Correlation and Path Coefficient Analysis for Determining Interrelationships among Grain Yield and Related Characters in Maize Hybrids (*Zea mays* L.)

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Abstract: **The present investigation for studying correlations and path analysis estimates for grain yield and yield contributing characters in maize was carried out at three locations and pooled analysis was carried out. Days to 50 per cent tasseling was significantly and positively correlated with days to 50 per cent silking and days to maturity and negatively correlated with plant height, ear length, ear girth, number of kernel rows per ear, number of kernels per row and grain yield per plant. Days to maturity was significant and negatively correlated with plant height, ear length, ear girth, number of kernel rows per ear, number of kernels per row, 100-seed weight and grain yield per plant. 100 seed weight exhibited significant positive association with plant height, ear height, ear length, ear girth, number of kernel rows per ear, number of kernels per row and grain yield per plant. The character grain yield per plant showed significant and negative correlation with days to 50 per cent tasseling , days to 50 per cent silking, days to maturity and positive correlation with plant height, ear height, ear length, ear girth, number of kernel rows per ear, number of kernels per row and 100-seed weight in pooled analysis. Path analysis revealed that days to maturity had direct negative genotypic effect on grain yield per plant and indirect negative contribution through days to 50 per cent silking, ear length, ear girth, number of kernels per row and 100-seed weight over locations. Pooled analysis revealed that the plant height had direct positive contribution whereas the days to 50 per cent silking, ear height, ear length, ear girth, number of kernels per row and 100-seed weight showed indirect positive contribution on grain yield per plant. 100-seed weight exhibited direct genotypic positive effect on grain yield per plant over locations while it had indirect positive influence through days to 50 per cent tasseling, ear height, ear length, ear girth and number of kernels per row over locations.**

Keywords**: maize, correlation, path analysis**

I. INTRODUCTION

Maize (*Zea mays* L.) is an important food and feed crop of the world, grown on more than 120 million hectares and is called the "king of grain crops". It ranks third in production close behind wheat and rice. Despite of staple food of many countries the average yield of maize is less to meet the food requirements of increasing world population. The development of improved cultivars/hybrids of maize is the need of the day. Determination of correlation and path coefficients between yield and yield traits is important for the selection of favorable plant types for effective maize breeding programs. Correlation coefficients show associations among independent characteristics and the degree of linear relation between these characteristics. It is not sufficient to describe this relationship when the causal association among characteristics is needed. Path analysis is used to determine the amount of direct and indirect effect of the causal components on the effect component. Keeping this in view, the present study was undertaken to study the extent of relationships among yield and its components for enhancing the usefulness of selection.

II. MATERIALS AND METHODS

The present investigation for studying correlations and path analysis estimates for grain yield and yield contributing characters in maize was carried out during *kharif* 2012, rabi 2012-13 and kharif 2013 at Agricultural Research Station, Madhira Agricultural Research Station (ARS), Tandur, Rangareddy district and Regional Agricultural Research Station (RARS), Warangal, respectively. Phenotypic and genotypic correlations were worked out in 60 crosses and 19 parents at these locations and the pooled analysis over these locations was carried out and presented in Tables 1 and 2, respectively. In general, genotypic correlations were of higher magnitude than the corresponding phenotypic values and hence only the genotypic correlations are discussed hereunder. Path coefficient analysis allows separation of the direct effect and their indirect effects through other attributes by partitioning the correlations (Wright, 1921). Hence, the path coefficient analysis was undertaken to know the direct and indirect effects in maize.

III. RESULTS AND DISCUSSION

In pooled analysis, days to 50 per cent tasseling was significantly and positively correlated with days to 50 per cent silking and days to maturity and it was negatively correlated

with plant height, ear length, ear girth, number of kernel rows per ear, number of kernels per row and grain yield per plant. Similar results for association of grain yield per plant with days to 50 percent tasseling were also reported by Raghu *et al.* (2011), Ravi *et al*. (2012) and Triveni Sharma *et al.* (2014). Days to 50 per cent silking in pooled analysis showed significant positive association to days to 50 percent tasseling and days to maturity, while it had negatively significant correlation with plant height, ear length, ear girth, number of kernel rows per ear, number of kernels per row and grain yield per plant.

Pooled analysis revealed that days to maturity was significant and negatively correlated with plant height, ear length, ear girth, number of kernel rows per ear, number of kernels per row, 100-seed weight and grain yield per plant. Ear length showed positive and significant association with plant height, ear height, ear girth, number of kernel rows per ear, number of kernels per row, 100-seed weight and grain yield per plant. Similar results were reported earlier in maize for the association of grain yield with ear length by Ravi *et al.* (2012), Kumar *et al.* (2014) and Nataraj *et al*. (2014a).

