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Performance of Six Maize (*Zea mays* L.) Inbred Lines and Their all Possible as Well as Reciprocal Cross Combinations

M. Ahsan
Department of Plant Breeding & Genetics, University of Agriculture, Faisalabad-38040, Pakistan

Abstract
The present work consisted of six elite, exotic and local maize inbred lines and their all possible as well as reciprocal cross combinations. This values of coefficients of variation were found to be lower for all agronomic traits except grain yield per plant (22.83%). Genotypic correlation coefficients had higher magnitude than the phenotypic correlation coefficients. Phenotypic correlation coefficients were found to significant and positive between leaf area, leaf angle, number of leaves per plant, plant height and grain yield. They were found negative and significant between days taken to tasseling, days taken to silking and grain yield. However, it is concluded from these results that grain yield can be improved by increasing leaf angle, leaf area, number of leaves per plant and plant height.

Introduction
Maize (*Zea mays* L.) is an important kharif cereal crop, adaptable to widely varying climatic and soil conditions. It is extensively grown in the irrigated and rainfed areas of Punjab, provides food for human beings, and feed for livestock and poultry and is a rich source of raw material for the industry. It has greater nutritious value as it contains starch (72%), protein (10%), oil (4.8%), fiber (8.5%), sugar (3.0%) and ash (1.7%). In view of its increasing importance, improvement work on maize has picked up considerable momentum in Pakistan and other countries of the world (Chaudhry, 1968; Hunter, 1980; Han, 1982; Prasad and Singh, 1982; Bhole and Patil, 1983; Russell, 1985; Dai *et al*., 1990; Hussain and Aziz, 1998).
The relationship of different agronomic traits with grain yield is essential tool for traditional selection of parents for developing outstanding cultivars of maize. Keeping in view the impacts on the future maize breeding strategy, the research work was conducted to find out the information on the extent of phenotypic and genotypic associations between yield and its various components in various cross combinations among different inbred lines of maize.

Materials and Methods
The experiment was conducted in the research area of the Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad. The experimental materials comprised of six inbred lines (A 638, W64 TMS, WM13 RA, AES204, 53 P-4, L4). The inbred lines were sown in the crossing block during spring season, 1987 with row-to row and plant to plant distances of 76 and 23 cm respectively. Normal cultural practices were applied to the crop throughout its growth. All possible combinations with reciprocals were attempted. At maturity, the crop was harvested and threshing was done by hand. During summer season, 1987, the F_1 single crosses and their reciprocals were sown along with their six parental lines. They were grown in three replications in randomized complete block design with row-to-row and plant-to-plant distances 76 cm and 23 cm respectively. Normal cultural practices were applied to the crop throughout its growth. At least 10 guarded plants in each treatment of each replication were tagged to record the data. Number of days taken to tasseling were counted when at least 50 percent were showing an thesis in half of the tassel. Number of days taken to silking were counted when at least 50 percent plants showed the emergence of silks. Data was also recorded for plant height (cm), number of leaves per plant and leaf area (cm^2). The leaf area was calculated as:

Leaf area = Maximum length (cm) x Maximum breadth (cm) x 0.75

The leaf angle was measured with the help of Bevel protractor of the selected plants. At maturity crop was harvested. Grains were shelled from each harvested plant and grain yield per plant (g) was determined.
Data were analyzed for the analysis of variance technique (Steel and Torrie, 1980). Phenotypic correlation coefficients were estimated by using the method of Kwon and Torrie (1964). Therefore, genotypic correlation coefficients were also estimated (Falconer, 1993).

Results and Discussion
Pooled means and coefficients of variation (CV%) for grain yield and other agronomic traits among six inbred lines and their all possible as well as reciprocal crosses are given in Table 1. The CV (%) magnitudes were found lower for days taken to tasseling and silking (4.32 and 3.77%, respectively). They were also found lower for number of leaves per plant (CV = 7.31 %), plant (CV = 9.76%), but slightly higher for leaf area (CV =14.68%) and leaf angle (CV = 15.30%). However, the values of CV (%) for grain yield per plant was found to be higher (22.83). These results indicate that there was more variability among inbred lines and all possible as well as reciprocal

Table 1: Pooled means and CV% for grain yield and agronomic traits among six inbred lines and their all possible as well as reciprocal crosses

Traits	Mean	SD	CV%
Grain yield per plant (g)	86.0	19.6360	22.83
Days taken to tasseling	49.8	2.1505	4.32
Days taken to silking	52.7	1.9898	3.77
Leaf area (cm^2)	323.9	47.5420	14.68
Leaf angle	41.6	6.3657	15.30
Number of leaves per plant	11.6	0.8481	7.31
Plant height (cm)	173.1	16.8917	9.76

Table 2: Phenotypic correlation coefficients (rp) and genotypic correlation coefficients (rg) in parentheses for grain yield and other traits among six maize inbred lines and their all possible as well as reciprocal crosses

Traits	Grain yield Per plant	Days taken to tasseling	Days taken to silking	Leaves per plant	Plant height	Leaf area
Days taken to tasseling	-0.623**					
	(-0.933)					
Days taken to silking	-0.718**	0.910**				
	(-0.998)	(0.961)				
Leaves per plant	0.607**	-0.436**	-0.471**			
	(0.739)	(-0.686)	(-0.661)			
Plant height	0.783**	-0.577**	-0.688**	0.690**		
	(0.848)	(-1.004)	(-0.955)	(0.818)		
Leaf area	0.664*	-0.538**	-0.565**	0.658**	0.679**	
	(0.857)	(-0.797)	(-0.820)	(0.901)	(0.831)	
Leaf angle	0.430**	-0.319*	-0.293^Ns	0.147^NS	0.452**	0.053^NS
	(0.473)	(-0.502)	(-0.401)	(0.187)	(0.494)	(0.069)

NS = Non significant, *,** = Significant at 5 and 1 percent level of significance respectively

combinations for grain yield per plant. Hussain and Aziz (1998) reported significant differences in maize for grain yield and other traits. When they crossed five maize inbred lines to each of the three testers.

Genotypic correlation coefficients had higher magnitude than the phenotypic correlation coefficients because the depressing effects of environmental associations had been eliminated. There were positive and significant phenotypic correlation coefficients found between grain yield, leaves per plant, plant height, leaf area and leaf angle (Table 2). Hameed *et al*. (1978) reported similar results in maize and concluded that total leaf area can be used to predict grain yield. Positive and significant correlation between leaf area, number of leaves per plant and grain yield was also reported. But grain yield per plant was negatively and significant correlated with days taken tasseling and silking. Similarly, Russell (1985) reported negative and significant correlation between yield and days taken to silking. A positive and significant phenotypic correlation coefficient was found between days taken to tasseling and days taken silking. Days taken to silking was negatively and significantly correlated with leaves per plant, plant height, leaf area and leaf angle.

The study of correlations is of interest in connection with the genetic causes of correlation through pleiotropy whereby gene affects two or more traits or through linkage. In both cases the segregation of the gene causes simultaneous variation in characters it effects or is linked with genes of other traits. However, incomplete linkage is cause of transient correlation, particularly in populations derived from crosses between divergent strains. To distinguish between these two causes of genetic correlation very sophisticated experiments are required. However, in present study high yielding markers which show genetic correlations can lead to predictable correlated responses that can be exploited as selection criteria and success could be achieved using this approach in maize.

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