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Correlation and Path Analysis in Certain Inbred Genotypes of Maize (Zea Mays L.) at Varanasi

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Abstract:
The phenotype as well as genotype correlation and path analysis of agronomic yield and yield contributing characters were analysed in 39 inbreds of maize (Zea mays L.). Grain yield has positive and significant correlation with ear diameter, number of kernels per row, number of kernel rows per ear, ear height, ear weight with husk, ear weight without husk, plant height, 100 grain weight and ear length both at genotypic and phenotypic levels. Path analysis revealed that that ear weight with husk, number of kernel rows per ear, number of kernels per row and 100 grain weight showed highest direct effect on grain yield per plant. The direct effects of plant height, ear height and ear diameter were also considerable. Whereas the remaining characters exhibited negative direct effect on grain yield per plant.

Key words: *correlation, path analysis, Zea mays L.*

1. Introduction

Maize (Zea mays L.) is the third most important cereal in India after rice and wheat that provides food, feed, fodder, fuel and serves as a source of basic raw material for a number of industrial products viz., starch, oil, protein, alcoholic beverages, food sweeteners, cosmetics and bio-fuel etc. The crop improvement efforts are directed to increase the grain production. Studies on correlation coefficients of different characters are useful criterion to identify desirable traits that contribute to improve the grain yield. The phenotypic expression of the latter is a complex entity which is jointly influenced by a number of other interrelated characters. The standardized partial regression helps to understand the various paths, i.e., the magnitude of direct influence of each character and the indirect influence through other characters. Path analysis is also equally beneficial since it is an efficient biometrical tool which indicates the direct contribution of characters and its influence through other traits in influencing the yield. Therefore, the present research work was undertaken to study the correlation and path coefficient in early generations of maize (Zea mays L.).

2. Material and Methods

The experimental materials consisted of 39 diverse germplasm of maize obtained from All India Co-ordinated Maize Improvement Project. The experiment was carried out during rabi season of 2011-2012 at the Research Farm of Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. Thirty nine genotypes were sown in Randomized Block Design with three replications. Each entry was sown as single row of 3 meter lengths with row-to-row and plant-to-plant distance of 60 cm and 20 cm respectively. Initially two seeds per hill were sown and later on one plant was thinned to maintain single plant per hill. Two border rows were also planted to avoid the border effect. The crop was raised as per the recommended package of practices. The observations on twelve quantitative characters, namely days to 50% silking, days to 50% tasseling, plant height (cm), ear height (cm), ear length (cm), ear diameter (cm), ear weight without husk (g). ear weight with husk (g), number of kernel rows per ear, number of kernels per row, 100-seed weight and grain yield per plant (g) were recorded. Observations were recorded on five plants selected at random from each genotype in each replication and were averaged. Data based on means of five observations were utilized to estimate correlation and path coefficients. The phenotypic (r_P), genotypic (r_G) and environmental (r_E) correlation coefficients for various characters were calculated by the method suggested by Panse and Sukhatme (1967). The path analysis was carried out as per the procedure of wright (1921) and as adopted by Dewey and Lu (1959).

3. Results and Discussion

The genotypic and phenotypic correlation coefficients among yield and yield attributing traits are presented in Table 1. The results showed that the r_G in general were higher than r_P. The interrelationships were, therefore, strongly inherent and low phenotypic expression were due to environmental factors. Days to 50% tasseling had a significant positive correlation with days to 50% silicon, plant height, ear height, ear length and 100 grain weight. Days to 50% silking had a significant positive correlation with days to 50% tasseling, plant height, ear length and 100 grain weight. Plant height had a significant positive correlation with ear height, ear length, 100 grain weight and number of kernels per row. Similar observations were reported by Bhole and Patil, (1984). Ear length and number of kernel rows per ear exhibited a significant correlation in a positive direction with ear height these were in agreement with the findings of Kumar and Kumar, (1997). Ear length had a significant positive association with ear weight and number of kernels per row. Ear diameter had a significant positive correlation with ear weight, number of kernels per row and number of kernel rows per ear. Ear weight showed significant positive phenotypic and genotypic correlations with ear height, ear length, ear diameter, number of kernels per row and number of kernel rows per ear. Number of kernel rows per ear had a significant positive correlation with plant height, ear height, ear diameter, ear weight with and without husk. Number of kernels per row had a significant positive correlation with plant height, ear height, ear length, ear diameter, ear weight with and without husk and number of kernel rows per ear.100 grain weight showed positive significant association with days to 50% tasseling, days to 50% silking, plant height and ear height. Grain yield per plant exhibited a high significant positive correlation with ear diameter followed by number of kernels per row, number of kernel rows per ear, ear height, ear weight with husk, ear weight without husk, plant height, 100 grain weight and ear length. Similar results were reported earlier in maize by several workers on different characters viz., for the association of grain yield with plant height (Moradi et al., 2011; Raghu et al., 2011, and Zarei et al., 2012, ear height (Raghu et al., 2011), ear length (Selvaraj and Nagarajan, 2011 and Zarei et al., 2012), ear diameter (Rafiq et al., 2010), number of kernels per row, number of kernel rows per ear (Sofi and Rather, 2007), ear weight with husk (Ojo et al., 2006), ear weight without husk (Oktem, 2008) and 100 grain weight (Rafiq et al., 2010; Raghu et al., 2011, and Zarei et al., 2012). The results indicated that ear diameter, number of kernel rows per ear and number of kernels per row are highly correlated with grain yield per plant and need to be considered for selection.

