CORRELATION AND PATH COEFFICIENT ANALYSIS OF MORPHOLOGICAL TRAITS OF MAIZE (*ZEA MAYS* L.)

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Abstract: *Maize is one of the most important grown plants in the world. Superior position of maize is due to his very wide and variety utilisation and because of that, the main goal of all maize breeding programs is to obtain new inbred lines and hybrids that will outperform the existing hybrids with respect to a number of traits. For efficient selection of grain yield, like the most important economic trait, in regard to its on the great influence the environmental factors, has complex mode of inheritance and low heritability, is necessary to know relation between grain yield and morphological traits which are influencing on the grain yield. One of the objectives of this paper was to determine relationship between grain yield and morphological traits. For these purpose two test-cross populations which are formed by crossing progenies of NSU_1 population after 16 cycles of phenotypic recurrent selection and two testers were tested. In both studied populations significant medium strong correlative relationship was established between grain yield per plant and 100-kernel weight. Among other traits in the test-cross population NSU_1×568/II NS, positive correlative relation was established only between ear height and length and it showed a high significance. In population NSU_1×B73 strongest correlation was established between ear height and kernel row number, but this relationship was negative. Also, since yield components are interrelated and develop sequentially at different growth stages it is important to define direct influence of specific yield components on yield, and their indirect effect via other traits. For that purpose path coefficient analysis were done. In test-cross population where we used inbred line 568/II NS like a tester high significant direct effect on grain yield was established for ear height (p_1=-0.403**) and kernel row number (p_3=0.390**), while in the second studied population path analysis showed high significant desirable influence of ear length (p_2=0.394**) and 100-kernel weight (p_4=0.573**) on grain yield.*

Key words**:** *maize, morphological traits, grain yield, correlations, path analysis*

INTRODUCTION

Maize is one of the most important grown plants in the world. Superior position of maize is due to his very wide and variety utilisation. During the centuries maize plant was known for it's 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 (BEKRIĆ and RADOSAVLJEVIĆ, 2008). Because of very wide utilization of maize, the main goal of all maize breeding programs is to obtain new inbreds and hybrids that will outperform the existing hybrids with respect to a number of traits. In working towards this goal, particular attention is paid to grain yield as the most important agronomic characteristic. Grain yield is a complex quantitative trait that depends on a number of factors. It's within great influence of environmental conditions, has complex mode of inheritance and low heritability. Because of that during selection of grain yield, in order to select the best selection method, we need to determine mean values, components of variance and heritability of studied traits.

Besides that, knowing the correlations between the traits is also of great importance for success in selections to be conduced in breeding programs, and analysis of correlation coefficient is the most widely used one among numerous methods that can be used (YAGDI and SOZEN, 2009).

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 since this analysis provides the direct effects of specific yield components on yield, and indirect effects via other yield components (GARCIA del MORAL et al., 2003).

The objective of this paper was to submit correlative relationship between grain yield and morphological traits of plant and ear. Also, one of the goals of this study was founding the direct and indirect effects of morphological traits on grain yield.

MATERIAL AND METHODS

The genetic material evaluated in the present study was developed by crossing progenies of high oil corn population after 16 cycles of recurrent selection, and two testers, 568/II NS and B73. During 2003 and 2004 testcrosses were evaluated in field experiments at one location (Rimski Sancevi) according to Nested Design (incomplete block design; COCHRAN and COX, 1957). 96 genotypes were assigned at random to 4 sets. Two replications within set were used and 20 plants per plot were grown. Each plot consisted of one, 5-m long row, 0.24 m between plants and spaced 0.75 m between plots. The standard maize growing technique was practiced. Harvest was done by hand. The data were recorded on 10 randomly taken competitive plants for ear height (EH), ear length (EL), kernel row number (KRN), 100–kernel weight (KW) and grain yield per plant (GY).

Analysis of variance and covariance were done by Nested Design (random model; COCHRAN and COX, 1957). Genetic correlation coefficients were based on ratio of joint variation and summary of individual variation two traits (HALLAUER and MIRANDA, 1988), and for testing significance of correlation coefficients we applied t test. Standardized partial regression coefficients (path coefficients) and levels of their significance were calculated according to the method of the inverse symmetric correlation matrix (EDWARDS, 1979).

RESULTS AND DISCUSSIONS

To determine association between studied traits we calculated genetic coefficient of correlations. In the first studied population ($NSU_1 \times 568/II$ NS) grain yield was in the strongest relation with kernel row number ($r = 0.8012^{**}$). The strong correlations between these two traits are reported by other researches. Studied hybrid and their parental lines, ALVI et al. (2003) and SOFI and RATHER (2007), also found strong association between grain yield and kernel row number. However, in a population where we have used inbred line B73 as a tester, between these two traits we established medium strong and negative association. These results are not in agreement with the results previously mentioned authors, but it is partly in agreement with the results of YOUSUF and SALEEM (2003) and BOCANSKI et al. (2009). YOUSUF and SALEEM (2003) also found negative correlations between these two traits, but that relation was low, while BOCANSKI et al. (2009) found medium strong, but positive association.

