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Study on correlation and path analysis among yield and its component traits in maize

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Abstract: The present experiment was conducted at department of genetics and plant breeding, Allahabad school of agriculture, Sam Higginbottom Institute of Agriculture Technology and Sciences, Deemed University. Analysis of variance showed highly significant differences among 20 genotypes for grain yield and its compent characters. In the present investigation, relative higher magnitude for the genotypic correlation than the phenotypic correlation was noted there by indicating strong inherent association among various characters. Correlation coefficient analysis indicated that ear girth, ear length, harvest index, biological yield, 100 grain weight and number of grains per row showed positive significant correlation with yield. Hence indirect selection for these traits could be helpful in the improvement of grain yield. Path analysis showed that, days to 50 per cent tasseling, plant height, ear girth, ear length, number of grains per row, biological yield, harvest index, ear height, days to 50 per cent silking and 100 grain weight had very strong relationship with grain yield per plant. An increase in any one of these or all of there quantitative characters would bring simultaneous increase in yield. Direct selection for these traits can help improve maize grain yield per unit area.

Key words: Genotypic, Phenotypic, Correlation, Path analysis

Introduction

India's maize production had declined to 16.8 million tonnes in the 2009-10 and the production of maize go up by 19 percent to touch 20 million tonnes in 2010-11 crop year on higher acreage and improved yield (Anonymous, 2009).However, productivity of maize has been continuously rising during last few years in India. Maize possesses a wide range of adaptation and is grown extensively in the temperate, sub-tropical and tropical zones in India. About 26% of the world's total cultivable land falls in arid and semi-arid areas (Paylore and Greenwell, 1979) and about 40 million hectares are planted annually in Asia. Correlation studied between yield and yield components themselves is a prerequisite to plan a meaningful breeding program (Ahmad and Saleem, 2003). Yield is a complex character,therefore selection for desirable genotype should be made based on grain yield and also the other yield components, which influence the yield, because the various yield components sometimes may be interlinked and may have pleiotropic effect among traits of other economic importance. 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. In the light of the above scenario, the present investigation is carried out with the objective of studying the character associations in maize genotypes for yield improvement.

Materials and Methods

The present experiment was conducted in the field experimentation centre of the Department of genetics and plant breeding, Allahabad School of Agriculture, Sam Higginbottom Institute of Agriculture Technology and Sciences. The present study was carried out with 20 genotypes including 3 checks (Table-1). These genotypes were procured from National Bureau of Plant Genetic Resources, New Delhi. The gross field area of 288 m^2 was divided into 3 sub plots. These sub plots were used to replicate the treatments thrice. Each sub plot was divided into thirty units of equal dimension and all the genotypes were grown in these units at a spacing of 60x20 cm. Observations for 14 traits were recorded in 10 randomly selected competitive plants for each treatment in each replication except for days to 50 percent tasselling, days to 50 percent silking, where the observations were recorded on plot basis. Five plants were selected randomly and dugged out along with the root system. Analysis of variance was done for partitioning the total variation into variation due to treatments and replications according to procedure given by Panse and Sukhatme (1967). Single correlation coefficients were computed at genotypic and phenotypic levels between pair of characters adopting following formula given by Al-Jibouri *et al.* (1958). To test the significance of correlation coefficient, the estimated values were compared with table values of correlation coefficient prescribed by Fisher and Yates (1935), at (n-2) treatment degrees of freedom at 5% and 1% level of significance. Path analysis was worked out by using the estimates of correlation coefficient in all possible combinations among the dependent variables as per Dewey and Lu (1959).

Results and Discussion

The mean sum of squares due to genotypes showed significant differences for all the characters except for number of cobs per plant (Table-2). This indicates the presence of substantial genetic variability among the genotypes. Correlation studies in the feeding material will help in developing a selection scheme, which would help in chancing the genetic potential of a crop. It also provides basic criteria for selection and a directional model based on yield and its components in field experiments. Genotypic and phenotypic correlation coefficients tell us the association between and among two or more character. A significant association suggests that such characters could be improved simultaneously. However, such an improvement depends on phenotypic correlation additive genetic variance and heritability (Hayas *et al.,* 1955).Phenotypic correlation determines the association between two verities, which can be directly observed. It includes both genotypic and environmental effects and therefore differs under different environmental conditions.

