

## Correlation and Path Coefficient Analysis of Yield and Agronomic Characters among some Maize Genotypes and Their F<sub>1</sub> Hybrids in a Diallel Cross



Dana Azad Abdulkhaleq\*, Sherwan Ismael Tawfiq\*\*

\* Field Crops Department, Faculty of Agricultural Sciences, University of Sulaimani, Sulaimani, Kurdistan Region, Iraq, e-mail: dana.abdulkhaleq@univsul.net.

\*\* Field Crops Department, Faculty of Agricultural Sciences, University of Sulaimani, Sulaimani, Kurdistan Region, Iraq, e-mail: sherwan.tawfiq@univsul.net.

### Abstract:

Grain yield in maize (*Zea mays* L.) can be improved by understanding the interrelationships among yield, yield components, vegetative growth, and growth period. The objective of this study was to determine the relationship among some of the most important growth and yield traits by using correlation coefficient and path coefficient. Data were obtained from 25 F<sub>1</sub> hybrids including reciprocals in a diallel mating design. Kernels yield plant<sup>-1</sup> had positive and significant correlation with No. of kernels row<sup>-1</sup>, kernels weight ear<sup>-1</sup> at both locations, and with cob weight at Kanipanka location, while has no significant correlation with the other characters. Path analysis indicated that kernel weight ear<sup>-1</sup>, No. of ears plant<sup>-1</sup>, and No. of kernels row<sup>-1</sup> showed high direct effect on kernel yield plant<sup>-1</sup> at Kanipanka location, while at Qlyasan location No. of kernel row<sup>-1</sup>, 300-kernel weight, No. of ears plant<sup>-1</sup>, and kernel weight ear<sup>-1</sup> showed the high direct effect on kernel yield plant<sup>-1</sup>, these traits can be considered as principal yield component and the breeder can be use these as selection criteria for kernel yield improvement.

**Key words:** Maize, *Zea mays* L., Correlation coefficient, Path coefficient analysis.

### I. Introduction:

Maize (*Zea mays* L.) is the world's most widely grown cereal and is the primary staple food in many developing countries and ranks second to wheat in production with milled rice occupying the third position in the world [1]. It is one of the most important grown plants in the world. Superior position of maize is due to his very wide and variety utilization. During the centuries maize plant was known for its multifariously use. Maize is used like a human food, livestock feed, for producing alcohol and no alcohol drinks,

built material, like a fuel, and like medical and ornamental plant [2].

Assuming yield is a contribution of several characters which are correlated among themselves and to the yield. Path coefficient analysis was suggested by Wright (1921) and described Dewey and Lu (1959) which was calculated to detect the relative importance of characters contributing to grain yield [3]. Unlike the correlation coefficient which measures the extent of relationship, path coefficient measures the magnitude of direct and

indirect contribution of a component character to a complex character and it has been defined as a standardized regression coefficient which splits the correlation coefficient into direct and indirect effects [4]. Because correlation coefficient measures the mutual association only between a pair of variables, when more than two variables are involved, the correlations per se may not provide a clear picture of the importance of each component in determining grain yield. Path coefficient analysis provides more information among variables than do correlation coefficients sense this analysis provides the direct effects of specific yield components on yield, and indirect effects via other yield components [5].

## **II. Materials and Methods**

This study was conducted at two locations in Sulaimani region, Kanipanka Nursery Station, Sulaimani Agricultural Directorate, Ministry of Agriculture (Lat 35° 22' ; N, Long 45° 43' ; E, 550 masl) in Shahrazoor valley 35 Km east of Sulaimani city and Qlyasan Agricultural Research Station, College of Agriculture, University of Sulaimani (Lat 35° 34' 307" ; N, Long 45° 21' 992" ; E, 765 masl), 2 Km north west of Sulaimani city during the autumn and spring growing season of 2009 – 2010 [6].