Path coefficient analysis allows separating direct effect and their indirect effects through other attributes by partitioning correlation (Wright, 1921). Path coefficient analysis (table 2) showed that number of kernels per row had exhibited the largest direct effect on grain yield followed by 100 grain weight, ear weight with husk, number of kernel rows per ear, plant height, ear diameter and ear height indicating the effectiveness of direct selection, where as direct and negative effects were exhibited by ear weight without husk, days to 50% tasseling, days to 50% silking and ear length indicating that selection for these traits result in less grain yield. The high positive direct effect of the number of kernels per row on yield was also reported by Geetha and Jayaraman (2000) and Jabeen (2005), the high positive direct effect of 100 grain weight was also revealed by Zarei et al., (2012), the high positive direct effect of a number of kernel rows per ear was also observed by Raghu et al., (2011), and high positive direct effect of ear weight with husk was also observed by Tiwari and Verma, (1999).

The results indicated that the high direct effect of the number of kernels per row, 100 grain weight, ear weight with husk, number of kernel rows per ear, plant height, ear diameter and ear height appeared to be the main factor for their strong association with grain yield. Hence, direct selection for these traits would be effective.

Characters		Days to 50% tasseling	Days to 50% silking	Plant height (cm)	Ear height (cm)	Ear length (cm)	ear diameter (cm)	Ear weight without husk (g)	Ear weight with husk (g)	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**	1.000	0.978**	0.307**	0.201*	0.311**	0.010NS	-0.098NS	0.079NS	-0.088NS	-0.276**	0.273**	-0.097NS
	G	1.000	0.989**	0.323**	0.245**	0.348**	0.022NS	-0.092NS	0.084NS	-0.114NS	-0.296**	0.285**	-0.103NS
Days to 50% silking	**P**		1.000	0.270**	0.177 NS	0.325**	-0.002NS	-0.108NS	0.066NS	-0.140NS	-0.342**	0.296**	-0.148NS
	G		1.000	0.258**	0.154 NS	0.293**	0.003NS	-0.111NS	0.061NS	-0.127NS	-0.329**	0.286**	-0.142NS
Plant height (cm)	**P**			1.000	0.389**	0.249**	0.188*	0.036NS	0.089NS	0.232*	0.213*	0.291**	0.465**
	G			1.000	0.344**	0.232*	0.150NS	0.038NS	0.088NS	0.202*	0.199*	0.273**	0.435**
Ear height (cm)	**P**				1.000	0.309**	0.445**	0.214*	0.377**	0.393**	0.348**	0.482**	0.614**
	G				1.000	0.305**	0.309**	0.203*	0.346**	0.317**	0.321**	0.443**	0.564**

Characters		Days to 50% tasseling	Days to 50% silking	Plant height (cm)	Ear height (cm)	Ear length (cm)	ear diameter (cm)	Ear weight without husk (g)	Ear weight with husk (g)	Number of kernel rows per ear	Number of kernels per row	100 seed weight (g)	Grain yield per plant (g)
Ear length (cm)	**P**					1.000	0.078NS	0.263**	0.471**	-0.009NS	0.335**	0.031 NS	0.236*
	G					1.000	0.132NS	0.257**	0.441**	-0.009NS	0.291**	0.035 NS	0.194*
Ear diameter (cm)	**P**						1.000	0.802**	0.772**	0.774**	0.569**	0.188*	0.727**
	G						1.000	0.669**	0.644**	0.544**	0.436**	0.167 NS	0.556**
Ear weight without husk (g)	**P**							1.000	0.934**	0.533**	0.558**	0.035 NS	0.517**
	G							1.000	0.929**	0.466**	0.527**	0.038 NS	0.489**
Ear weight with husk (g)	**P**								1.000	0.477**	0.558**	0.103 NS	0.550**
	G								1.000	0.409**	0.531**	0.104 NS	0.522**
Number of kernel rows per ear	**P**									1.000	0.473**	0.015 NS	0.717**
	G									1.000	0.414**	-0.015 NS	0.599**
Number of kernels per row	**P**										1.000	-0.144 NS	0.722**
	G										1.000	-0.136 NS	0.690**
100 seed weight(g)	**P**											1.000	0.413**
	G											1.000	0.403**
Grain yield per plant (g)	**P**												1.000
	G												1.000

