect, but had negative association with grain yield per plant.

Low positive effect was obtained for the trait test weight which also had positive and highly significant association with single plant yield. From the present study point toward that an ideal pearl millet plant should have significant number of productive tillers, test weight and single head grain weight since they expressed significant correlation with maximum direct effect on grain yield per plant. Selection based on these traits may be helpful in development of efficient breeding programme.

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