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Correlation and path analysis studies in finger millet for yield and yield contributing traits (*Eleusine coracana* L. Gaertn)

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Abstract
The present investigation entitled "Correlation and Path Analysis of finger millet for yield and yield contributing traits (*Eleusine coracana* L. Gaertn)" was undertaken during Kharif 2017. The experiment was carried out in Randomized Block Design (RBD) with three replications to derive Correlation coefficient and Direct and Indirect effects in 13 different genotypes with 2 checks Nagali Dapoli 1 and Nagali Dapoli safed 2 of finger millet. Association studies revealed that plant height, days 50% flowering, number of tillers per plant, number of fingers per ear, length of finger (cm), test weight (g), straw yield per plant (g) and harvest index (%) shows positive correlation with grain yield per plant (g) at genotypic and phenotypic levels and days to maturity shows positive correlation with grain yield per plant at phenotypic levels only. The characters which emerged as the major component of grain yield per plant (g) in path coefficient analysis was exerted by harvest index (%) followed by straw yield per plant (g), number of fingers per ear, number of tillers per plant, plant height which had highest direct effects on grain yield per plant at genotypic level and phenotypic level.

Keywords: Finger millet, correlation, path analysis, yield and quality related traits

Introduction

Finger millet (*Eleusine coracana* (L.) Gaertn. 2n=4x=36) belongs to the family Poaceae, and is widely cultivated in the arid and semi-arid regions of the world. It is also known as African millet, ragi, nachani, nagali. Recently, government of India declared millets as a 'Nutricereal' crops being a rich source of minerals in almost all types of millets. It is small seeded minor cereal having light brown to red and also white coloured seed coat with minutely undulated surface. The crop is performing well under diverse conditions of soil, climate and moisture. Finger millet is an erect, tufted annual growing to 60-120 cm height with profuse tillers. The tillers have ear consisting of whorl of finger like spike. The spikelets in spike are arranged closely on both sides of a slender rachis. Flowering takes place simultaneously in all fingers. Flowers are hermaphrodite, alternately arranged on the zigzag rachilla. The terminal ones may be male or sterile. Being cleistogamy flowering nature it leads to self-fertilization. It contains almost all the nutrients like protein (9.2 per cent), carbohydrates (76.32 per cent) and fat (1.29 per cent). It is very rich in minerals (2.70 per cent) such as calcium (452mg/100g), iron (3.90 mg/100g) and ash (3.90 per cent) which are the core ingredients of normal human diet (Pandey and Kumar, 2005) [4]. Being rich in protein, iron and calcium, finger millet serves as an important staple food for rural populations in developing tropical countries where calcium deficiency and anaemia are widespread (Owere *et al.*, 2015) [3]. Finger millet is an excellent source of methionine, Ca, Fe, Mn. It is appreciated by the people because it gets digested slowly there by furnishing energy required for hard work throughout the day.

The correlation and path analysis in combination, can give a better insight, into cause and effect relationship between different pairs of characters. Information on association of characters, direct and indirect effects contributed by each character towards yield will be an added advantage in aiding the selection process. Correlation and path analysis establish the extent of association between yield and its components and also bring out relative importance of their direct and indirect effects, thus giving an obvious understanding of their association with grain yield. Ultimately, this kind of analysis could help the breeder to design his selection strategies to improve grain yield.

The path coefficient analysis initially suggested by Wright (1921) [7] and described by Dewey and Lu (1959) [1] allows partitioning of path coefficient analysis into direct and indirect contributions (effects) of various traits towards dependent variable and thus helps in assessing the cause-effect relationship as well as effective selection. In the light of the above scenario, the present investigation was carried out with the objective of studying the character associations in finger millet genotypes for yield improvement.