Five maize lines (MIS 4218, MIS 4279, MIS 43100, ZP 434, and 5012) were crossed in the spring of the year 2009, in a diallel mating design including reciprocals to form 25 F<sub>1</sub> hybrids. Each ear was obtained by cross fertilization to one tassel only and no tassel was used to pollinate more than two ear shoots. The ears were harvested, dried and shelled manually; they were kept in the controlled environment to be used in the trials next growing season.

All the F<sub>1</sub> hybrids along with their parental lines were grown in the following growing season. Trials were irrigated throughout the growing season cultural operations, fertilization, and weed control were accomplished according to normal field practices. Hills were overplanted and thinned after emergence for a final plant density of about 55,000 plants ha<sup>-1</sup>. Each cross was planted in one row, 0.75 m apart and 5 m long with 0.25 m between plants. Samples were harvested by hand, for yield assessment.

### *A. Correlation Analysis*

The correlation coefficients were calculated to determine the degree of association of characters with yield and also among the yield components themselves in each environment. Phenotypic correlations were computed by using the formula given by Webber and Moorthy (1952) and Singh and Chaudhary (1985) [7, and 8].

### *B. Path Coefficient Analysis*

The path coefficient analysis was carried out as suggested by Dewey and Lu (1959), Soomro (2010), Singh and Chaudhary (1985), Arbuckle (2009), through (Analysis of Moment Structures) AMOS Ver. 18 Software [9, 10, and 11].

## **III. Results and Discussion**

### *A. Correlation Among Traits*

Data in Table I show the correlation among all pairs of traits, at Kanipanka location, highly significant and positive correlation (0.693\*\*) was observed between days to 50 % tasseling and days to 50 % silking, while days to 50 % tasseling has negative and highly significant correlation (- 0.569\*\*) with cob weight and negative, but significant

correlation (-0.404\*) with cob length. Ear height has a highly significant and positive correlation (0.530\*\*) with No. of rows ear<sup>-1</sup>. Cob width has highly significant positive correlations (0.529\*\* and 0.562\*\*) with No. of rows ear<sup>-1</sup> and kernels weight ear<sup>-1</sup> respectively. Highly significant and positive correlation (0.529\*\*) was observed between No. of ears plant<sup>-1</sup> and kernels weight row<sup>-1</sup>. No. of rows ear<sup>-1</sup> has positive and highly significant correlations (0.620\*\* and 0.533\*\*) with No. of kernels row<sup>-1</sup> and kernels weight ear<sup>-1</sup> respectively. No. of kernels row<sup>-1</sup> has highly significant positive correlations (0.671\*\* and 0.610\*\*) with kernels weight ear<sup>-1</sup> and kernels yield plant<sup>-1</sup> successively. This result is in accordance with the previous result of Appadurai and Nagarajan (1975) [12]. A positive and highly significant correlation (0.682\*\*) was observed between kernel weight row<sup>-1</sup> and 300-kernels weight. Highly significant and positive correlation (0.758\*\*) was observed between kernel weight row<sup>-1</sup> and kernels yield plant<sup>-1</sup>. Kernels yield plant<sup>-1</sup> has no significant correlation with most of the characters under study, but it has significant and positive correlation with No. of kernels row<sup>-1</sup>, and kernels weight row<sup>-1</sup>. In contrary to our results, previous workers recorded that kernels yield plant<sup>-1</sup> has significant and positive correlation with days to 50 % silking, plant height, ear height, cob weight, cob length, No. of rows ear<sup>-1</sup>, No. of kernels row<sup>-1</sup>, and 300-kernels weight [3]. At Qlyasan location, days to 50 % Tasseling was correlated high significantly and positively (0.861\*\*) with days to 50 % silking, while has negative and highly significant correlation (-0.586\*\*) with cob weight and negative and significant correlations (-0.402\* and -0.483\*) with cob length and No. of kernels row<sup>-1</sup> alternatively. Concerning Days to 50

