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Character association and path coefficient analysis in finger millet (*Eleusine coracana* (L.) Gaertn) genotypes under sodic condition

K Keerthana, S Chitra, A Subramanian and M Elangovan

Abstract
The present investigation was carried out with the objective to assess the character association and magnitude of direct and indirect effects of yield component traits on grain yield of 120 finger millet germplasm accessions which were grown under sodic conditions during *Kharif* 2018. Correlation analysis revealed that the grain yield per plant was positively and significantly correlated with number of productive tillers per plant, number of tillers per plant, straw yield per plant, plant height, 1000 grain weight, days to 50% flowering and days to maturity. Path analysis showed that the high magnitude of direct effect of number of productive tillers per plant, days to 50% flowering, finger length, plant height and 1000 grain weight along with significant correlation in the desirable direction towards grain yield per plant which indicated the true relationship of these characters with grain yield per plant. Hence, these characters are best considered for yield improvement in finger millet.

Keywords: Finger millet, correlation, path analysis

Introduction

Finger millet (*Eleusine coracana* (L.) Gaertn) is one of the most important minor millet grown in arid and semi-arid regions after sorghum and pearl millet. It is widely cultivated in Africa and South Asia which is a rich source of seed protein, fibre and minerals such as iron, calcium and manganese (Upadhyaya *et al.,* 2010) [15]. It is considered as an ideal crop for changing food habits of people due to its nutritional richness, high photosynthetic efficiency and good resistance to biotic and abiotic stresses.

The genetic potential of finger millet serves as an indispensable resource for understanding their tolerance to abiotic stresses through selection. The efficiency of selection for yield mainly depends on the direction and magnitude of association between yield and its component characters and among themselves. The character association provides information on the nature and extent of association between pairs of metric traits and helps in selection for the improvement of the character. Correlation gives only the relation between two variables whereas, path coefficient analysis allows separation of the direct and indirect effects through other attributes by partitioning the correlations (Wright, 1921) [16]. Hence, the present investigation was carried out with the objective to study the correlation and path coefficient analysis in finger millet.

Materials and Methods

The experiment was conducted during *Kharif* 2018 at Anbil Dharmalingam Agricultural College and Research Institute, Trichy under sodic conditions. The experimental material consisted of 120 finger millet genotypes which were raised in randomized block design with two replications. The observations such as plant height, flag leaf length, earhead length, finger length, number of fingers per earhead, number of tillers per plant, number of productive tillers per plant, 1000 grain weight, Na^+/K^+ ratio, straw yield per plant and grain yield per plant were recorded from five randomly chosen plants in each genotype and in each replication while the traits days to 50% flowering and days to maturity were recorded on each genotype. The mean of the five randomly selected plants were analysed statistically. The genotypic and phenotypic correlation coefficients were analysed as per the method suggested by Al- Jibouri *et al.* (1958) [2] while the path analysis was carried out as suggested by Dewey and Lu (1959) [4].

Results and Discussion

Trait association

In the present study, the phenotypic and genotypic correlation coefficients between important yield components varied from being significantly positive to significantly negative besides being non significant for many character pairs. This revealed the presence of proper balance between yield and its components of finger millet genotypes used in present study.

Genotypic correlations in general were higher than phenotypic correlations which might be due to genes governing two traits were similar and the environmental conditions pertaining to the expression of these traits might have similar and small effects. The genotypic correlations coefficients between different characters were generally similar in direction and nature to the corresponding phenotypic correlation coefficients in the experiment. However, genotypic correlations were higher in magnitude than the corresponding phenotypic values. The same result was obtained by Misra *et al*. (2008) [8], Ali *et al*. (2013) [1] and Suryanarayana *et al*. (2014) [14] for yield and its component traits in finger millet.

In the present investigation, the highest positive and significant correlation with grain yield was recorded by number of productive tillers per plant (0.6610, 05957) followed by number of tillers per plant (0.5595, 0.5250), straw yield per plant (0.4611, 0.4490), plant height (0.3793, 0.3681), 1000 grain weight (0.2526, 0.2298), days to 50% flowering (0.1994, 0.1969) and days to maturity (0.1863, 0.1831) at genotypic and phenotypic levels. Similar results were reported by Shinde *et al*. (2014) [11], Bezaweletaw *et al*. (2006) [3], Jadhav *et al*. (2014), Sneha *et al*. (2019) [13], Negi *et al*. (2016) [9] for number of productive tillers per plant, Singh *et al*. (1995) [12], Sneha *et al*. (2019) [13], Kumar *et al*. (2015) for number of tillers per plant, John and Kumar (2018) for straw yield per plant, Singh *et al*. (1995) [12], Negi *et al*. (2016) [9], Jadhav *et al*. (2014), Bezaweletaw *et al*. (2006) [3], Jadhav *et al*.(2014), Sneha *et al*. (2019) [13], Kumar *et al*. (2015) for days to 50% flowering and Jadhav *et al*. (2018), Sneha *et al*. (2019) [13], Negi *et al*. (2016) [9] for days to maturity.