Material and Methods

The present investigation was carried out to assess the correlation and path analysis in finger millet. The study was conducted during *Kharif*, 2017 at the Department of Agricultural Botany, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani by taking three replications in Randomized Block Design. Experimental material comprises of 13 different genotypes with 2 checks Nagali Dapoli 1 and Nagali Dapoli safed 2 from different diverse sources of country. Spacing between the row to row was 30 cm while, 10 cm spacing was kept between the plants. The gross plot size was 2 m x 2 m and net plot size maintained was 1.50 x 1.60 m. The fertilizers in the experimental area was applied at the rate of 120 kg/ha N, 60 kg/ha P_2O_5 and 40 kg/ha K_2O, as it is a recommended dose for cultivation of finger millet in the region. In each replication and in each plot, five plants were randomly selected and average values are used for statistical analysis. For days to 50% flowering and days to maturity, the observations were recorded for plot basis. Data were collected on ten yield and yield contributing characters *viz.*, plant height (cm), days 50% flowering, days to maturity, number of tillers per plant, number of fingers per ear, length of finger (cm), test weight (g), straw yield per plant (g), harvest index (%) and grain yield per plant (g). The mean of five plants was subjected to statistical analysis. The data for different characters were statistically analyzed for significance by using analysis of variance technique described by Panse and Sukhatme (1985) [5]. The significance of mean sum of square for each character was tested against the corresponding error degrees of freedom using "F" Test (Fisher and Yates, 1967) [2]. Correlation between eleven characters was estimated according to the method given by Singh and Chaudhary (1977) [6]. Direct and indirect effects were estimated as described by Dewey and Lu (1959) [1]. Statistical analysis was done by using WINDOSTAT program.

Results and Discussion

Analysis of variance revealed significant differences among genotypes for all the characters (Table 1). Analysis of variance for ten characters indicated that the genotypes used in the present studies were significantly different. The correlation coefficients at both genotypic and phenotypic levels estimated between grain yields per plant with all other characters are presented in Table 2. For path coefficient analysis, grain yield was considered as the dependent variable while the remaining characters were considered as independent variables. The phenotypic and genotypic path analyses representing the direct and indirect effects of different characters are explained here under. The value assigned to a path is formed as path coefficient and defined as the proportion of standard deviation of a dependent variable Y arising as a result of variation in the independent variable X.

Genotypic correlations were higher than the corresponding phenotypic correlations, Low phenotypic correlations can be explained due to masking or modifying effects of environment on genetic association between characters. Plant height, days 50% flowering, number of tillers per plant, number of fingers per ear, length of finger (cm), test weight (g), straw yield per plant (g) and harvest index (%) showed positive correlation with grain yield per plant at genotypic and phenotypic levels and days to maturity showed positive correlation with grain yield per plant at phenotypic level only while, it showed negative correlation at genotypic level. These results are in accordance with the findings of Anuradha *et al.*, (2013) [10], Brunda *et al.*, (2015) [11], Ezeaku *et al.*, (2015) [15], Jyothsna *et al.*, (2016) [8], Manoj Kumar *et al.*, (2015) [16] and Patil *et al.*, (2013) [14]. This suggests selecting for the characters with high positive correlation would improve the grain yield in finger millet.

The path coefficients at both genotypic and phenotypic levels estimated between grain yield per plant and yield contributing characters. These results estimated by using correlation coefficient. The path analysis results are presented in Table no. 3. The characters which emerged as the major component of grain yield per plant in path coefficient analysis (Table 3.) was exerted by harvest index (%) followed by straw yield per plant (g), number of fingers per ear number of tillers per plant, plant height which had highest direct effects on grain yield per plant at both genotypic level and phenotypic levels. These results are in confirmation with the findings of Ganapathy *et al.*, (2011) [13], Anuradha *et al.*, (2013) [10], Kumar (2014) [12], Jyothsna *et al.*, (2016) [8] and Negi *et al.*, (2017) [9].

Table 1: Analysis of variance for different characters in finger millet

Sr. No	Characters	Mean sum of Squares		
		Replication	Treatment	Error
1	Plant height (cm)	1.870	197.369**	15.358
2	Days 50% flowering	3.800	215.819**	13.633
3	Days to maturity	18.20	407.51**	27.70
4	No. of tillers per plant	0.179	0.484**	0.089
5	No. of fingers per ear	0.108	1.757**	0.167
6	Length of finger (cm)	0.347	4.112**	0.206
7	Test weight (g)	0.044	1.606**	0.130
8	Straw yield per plant (g)	0.979	19.258**	1.587
9	Harvest index (%)	19.160	81.168**	8.286
10	Grain yield per plant (g)	0.549	14.468**	0.429

*, ** Significance at 5% and 1% level, respectively

Table 2: Genotypic and Phenotypic correlation coefficient for thirteen characters in finger millet (*Eleusine coracana* L. Gaertn).

