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RESEARCH ARTICLE

Path Coefficient Analysis for Yield and its Contributing Traits in Finger Millet

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Abstract

The experimental material comprised of 140 genetically diverse genotypes of finger millet (*Eleusine coracana* (L.) Gaertn.) and it was conducted during kharif 2007 in well prepared plots at the research farm attached to the Department of Genetics & Plant Breeding, Ch. Charan Singh University campus, Meerut. The data on 10 quantitative traits viz. days to 50 % flowering, days to maturity, plant height, no. of tillers/plant, productive tillers/plant, no. of. fingers/ plant, total fingers/plant, biological yield, grain yield and harvest index were collected from a random sample of 10 plants for each genotype. The analysis of variance exhibited significant difference among the genotypes for all the characters indicating substantial degree of variability. Path coefficient analysis indicated that positive genotypic and phenotypic direct effects were observed for productive tillers/plant, biological yield, harvest index and no. of fingers/ear had higher positive direct effect on grain yield. These traits having a positive direct effect on grain yield can be considered as a suitable selection criterion for evolving high yielding Finger millet genotype.

Introduction

Finger millet is an important traditional food crop for human cunsmption in Africa and South Asia (FAO, 1990). It is domesticated about 5000 BC in eastern Africa (possibly Ethiopia) and introduced to India as a crop 3000 years ago (Hilu *et al*., 1979). Finger millet *(Eleusine coracana* L. subsp. *coracana*) and its wild relatives are the members of Chloridoidea, one of the primary subfamilies of the grass (Poaceae) family. The cultivated finger millet is a tetraploid species with 36 chromosomes ($2n = 4x = 36$). derived from wild ancestor *E. coracana* subsp. *Africana* (Zeven and de Wet, 1982). East Africa is recently reported as the center of origin and diversity of finger millet (FAO, 1998).

Finger millet has high nutritional value; its seeds contain protein ranging from 7-14% and are particularly rich in tryptophan, cysteine and methionine. The seeds are exceptionally rich in calcium containing about 0.34% in whole seed compared with 0.01-0.06% calcium in most cereals. The fat content of finger millet is very low (1.3%). Millet seeds are also rich in iron containing 46 mg/kg (Serna-Saldivar and Rooney, 1995), which is much higher than the amount in wheat and rice.

The path coefficient analysis initially suggested by Wright (1921) and described by Dewey and Lu (1959) 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. Hence, this study is aimed to analyze and determine the traits having interrelationship with grain yield utilizing the correlation and path analysis. Therefore, the present investigation was undertaken to study the relative contribution of different yield attributes to grain yield and their interrelationship by estimating correlation, path analysis to assess the direct and indirect effect of component character on grain yield

Methods and Materials

The experimental material for the present investigation comprised of 140 accessions of finger millet was evaluated in a randomized block design with two replications during kharif 2007 and adopted a spacing of 25 cm between rows and 10 cm between plants respectively maintained at Deportment of Genetics & Plant Breeding, Ch. Charan Singh University, Meerut by Prof. B. Ramesh. The selection of the accessions was based on geographical and apparent diversity in respect of most the economic characters. All the recommended agronomic and cultural practices were followed for raising a healthy crop. Data were recorded on ten randomly taken plants per replication of each genotype for ten agronomic characters viz., days of 50% flowering, days to maturity, plant height (cm), number of tillers per plant, number of productive tillers per plant, number of fingers per ear, total number of fingers per plant, biological yield per plant (g), grain yield per plant (g), harvest index. The data were analyzed for analysis of variance model suggested by Panse and Sukhatme (1969) and path coefficient analysis, as suggested by Dewey and Lu (1959), which provides a means of understanding the complex correlations into direct and indirect contributions, was carried out at both genotypic and phenotypic levels.

Results and discussion

The analysis of variance exhibited significant difference among the genotypes for all the characters indicating substantial degree of variability. 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 difined as the proportion of standard deviation of a dependent variable Y arising as a result of variation in the independent variable X

Path-coefficient analysis is simply a standardized partial regression coefficient, which splits the correlation coefficient into the measures of direct and indirect effects (Singh and Narayanan, 1993). The information obtained by this technique helps in indirect selection for genetic improvement of yield. In this investigation, the genotypic correlation coefficient was further divided into direct and indirect effects using path-coefficient analysis. In computing the path-analysis, grain yield per plant was considered as resultant (dependable) variable while the rest of the variables that were significantly correlated with plant grain yield were used as causal (independent) variables.