Table 1: Phenotypic (P) and Genotypic (G) Correlation Coefficients
Among Yield and Yield Attributes in Thirty Nine Genotypes of Maize
**Significant At 5 Per Cent Level: **Significant At 1 Percent Level: NS - Non Significant*

Characters		Days to 50% tasseling	Days to 50% silking	Plant height (cm)	Ear height (cm)	Ear length (cm)	ear diameter (cm)	Ear weight without husk (g)	Ear weight with husk (g)	Number of kernel rows per ear	Number of kernels per row	100 seed weight (g)	Correlation Coefficient
Days to 50% tasseling	**P**	**-0.085**	-0.083	-0.026	-0.017	-0.026	-0.001	0.008	-0.007	0.007	0.023	-0.023	-0.097NS
	G	**0.836**	0.827	0.270	0.204	0.291	0.018	-0.077	0.070	-0.095	-0.247	0.238	-0.103NS
Days to 50% silking	**P**	-0.063	**-0.065**	-0.167	-0.010	-0.019	0.000	0.007	-0.004	0.008	0.021	-0.019	-0.148NS
	G	-0.984	**-0.994**	-0.268	-0.176	-0.323	0.002	0.107	-0.066	0.140	0.340	-0.295	-0.142NS
Plant height (cm)	**P**	0.053	0.045	**0.173**	0.060	0.040	0.026	0.007	0.015	0.035	0.034	0.047	0.465**
	G	0.037	0.031	**0.116**	0.045	0.029	0.022	0.004	0.010	0.027	0.025	0.034	0.435**
Ear height (cm)	**P**	0.005	0.004	0.009	**0.025**	0.008	0.008	0.005	0.009	0.008	0.008	0.011	0.614**
	G	-0.050	-0.036	-0.079	**-0.204**	-0.063	-0.091	-0.044	-0.077	-0.080	-0.071	-0.098	0.564**
Ear length (cm)	**P**	-0.013	-0.012	-0.010	-0.013	**-0.041**	-0.005	-0.011	-0.018	0.000	-0.012	-0.001	0.236*
	G	0.008	0.007	0.006	0.007	**0.023**	0.002	0.006	0.011	0.000	0.008	0.001	0.194*
Ear diameter (cm)	**P**	0.001	0.000	0.008	0.017	0.007	**0.055**	0.037	0.035	0.030	0.024	0.009	0.727**
	G	0.002	0.000	0.015	0.034	0.006	**0.077**	0.620	0.060	0.060	0.044	0.015	0.556**

Characters		Days to 50% tasseling	Days to 50% silking	Plant height (cm)	Ear height (cm)	Ear length (cm)	ear diameter (cm)	Ear weight without husk (g)	Ear weight with husk (g)	Number of kernel rows per ear	Number of kernels per row	100 seed weight (g)	Correlation Coefficient
Ear weight without husk (g)	**P**	0.028	0.032	-0.011	-0.058	-0.074	-0.192	**-0.287**	-0.267	-0.134	-0.151	-0.011	0.517**
	G	0.054	0.063	-0.021	-0.125	-0.154	-0.469	**-0.584**	-0.546	-0.312	-0.326	-0.021	0.489**
Ear weight with husk (g)	**P**	0.025	0.019	0.028	0.110	0.141	0.205	0.296	**0.318**	0.130	0.169	0.033	0.550**
	G	0.043	0.034	0.046	0.194	0.242	0.397	0.480	**0.514**	0.245	0.287	0.053	0.522**
Number of kernel rows per ear	**P**	-0.028	-0.040	0.063	0.099	-0.003	0.170	0.146	0.128	**0.313**	0.129	-0.005	0.717**
	G	-0.055	-0.068	0.111	0.189	-0.004	0.372	0.257	0.230	**0.481**	0.228	0.007	0.599**
Number of kernels per row	**P**	-0.138	-0.165	0.100	0.161	0.146	0.219	0.265	0.267	0.208	**0.502**	-0.069	0.722**
	G	-0.152	-0.176	0.110	0.179	0.173	0.293	0.287	0.287	0.244	**0.515**	-0.074	0.690**
100 seed weight(g)	**P**	0.117	0.123	0.117	0.190	0.015	0.072	0.016	0.045	-0.006	-0.059	**0.429**	0.413**
	G	0.158	0.164	0.161	0.266	0.017	0.104	0.020	0.057	0.008	-0.079	**0.553**	0.403**

Table 2: Phenotypic (P) and Genotypic (G) Path Coefficient Analysis Indicating Direct and Indirect Effects of Component Characters on Grain Yield in 39 Genotypes of Maize Phenotypic Residual Effect = 0.372; Genotypic Residual Effect = 0.152; Diagonal Values Indicate Direct Effects; NS – Non Significant

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