Relationship between grain yield, yield components and morphological traits in maize (*Zea mays* L.)

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Abstract

Twelve early to medium maturity maize hybrids were observed at two locations during 2010. to assess the phenotypic correlations among grain yield and six quantitative traits. Significant variations for grain yield and all investigated traits was found at probability level of P=0.05. Plant height showed the strongest positive correlation with grain yield (r_p=0.521**) followed by number of leaves per plant (r_p= 0.394**), while positive phenotypic correlations was recorded between grain yield and all of the investigated traits.

Key words: maize, grain yield, phenotypic correlations

Introduction

Maize is grown in Serbia on the area of 1.2-1.3 million hectares, and due to it, maize is the main field crop.

Globally, it is the third most important crop, after rice and wheat. The grain yield is economically the most important trait of maize and therefore the principal aim of breeders is to develop hybrids of high yielding potential. At the same time, the yield is a very complex quantitative trait affected by a great number of genes of a small individual effect. Its heritability is low and therefore it is under strong environmental impacts, which furthermore make breeding and selection more difficult (Boćanski, et al., 2009). Information on correlations among different traits in maize could help plant breeders to choose the most suitable selection procedure (Buhiniček, et al. 2008).

The association between two characters can directly be observed as phenotypic correlation while genotypic correlation expresses the extent to which two traits are genetically associated (Yousuf and Saleem, 2001).

Several researches have attempted to determine relationship between some agronomic traits and grain yield. Results showed that kernel per ear has the highest positive correlation with grain yield. After this trait, the number of rows per ear and grain length showed the strongest correlation with grain yield (Nemati, et al. 2009).

Annapurna et al. (1998) found that plant height, ear diameter, number of grain per row and number of rows per ear are in positive correlation with grain yield per unit area. Saleem et al. (2007) reported that plant height showed maximum positive direct effect on grain yield. Kernel per row was marked as the most contributing character towards high grain yield, followed by leaf area, plant height and number of leaves per plant (Malik, et al. 2005).

The objective of the study was to determine interrelationships of certain agronomic traits and grain yield of these hybrids.

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Material and methods

Twelve early to medium maturity maize hybrids (ZP-1, ZP-2, ZP-3, ZP-4, ZP-5, ZP-6, ZP-7, ZP-8, ZP-9, ZP-10, ZP-11, ZP-12) were observed under conditions of dry-land farming in two locations during 2010. First six hybrids are belonging to FAO 400 maturity group and the other six hybrids are belonging to FAO 500 maturity group.

The two-replicate trial was set up according to the RCB design. Sowing was mechanically performed. Each hybrid was sown in two rows. The distance between rows was 75 cm. The elementary plot length amounted 4 m. The crop was thinned at the 6-8-leaf stage and wanted density of 67,000 plants ha-1 was obtained.

The measurement of morphological traits was done after the flowering stage.

Harvest was done by hand, and 10 ears of each genotype were collected for further analyses. The grain yield in tonnes per hectare was calculated at 14% moisture. The following agronomic traits were analyzed: plant height, ear height, number of leaves per plant, ear length, kernel row number and number of kernels per row.

The interrelationships between these triats and yield were determined using correlation coefficients.

The data for grain yield and observed traits were tested to the least significant difference test (LSD test, α=0.05).

The MSTAT-C programme was used for the complete statistical processing of data.

Results and discussion

In this study we found significant differences for the data of all investigated traits among examined hybrids (Table 1), which is in accordance with results obtained by Čamdžija et al. (2011).

Grain yield of hybrids used in our study significantly varied from 9.98 t/ha (ZP-3) to 12.12 t/ha (ZP-8) and it was expected because the hybrids are belonging to the different maturity groups.

Plant height varied from 261.3 cm (ZP-3) to 284.9 cm (ZP-11). Ear height of hybrids ranged from 106.7 cm (ZP-2) to 129.5 cm (ZP-11). The smallest number of leaves per plant was found in hybrid ZP-2 (12.00), and conversely the most number of leaves per plant was recorded in hybrid ZP-11 (13.73). The minimum ear length was observed in hybrid ZP-6 (17.80 cm), while maximum length was found in hybrid ZP-4 (20.85 cm). Furthermore, kernel row number varied from 14.20 (ZP-7) to 16.60 (ZP-5) and finally number of kernels per row ranged from 37.20 (ZP-5) to 40.50 (ZP-6).

