The Andhra Agric. J 55(4):430-434, 2008

Correlation and Path Analysis over Environments in Finger Millet [*Eleusine coracana* (L.) Gaertn]

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ABSTRACT

Correlation and path coefficient analysis were carried out using 18 genotypes of finger millet in 14 environments. Plant height, 1000 seed weight, productive tillers per plant, yield per plot, straw yield per plot, volume of root in mainfield, fingers per ear, volume of shoot in main field and weight of shoot in main field were positively correlated with seed yield over environments. The positive correlation of ear weight per plant, 1000 seed weight, yield per plot, volume of shoot in main field and weight of shoot in main field with seed yield and among themselves for these characters was observed suggesting that these are the major yield contributing traits in finger millet. Path coefficient analysis also showed direct positive contribution of ear weight per plant, 1000 seed weight, yield per plot, straw yield per plot, volume of root in main field, volume of shoot in main field and weight of shoot in main field on seed yield. These traits deserve special emphasis in selection while selecting for improvement in seed yield of finger millet.

Key words : Correlation, Finger Millet, Path Analysis.

Fingermillet [*Eleusine coracana* (L.) Gaertn] is an important minor millet among the small millets. An efficient breeding programme is dependent on the proper selection of the parents as well as component characters of grain yield. A knowledge of the association of various quantitative characters and the direct and indirect effects of yield components on grain yield would be of immense help to the breeders Sarvaiya *et al*., 1982). Therefore, in the present study the association between yield and its component characters through correlations and the magnitude of direct and indirect effects of component characters on yield through path analysis were estimated in fourteen environments.

MATERIAL AND METHODS

Eighteen finger millet genotypes *viz*., GE 1035, VMEC 219, GE 2999, VMEC 226, GE 4468, GE 532, GE 3790, VMEC 210, GE 1240, GE 1683, GE 3363, GE 2869, GE 1853, GE 4798, GE 3986, GE 3678, GE 1287 and GE 1077 were raised in randomized block design with three replications at Agricultural College Farm, Bapatla during three consecutive seasons namely *kharif* 2006 (three sowing dates), *rabi* 2006 (three sowing dates) and early summer 2007 (one sowing date) with two fertility levels (high fertility N: 120 kg ha^{-1}, P_2O_5 30 kg ha^{-1}, K_2O 20 kg ha^{-1} and normal fertility N : 60 kg ha^{-1}, P_2O_5 30 kg ha^{-1}, K_2O 20 kg ha^{-1}), thus providing 14 environments for study. Each genotype was planted in four rows adopting an inter- row and intra-row spacing of 20 cm and 10 cm. Five plants in each genotype and each replication from the center of row were chosen at random. The data were collected on plant height, days to 50% flowering, number of productive tillers per plant, number of fingers per ear, length of finger, ear weight per plant, 1000 seed weight, yield per plant, yield per plot, seed protein content, seed calcium content, straw yield per plot, length of root at main field (LRM), volume of root at main field (VRM), volume of shoot at main field (VSM), weight of root at main field (WRM) and weight of shoot at main field (WSM). The means of the data were utilized for statistical analysis of correlations (as per Falconer, 1964) and path analysis (as per Dewey and Lu, 1959).