Table-1: List of genotypes used in present investigation

S. No.	GENOTYPES	S. No.	GENOTYPES
1	IC-75057	11	IC-541055
2	IC-75060	12	IC-541058
3	IC-75064	13	IC-550363
4	IC-75071	14	IC-361398
5	IC-75103	15	IC-361713
6	IC-75108	16	IC-381506
7	IC -21501	17	IC-130641
8	IC -32826	18	NAVJOT (C1)
9	IC-538703	19	MALVIYA MAKKA (C2)
10	IC-541054	20	PRAKASH (C3)

Table-2: Analysis of variance for different quantitative characters in maize

Parameters	Mean Sum of Squares		
	Replications (df = 1)	Treatments (df = 19)	Error (df = 19)
Days to 50% tasseling	0.90	14.03**	0.84
Days to 50% silking	1.60	16.10**	1.07
Anthesissilking interval	0.10	1.08*	0.25
Plant height	0.13	399.7**	1.65
Ear height	1.10	232.72 **	0.95
No. of cobs per plant	0.22	0.10	0.07
Ear girth	2.02	0.84*	0.26
Ear length	0.63	3.11**	0.83
100 grain weight	0.15	32.20**	0.68
No. of grain rows per cob	0.01	2.83*	0.91
No. of grains per row	2.16	12.74**	1.43
Biological yield	3.91	986.18**	1.14
Harvest index	0.62	5596.41**	37.46
Grain yield per plant	0.12	16.82**	0.05

Where, * and ** significant at 5% and 1% level of significance respectively

Table-3: Correlation coefficient at phenotypic and genotypic level for quantitative characters in maize

Character	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1	0.9606**	0.1072	0.2905	0.3366*	0.4627**	0.4095**	0.3546*	0.2559	0.1358	0.1561	0.5509**	0.1422	0.4327**
	-1	(0.9728**)	-0.1547	-0.2959	(0.3477*)	(1.1383**)	(0.5079**)	(0.4009*)	-0.2411	-0.81893	-0.1625	(0.5768**)	-0.1544	(0.4561**)
2		1	0.3793*	0.1615	0.2354	0.4836**	0.3223*	0.2728	0.3063	0.0236	0.0837	0.5873**	0.0414	0.3573*
		-1	-0.3793	-0.1563	-0.2409	-1.075	-0.3366	-0.2881	-0.2867	-0.0668	-0.088	-0.6115	-0.0548	-0.3807
3			1	-0.3894*	-0.2783	0.1898	-0.2104	-0.2047	0.2437	-0.3676*	-0.2206	0.2671	-0.3253*	-0.1626
			-1	(-0.5155**)	(-0.3616) *	-0.0379	(-0.5933**)	(-0.3725*)	-0.26	(-0.4711**)	(-0.2741)	-0.3042	(-0.3832*)	(-0.1985)
4				1	0.5758**	0.1589	0.3852*	0.3165*	0.3517*	0.1413	0.3117	0.1189	0.4391**	0.4722**
				-1	(0.5759**)	(0.4261**)	(0.4884**)	(0.4172**)	(0.3477*)	-0.1742	(0.3364*)	-0.1185	(0.4425**)	(0.4741**)
5					1	0.5191**	0.1803	0.2918	-0.0363	0.3398*	0.1643	0.0239	0.3239*	0.316
					-1	(1.3880**)	-0.2182	(0.3712*)	(-0.0492)	(0.4491**)	-0.1728	-0.0216	(0.3278*)	(0.3177*)
6						1	0.0054	0.2054	-0.0156	-0.0011	0.1582	0.1115	0.1576	0.2011
						-1	-0.1799	(0.8731**)	(-0.1503)	(0.8838**)	-0.2852	-0.2486	(0.4242**)	(0.5157**)
7							1	0.5894**	0.072	0.3034	0.5108**	0.295	0.3884*	0.5270**
							-1	(0.7786**)	-0.0076	(0.4264**)	(0.6298**)	(0.3738*)	(0.5440**)	(0.7125**)
8								1	0.0149	0.1176	0.6591**	0.2883	0.5972**	0.6661**
								-1	-0.0075	-0.2413	(0.7042**)	(0.3315*)	(0.7958**)	(0.8966**)
9									1	-0.4637**	0.044	0.3968*	0.1994	0.3785*
									-1	(-0.6594**)	-0.0336	(0.4001*)	-0.2088	(0.3867*)
10										1	0.0702	-0.2473	-0.0048	-0.1122
										-1	-0.1547	(-0.3328*)	(-0.0029)	(-0.1481)
11											1	0.0039	0.5140**	0.4662**
											-1	(-0.0110)	(0.5723**)	(0.5093**)
12												1	0.0039	0.4198**
												-1	(-0.1095)	(0.4220**)
13													1	0.8519**
													-1	(0.8535**)
14														1
														-1

