Himachal Journal of Agricultural Research 41(2): 163-167 (2015)

Short Note

Correlation and path analysis of agro-morphometric traits in maize (*Zea mays* L.)

Ankita Sood, Naresh Thakur and S. Lata
Department of Crop Improvement
CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur-176 062
Corresponding author: slatasharma@gmail.com

Received: 08 December 2015; Accepted: 20 December 2015

Abstract

Correlation and path coefficient among eleven agro-morphometric traits of forty maize inbred lines (14 QPM lines and 26 non-QPM lines) grown during *kharif* 2011 were studied. Correlation analysis revealed that grain yield exhibited significant positive association with 100-seed weight implying that improvement in grain yield can be obtained by improving the latter. Further, path coefficient analysis partitioned the correlation into direct and indirect effects. Path analysis revealed highest positive direct effect of days to 50% silking on grain yield, followed by cob girth and 100-seed weight; hence selection based on these characters would be more rewarding.

Key words: Maize, agro-morphometric traits, correlation, path analysis

Maize (*Zea mays* L.) belongs to the tribe Maydeae of the grass family Poaceae. The genus *Zea* consists of four species, of which *Z. mays* L. is economically important and is one of the nature's most efficient energy-storing cereal. It has the highest potential for carbohydrate production per unit area per day. It is a major food and calorie source for the people in the developing world, with a total direct consumption of 100 mt as food, contributing 15% of the protein and 19% of the calories delivered from food crops. The crop improvement efforts are directed to increase the grain production. Grain yield is a complex trait conditioned by the interaction of various growth and physiological processes throughout the life cycle. A rational choice of characters on which selection is to be exercised for higher yields requires an understanding of the association of characters with yield and among themselves. Further path coefficient analysis is an efficient tool to elucidate the direct and indirect effect of each character towards yield. Hence, the present investigation was taken up to study the association of yield and its component traits in maize**.**

The study was carried out at the Experimental Farm of the Department of Crop Improvement, College of Agriculture, CSK HPKV, Palampur (32°6' N latitude, 76°3' E longitude and 1290.8 m altitude) during 2011. The experimental material consisted of 40 maize inbred lines which comprised of 14 QPM lines and 26 non-QPM lines was sown in α-RBD design with three replications (five blocks per replication and eight entries per block with plot size of 3.0 × 1.2 m^2) at row to row and plant to plant distance of 60 cm and 20 cm, respectively (having 2 rows/plot). Recommended cultural practices were followed to raise the crop. Plant height, cob placement height, cob length, cob girth, kernel rows per ear, grains per row and 100-seed weight were recorded on ten randomly selected plants in each plot. Grain yield was harvested from net plot. Days to 50% pollen shed, 50% silking and 75% maturity were recorded on plot basis. The phenotypic [r_{12} (P)] and genotypic [r12 (G)] correlation coefficients were calculated as per formulae suggested by Al -Jibouri *et al.* (1958).

$$r_{12-} (P) = s_{p12} / \sqrt{[s^2_p (X_1) \times s^2_p (X_2)]}$$
$$r_{12-} (G) = s_{g12} / \sqrt{[s^2_g (X_1) \times s^2_g (X_2)]}$$

Where,
s_{p12} = phenotypic covariance between characters X_1 and X_2
s_{g12} = genotypic covariance between characters X_1 and X_2

$s^2_p(X_1)$ and $s^2_p(X_2)$ = phenotypic variance of traits X_1 and X_2, respectively

$s^2_g(X_1)$ and $s^2_g(X_2)$ = genotypic variance of traits X_1 and X_2, respectively

The path coefficient analysis was performed according to Dewey and Lu (1959).

$Py_1 + Py_2.r_{12} + Py_3.r_{13} + \ldots\ldots\ldots\ldots + Py_n.r_{1n} = ry_1$

$Py_1.r_{12} + Py_2 + Py_3.r_{23} + \ldots\ldots\ldots\ldots + Py_n.r_{2n} = ry_2$

$Py_1.r_{13} + Py_2.r_{23} + Py_3 + \ldots\ldots\ldots\ldots + Py_n.r_{3n} = ry_3$

$Py_1.r_{1n} + Py_2.r_{2n} + Py_3.r_{3n} \ldots\ldots\ldots\ldots + Py_n.r_{(n-1)n} = ry_n$

Where,

Py_1, Py_2, Py_3 ………….. Py_n are the direct path effects of 1, 2, 3, ………., n variables on the dependent variable 'y'.

r_{12}, r_{13},………….. r (n-1) n are the coefficients of correlation between various independent variables and ry_1, ry_2, ry_3, …………… ryn are the correlation coefficients of independent variables with dependent variable 'y'.