RESULTS AND DISCUSSION

The trait, yield per plant, showed positive association in most of the environments with the following characters, plant height in environments I (rg=0.62, rp=0.54); II (rg=0.74, rp=0.55); III (rg=0.46, rp=0.35); IV (rg=0.67, rp=0.45); V (rg=0.51, rp=0.42); VII (rg=0.42, rp=0.36); XIII (rg=0.58, rp=0.61) and XIV (rg=0.54, rp=0.48), with productive tillers per plant in environments III (rg=0.49, rp=0.42); IV (rg=0.58, rp=0.43); VIII (rg=0.45, rp=0.35); XI (rg=0.43, rp=0.39); XII (rg=0.64, rp=0.51); XIII (rg=0.54, rp=0.45) and XIV (rg=0.65, rp=0.58), with ear weight per plant in environments I (rg=0.87, rp=0.83); II (rg=0.84, rp=0.73); III (rg=0.91, rp=0.83); IV (rg=0.86, rp=0.76); V (rg=0.76, rp=0.63); VI (rg=0.80, rp=0.66); VII (rg=0.81, rp=0.71); VIII (rg=0.80, rp=0.66); IX (rg=0.85, rp=0.66); X (rg=0.86, rp=0.72); XI (rg=0.74, rp=0.67); XII (rg=0.79, rp=0.67); XIII (rg=0.87, rp=0.76) and XIV (rg=0.84, rp=0.74); with 1000 seed weight in environments I (rg=0.58, rp=0.48); III (rg=0.60, rp=0.45); VII (rg=0.54, rp=0.47); VIII (rg=0.63, rp=0.53); X (rg=0.44, rp=0.37); XII (rg=0.47, rp=0.43); XIII (rg=0.78, rp=0.64) and XIV (rg=0.80, rp=0.63); with yield per plot in environments I (rg=1.009, rp=0.98); II (rg=1.00, rp=1.00); III (rg=1.00 rp=0.99); IV (rg=1.00, rp=0.98); V (rg=1.01, rp=0.98); VI (rg=1.01, rp=0.97); VII (rg=1.00, rp=0.97); VIII (rg=1.00, rp=0.94); IX (rg=0.99, rp=0.99); X (rg=1.00, rp=0.98); XI (rg=1.008, rp=0.99); XII (rg=1.00, rp=0.98); XIII (rg=1.00, rp=0.98) and XIV (rg=1.00, rp=0.99); with straw yield per plot in environments I (rg=0.67, rp=0.57); II (rg=0.66, rp=0.56); III (rg=0.70, rp=0.61); IV (rg=0.66, rp=0.55); V (rg=0.62, rp=0.53); VI (rg=0.62, rp=0.54); VII (rg=0.76, rp=0.68); VIII (rg=0.67, rp=0.53); XI (rg=0.56, rp=0.49); XII (rg=0.64, rp=0.59); XIII (rg=0.66, rp=0.55) and XIV (rg=0.72, rp=0.62) with volume of root at main field in environments I (rg=0.70, rp=0.38); II (rg=0.80, rp=0.51); III (rg=0.71, rp=0.49); VI (rg=0.53, rp=0.35); VII (rg=0.65, rp=0.48); VIII (rg=0.59, rp=0.59); X (rg=0.56, rp=0.39); XII (rg=0.69, rp=0.47); XIII (rg=0.71, rp=0.60) and XIV (rg=0.74, rp=0.61); with volume of shoot at main field in environments I (rg=0.88, rp=0.66); II (rg=0.79, rp=0.68); III (rg=0.77, rp=0.63); IV (rg=0.78, rp=0.66); V (rg=0.78, rp=0.67); VI (rg=0.62, rp=0.50); VII (rg=0.79, rp=0.58) and VIII (rg=0.70, rp=0.56); with weight of shoot at main field in environments I (rg=0.82, rp=0.70); II (rg=0.77, rp=0.66); III (rg=0.76, rp=0.69; IV (rg=0.73, rp=0.63); V (rg=0.64, rp=0.57); VI (rg=0.69, rp=0.55); VII (rg=0.72, rp=0.57); VIII (rg=0.77, rp=0.62); IX (rg=0.65, rp=0.51); X (rg=0.70, rp=0.51); XI (rg=0.59, rp=0.55); XII (rg=0.60, rp=0.54); XIII (rg=0.71, rp=0.67) and XIV (rg=0.70, rp=0.66). This type of positive association between yield and its components is highly desirable and selection for ear weight per plant ,1000 seed weight and yield per plot would be useful in getting simultaneous improvement of these traits including yield. Hence selection for these traits may help in improving yield. The results obtained in present study are in conformity with Shanthakumar and Gowda (1997, 1998), Bendale *et al.* (2002), Chuni Lal *et al.* (1996), Harikrishna *et al.* (2005) and Bedis *et al.* (2006). Protein content showed significant negative association with yield per plant in all environments *i.e.*, I (rg=-0.55, rp=-0.47); II (rg=-0.49, rp=-0.44); III (rg=-0.83, rp=-0.75); IV (rg=-0.81, rp=-0.72); V (rg=-0.79, rp=-0.71); VI (rg=-0.80, rp=-0.66); VII (rg=-0.83, rp=-0.76); VIII (rg=-0.79, rp=-0.67); IX (rg=-0.72, rp=-0.61); X (rg=-0.72, rp=-0.61); XI (rg=-0.74, rp=-0.67); XII (rg=-0.76, rp=-0.69); XIII (rg=-0.63, rp=-0.58) and XIV (rg=-0.56, rp=-0.53); indicated that simultaneous improvement of these two traits is not possible, and compromise between the two attributes has to be made to findout an acceptable level of both the characters under improvement. Similar findings were reported by Byre Gowda *et al.* (1999), Byre Gowda *et al.* (2000) and Hari Krishna *et al.* (2005).

