Electronic Journal of Plant Breeding, 6(2): 535-539 (June 2015)
ISSN 0975-928X

Research Note

Character association and path coefficient analysis for grain yield and yield components in finger millet (*Eleusine coracana* (L.) Gaertn.)

Rani Jadhav, D. Ratna Babu*, Lal Ahamed M. and V. Srinivasa Rao
[1]Department of Genetics and Plant Breeding Bapatla Agricultural College, Bapatla-522 101.
[2]Department of Statistics and Mathematics, Agricultural College, Bapatla Agricultural College, Bapatla-522 101.
Email: didlaratnababu@gmail.com

(Received: 13 Oct 2014; Accepted:7 Nov 2014)

Abstract
An investigation was carried out to assess the character association and the magnitude of direct and indirect effects of yield component traits on grain yield of finger millet for 11 characters *viz.*, days to 50% flowering, days to maturity, plant height (cm), number of productive tillers per plant, number of fingers per ear, finger length (cm), ear weight per plant (g), 1000-seed weight (g), seed protein content (%), seed calcium content (mg/100gm) and seed yield per plant (g). Character association studies revealed that, traits like 1000-seed weight, number of fingers per ear, ear weight per plant, finger length, days to maturity, productive tillers per plant, days to 50% flowering and plant height were found to possess significant positive association with seed yield per plant at both genotypic and phenotypic levels. Further, path analysis studies revealed that 1000-seed weight, number of fingers per ear, days to maturity, ear weight per plant, finger length and days to 50% flowering showed true relationship with seed yield per plant by establishing significant positive association and high positive direct effect.

Keywords
Finger millet**,** character association, path analysis, yield.

Finger millet (*Eleusine coracana* Gaertn.) is one of the important food crops and largely grown in southern states of India. In India, it is cultivated on 1.3 M ha, with a production of 1.59 Mt and a productivity of 1.7 t ha^{-1} while in Andhra Pradesh it is grown in an area of 41,000 ha with a production of 45,000 t and a productivity of 1.19 t ha^{-1} (Ministry of Agriculture, 2013). It is commonly famous as "Nutritious millet" as the grains are nutritionally superior to many cereals. It contains protein (7-10%), calcium (344 mg/100 g), iron and other minerals. It is also rich in phosphorus (283 mg/100 g) and potassium (408 mg/100 g). Yield is a complex character and dependent on many component traits. Hence it is necessary to have knowledge on the extent of association between yield and yield contributing characters. Therefore, correlation studies are of considerable importance in any selection programmes as they provide relationship between two or more component characters. But to know the direct effects of each independent variable on yield and indirect effects through other characters of each variable, path coefficient analysis has to be performed. In the present study, path analysis was used to work out the direct and indirect effects of yield contributing characters on yield using 40 genotypes of finger millet.

Forty genotypes were evaluated during *kharif* 2013 at Agricultural College Farm, Bapatla in a Randomized Block Design with three replications. The seeds were directly sown by dibbling. Each genotype was represented by four rows of 3m length. The spacing of 20 cm between rows and 10 cm between the plants was followed. Observations were recorded on ten randomly chosen plants for eleven quantitative characters *viz*., plant height, days to 50% flowering, days to maturity, number of productive tillers per plant, fingers per ear, finger length, ear weight per plant, 1000-seed weight, seed protein content, seed calcium content and seed yield per plant. The data were subjected to statistical analysis and estimates of correlation coefficients were worked out as per Snedecor and Cochran, (1967). Direct and indirect effects of yield components on yield were calculated as suggested by Dewey and Lu (1959).

Genotypic correlations in general were higher than phenotypic correlations indicating that the apparent associations are largely due to genetic reasons. The traits, 1000-seed weight, number of fingers per ear, ear weight per plant, finger length, days to maturity, productive tillers per plant, days to 50% flowering and plant height were found to possess significant positive association with seed yield per plant at both genotypic and phenotypic levels (Table 1). These results were in accordance with findings of Srilakshmi (2013) for 1000-seed weight, number of finger per ear, finger length, days to maturity, productive tillers per plant and days to 50% flowering, Muduli *et al.* (2012) for ear weight per plant and Haradari *et al.* (2012) for plant height. The trait protein and calcium content showed negative non-significant association with seed yield per plant at both genotypic and phenotypic levels. Similar results were found by

Padmaja (2006) for both protein and calcium content.