Sr. No	Characters		Plant height (cm)	Days 50% flowering	Days to maturity	No. of tillers per plant	No. of fingers per ear	Length of finger (cm)	Test weight (g)	Straw yield per plant (g)	Harvest index (%)	Grain yield per plant (g)
1	Plant height (cm)	G	1	0.068	-0.061	0.945	0.484	0.644	0.125	0.475	0.287	0.419
		P	1	0.104	-0.068	0.582**	0.428**	0.562**	0.0621	0.388**	0.202	0.314*
2	Days 50% flowering	G		1	0.572	0.183	0.234	0.127	-0.316	-0.153	0.481	0.089
		P		1	0.509**	0.084	0.183	0.114	-0.229	-0.126	0.388**	0.071
3	Days to maturity	G			1	-0.078	-0.186	-0.033	-0.013	-0.260	-0.011	-0.017
		P			1	-0.099	-0.150	0.012	-0.010	-0.220	0.063	0.009
4	No. of tillers per plant	G				1	0.772	0.734	0.178	0.568	0.253	0.369
		P				1	0.439**	0.541**	0.063	0.408**	0.232	0.314*
5	No. of fingers per ear	G					1	0.775	0.045	0.417	0.305	0.473
		P					1	0.675**	0.075	0.350*	0.203	0.363*
6	Length of finger (cm)	G						1	-0.113	0.281	0.167	0.292
		P						1	-0.071	0.233	0.192	0.284
7	Test weight (g)	G							1	0.778	-0.378	0.205
		P							1	0.531**	-0.257	0.176
8	Straw yield per plant (g)	G								1	0.236	0.717
		P								1	0.119	0.653**
9	Harvest index (%)	G									1	0.750
		P									1	0.664**
10	Grain yield per plant (g)	G										1
		P										1

P = Phenotypic correlation coefficient, G = Genotypic correlation coefficient, *Significant at 5% level and **Significant at 1%level

Table 3: Path coefficients for yield and yield components in Finger millet (*Eleusine coracana* L. Gaertn).

Sr. No	Characters		Plant height (cm)	Days 50% flowering	Days to maturity	No. of tillers per plant	No. of fingers per ear	Length of finger (cm)	Test weight (g)	Straw yield per plant (g)	Harvest index (%)	Grain yield per plant (g)
1	Plant height (cm)	G	60.670	0.069	-0.061	0.945	0.485	0.644	0.126	0.476	0.288	0.419
		P	76.030	0.104	-0.069	0.582	0.429	0.562	0.062	0.389	0.202	0.314*
2	Days 50% flowering	G	4.378	67.395	0.572	0.184	0.234	0.128	-0.317	-0.153	0.482	0.089
		P	8.178	81.029	0.510	0.084	0.183	0.114	-0.230	-0.127	0.389	0.071
3	Days to maturity	G	-5.384	52.869	126.605	-0.079	-0.186	-0.033	-0.013	-0.260	-0.012	-0.017
		P	-7.443	57.019	154.305	-0.100	-0.150	0.013	-0.011	-0.221	0.063	0.009
4	No. of tillers per plant	G	2.672	0.547	-0.321	0.132	0.773	0.734	0.179	0.569	0.254	0.369
		P	2.386	0.357	-0.582	0.221	0.440	0.541	0.064	0.409	0.232	0.314*
5	No. of fingers per ear	G	2.750	1.400	-1.525	0.204	0.530	0.776	0.045	0.417	0.305	0.473
		P	3.120	1.376	-1.560	0.173	0.697	0.675	0.076	0.350	0.204	0.363*
6	Length of finger (cm)	G	5.727	1.195	-0.424	0.304	0.644	1.302	-0.114	0.281	0.167	0.292
		P	6.018	1.264	0.197	0.312	0.692	1.508	-0.071	0.233	0.193	0.284
7	Test weight (g)	G	0.688	-1.823	-0.105	0.046	0.023	-0.091	0.492	0.778	-0.378	0.205
		P	0.427	-1.632	-0.106	0.024	0.050	-0.069	0.622	0.531	-0.257	0.176
8	Straw yield per plant (g)	G	8.992	-3.051	-7.110	0.501	0.737	0.779	1.325	5.890	0.235	0.717
		P	9.269	-3.120	-7.502	0.525	0.799	0.783	1.146	7.477	0.119	0.653**
9	Harvest index (%)	G	11.043	19.497	-0.642	0.453	1.095	0.940	-1.307	2.816	24.294	0.750
		P	10.058	19.983	4.466	0.622	0.970	1.350	-1.157	1.859	32.580	0.664**

Bold are direct effects, P: Phenotypic path coefficient, Residual effects (P): 0.051, G: Genotypic path coefficient, (G):0.057

Conclusion

In general, correlation and path analysis concluded that the number of tillers per plant, number of fingers per ear, length of finger (cm), test weight (g), straw yield per plant (g) and harvest index (%) influenced the grain yield more than any of the other characters. Hence, it would be worthwhile to lay more emphasis on these characters in selection programme to improve the grain yield in finger millet.

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