In most of the environments the following characters showed significant positive association among themselves, they are plant height with days to 50% flowering, volume of root at main field and volume of shoot at main field; productive tillers per plant with ear weight per plant, 1000 seed weight and volume of root at main field; days to 50% flowering with plant height; fingers per ear with plant height, ear weight per plant and yield per plot; length of finger with weight of shoot at main field; ear weight per plant with productive tillers per plant, fingers per ear, yield per plot, straw yield per plot, volume of root at main field, volume of shoot at main field, weight of root at main field, weight of shoot at main field; 1000 seed weight with productive tillers per plant, yield per plot and straw yield per plot; yield per plot with ear weight per plant, straw yield per plot, volume of root at main field, volume of shoot at main field and weight of shoot at main field; straw yield per plot with ear weight per plant, 1000 seed weight, yield per plot, volume of shoot at main field and weight of shoot at main field ; length of root at main field with ear weight per plant, volume of root at main field; volume of root at main field with productive tillers per plant, ear weight per plant, yield per plot, length of root at main field; volume of shoot at main field with plant height, ear weight per plant, yield per plot, straw yield per plot, weight of root at main field and weight of shoot at main field; weight of root at main field with ear weight per plant, volume of shoot at main field and weight of shoot at main field; weight of shoot at main field with ear weight per plant, 1000 seed weight, yield per plot, straw yield per plot, volume of shoot at main field and weight of shoot at main field; these results revealed that selection based on these traits will improve the yield. However, the association of protein content with all other traits is negative hence simultaneous improvement of this trait with others is not possible and a compromise has to be made. Calcium content

Table 1. Environments (I to XIV) indicating significant phenotypic correlations between yield and yield components in finger millet *Eleusine coracana* (L.) Gaertn]

	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}^*
X_1	I- V, VII, XIII, XIV	III,IV,VIII, XI-XIV	I,II & III	II-V,XI-XIV	XIII,XIV	I-XIV	I,III,VII, VIII, X, XII-XIV	I-XIV	I-VII,XI -XIV	V,IX,XII-XIV	I-III,VI-VIII,XII-XIV	I-VIII,X-XIV	II,XIII,XIV	I-XIV	I-XIV
X_2		-	I-VI, X,XII	I-VI,X, XII	XIV	I, II, VI, VII, VIII, XIII, XIV	-	I-V,VII, XIII,XIV	IV,XII	I,II, IV, V, VI, IX, X, XII, XIV	I, II, VII, VIII, X, XII, XIII, XIV	I – XIV	XIII, XIV	II, IV-VI, VIII, XIII, XIV	I-VI
X_3			VI	VI, XIII, XIV	-	III-XIV	III, VII-XIV	III, IV, XI-XIV	V,VI, XIII, XIV	-	I-VI, IX, X, XII, XIV	XIV,	XII-XIV	II, IV-VI, XIII, XIV	XIV
X_4				I-VI, X, XII	VI	II-VI	VII	-	-	I, II, VII, VIII	-	XI, XIII	-	-	I-X
X_5					III, XI-XIV	I-VI	X-XIV	II-V, IX, XI, XIII, XIV	III, IV, XI-XIV	IV, XIV	III, X, XI, XIII, XIV	I, II, XI-XIV	IV, XIII, XIV	III, IV, XI-XIV	X
X_6						XIV	-	XIII, XIV	IX-XII, XIV	-	XIII, XIV	XIV	-	IV, VII, X-XIV	VII
X_7							III, IX-XIV	I-XIV	I-XIV	III, V-IX, XIII, XIV	I-XIV	I-XIV	I-X, XIII-XIV	I-XIV	I-XIV
X_8								I, III, VII, VIII, X, XII-XIV	I, II, VI-X, XIII-XIV	-	I, VII, VIII, X, XIV	I, IX, XI, XIII, XIV	I, XIII, XIV	I-VI, XIII	I, II, VIII-XIV
X_9									I-VIII, XI, XIV	V, IX, XII-XIV	II, III, VII, VIII, X- XIV	I-XIV	II, XIII, XIV	I-XIV	I-XIV
X_{10}										-	VIII, XI, XIV	I-XII, XIV	II-VI, XIII, XIV	I-VIII, X-XIV	I, III, V-VIII, X-XIV
X_{11}											I-XIV	V, VI, VII, IX, X, XIII, XIV	-	VI, X	I, IV-VIII, XIV
X_{12}												VIII, XIII-XIV	II, VIII, XIV	II, VIII, XIII	I, III, VII, VIII, X, XI, XIII, XIV
X_{13}													II-X, XIII, XIV	I-XIV	I-XIV
X_{14}														I-IX, XIII, XIV	VII-IX
X_{15}															VI-XII