The correlation coefficient does not always give precise information on the contribution of each trait towards dependent variable. To understand the characters which really contribute towards grain yield, the path analysis is obvious. There were many cases in the present study where correlation coefficients of grain yield with the component characters were sufficiently high to establish their importance in selection programme for yield improvement in finger millet.

It is evident from the data presented in Table 2 that positive genotypic direct effects were observed for productive tillers/plant (3.381), biological yield (1.312), harvest index (0.862), no of fingers/ear (0.453), days to 50% flowering (0.041), and plant height (0.037). Negative direct effects on grain yield were also observed for total fingers/plant (-3.656), no. of tillers/plant (-0.075), and days to maturity (-0.03). Indirect significant positive effects on grain yield were observed for total fingers/plant (3.339), tillers/plant (3.244), biological yield (2.469), harvest index (1.214), days to 50% flowering (1.187), productive tillers/plant (0.958), days to maturity (0.647), plant height (0.182), and fingers/ear (0.084). The residual effect was 0.1908. Abraham *et al.* (1989) reported high genotypic and phenotypic coefficients of variation for productive tillers, finger length and grain weight per plant and 1000 grain weight in finger millet. (Joshi and Mehra 1989) reported significant variation for days to heading, plant height, finger length, number of fingers, and grain yield but non-significant differences for number of effective tillers.

A perusal of data presented in Table 2 indicated that the maximum positive direct effects on grain yield were due to productive tillers/plant (2.850), biological yield (1.248), harvest index (0.867), no of fingers/ear (0.404), plant height (0.037), and days of 50% flowering (0.021). Negative direct effects on grain yield were also observed for total fingers/plant (-3.078), no. of tillers/plant (-0.079), and days to maturity (-0.019). The indirect path revealed that maximum positive indirect effects of productive tillers/plant (2.850), biological yield (0.021), harvest index (0.946), no of fingers/ear (0.064), plant height (0.173), and days of 50% flowering (0.801). Negative direct effects on grain yield were also observed for total number of fingers/plant (2.666), total tillers/plant (2.811), and days to maturity (0.526). The residual effect was 0.1668. The residual effect associated with the values with standard partial regression of 0.1908 at genotypic level and 0.1668 at phenotypic level indicate the contribution of factors other than those studied.

In line to the finding of the present study, strong direct effect of productive tillers (Mahudeswaran and Marugesan, 1973; Prabhakar and Prasad, 1983; Ravindran *et al*., 1996; Daba, 2000), finger number (Ravindran *et al*., 1996), 1,000-grain weight (Prabhakar and Prasad, 1983 and Daba, 2000), days to flowering and tillers/plant (Misra *et al.*, 2008) on grain yield were reported by earlier workers. However, as opposed to this, (Reddy *et al*. 1995) recorded negative direct effect of productive tillers on grain yield while reported the some by. (Premalatha *et al*. 2006) studied genotypic correlation coefficient and path coefficient analysis in 49 genotypes of sorghum and reported that grain yield was significantly and positively correlated with number of grains per panicle and 100-grain weight. The results of path analysis revealed that the direct contribution of 100-grain weight was high (0.9499) on grain yield followed by number of grains per panicle (0.3540), leaf area index (0.0495), plant height (0.0239) and days to 50% flowering (0.0236). Hence, they suggested that along with grain yield, the component traits can also be considered for selection of superior and dual purpose sorghum genotypes. (Bedis *et al*. 2006) also carried out correlation and path coefficient analyses using 37 diverse genotypes of finger millet. Days to flowering, days to maturity, plant height, main ear length, number of fingers per ear and fodder yield were positively correlated with grain yield. The positive correlation of plant height, main ear length and number of fingers/ear with grain yield and among themselves suggest that these are the major yield contributing traits in finger millet. Path coefficient analysis also showed direct positive contribution of days to maturity, plant height, number of fingers per ear and fodder yield on grain yield. These traits deserve special emphasis in selection of suitable genotypes for improvement in grain yield of finger millet (Babu *et al.*, 2002; Anantharaju and Meenakshiganesan, 2005; Muthuswamy and Kumar, 2006).