% silking, highly significant and negative correlation (-0.642\*\*) was observed with cob weight, while has negative and significant correlation (-0.503\*) with cob width, while Rather *et al.* (1999) estimated positive correlation between Days to 50 % silking with ear height and kernels yield plant<sup>-1</sup> [13]. Plant height has a positive and significant correlation (0.426\*) with ear height only. Rather *et al.* (1999) found that plant height has no significant correlation with kernels yield plant<sup>-1</sup> also, whereas Kumar and Kumar (2000) put an emphasis on plant height with greater ear height, No. of row.ear<sup>-1</sup>, and No. of kernels row<sup>-1</sup> for better kernels yield plant<sup>-1</sup> [13, and 14]. Highly significant and positive correlation (0.576\*\*) was observed between cob weight and cob width, while cob weight has positive and significant correlations (0.492\* and 0.431\*) with cob length and kernels yield plant<sup>-1</sup> successively. Cob width has significant positive correlation (0.497\*) with No. of rows ear<sup>-1</sup>. No. of rows ear<sup>-1</sup> has no significant correlation with other traits under study, while previous workers recorded significant correlation between No. of row ear<sup>-1</sup> and kernels yield plant<sup>-1</sup> [15]. Highly significant and positive correlation (0.583\*\*) was observed between No. of kernels row<sup>-1</sup> and kernels weight row<sup>-1</sup>, while has significant and positive correlation (0.505\*\*) with kernels yield plant<sup>-1</sup>. Kernels weight row<sup>-1</sup> has positive and highly significant correlations (0.669\*\* and 0.553\*\*) with kernel weight ear<sup>-1</sup> and 300-kernels weight respectively, while has a positive and significant correlation (0.399\*) with kernels yield plant<sup>-1</sup>. This is agreeing with a previous work of Mani *et al.* (1999), while disagree with Gautam *et al.* (1999a) [16, and 17]. A positive and significant correlation (0.462\*) was observed between kernel

weight ear<sup>1</sup> and 300-kernels weight. Kernels yield plant<sup>-1</sup> has no significant correlation with most of the characters under study, but it has significant and positive correlation with cob weight, No. of kernels row<sup>-1</sup>, and kernels weight row<sup>-1</sup>. But previous workers recorded that kernels yield plant<sup>-1</sup> has significant and positive correlation with No. of kernel row<sup>-1</sup> [14].

#### *B. Path Coefficient Analysis for Some Yield Related Traits*

Table II shows the path coefficient analysis confirming direct and indirect effects on kernels yield plant<sup>-1</sup>, at Kanipanka location, the maximum positive direct effect on kernels yield plant<sup>-1</sup> was obtained by the traits kernels weight ear<sup>-1</sup> (0.606) confirm the positive contribution of this traits on kernel yield plant<sup>-1</sup>, followed by No. of ears plant<sup>-1</sup> with (0.366) and No. of kernels row<sup>-1</sup> with (0.223), while kernels weight row<sup>-1</sup> and 300-kernels weight recorded negative direct effect on kernels yield plant<sup>-1</sup> with -0.059 and -0.030 respectively. No. of kernels row<sup>-1</sup> had the maximum positive indirect effect on kernels yield plant<sup>-1</sup> via kernels weight ear<sup>-1</sup> with (0.407), while have negative indirect effect via No. of ears plant<sup>-1</sup> (-0.020) and kernels weight row<sup>-1</sup> (-0.004). No. of rows ear<sup>-1</sup> recorded positive indirect effect on kernels yield plant<sup>-1</sup> via kernels weight ear<sup>-1</sup> (0.323), but the negative indirect effect of this traits was via No. of ears plant<sup>-1</sup> (-0.101). Kernels weight row<sup>-1</sup> recorded positive indirect effect on kernels yield plant<sup>-1</sup> via No. of ears plant<sup>-1</sup> with (0.194) and kernels weight ear<sup>-1</sup> possessed positive indirect effect on kernels yield plant<sup>-1</sup> via No. of kernels row<sup>-1</sup> (0.150). 300-kernels weight showed highest negative indirect effect on kernels yield plant<sup>-1</sup> via No. of ears plant<sup>-1</sup> (-0.132). At Qlyasan location, the maximum positive direct effect on