Significant negative correlation was recorded by Na+/K+ ratios (-0.8128, -0.7897) with grain yield which showed that the increase in Na+/K+ ratio may relate indirectly to decrease in yield. The negative relationship between high Na+/K+ ratio and salinity tolerance revealed it as a best indicator of growth and yield under salt stress. Whereas, the traits flag leaf length (-0.0247, -0.0218) and number of finger per earhead (-0.0226, -0.0213) showed negative non significant association with grain yield per plant at both genotypic and phenotypic levels. Similar results were found by Padmaja (2006) [10] and Jadhav *et al*. (2015) [5] for both protein and calcium content.

In any crop species, the leaves and other green tissues are the original source of assimilates (source). The flag leaf is considered as the closest source of grain yield. In the present study with an increase in productive tillers per plant, the grain yield increase due to more grains weight but due to negative flag leaf area association the result indicates that flag leaf area is not a main contributor for increasing grain yield.

These results indicated that as the tillering capacity increases with plant height, finger length and 1000 grain weight would also increase. This can probably be explained as the available resources were used for production of profuse vegetative growth that may be used as a source for production that should be stored in the seeds (Sink).

Path analysis

Path analysis studies revealed that out of twelve characters studied, the characters number of productive tillers per plant, days to 50% flowering, finger length and 1000 grain weight showed true relationship with grain yield per plant by establishing significant positive association and high positive direct effect. Whereas, the character straw yield had positive direct effect but showed negative association. This may be due to high negative indirect effect of other characters which contributed to negative correlation with grain yield.

The results of path analysis showed that, the direct effects of straw yield, number of tillers per plant, earhead length and days to maturity are negative and the correlation coefficient are significantly positive at genotypic level. While it had positive indirect effects through other characters which seem to be the cause for positive correlation. Hence, these indirect characters through which the direct characters are showing positive indirect effect are to be considered simultaneously during selection process for the improvement of the dependent variable grain yield per plant.

Considering the nature and magnitude of character association and their direct effects, it can be inferred that number of productive tillers per plant followed by days to 50% flowering, finger length and 1000 grain weight could serve as important traits in any selection programme for selecting high yielding genotypes in finger millet.

Conclusion

From the present study, it is concluded that the number of productive tillers per plant, days to 50% flowering, finger length and 1000 grain weight influenced the grain yield more than any other characters studied in the present investigation. Hence, it would be worth to lay more emphasis on these characters in selection programme to improve the grain yield of finger millet.

Table 1: Genotypic (G) and Phenotypic (P) Correlation coefficient of yield and yield components in finger millet genotypes

S. No	Character		DFF	DM	PH	FLL	EL	FL	NOF	NOT	NOPT	TW	Na+/K+	SY	GY
1.	DFF	G	1.000	0.8830**	0.4864**	0.0790	0.3666**	0.4976**	-0.0932	0.2439**	0.2174*	0.2627**	-0.0967	0.2556**	0.1994*
		P	1.000	0.8755**	0.4789**	0.0714	0.3613**	0.4308**	-0.0942	0.2223*	0.1879*	0.2481**	-0.0919	0.2481**	0.1969*
2.	DM	G		1.000	0.3797**	0.0002	0.3268**	0.3940**	-0.0495	0.2699**	0.2419**	0.3026**	-0.1366	0.2598**	0.1863*
7		P		1.000	0.3749 **	-0.0004	0.3222 **	0.3349 **	-0.0480	0.2208 *	0.2153 *	0.2840**	-0.1315	0.2527 **	0.1831*
3.	PH	G			1.000	0.2592**	0.3789**	0.5258**	-0.1366	0.2615**	0.3460**	0.2434**	-0.2720**	0.2573**	0.3793**
		P			1.000	0.2460**	0.3750**	0.4503**	-0.1354	0.2467**	0.3094**	0.2271*	-0.2671**	0.2521**	0.3681 **
4.	FLL	G				1.000	0.1684	0.1956*	-0.0866	-0.1122	-0.0176	-0.0245	0.0536	-0.0866	-0.0247
		P				1.000	0.1588	0.1541	-0.0856	-0.1104	-0.0058	-0.0290	0.0538	-0.0845	-0.0218
5.	EL	G					1.000	0.7616**	0.1918*	0.0202	0.0740	0.1920*	-0.2226*	0.0371	0.2048*
		P					1.000	0.6573**	0.1899*	0.0195	0.0653	0.1833*	-0.2184*	0.0351	0.2030*
6.	FL	G						1.000	0.0902	0.0203	0.0396	0.2204*	-0.1412	0.0275	0.1953*
		P						1.000	0.0863	0.0419	0.0616	0.1521	-0.1156	0.0260	0.1636