The variation in the dependent variable which remained undetermined was assumed to be due to variables (s) not included in the present investigation. The degree of determination of such variables was calculated as follows:

$$\text{Residual effect } (P \times R) = \sqrt{(1 - R^2)}$$

where,

$$R^2 = \sum_{i=1}^{n} p_{iy} r_{iy}$$

where,

R^2 is the squared multiple correlation coefficient and is the amount of variation in the yield that can be accounted for any yield component characters. Morphological traits were measured based on maize descriptors developed by the Biodiversity International.

The estimates of phenotypic and genotypic correlation coefficients among yield and yield attributes are presented in Table 1. The estimates of genotypic correlations, in general, were higher than their respective phenotypic correlations for most of the traits, indicating that the interrelationships were strongly inherent. The low phenotypic expression was due to environmental factors.

Days to 50% pollen shed exhibited a significant and positive association with 50% silking and 75% maturity. Similarly, significant positive correlation was also observed for 50% silking with 75% maturity indicating that selection for early silking would be sufficient to identify the earliness in maturity which would ultimately result in higher yield. Grain yield showed significant positive correlation with 100-seed weight indicating that this trait can be considered for effective selection. The grain yield was also positively correlated with all the other traits. Liu (1997) also reported positive correlation between grain yield and seed weight. Similar results were reported earlier in maize by Kaundal and Sharma (2005), Rafiq *et al.* (2010) and Zarei *et al.* (2012) which were in confirmation with the present study. Whereas, Barros *et al*. (2010) observed negative correlation between grain yield and days to silking, this was not in accordance with the present study, as these traits were positively correlated.

Path coefficient analysis (Table 2) provides better means for selection by resolving the correlation coefficient of yield and its components into direct and indirect effects. In the present study, six traits *viz.*, days to 50% silking, plant height, cob placement height, 100-seed weight, cob girth and grains per row exhibited positive correlation with grain yield. Whereas, days to 50% pollen shed, 75% maturity, cob length and kernel rows per ear exhibited negative correlation with grain yield. Geetha and Jayaraman (2000) reported that number of grains per row exerted a maximum direct effect on grain yield. However, in the present study the direct and indirect contribution of correlation revealed the high positive direct effect of days to 50% silking only, so this trait may be given more emphasis for selecting high yielding maize genotypes.

The high positive direct effect of days to 50% silking on yield was also reported by Kumar and Singh (2004) which were in confirmation with present study. From the present study it can be inferred that the traits showing positive direct effects on correlation with grain yield have low direct values, indicating that selection based on these traits for increasing the grain yield would not be effective. Whereas, their indirect effects through days to 50% silking were high, therefore 50% pollen shed, 75% maturity, cob placement height and 100-seed weight contributed indirectly through days to 50% silking which means that these traits act as precursors for other traits and selection on their basis would help in increasing the grain yield of maize.

References

Al-Jibouri HA, Miller PA and Robinson HF 1958. Genetic and environmental variances and covariances in upland cotton cross of interspecific origin. J. of American Society of Agro. **50**: 633-637.

Barros LB, Moreira RMP and Ferreira JM 2010. Phenotypic, additive genetic and environment correlations of maize landraces populations in family farm systems. Scientific Agric. **67** (6): 685-691.

Table 1. Estimates of correlation coefficients at phenotypic (P) and genotypic (G) levels among various yield and morphological traits of maize

Traits		Days to 50% silking	Days to 75% maturity	Plant height (cm)	Cob placement height (cm)	Grain yield (kg/ ha)	100-seed weight (g)	Cob length (cm)	Cob girth (cm)	Kernel rows/ ear	Grains/row
Days to 50% pollen shed	**P**	0.996*	0.990*	0.086	0.226	0.147	0.116	0.020	-0.063	-0.080	-0.191
	G	0.999	0.998	0.093	0.251	0.154	0.129	0.022	-0.066	-0.090	-0.212
Days to 50% silking	**P**		0.994*	0.104	0.231	0.175	0.136	0.029	-0.045	-0.081	-0.172
	G		1.000	0.109	0.259	0.181	0.154	0.041	-0.038	-0.085	-0.194
Days to 75% maturity	**P**			0.104	0.236	0.169	0.133	0.019	-0.047	-0.064	-0.178
	G			0.112	0.259	0.175	0.144	0.026	-0.042	-0.091	-0.207
Plant height (cm)	**P**				0.753	0.513	0.552	0.604	0.552	0.277	0.539
	G				0.790	0.556	0.603	0.717	0.637	0.349	0.611
Cob placement height (cm)	**P**					0.575	0.598	0.596	0.541	0.292	0.443
	G					0.621	0.659	0.680	0.611	0.344	0.478
Grain yield (kg/ ha)	**P**						0.695*	0.435	0.677	0.296	0.458
	G						0.751	0.538	0.842	0.398	0.579
100-seed weight (g)	**P**							0.540	0.731	0.350	0.499
	G							0.662	0.824	0.405	0.587
Cob length (cm)	**P**								0.650	0.377	0.682
	G								0.712	0.482	0.764
Cob girth (cm)	**P**									0.622	0.709
	G									0.761	0.743
Kernel rows/ear	**P**										0.351
	G										0.426