Analysis of variance for all the agronomic traits studied reveal the presence of considerable amount of variability among the finger millet genotypes under investigation. For path coefficient analysis, grain yield was considered as the dependent variable while the remaining characters were considered as independent variables. The residual effect associated with the values with standard partial regression of 0.1908 at genotypic level and 0.1668 at phenotypic level indicate the contribution of factors other than those studied. Therefore, it is emphasized to lay attention on traits like productive tillers per plant followed by biological yield, harvest index and no. of fingers/ear while selecting for improvement in grain yield of finger millet.

Table 1. Analysis of variance (ANOVA) for different characters in 140 genotypes of finger millet.

Source of variance	d.f.	Days to 50% flowering	Days to maturity	Plant height	No. of tillers/ plant	Productive tillers/ plant	No. of fingers per ear	Total fingers/ plant	Biological yield	Grain yield	Harvest index
Replication	1	1.13	8.00	2.25	1.55	0.32	1.86	0.86	100.50	23.68	39.36
Treatment	139	267.41**	285.38**	155.10**	6.14**	4.16**	0.90**	238.91**	1389.15**	21.38**	85.99**
Error	139	37.39	1.31	4.56	0.13	0.19	0.09	10.73	15.30	0.71	4.88

Table 2. Genotypic and phenotypic path for different characters in 140 genotypes of finger millet.

Character		Days to 50% flowering	Days to maturity	Plant height	No. of tillers / plant	Productive tillers / plant	No. of fingers per ear	Total fingers / plant	Biological yield	Harvest index	'r' value with grain yield
Days to 50% flowering	G	**0.041**	-0.009	0.006	-0.022	1.151	-0.039	-1.187	0.702	-0.353	0.291*
	P	**0.021**	-0.005	0.006	-0.020	0.801	-0.025	-0.829	0.570	-0.279	0.241*
Days to maturity	G	0.012	**-0.03**	0.004	-0.014	0.647	0.08	-0.75	0.437	-0.237	0.148
	P	0.005	**-0.019**	0.003	-0.015	0.526	0.065	-0.609	0.410	-0.224	0.143
Plant height	G	0.007	-0.003	**0.037**	0.003	-0.102	-0.007	0.138	0.182	-0.311	-0.056
	P	0.004	-0.002	**0.037**	0.003	-0.071	-0.003	0.098	0.173	-0.286	-0.046
Tillers / plant	G	0.012	-0.006	-0.002	**-0.075**	3.244	0.036	-3.511	0.973	-0.263	0.409**
	P	0.005	-0.004	-0.002	**-0.079**	2.666	0.033	-2.885	0.900	-0.245	0.390**
Productive tillers / plant	G	0.014	-0.006	-0.001	-0.072	**3.381**	-0.002	-3.611	0.958	-0.278	0.385**
	P	0.006	-0.004	-0.001	-0.074	**2.850**	0.002	-3.036	0.866	-0.259	0.351**
Fingers / ear	G	-0.004	-0.005	-0.001	-0.006	-0.013	**0.453**	-0.473	0.084	-0.057	-0.021
	P	-0.001	-0.003	0.000	-0.006	0.015	**0.404**	-0.447	0.064	-0.042	-0.018
Total fingers / plant	G	0.013	-0.006	-0.001	-0.072	3.339	0.059	**-3.656**	0.971	-0.286	0.360**
	P	0.006	-0.004	-0.001	-0.074	2.811	0.059	**-3.078**	0.878	-0.267	0.329**
Biological yield	G	0.022	-0.01	0.005	-0.055	2.469	0.029	-2.704	**1.312**	-0.511	0.557**
	P	0.010	-0.006	0.005	-0.057	1.979	0.021	-2.164	**1.248**	-0.503	0.531**

Harvest index	G	-0.017	0.008	-0.013	0.023	-1.088	-0.03	1.214	-0.778	**0.862**	0.181*
	P	-0.007	0.005	-0.012	0.022	-0.852	-0.020	0.946	-0.725	**0.867**	-0.580

*Significant at 5% level; ** Significant at 1% level,

Bold figures indicates direct effects

Residual effects = 0.1908 genotypic and 0.1668 phenotypic

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