kernels yield plant<sup>-1</sup> was obtained by the traits No. of kernels row<sup>-1</sup> (0.686) confirm the positive contribution of this traits on kernel yield plant<sup>-1</sup>, followed by 300-kernels weight (0.340), No. of ears plant<sup>-1</sup> (0.268), and kernel weight ear<sup>-1</sup> (0.218) while kernels weight row<sup>-1</sup> has maximum negative direct effect (-0.330) on kernels yield plant<sup>-1</sup> [18], and Akbar *et al.* (2008) reported previously that maize yield was mainly influenced positively by No. of kernels row<sup>-1</sup>, No. of rows ear<sup>-1</sup>, and 300-kernels weight has appositive direct effect on kernels yield plant<sup>-1</sup> [19]. Kernels weight row<sup>-1</sup> possessed the maximum positive indirect effect on kernels yield plant<sup>-1</sup> via No. of kernels row<sup>-1</sup> (0.400), while negative indirect effect was via No. of ears plant<sup>-1</sup> (-0.008). Kernels weight ear<sup>-1</sup> recorded positive indirect effect on kernels yield plant<sup>-1</sup> via No. of kernels row<sup>-1</sup> with (0.196) and No. kernels row<sup>-1</sup> possessed positive indirect effect on kernels yield plant<sup>-1</sup> via kernels weight row<sup>-1</sup> (0.192). In contrary to these results, Kumar and Kumar (2000) suggested previously that indirect selection for kernel yield through No. of rows ear<sup>-1</sup> would be effective [14].

#### **IV. Conclusions**

Kernel yield plant<sup>-1</sup> revealed positive and significant correlation with No. of kernels row<sup>-1</sup> and kernel weight row<sup>-1</sup> at Kanipanka location, and with cob weight, No. of kernels row<sup>-1</sup>, and kernel weight row<sup>-1</sup> at Qlyasan location.

Path coefficient analysis indicated that the characters kernel weight ear<sup>-1</sup>, No. of ears plant<sup>-1</sup>, and No. of kernels row<sup>-1</sup> at Kanipanka location, and the characters No. of kernels row<sup>-1</sup>, 300-kernels weight, No. of ears plant<sup>-1</sup>, and kernel weight ear<sup>-1</sup> at Qlyasan location, exerted high positive direct effect on kernel yield plant<sup>-1</sup>

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Table.I: Correlation among all pairs of traits at Kanipanka (upper values) and Qlyasan (lower values) locations