The association of number of kernel rows per ear was significant and positive with plant height, ear height, ear length, ear girth, number of kernels per row, 100-seed weight and grain yield per plant in pooled analysis. 100 seed weight exhibited significant positive association with plant height, ear height, ear length, ear girth, number of kernel rows per ear, number of kernels per row and grain yield per plant. The character grain yield per plant showed significant and negative correlation with days to 50 per cent tasseling , days to 50 per cent silking, days to maturity and positive correlation with plant height, ear height, ear length, ear girth, number of kernel rows per ear, number of kernels per row and 100-seed weight in pooled analysis. Similar results were reported Nataraj *et al*. (2014a) and Triveni Sharma *et al.* (2014).

In pooled analysis, days to 50 per cent tasseling showed a negative direct effect on grain yield and also indirect positive contribution by days to 50 per cent silking, days to maturity, plant height, ear height and number of kernel rows per ear. The indirect negative contribution was through ear length, ear girth and number of kernels per row. Similar results of direct negative effect of days to 50 per cent tasseling on grain yield was reported by Zarei *et al.* (2012) and Mahesh *et al.* (2013).

Days to maturity had direct negative genotypic effect on grain yield per plant and the indirect negative contribution on grain yield per plant was through days to 50 per cent silking, ear length, ear girth, number of kernels per row and 100-seed weight in pooled analysis. Direct negative effect on grain yield per plant was recorded by days to maturity and the indirect positive contribution on grain yield through days to 50 per cent tasseling , plant height, number of kernel rows per ear in pooled analysis.

Pooled analysis revealed that the plant height had direct positive contribution whereas the days to 50 per cent silking, ear height, ear length, ear girth, number of kernels per row and 100-seed weight showed indirect positive contribution on grain yield per plant. It also showed negative indirect effect on grain yield per plant by days to 50 per cent tasseling, days to maturity and number of kernel rows per ear. Ear length had direct positive influence and indirect positive influence through days to 50 per cent silking, ear height, ear girth, number of kernels per row and 100-seed weight. Days to 50 per cent tasseling, days to maturity, plant height and number of kernel rows per ear had indirect negative influence on grain yield per plant.

In pooled analysis ear girth had direct positive influence on grain yield. The days to 50 per cent tasseling, days to maturity, plant height and number of kernel rows per ear showed indirect negative contribution on grain yield. It also had indirect positive contribution through days to 50 per cent silking, ear height, ear length, number of kernels per row and 100-seed weight. Number of kernels per row had direct positive influence on grain yield,while it had indirect positive influence through days to 50 per cent silking, ear height, ear length, ear girth and 100-seed weight over the locations. It also had indirect negative contribution through days to 50 per cent tasseling, days to maturity, plant height and number of kernel rows per ear over locations.

The 100-seed weight exhibited the direct genotypic positive effect on grain yield per plant over locations while it had indirect positive influence through days to 50 per cent tasseling, ear height, ear length, ear girth and number of kernels per row over locations. It also had indirect negative influence on grain yield per plant through days to 50 per cent silking, days to maturity, plant height and number of kernel rows per ear over locations. Similar results of direct positive effect of 100-seed weight on grain yield was found by Reddy *et al.* (2013) and Dana Azad Abdulkhaleq and Sherwan Ismael Tawfiq (2014).

The genotypic residual effect was 0.0300 over locations, which is low indicating that all the characters studied contribute for grain yield in the present investigation.

Table 1: Phenotypic (P) and Genotypic (G)) pooled correlations for 11 characters in maize.