Where, *Significant at 0.05 level of significance; **Significant at 0.01 level of significance; Figures in parenthesis are genotypic correlation coefficients; 1- Days to 50% tasseling; 2- Days to 50% silking; 3- Anthesissilking interval; 4- Plant height (cm); 5- Ear height (cm); 6- No. of cobs/plant; 7- Ear girth (cm); 8- Ear length (cm); 9- 100 grain weight; 10- No. of grain rows/cob; 11-No. of grains/row; 12- Biological yield (g); 13- Harvest index; 14- Grain yield/plant (g)

Table-4: Direct and indirect effects at phenotypic and genotypic level for quantitative characters on grain yield per plan

Character	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	**0.4596**	0.4415	0.4926	0.1335	0.1546	0.2126	0.1882	0.1629	0.116	0.6241	0.7176	0.2531	0.6534	0.4327**
	(-0.4071)	(-0.3960)	(-0.0630)	(-0.1205)	(-0.1416)	(-0.4634)	(-0.2068)	(-0.1632)	(-0.0981)	(-0.0771)	(-0.0662)	(-0.2348)	(-0.0629)	(0.4561**)
2	**-0.4742**	**-0.4936**	-0.1872	-0.7973	-0.1162	-0.2387	-0.159	-0.1346	-0.1512	-0.1166	-0.413	-0.2899	-0.2043	0.3573*
	-0.388	**-0.3988**	-0.1513	-0.0623	-0.0961	-0.4287	-0.1342	-0.1149	-0.1144	-0.0267	-0.0351	(-0.2348)	-0.0219	(0.3807*)
3	0.1479	0.5236	**0.138**	-0.5376	-0.3842	0.262	-0.2904	-0.2826	0.3364	-0.5175	-0.3045	0.3687	-0.4491	-0.1626
	(-0.0021)	(-0.0050)	**(-0.0133)**	-0.0069	-0.0048	(-0.0005)	-0.0007	-0.005	(-0.0035)	-0.0063	-0.0036	(-0.0040)	-0.0051	(-0.1985)
4	0.0042	0.0023	-0.0056	**0.0145**	0.0083	0.0023	0.0056	0.0046	0.0051	0.002	0.0045	0.0017	0.0064	0.4722**
	-0.0039	-0.002	(-0.0067)	**-0.0131**	-0.0075	-0.0056	-0.0064	-0.0054	-0.0045	-0.0024	-0.0044	-0.0015	-0.0058	(0.4741**)
5	-0.0009	-0.0006	0.0008	-0.0016	**-0.0028**	-0.0014	-0.0005	-0.0008	0.0001	-0.0009	-0.0005	-0.0001	-0.0009	0.3160*
	-0.0121	-0.0084	(-0.0126)	-0.0201	**-0.0349**	-0.0484	-0.0076	-0.013	(-0.0017)	-0.0157	-0.006	-0.0008	-0.0114	(0.3177**)
6	-0.0036	-0.0038	-0.0015	-0.0013	-0.0041	**-0.0079**	0	-0.0016	0.0001	0	-0.0012	-0.0009	-0.0012	0.2011
	(-0.0145)	(-0.0137)	(-0.005)	(-0.0054)	(-0.0177)	**(-0.0127)**	(-0.0023)	(-0.0111)	-0.0019	(-0.0113)	(-0.0036)	(-0.0032)	(-0.0054)	(0.5157**)
7	0.008	0.036	-0.0041	0.0075	0.0035	0.001	**0.0194**	0.0115	0.0014	0.0059	0.0099	0.0057	0.0075	0.5270**
	-0.0543	-0.006	(-0.0634)	-0.0522	-0.0233	-0.0192	**-0.1069**	-0.0832	-0.0008	-0.0456	-0.0673	-0.0399	-0.0581	(0.7125**)
8	-0.0046	-0.0036	0.0027	-0.0041	-0.0038	-0.0027	-0.0077	**-0.013**	-0.0002	-0.0015	-0.0085	-0.0038	-0.0078	0.6961**
	(-0.0487)	(-0.0350)	-0.0453	(-0.0507)	(-0.0451)	(-0.1061)	(-0.0946)	**(-0.1215)**	(-0.009)	(-0.0293)	(-0.0856)	(-0.0403)	(-0.0967)	(0.8966**)
9	-0.0051	-0.0061	-0.0049	-0.0071	0.0007	0.0003	-0.0014	-0.0003	**-0.0201**	0.0093	-0.0009	-0.008	-0.004	0.3785*
	(-0.0075)	(-0.0089)	(-0.0081)	(-0.0108)	-0.0015	-0.0047	(-0.0002)	(-0.0002)	**(-0.0311)**	-0.0205	(-0.0010)	(-0.0124)	(-0.0065)	(0.3867*)
10	0.001	0.0002	-0.0028	0.0011	0.0026	0	0.0023	0.0009	-0.0036	**0.0077**	0.0005	-0.0019	0	-0.1122
	-0.0081	-0.0029	(-0.0202)	-0.0079	-0.0192	-0.0379	-0.0183	-0.0103	(-0.0283)	**-0.0428**	-0.0066	(-0.0143)	(-0.0001)	(-0.1481)
11	-0.002	-0.0011	0.0028	-0.004	-0.0021	0.002	-0.0066	-0.0084	-0.0006	-0.0009	**-0.0129**	-0.0001	-0.0066	0.4662**
	(-0.0034)	(-0.0018)	-0.0057	(-0.0071)	(-0.0036)	(-0.0060)	(-0.0132)	(-0.0148)	(-0.0007)	(-0.0032)	**(-0.0210)**	-0.0002	(-0.0120)	(0.5093**)
12	0.2869	0.3059	0.1391	0.0619	0.0124	0.0581	0.1537	0.1502	0.2067	-0.1288	0.002	**0.5208**	-0.0599	0.4198**
	-0.3193	-0.3385	-0.1684	-0.0656	-0.012	-0.1376	-0.2069	-0.1835	-0.2215	(-0.1842)	(-0.0061)	**-0.5536**	(-0.0606)	(0.4220**)
13	0.1306	0.038	-0.2988	0.4033	0.1975	0.1447	0.3567	0.5485	0.1831	-0.0044	0.4722	**-0.1057**	**0.9186**	0.8519**
	-0.1537	-0.0546	(-0.3814)	-0.4405	-0.3263	-0.4223	-0.5415	-0.7921	-0.2078	(-0.0029)	-0.5697	(-0.1090)	**-0.9954**	(0.8535**)