Traits	Days to 50 % Tasseling	Days to 50 % silking	Plant height (cm)	Ear height (cm)	Cob weight (g)	Cob length (cm)	Cob width (cm)	No. of ears plant <sup>-1</sup>	No. of rows ear <sup>-1</sup>	No. of kernels row <sup>-1</sup>	Kernels weight row <sup>-1</sup> (g)	Kernels weight ear <sup>-1</sup> (g)	300- kernels weight (g)
Days to 50 % silking	0.693** 0.861**												
Plant height (cm)	-0.060 0.180	0.230 0.240											
Ear height (cm)	0.050 0.130	0.120 0.150	0.100 0.426*										
Cob weight (g)	-0.569** -0.586**	-0.390 -0.642**	0.240 -0.040	-0.140 0.130									
Cob length (cm)	-0.404* -0.402*	-0.130 -0.240	-0.070 -0.090	-0.020 0.250	0.120 0.492*								
Cob width (cm)	-0.050 -0.090	0.110 -0.110	0.400 0.130	0.340 0.070	-0.080 0.170	0.240 0.000							
No. of ears plant <sup>-1</sup>	-0.060 -0.320	0.170 -0.503*	0.260 -0.200	-0.060 -0.030	0.320 0.576**	-0.090 0.090	-0.050 -0.030						
No. of rows ear <sup>-1</sup>	-0.060 -0.100	-0.060 -0.130	0.190 0.170	0.530** 0.200	-0.010 -0.010	-0.020 -0.040	0.529** 0.479*	-0.280 -0.190					
No. of kernels row <sup>-1</sup>	-0.240 -0.483*	-0.030 -0.300	0.300 0.250	0.478* 0.190	0.150 0.260	0.360 0.310	0.370 0.180	-0.060 -0.030	0.620** 0.090				
Kernels weight row <sup>-1</sup> (g)	-0.060 -0.250	0.210 -0.310	0.290 -0.030	0.200 0.060	0.050 0.250	0.290 0.250	0.170 0.060	0.529** -0.030	-0.060 -0.170	0.070 0.583**			
Kernels weight ear <sup>-1</sup> (g)	-0.320 0.020	-0.350 -0.130	0.140 0.100	0.230 0.140	0.110 0.220	0.390 0.120	0.562** 0.260	0.030 0.010	0.533** 0.070	0.671** 0.290	0.140 0.669**		
300-kernels weight (g)	-0.070 0.070	-0.210 -0.150	-0.300 -0.150	-0.180 0.180	-0.070 0.170	0.010 0.280	-0.040 -0.170	-0.360 -0.020	-0.080 -0.360	-0.070 -0.120	-0.682** 0.553**	0.060 0.462*	
Kernels yield plant <sup>-1</sup> (g)	-0.300 -0.130	-0.210 -0.260	0.070 0.040	0.350 0.120	0.180 0.431*	0.350 0.390	0.390 0.160	0.350 0.260	0.370 -0.060	0.610** 0.505*	0.260 0.399*	0.758** 0.350	-0.102 0.180

\*\**. Correlation is significant at the 0.01 level (2-tailed),  $t_{0.01}(23)=2.807$*

\**. Correlation is significant at the 0.05 level (2-tailed),  $t_{0.05}(23)=2.068$*

Table.II: Path coefficient analysis confirming direct (diagonal values) and indirect on Kernels yield plant<sup>-1</sup> at Kanipanka (upper values) and Qlyasan (lower values) locations

Traits	No. of ears plant <sup>-1</sup>	No. of rows ear <sup>-1</sup>	No. of kernels row <sup>-1</sup>	Kernels weight row <sup>-1</sup> (g)	Kernels weight ear <sup>-1</sup> (g)	300-kernels weight (g)	Kernels yield plant <sup>-1</sup> (g) Correlation
No. of ears plant <sup>-1</sup>	0.366	-0.001	-0.012	-0.031	0.017	0.011	0.350 <sup>n.s</sup>
	0.268	0.004	-0.019	0.010	0.002	-0.007	0.260 <sup>n.s</sup>
No. of rows ear <sup>-1</sup>	-0.101	0.004	0.138	0.003	0.323	0.002	0.370 <sup>n.s</sup>
	-0.051	-0.020	0.063	0.057	0.015	-0.122	-0.060 <sup>n.s</sup>
No. of kernels row <sup>-1</sup>	-0.020	0.002	0.223	-0.004	0.407	0.002	0.610 <sup>**</sup>
	-0.008	-0.002	0.686	0.192	0.062	-0.041	0.505 <sup>*</sup>
Kernels weight row <sup>-1</sup> (g)	0.194	-0.0002	0.016	-0.059	0.087	0.020	0.258 <sup>n.s</sup>
	-0.008	0.003	0.400	-0.330	0.146	0.188	0.399 <sup>*</sup>
Kernels weight ear <sup>-1</sup> (g)	0.010	0.002	0.150	-0.008	0.606	0.002	0.758 <sup>**</sup>
	0.003	-0.001	0.196	-0.221	0.218	0.157	0.350 <sup>n.s</sup>
300-kernels weight (g)	-0.132	-0.0003	-0.015	0.040	0.035	-0.030	-0.102 <sup>n.s</sup>
	-0.006	0.007	-0.084	-0.182	0.101	0.340	0.180 <sup>n.s</sup>