The result of path analysis showed that, the direct effects of plant height are negative and the correlation coefficients are significantly positive at both phenotypic and genotypic level. Similar results were reported by Bendale *et al.* (2002). While it had positive indirect effects via days to maturity, fingers per ear, 1000-seed weight, ear weight per plant, finger length and days to 50% flowering at both genotypic and phenotypic levels which seem to be the cause for positive correlation. Hence, these characters through which plant height is showing positive indirect effect are to be considered simultaneously during the selection process for the improvement of the dependent variable seed yield per plant. The character days to 50% flowering recorded positive direct effects as well as significant positive correlation coefficients with seed yield per plant both at genotypic and phenotypic level. Similar results were recorded by Reddy *et al.* (1994), Bendale *et al.* (2002) and Anuradha and Suryakumari (2005). Further, this trait also recorded positive indirect effects via fingers per ear, days to maturity, 1000-seed weight, ear weight per plant and finger length at both genotypic and phenotypic levels. Hence, for improvement of seed yield per plant simultaneous selection of these characters along with days to 50% flowering should be carried out.

Days to maturity recorded positive direct effect coupled with positive correlation on seed yield per plant both at genotypic and phenotypic levels. These results are in accordance with Lal *et al*. (1996). The indirect effects via 1000-seed weight, fingers per ear, ear weight per plant, finger length and days to 50% flowering were also positive. Therefore along with days to maturity, the causal factors which had positive indirect effects on seed yield per plant may be considered simultaneously during the process of selection. Productive tillers per plant showed negative direct effects coupled with highly significant positive association on seed yield per plant at both phenotypic and genotypic levels. These findings were in agreement with the results of Bendale *et al*. (2002) and Anuradha and Suryakumari (2005). This type of correlation does not explains the true relationship and direct selection through this trait will not be rewarding. In such situations the casual factors showing positive indirect effects on seed yield per plant viz., fingers per ear, 1000-seed weight, ear weight per plant, days to maturity and finger length which are responsible for positive correlation. Therefore these traits are to be considered simultaneously in selection process for improvement of the dependent variable.

Fingers per ear showed positive direct effects coupled with highly significant positive association on seed yield per plant at both phenotypic and genotypic levels. These findings were in agreement with the results of Reddy *et al*. (1994), Lal *et al.* (1996), Anuradha and Suryakumari (2005), Nishit (2013) and Srilakshmi (2013) at phenotypic and genotypic levels. The correlation coefficients are positive and highly significant and they are high particularly at genotypic level. This indicate direct effects of fingers per ear on yield at both genotypic and phenotypic level accounted for the major portion in the total correlation between them, direct selection through fingers per ear will be effective. The trait, finger length showed low positive direct effects coupled with significant positive association on seed yield per plant at both phenotypic and genotypic levels. Similar results were reported by Lal *et al.* (1996), Bendale *et al.* (2002) and Anuradha and Suryakumari (2005). These results indicate that there is considerable amount of contribution through the indirect effects via 1000-seed weight, fingers per ear, days to maturity, ear weight per plant and days to 50% flowering towards the positive correlation. In such situations, these indirect causal factors are to be considered along with finger length during selection.

The trait, ear weight per plant showed positive direct effects coupled with significant positive correlation coefficients with seed yield per plant at both phenotypic and genotypic levels. These findings are in agreement with the results of Bendale *et al*. (2002) and Srilakshmi (2013). Further, this trait also recorded positive indirect effects via fingers per ear, 1000-seed weight, days to maturity, finger length and days to 50% flowering at both genotypic and phenotypic levels. Hence, for improvement of seed yield per plant simultaneous selection of these characters along with ear weight per plant should be carried out. The trait, 1000-seed weight had positive direct effect coupled with significant positive association on seed yield per plant at both phenotypic and genotypic levels. Similar results were reported by Reddy *et al.* (1994), Nishit (2013) and Srilakshmi (2013). As the direct effects of 1000-seed weight on yield at both genotypic and phenotypic level accounted for the major portion in the total correlation between them, direct selection through 1000 seed weight will be effective.

The seed protein content showed negative direct effect at phenotypic level and positive direct effect at genotypic level coupled with non-significant negative association at both phenotypic and genotypic levels. These results were in accordance with Harikrishna *et al.* (2005) for phenotypic level and Sarala *et al.* (2008) for genotypic level. Negative direct effect at phenotypic level and low

positive direct effect at genotypic level along with negative correlation at both the levels indicate that, the casual factors viz., plant height, productive tillers per plant, ear weight per plant and 1000-seed weight which had positive indirect effects on seed yield per plant may be considered during the process of selection. Thus this trait recorded negative direct effects coupled with negative non-significant correlations on seed yield per plant at both phenotypic and genotypic levels. These results are in accordance with Srilakshmi (2013). As the correlation coefficients are non-significant and the direct effects are also negative at both phenotypic and genotypic levels the traits which had positive correlation with seed calcium content as well as with seed yield per plant may be considered during selection.

Thus, path analysis studies revealed that out of 11 characters studied, the characters viz., 1000-seed weight, number of fingers per ear, days to maturity, ear weight per plant, finger length and days to 50% flowering showed true relationship with seed yield per plant by establishing significant positive association and high positive direct effect (Table 2).