Where, *Significant at 0.05 level of significance; **Significant at 0.01 level of significance Figures in parenthesis are genotypic effects

1- Days to 50% tasseling; 2- Days to 50% silking; 3- Anthesissilking interval; 4- Plant height (cm); 5- Ear height (cm); 6- No. of cobs/plant; 7- Ear girth (cm); 8- Ear length (cm); 9- 100 grain weight; 10- No. of grain rows/cob; 11-No. of grains/row; 12- Biological yield (g); 13- Harvest index; 14- Grain yield/plant (g)

Correlation coefficient at phenotypic and genotypic level for quantitative characters in maize is presented in table 3. In the present investigation, relative higher magnitude for the genotypic correlation than the phenotypic correlation was noted there by indicating strong inherent association among various characters. The phenotypic expression of correlation coefficient, however appeared to be depressed in same cases due to environmental influence, thus selection based on phenotypic may be effective. The present study revealed that correlation coefficient for grain yield per plant was positively and significantly correlated with days to 50 per cent tasselling, days to 50 per cent silking, plant height, ear girth, ear length, 100 grain weight, number of grains per row, biological yield and harvest index. It shows that these characters strongly associated with grain yield per plant. The positive correlation coefficient value between the yield component and grain yield indicate that, an increase in any one of these or all of these quantitative characters would bring a simultaneous increase in the yield. Differences were observed in the correlation coefficient in terms of magnitude and direction. The phenotypic correlation revealed that grain yield per plant had highest significant and positive correlation with days to 50 per cent tasseling, plant height, ear girth, ear length, 100 grain weight, number of grains per row, biological yield and harvest index. This shows that phenotypic correlation coefficient showed similar trend toward genotypic correlation indicating minimum influence of environmental over the expression of characters. Similar results were also reported by Satyanorana *et al.,*(2003) that grain yield was showing significant and positive correlation with number of grain rows per cob, 100 grain weight and ear girth. Whereas plant height showed positive non significant correlation with grain yield as reported by Uma Kanth *et al.* (2000).High correlation of grain yield with the number of grain rows per cob was reported by Corke and Khannenberg (1998),. Mohammade *et al.,* (2003). Agrama (1996) reported that the number of grain rows per cob has the greatest direct effect on grain yield. As simple correlation does not provide the true contribution of the characters towards the yield, these genotypic correlations were partitioned into direct and indirect effects through path coefficient analysis. It allows separating the direct effect and their indirect effects through other attributes by apportioning the correlations (Wright, 1921) for better interpretation of cause and effect relationship.