Table 1. Means and lsd values for yield performance and yield components of evaluated maize (*Zea Mays*, L.) hybrids

Hybrid	GY	PH	EH	NL	EL	KRN	NKPR
ZP-1	11.71 ab	273.6 bcde	121.3 ab	12.75 bcd	19.10 cd	15.60 bc	37.65 b
ZP-2	11.26 abc	267.7 def	106.7 d	12.00 e	19.27 bcd	14.95 cde	37.70 b
ZP-3	9.98 c	261.9 f	107.0 d	12.13 e	18.45 de	15.20 c	38.45 b
ZP-4	11.07 abc	266.5 def	107.9 cd	12.35 de	20.85 a	15.00 cde	41.50 a
ZP-5	10.46 bc	275.3 abcd	114.0 bcd	12.63 bc	18.50 cde	16.60 a	37.20 b
ZP-6	10.88 abc	269.8 cdef	117.6 bc	12.88 bc	17.80 e	16.40 ab	40.50 a
ZP-7	10.49 bc	281.6 ab	127.8 a	13.10 b	19.35 bcd	14.20 e	38.30 b
ZP-8	12.12 a	278.6 abc	121.9 ab	12.85 bc	19.50 bc	14.90 cde	38.05 b
ZP-9	10.09 c	264.4 ef	114.0 bcd	12.45 cde	19.10 cd	15.05 cd	37.00 b
ZP-10	12.00 a	262.2 f	110.6 cd	12.48 cde	20.15 ab	14.35 de	40.35 a
ZP-11	11.68 ab	284.9 a	129.5 a	13.73 a	19.20 bcd	15.60 bc	38.50 b
ZP-12	11.34 abc	271.5 cdef	110.4 cd	12.63 bcd	18.55 cde	16.40 ab	40.35 a
lsd (0.05)	1.50	10.1	9.9	0.48	1.02	0.81	1.80

GY= grain yield, PH= plant height, EH= ear height, NL= number of leaves per plant, EL= ear length, KRN= kernel row number, NKPR= number of kernels per row

The simple correlation coefficients of yield and yield components varied from -0.151 to 0.785 (Table 2). The highest value of phenotypic correlation was obtained between grain yield and plant height (r_p=0.521**). Highly significant, positive values of phenotypic correlation was also found between grain yield and number of leaves per plant (r_p=0.394**). This is in agreement with results of Malik, et al. (2005), but oposite to the results of Jasa-Vega (1985), who found negative association between grain yield per plant and plant height.

Significant correlations were found between grain yield, on one side and number of kernels per row, ear length, kernel row number and ear height on the other side. Our results are similar to the results of Boćanski et al. (2009). In their study they found strong phenotypic correlation between grain yield and cob weight, plant height, ear height, ear length, kernel number per row and 100-kernel weight.

Plant height exhibited strong positive correlation with ear height, number of leaves per plant and kernel row number and medium correlation with ear length and number of kernels per row. Malik,et al. (2005) also reported positive correlation between plant height on the one side and ear length and kernels per row on the other side.

Ear height showed strong and positive correlation with number of leaves per plant and kernel row number and weak positive correlation with ear length and number of kernels per row. These results are partly in agreement to the results obtained by Srećkov et al. (2011), who found positive correlations between ear height and ear length, but negative correlation between ear height and kernel rows.

Number of leaves per plant have a positive relationship with kernel row number and number of kernels per row and negative relationship with ear length. Ear length exhibited strong positive correlation with number of kernels per row and negative correlation with kernel row number which is in agreement with the results obtained by Čamdžija, et al. (2011).

Kernel row number was positively correlated with number of kernels per row,which is not in accordance with results Yousuf and Saleem, (2001).

Table 2.Simple correlation coefficients between the yield and agronomic traits

	GY	PH	EH	NL	EL	KRN	NKPR
GY	x	0.521**	0.300*	0.394**	0.332*	0.320*	0.348*
PH		x	0.709**	0.785**	0.107	0.383**	0.083
EH			x	0.729**	0.020	0.303	0.003
NL				x	-0.058	0.232	0.067
EL					x	-0.151	0.487**
KRN						x	0.208
NKPR							x

GY= grain yield, PH= plant height, EH= ear height, NL= number of leaves per plant, EL= ear length, KRN= kernel row number, NKPR= number of kernels per row; **-significant at P=0.01; *** -significant at P=0.001

Conclusion

Based on the results obtained in our study it can be concluded that there are significant differences for all investigated traits among the examined hybrids, which is expected because they belonging to different FAO maturity groups. The highest grain yield was observed for hybrid ZP-8, and the lowest grain yield showed hybrid ZP-3. The simple correlation coefficient among investigated traits varied from -0.151 to 0.785. Plant height showed the strongest positive correlation with grain yield (r_p=0.521**), followed by number of leaves per plant (r_p= 0.394**). Positive correlations were also found between grain yield and all of the investigated traits.

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