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

References

Anuradha, T and Suryakumari, S. 2005. Genetic parameters, correlations and path analysis in finger millet. *The Andhra Agri. J*. **52** (3& 4): 575-576.

Bendale, W.W., Bhave, S.G and Pethe, U.B. 2002. Genetic variability correlation and path analysis in finger millet (*Eleusine coracana* Gaertn.). *J. Soils and Crops*. **12** (2): 187-191.

Dewey, D. and Lu, K.H. 1959. A correlation and path coefficient analysis of components of crested wheat grass seed production. *Agron. J.* **51**: 515-518.

Haradari, C., Ugalat, J and Nagabhushan. 2012. A study on character association, genetic variability and yield components finger millet (*Eleusine coracana* L.). *J. Crop and Weed.* **8** (2): 32-35.

Harikrishna, G., Rao, C.P., Kumar, P.V.R and Rao, V.S. 2005. Correlation and path analyses in finger millet (*Eleusine coracana* (L.) Geartn.). *The Andhra Agri. J*. **52** (1&2): 75-85.

Lal, C., Dawa, T., Plana, P and Sharma, S.K. 1996. Studies on genetic variability and component analysis in ragi [*Eleusine coracana* (L.) Gaertn.]. *Indian J. Genet.* **56** (2): 162-168.

Ministry of Agriculture. 2013. http://www.indiastat.com/agriculture/2/stats/asp

Muduli, K.C and Misra, R.C. 2012. Genetic divergence analysis among micromutant lines in finger millet (*Eleusine coracana* G.). *J. Crop Sci. and Biotech.*, **11** (1): 63-68.

Nishit, D. 2013. Study of genetic divergence for grain yield and yield components in finger millet [*Eleusine coracana* (L.) Gaertn.]. *M.Sc. (Ag.) Thesis*, Acharya N.G. Ranga Agricultural University, Hyderabad.

Padmaja, G. 2006. Character association and selection indices in finger millet [*Eleusine coracana* (L.) Gaertn.]. *M.Sc. (Ag.) Thesis*, Acharya N.G. Ranga Agricultural University, Hyderabad.

Reddy, K.R., Reddy, C.R., Kumar, C.V.S and Sekhar, M.R. 1994. Association and path analysis in ragi [*Eleusine coracana* (L.)]. *Annals of Agric. Res.*, **15** (4): 428-431.

Sarala, N., Rao, C.P., Kumar, P.V.R and Rao, V.S. 2008. Correlation and path analysis over environments in finger millet (*Eleusine coracana* (L.) Gaertn.). *The Andhra Agric. J.* **55** (4): 430-434.

Snedecor, G. W. and Cochran, W. G. 1967. *Statistical Methods.* The Iowa State College Press, Ames, Iowa. U.S.A. 160-413.

Srilakshmi, P. 2013. Character association and selection indices in finger millet [*Eleusine coracana* (L.) Gaertn]. *M.Sc (Ag.) Thesis.* Acharya N.G. Ranga Agricultural University, Hyderabad, India.

Table 1. Phenotypic and Genotypic correlations among seed yield and yield contributing characters in finger millet [*Eleusine coracana* (L.) Gaertn.]

Character	Correlation	Days to 50% flowering	Days to maturity	Productive tillers per plant	Fingers per ear	Finger length	Ear weight per plant	1000-seed weight	Seed protein content	Seed calcium content	Seed yield per plant
Plant height	G	0.6730**	0.7207**	0.2156*	0.3965**	0.1898*	0.2342**	0.1805*	-0.3022**	0.0450	0.2665**
	P	0.5896**	0.6537**	0.1121	0.3366**	0.1283	0.1859*	0.1497	-0.2741**	0.0432	0.2006*
Days to 50% flowering	G		0.8277**	0.3252**	0.5025**	0.4485**	0.3978**	0.3238**	-0.2241**	-0.0605	0.5079**
	P		0.8148**	0.2754**	0.4791**	0.3714**	0.3369**	0.3170**	-0.2196*	-0.0599	0.4249**
Days to maturity	G			0.2883**	0.4912**	0.5375**	0.5316**	0.4755**	-0.2392**	0.0635	0.6245**
	P			0.2458**	0.4771**	0.4271**	0.4799**	0.4600**	-0.2375**	0.0638	0.5137**
Productive tillers per plant	G				0.7332**	0.3625**	0.4388**	0.5353**	-0.2983**	-0.0387	0.5669**
	P				0.6178**	0.2211*	0.3236**	0.4648**	-0.2612**	-0.0334	0.4148**
Fingers per ear	G					0.5211**	0.6516**	0.7330**	-0.2406**	-0.1527	0.8534**
	P					0.4068**	0.5911**	0.6944**	-0.2341*	-0.1479	0.6838**
Finger length	G						0.6181**	0.6233**	-0.0711	-0.0127	0.7573**
	P						0.4416**	0.4950**	-0.0609	-0.0098	0.5103**
Ear weight per plant	G							0.5671**	0.0549	-0.1252	0.7850**
	P							0.5130**	0.0531	-0.1125	0.6450**
1000-seed weight	G								0.0068	0.0101	0.9021**
	P								0.0075	0.0099	0.7640**
Seed protein content	G									-0.1638	-0.0558
	P									-0.1634	-0.0467
Seed calcium content	G										-0.1139
	P										-0.0891