Source		Days to 50% tasseling	Days to 50% silking	Days to maturity	Plant height (cm)	Ear height (cm)	Ear length (cm)	Ear girth (cm)	Number of kernel rows per ear	Number of kernels per row	100-seed weight (g)	Grain yield per plant (g)
Days to 50% tasseling	P	1.00	0.98**	0.67**	-0.25**	-0.05	-0.26**	-0.21**	-0.35**	-0.28**	-0.02	-0.27**
	G	1.00	1.00**	0.86**	-0.26**	0.01	-0.32**	-0.28**	-0.36**	-0.36**	0.01	-0.34**
Days to 50% silking	P		1.00	0.66**	-0.28**	-0.07	-0.28**	-0.23**	-0.35**	-0.30**	-0.02	-0.28**
	G		1.00	0.86**	-0.30**	-0.02	-0.34**	-0.30**	-0.38**	-0.37**	0.01	-0.37**
Days to maturity	P			1.00	-0.21**	-0.06	-0.28**	-0.21**	-0.24**	-0.30**	-0.12*	-0.24**
	G			1.00	-0.27**	-0.01	-0.38**	-0.28**	-0.25**	-0.45**	-0.13*	-0.38**
Plant height (cm)	P				1.00	0.81**	0.60**	0.63**	0.55**	0.67**	0.12*	0.66**
	G				1.00	0.90**	0.80**	0.83**	0.67**	0.83**	0.12*	0.80**
Ear height (cm)	P					1.00	0.52**	0.60**	0.53**	0.60**	0.13*	0.61**
	G					1.00	0.69**	0.80**	0.64**	0.75**	0.14*	0.76**
Ear length (cm)	P						1.00	0.60**	0.54**	0.68**	0.29**	0.69**
	G						1.00	0.84**	0.73**	0.86**	0.36**	0.89**
Ear girth (cm)	P							1.00	0.68**	0.70**	0.29**	0.72**
	G							1.00	0.88**	0.89**	0.34**	0.92**
Number of kernel rows per ear	P								1.00	0.61**	0.18**	0.69**
	G								1.00	0.75**	0.19**	0.83**
Number of kernels per row	P									1.00	0.21**	0.79**
	G									1.00	0.24**	0.91**
100 seed weight (g)	P										1.00	0.40**
	G										1.00	0.45**

* Significant at 5 percent level; ** significant at 1 percent level

Table 2: Phenotypic (P) and Genotypic (G) pooled path coefficients for various characters in maize

Source		Days to 50% tasseling	Days to 50% silking	Days to maturity	Plant height (cm)	Ear height (cm)	Ear length(cm)	Ear girth (cm)	Number of kernel rows per ear	Number of kernels per row	100-seed weight (g)	Grain yield per plant (g)
Days to 50% tasseling	P	**0.13**	-0.18	0.04	-0.02	0.00	-0.03	-0.02	-0.07	-0.11	0.00	-0.27**
	G	**-0.28**	0.42	0.46	0.35	0.01	-0.08	-0.03	0.11	-0.47	0.00	-0.34**
Days to 50% silking	P	0.13	**-0.18**	0.04	-0.02	0.00	-0.03	-0.02	-0.07	-0.12	0.00	-0.28**
	G	11.70	**-12.43**	0.46	0.39	-0.01	-0.08	-0.03	0.11	-0.48	0.00	-0.37**
Days to maturity	P	0.09	-0.12	**-0.04**	-0.01	0.10	-0.03	-0.02	-0.05	-0.12	-0.03	-0.24**
	G	10.11	-9.71	**-0.47**	0.35	0.00	-0.09	-0.03	0.07	-0.59	-0.03	-0.38**
Plant height (cm)	P	-0.03	0.05	-0.01	**0.07**	0.05	0.07	0.05	0.11	0.26	0.03	0.66**
	G	-3.08	1.70	-0.14	**0.68**	0.46	0.19	0.08	-0.20	1.08	0.03	0.80**
Ear height (cm)	P	-0.01	0.01	0.00	0.06	**0.07**	0.06	0.05	0.11	0.24	0.03	0.61**
	G	0.12	0.25	0.00	-1.19	**0.52**	0.16	0.07	-0.19	0.99	0.04	0.76**
Ear length (cm)	P	-0.03	0.05	-0.02	0.04	0.03	**0.12**	0.05	0.11	0.27	0.06	0.72**
	G	-3.73	4.20	-0.20	-1.06	0.36	**0.24**	0.08	-0.22	1.13	0.09	0.92**
Ear girth (cm)	P	-0.03	0.04	-0.01	0.04	0.04	0.07	**0.08**	0.14	0.28	0.06	0.69**
	G	-3.28	3.76	-0.15	-1.10	0.41	0.20	**0.09**	-0.27	1.17	0.09	0.89**
Number of kernel rows per ear	P	-0.04	0.06	-0.01	0.04	0.04	0.06	0.06	**0.20**	0.24	0.04	0.69**
	G	-4.18	4.71	-0.13	-0.89	0.33	0.17	0.08	**0.20**	0.48	0.05	0.83**
Number of kernels per row	P	-0.04	0.05	-0.02	0.05	0.04	0.08	0.06	0.13	**0.40**	0.05	0.79**
	G	-4.16	4.58	-0.24	-1.09	0.39	0.20	0.08	-0.23	**1.31**	0.06	0.91**
100 seed weight (g)	P	0.00	0.00	-0.01	0.01	0.01	0.03	0.02	0.04	0.08	**0.21**	0.40**
	G	0.15	-0.18	-0.07	-0.15	0.07	0.09	0.03	-0.06	0.32	**0.26**	0.45**

Bold values are direct effects; Phenotypic residual effect = 0.4788 ; Genotypic residual effect = 0.0300

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