*Significant at 5% level of significance

Table 2. Estimates of direct and indirect phenotypic (P) and genotypic (G) effects of different traits on seed yield

Traits		Days to 50% pollen shed	Days to 50% silking	Days to 75% maturity	Plant height (cm)	Cob placement height (cm)	100-seed weight (g)	Cob length (cm)	Cob girth (cm)	Kernel rows/ ear	Grains/row
Days to 50% pollen shed	P	**-0.949**	-0.945	-0.939	-0.054	-0.179	-0.102	-0.024	0.064	0.084	0.194
	G	**-5.926**	-5.886	-5.786	-5.576	-1.023	-7.726	-1.302	3.948	5.379	12.739
Days to 50% silking	P	1.223	**1.229**	1.221	0.092	0.242	0.155	0.037	-0.064	-0.114	-0.233
	G	1.441	**1.442**	1.442	0.157	0.373	0.222	0.059	-0.055	-0.123	-0.280
Days to 75% maturity	P	-0.204	-0.205	**-0.206**	-0.015	-0.042	-0.025	-0.004	0.012	0.017	0.041
	G	7.980	8.116	**8.115**	6.486	1.069	8.391	1.524	-2.420	-5.294	-12.042
Plant height (cm)	P	0.002	0.002	0.002	**0.030**	0.023	0.017	0.017	0.017	0.008	0.016
	G	-0.085	-0.100	-0.102	**-0.916**	-0.724	-0.552	-0.657	-0.583	-0.320	-0.560
Cob placement height (cm)	P	0.031	0.033	0.034	0.124	**0.167**	0.096	0.090	0.088	0.047	0.072
	G	0.379	0.392	0.393	1.196	**1.514**	0.997	1.029	0.925	0.521	0.724
100-seed weight (g)	P	0.037	0.044	0.043	0.195	0.202	**0.350**	0.184	0.254	0.120	0.167
	G	0.888	1.060	0.995	4.153	4.540	**6.890**	4.564	5.680	2.793	4.044
Cob length (cm)	P	-0.004	-0.005	-0.003	-0.101	-0.096	-0.093	**-0.176**	-0.115	-0.070	-0.117
	G	-0.033	-0.062	-0.039	-1.081	-1.025	-0.999	**-1.508**	-1.073	-0.727	-1.152
Cob girth (cm)	P	-0.030	-0.023	-0.025	0.245	0.237	0.324	0.292	**0.446**	0.286	0.315
	G	1.037	0.598	0.655	-10.020	-9.619	-12.973	-11.200	**-15.737**	-11.979	-11.693
Kernel rows/ear	P	0.007	0.008	0.007	-0.023	-0.024	-0.029	-0.034	-0.054	**-0.084**	-0.031
	G	-0.682	-0.650	-0.692	2.651	2.616	3.080	3.664	5.784	**7.598**	3.236
Grains/row	P	-0.003	-0.003	-0.003	0.009	0.007	0.008	0.011	0.012	0.006	**0.016**
	G	-1.189	-1.087	-1.159	3.416	2.674	3.282	4.274	4.155	2.382	**5.592**

Residual effect (P) = 0.402, (G) = 1.762; Bold values indicate direct effects

Dewey DR and Lu KH 1959. A correlation and path analysis of components of crested wheat grass seed production. J. of American Society of Agro. **51**: 515-518.

Geetha K and Jayaraman N 2000. Path analysis in maize (*Zea mays* L.). Agric. Sci. Digest. **20** (1): 60-61.

Kaundal R and Sharma BK 2005. Genetic variability and association studies for different yield components over the environments in elite cultivars of (*Zea mays* L.). Him. J. Agric. Res. **31** (1): 26-31.

Kumar A and Singh NN 2004. Identification of yield contributors through path analysis in maize. Annals of Agric. Res. **25** (3): 448-450.

Liu Z 1997. Correlation analysis among kernel physical and quality characters in quality protein maize (QPM). Maize Genetics Cooperation Newsletter. **71**: 41.

Rafiq CM, Rafique M, Hussain A and Altaf A 2010. Studies on heritability, correlation and path analysis in maize (*Zea mays* L.). J. of Agric. Res. **48** (1): 35-38.

Zarei B, Kahrizi D, Aboughadaresh AP and Sadeghi F 2012. Correlation and path coefficient analysis for determining interrelationships among grain yield and related characters in corn hybrids. Inter. J. of Agric. and Crop Sci. **4** (20): 1519-1521.