X_1 = grain yield per plant ; X_2 = plant height ; X_3 = productive tillers per plant; X_4 = days to 50% flowering ; X_5 = fingers per ear ; X_6 = length of finger ; X_7 = ear weight per plant ; X_8 = 1000 seed weight ; X_9 = yield per plot ; X_{10} = straw yield per plot ; X_{11} = LRM ; X_{12} = VRM ; X_{13} = VSM ; X_{14} = WRM ; X_{15} = WSM ; X_{16} = protein content I – XIV = environments * indicates negative association showed no relationship with other traits indicating that calcium can be improved independently of other characters.

Path analysis study revealed that the following characters exhibited predominant positive direct effect on yield per plant both at phenotypic and genotypic levels in most of the environments *i.e.*, ear weight per plant I (0.07p,0.70g); II (0.008p,0.620g);IV(0.039p,0.017g);V (0.065p,0.095g);VI(0.053p,0.118g);VII (0.131p,5.583g); VIII (0.110 p,0.225g); IX (0.014p,0.049g); XI (0.012p,0.031g) and XIII (0.045p,0.253g) as also reported by Marimuthu, 1997 and Bendale *et al.*, 2002; 1000 seed weight III (0.030 p,0.027g); VII (0.045 p,6.098g); VIII (0.179p,0.092g) and XIV (0.0017p,0.098g) the results are in con firmity with Hari Krishna *et al.,* 2005; yield per plot I (0.960p,7.62g); II (0.957p,1.028g); III (1.08p,1.10g); IV(1.013p,1.035g); V (0.931p,0.956g); VI (0.977p,1.049g); VIII (0.808p,0.705g); IX (0.987p,0.935g); X (0.952p,0.654g); XI (0.992p,1.028g); XII (0.957p,1.028g); XIII (1.051p,0.807g) and XIV (0.963p,0.863g) similar findings are reported by Hari Krishna *et al.,* 2005; straw yield per plot IV (0.580p,0.073g); VI (0.048p,0.190g); XII (0.0038p,0.732g) as also reported by Bendale, 2002; volume of root at main field X (0.023p,0.0086g); XI (0.017p,0.028g); XIII (0.050p,0.225g) and XIV (0.049p,0.103g) similar findings are reported by Hari Krishna *et al.,* 2005; volume of shoot at main field I (0.013p,2.32g); IV (0.064p,0.011g) and XIII (0.039p,0.199g) the results are in confirmity with Hari Krishna *et al.,* 2005; weight of shoot at main field II (0.0013p,0.477g); V (0.036p,0.003g); VIII (0.112p,0.097g) and XII (0.048p,0.076g) as also reported by Hari Krishna *et al.,* 2005; coupled with high positive correlation with yield indicating suitability of these traits for selection in improving the yield. Hence greater emphasis may be placed on these traits during selection for yield improvement.The residual effects are low in the environments.

The study indicated the association and direct effects were positive between yield per plant and yield per plot in all environments. However, protein content showed negative association with yield in all environments. There should be a balance between protein and yield during the selection programme. The positive correlation and direct effect of ear weight per plant, 1000 seed weight, towards yield per plant in several environments indicated that selection for these traits may improve yield per plant. Calcium content can be improved independently. The other traits showed positive and negative direct effects even though the correlation was positive in all environments. Consequently care has to be taken in effecting selection by maintaining balance among these traits so that genotypes with more desirable attributes can be developed.

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(Received on 16.10.2007 and revised on 29.12.2007)