7.	NOF	G							1.000	0.0725	0.0481	-0.1737	0.0248	0.1215	-0.0226
		P							1.000	0.0681	0.0437	-0.1657	0.0243	0.1177	-0.0213
8.	NOT	G								1.000	0.9361**	0.1519	-0.4436**	0.8840**	0.5595**
		P								1.000	0.8669**	0.1328	-0.4097**	0.8593**	0.5250**
9.	NOPT	G									1.000	0.1418	-0.5300**	0.8735**	0.6610**
		P									1.000	0.1183	-0.4647**	0.7987**	0.5957**
10.	TW	G										1.000	-0.2488**	0.0459	0.2526**
		P										1.000	-0.2364**	0.0406	0.2298*
11.	Na+/K+	G											1.000	-0.3406**	-0.8128**
		P											1.000	-0.3316**	-0.7897**
12.	SY	G												1.000	0.4611**
		P												1.000	0.4490**
13.	GY	G													1.000
		P													1.000

* Significant at 5% level ** Significant at 1% level DFF- Days to 50% flowering, DM – Days to maturity, PH – Plant height, FLL – Flag leaf length, EL – Earhead length, FIN L – Finger length, NOF – No. of fingers per earhead, NOT – No. of tillers per plant, NOPT – No. of productive tillers per plant, TW – 1000 grain weight, Na+/K+ - Na+/K+ ratio, SY – Straw yield per plant, GY – Grain yield per plant

Table 2: Direct and indirect effects of yield components on grain yield at genotypic level in finger millet genotypes

S. No.	Characters	DFF	DM	PH	FLL	EL	FIN L	NOF	NOT	NOPT	TW	Na^+/K^+	SY	Correlation
1	DFF	0.1948	-0.1502	0.0185	-0.0061	-0.0273	0.0536	-0.0013	-0.0551	0.1503	0.0086	0.0568	-0.0432	0.1994*
2	DM	0.1720	-0.1701	0.0145	0.0000	-0.0244	0.0425	-0.0007	-0.0609	0.1672	0.0099	0.0803	-0.0439	0.1863
3	PH	0.0947	-0.0646	0.0381	-0.0200	-0.0283	0.0567	-0.0019	-0.0590	0.2392	0.0079	0.1599	-0.0435	0.3793**
4	FLL	0.0154	0.0000	0.0099	-0.0771	-0.0126	0.0211	-0.0012	0.0253	0.0122	-0.0008	-0.0315	0.0146	-0.0247
5	EL	0.0714	-0.0556	0.0144	-0.0130	-0.0746	0.0821	0.0027	-0.0046	0.0512	0.0063	0.1308	-0.0063	0.2048*
6	FIN L	0.0969	-0.0670	0.0200	-0.0151	-0.0568	0.1078	0.0013	-0.0046	0.0274	0.0072	0.0829	-0.0047	0.1953*
7	NOF	-0.0182	0.0084	-0.0052	0.0068	-0.0143	0.0097	0.0140	-0.0164	0.0332	-0.0057	-0.0146	-0.0205	-0.0226
8	NOT	0.0475	-0.0459	0.0100	0.0087	-0.0015	0.0022	0.0010	-0.2258	0.6472	0.0049	0.2607	-0.1493	0.5596**
9	NOPT	0.0423	-0.0411	0.0132	-0.0014	-0.0055	0.0043	0.0007	-0.2113	0.6914	0.0046	0.3114	-0.1475	0.6610**
10	TW	0.0512	-0.0515	0.0093	0.0019	-0.0143	0.0238	-0.0024	-0.0343	0.0980	0.0326	0.1462	-0.0077	0.2526**
11	Na^+/K^+	-0.0188	0.0232	-0.0104	-0.0041	0.0166	-0.0152	0.0003	0.1002	-0.3664	-0.0081	-0.5876	0.0575	-0.8128**
12	SY	0.0498	-0.0442	0.0098	0.0067	-0.0028	0.0030	0.0017	-0.1996	0.6039	0.0015	0.2002	-0.1689	0.4611**

Residual effect = 0.4821

DFF- Days to 50% flowering, DM – Days to maturity, PH – Plant height, FLL – Flag leaf length, EL – Earhead length, FIN L – Finger length, NOF – No. of fingers per earhead, NOT – No. of tillers per plant, NOPT – No. of productive tillers per plant, TW – 1000 grain weight, Na+/K+ - Na+/K+ ratio, SY – Straw yield per plant, GY – Grain yield per plant.

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