G: Genotypic correlation
P: Phenotypic correlation

* Significant at 5% level
** Significant at 1% level

Electronic Journal of Plant Breeding, 6(2): 535-539 (June 2015)
ISSN 0975-928X

Table 2. Direct and indirect effects of different traits on yield per plant in finger millet [*Eleusine coracana* (L.) Gaertn.]

Character		Plant height	Days to 50% flowering	Days to maturity	Productive tillers per plant	Fingers per ear	Finger length	Ear weight per plant	1000-seed weight	Seed protein content	Seed calcium content
Plant height	G	**-0.1676**	-0.1128	-0.1208	-0.0361	-0.0664	-0.0318	-0.0392	-0.0302	0.0506	-0.0075
	P	**-0.0568**	-0.0335	-0.0371	-0.0064	-0.0191	-0.0073	-0.0106	-0.0085	0.0156	-0.0025
Days to 50% flowering	G	0.0112	**0.0166**	0.0138	0.0054	0.0084	0.0075	0.0066	0.0054	-0.0037	-0.0010
	P	0.0624	**0.1059**	0.0863	0.0292	0.0507	0.0393	0.0357	0.0336	-0.0232	-0.0063
Days to maturity	G	0.1535	0.1762	**0.2129**	0.0614	0.1046	0.1144	0.1132	0.1012	-0.0509	0.0135
	P	0.0218	0.0271	**0.0333**	0.0082	0.0159	0.0142	0.0160	0.0153	-0.0079	-0.0021
Productive tillers per plant	G	-0.0193	-0.0291	-0.0258	**-0.0894**	-0.0655	-0.0324	-0.0392	-0.0478	0.0267	0.0035
	P	-0.0027	-0.0067	-0.0060	**-0.0243**	-0.0150	-0.0054	-0.0079	-0.0113	0.0064	0.0008
Fingers per ear	G	0.1517	0.1923	0.1879	0.2805	**0.3826**	0.1994	0.2493	0.2805	-0.0921	-0.0584
	P	0.0401	0.0571	0.0568	0.0736	**0.1191**	0.0485	0.0704	0.0827	-0.0279	-0.0176
Finger length	G	0.0264	0.0624	0.0748	0.0504	0.0725	**0.1391**	0.0860	0.0867	-0.0099	-0.0018
	P	0.0079	0.0230	0.0264	0.0137	0.0252	**0.0619**	0.0273	0.0306	-0.0038	-0.0006
Ear weight per plant	G	0.0398	0.0675	0.0902	0.0745	0.1106	0.1049	**0.1698**	0.0963	0.0093	-0.0213
	P	0.0483	0.0875	0.1246	0.0840	0.1535	0.1147	**0.2597**	0.1332	0.0138	-0.0292
1000-seed weight	G	0.0741	0.1329	0.1952	0.2197	0.3009	0.2559	0.2398	**0.4105**	0.0028	0.0041
	P	0.0732	0.1550	0.2249	0.2273	0.3396	0.2421	0.2509	**0.4890**	0.0037	0.0048
Seed protein content	G	-0.0013	-0.0009	-0.0010	-0.0012	-0.0010	-0.0003	0.0002	0.0000	**0.0041**	-0.0007
	P	0.0084	0.0068	0.0073	0.0080	0.0072	0.0019	-0.0016	-0.0002	**-0.0308**	0.0050
Seed calcium content	G	-0.0020	0.0027	-0.0028	0.0017	0.0068	0.0006	0.0056	-0.0004	0.0073	**-0.0444**
	P	-0.0020	0.0027	-0.0029	0.0015	0.0068	0.0051	-0.0005	0.0075	-0.0457	**-0.0481**
Seed yield per plant	G	0.2665**	0.5079**	0.6245**	0.5669**	0.8534**	0.7573**	0.7850**	0.9021**	-0.0558	-0.1139
	P	0.2006**	0.4249**	0.5137**	0.4148**	0.6838**	0.5103**	0.6450**	0.7640**	-0.0467	-0.0891

* Significant at 1% level
** Significant at 5% level
Diagonal values indicate direct effects
Residual effect at genotypic level = 0.1166
Residual effect at phenotypic level = 0.5475

G: at genotypic level
P: at phenotypic level