In both studied populations, between grain yield, on the one side, and ear length and 100-kernel weight, on the other side, we found positive values of genetic coefficient of correlations, while grain yield was negatively associated with ear height (Tab. 1). Association between grain yield and 100-kernel weight was medium strong, positive and significant, which is contra to the results of many authors. SUMATHI et al. (2005) also found medium strong correlative relation between these two traits, but that relation was negative, while the majority of authors (ALVI et al., 2003; SOFI and RATHER, 2005; BOCANSKI et al., 2009) who studied relation between these two traits established strong correlations between grain yield and 100-kernel weight.

In $NSU_1 \times 568/II$ NS negative values of coefficient of correlations was found between almost all other studied traits, except between ear height and length. These two traits were in highly significant, positive and strong correlations. Although most authors (ALVI et al., 2003; NAJEEB et al., 2009; BOCANSKI et al., 2009) found strong correlative relation between thee two traits, SOFI and RATHER (2007), in their research established low values of coefficient of correlation between ear height and length. In second studied population ($NSU_1 \times B73$) ear height and length also was in positive, but medium strong correlations. Medium strong, but negative correlations was found and between ear height and kernel row number which is contra to the results of many authors (ALVI et al., 2003; SOFI and RATHER, 2007; NAJEEB et al., 2009; BCANSKI et al, 2009).

Table 1

Genetic correlations in $NSU_1 \times 568/II$ NS (above diagonal) and in $NSU_1 \times B73$ (below diagonal)

	EH	*EL*	*KRN*	*100-KW*	*GY*
EH	*1*	*0.6267***	*-0.0880*	*-0.5440*	*-0.1450*
EL	*0.5272*	*1*	*-0.2660*	*-0.1000*	*0.2195*
KRN	*-0.544*	*-0.0380*	*1*	*-0.6130*	*0.8012***
100-KW	*0.2099*	*0.0656*	*-0.1700*	*1*	*0.5970**
GY	*-0.6120*	*0.6642*	*-0.3470*	*0.5985**	*1*

* $p < 0.05$
** $p < 0.01$

Path analysis results are shown in table 2. In population $NSU_1 \times 568/II$ NS high significant, undesirable direct influence on grain yield was found for ear height which is in agreement with the results of ALVI et al (2003) and SOFI et RATHER (2007), but contra to the results of path analysis which in their research found AKBAR et al. (2008) and NAJEEB et al. (2009). Indirect influence of this trait via other studiet trait (ear length, kernel row number, 100-kernel veight) also was negative and significant. However, in second studied population we, as AKBAR et al. (2008) and NAJEEB et al. (2009), also found a positive direct influence of ear height on grain yield, but it wasn't significant. High significant, positive desirable effect on grain yield, in $NSU_1 \times 568/II$ NS, also was established and for kernel row number, and in the second studied population for ear length and 100-kernel weight. These results are in agreement with the results of many authors (ALVI et al., 2003; SUMATHI et al., 2005; SOFI and RATHER, 2007; NAJEEB et al., 2009).

CONCLUSIONS

Based on the results which we get in this research conclusions are:

In first studied population, grain yield was positively associated with almost all studied traits. Negative correlation was found only between grain yield and ear height. In the strongest correlation was with kernel row number, and that relationship was highly significant. In population where we used inbred line B73 as a tester negative association was found between grain yield, on the one side, and ear height and kernel row number, on the other side, while with ear length and 100-kernel weight grain yield was positively correlated.

In population $NSU_1 \times 568/II$ NS path coefficient analysis show that the greatest influence on grain yield have ear height, but that influence was undesirable. High significant and positive direct effect, in this population was found for kernel row number, while in population where we used inbred line B73 like a tester, positive and highly significance direct influence on grain yield was found for ear length and 100-kernel weight.

Table 2

Direct and indirect effects of studied traits on grain yield in NSU_1 × 568/II NS and NSU_1 × B73 populations

		NSU_1 × 568/II NS	NSU_1 × B73
Ear height vs. Grain yield			
Direct effect		***-0.403*****	***0.053***
Indirect effect via	*Ear length*	*-0.090*	*0.208*
	Kernel row number	*-0.034*	*0.077*
	100-kernel weight	*-0.089*	*0.120*
Ear length vs. Grain yield			
Direct effect		***-0.144***	***0.394*****
Indirect effect via	*Ear height*	*-0.252*	*0.028*
	Kernel row number	*-0.104*	*0.005*
	100-kernel weight	*-0.016*	*0.038*
Kernel row number vs. Grain yield			
Direct effect		***0.390*****	***-0.141***
Indirect effect via	*Ear height*	*0.035*	*-0.029*
	Ear length	*0.038*	*-0.015*
	100-kernel weight	*-0.100*	*-0.097*
100-kernel weight vs. Grain yield			
Direct effect		***0.163***	***0.573*****
Indirect effect via	*Ear height*	*0.219*	*0.011*
	Ear length	*0.014*	*0.026*
	Kernel row number	*-0.239*	*0.024*
Coefficient of determination R^2_{y1234}		*0.4361***	*0.6212***

* $p < 0.05$
** $p < 0.01$

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