Direct and indirect effects at phenotypicand genotypic level for quantitative characters on grain yield per plant are given in table 4.Days to 50 per cent tasselling showed positive direct effect on grain yield per plant. Days to 50 per cent silking showed negative direct effect on grain yield. Plant height showed positive direct effect with grain yield per plant. Number of grain rows per cob showed positive direct effect was on grain yield per plant. In the present investigation, the results of path coefficient analysis indicated that the traits having direct effects on grain yield are understood to be strongly associate with it. Therefore, any variation in these traits will highly influence grain yield per plant. Days to 50 per cent tasselling showed negative direct effect on grain yield per plant. Anthesis silking interval showed negative direct effect on grain yield. Plant height showed positive direct effect on grain yield. Ear height showed positive direct effect on grain yield per plant. Number of cobs per plant showed negative direct effect on grain yield per plant. It showed positive indirect effect with 100 grain weight Number of grains per row showed negative direct effect on grain yield per plant. It showed positive indirect effects through anthesis silking interval and biological yield. Biological yield showed positive direct effect on grain yield per plant.

The results of path analysis showed that, days to 50 per cent tasseling, plant height, ear girth, ear length, number of grains per row, biological yield, harvest index, ear height, days to 50 per cent silking and 100 grain weight had very strong relationship with grain yield per plant. An increase in any one of these or all of there quantitative characters would bring simultaneous increase in yield. This observation should the extent of reliability of these traits as a good selection index for grain yield. So, direct selection for these traits can help improve maize grain yield per unit area.Similar results were obtained by Debnath (1987) for days to 50 per cent silking, ear height and ear length. Ear height showed positive direct effect on grain yield per plant. This result was similar to Trilfunovic (1989). Days to 50 per cent tassling had direct effect on yield per plant (Devi *et al.,* 2001).Ear girth, number of grains per row and 100 grain weight showed maximum positive direct effects and indirect contribution through other characters on grain yield (Umakhant *et al*., 2000).Thus in light of the results obtained in the present study, it can be suggested that the traits such as ear girth, ear length, number of grain rows per ear and number of cobs per plant should be used as target traits for improvement of grain yield in maize.

References

Agrama, H.A.S.: Sequential path analysis of grain yield and its components in maize. *Indian Journal of Plant Breeding,* **115:** 343-346 (1996).

Ahmad, A. and Saleem M.: Path coefficient Analsys in maize (*Zea mays* L.) *International Journal of Agriculture and Biology,* **5:** 3 (2003).

Al-Jibouri, A. Miller, P.A. and Robinson, H.F.: Genotypic and environmental variation and co-variation in an upland crops of interspecific origin.*Agronomyjournal,* **50**: 626-636 (1958).

Anonymous: Annual Progress Report, Directorate of Maize Research, New Delhi, p 1-2 (2009).

Corke, H. and Kannenberg L.W.: Selection for vegetative phase and actual grain filling period duration in short season maize. *Crop Science,* **29**: 607-612 (1998).

Debnath, S.C.: Genetic variability in maize. *Bangladesh Journal of Agriculture,* **12**: 217-221 (1987).

Devi, I.S., Singh, A.K. and Mohammad, S.: Character association and path coefficient analysis of gain yield and yield components in double crosses of Maize. *Crop Research,* **21**: 355-359 (2001).

Dewey, R.D. and Lu, K.H.: A correlation and path coefficient analysis of component of crested wheat grass seed production. *Agronomyjournal,* **51**: 515-518 (1959).

Fisher, R.A. and Yates, F.: Statistical table for Biological, Agricultural and medical Research, Longman Group limited, London (1935).

Hayes, H.K. Forrest, R.I. and Smith, D.C.: Methods of plant Breeding Correlation and regression in relation to plant breeding. McGraw-Hill Company Inc. 2nd Ed, p. 439-451 (1955).

Mohammadi, S.A., Prasanna. B.M. and Singh, N.N.: Sequential path model for determining interrelationship among grain yield and related characters in maize. *Crop Science,* **43***:* 1690-1697 (2003).

Panse, and Sukhatme P.V.: Satistical methods for agricultural workers (IInd ed.) *ICAR Publication*, New Delhi (1967).

Paylore, P. and Greenwell J.R.: Fools run in pinpointing the arid zones. *Journal of Arid Environment*, **10**: 17–8 (1979).

Satyanarayana, E. Shanthi, P. and Kumar, R.S.: Genetic variability studies for morphological quantitative parameters in sweet corn. *Journal of Maharashtra Agriculture University,* **28:** 41-44 (2003).

Umakanth, A.V. Satyanarayana, E. and Kumar, M.V.N.: Genetic variability in two maize populations. *Annals of Agriculture Research,* **21**: 230-233 (2000).

Wright, S.:Correlation and causation. *Journal of Agricultural Research,* **20**: 557-85 (1921).