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CORRELATIONS AMONG YIELD COMPONENTS IN *DURUM* WHEAT

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The main reason that makes breeding for the main yield components difficult is that they are in negative correlation with each other. Numerous researchers have studied relations between yield and different yield components in order to find dependable selection criteria. The goal of this paper is to estimate the variability and correlations between yield components. The experiment was conducted on twelve *durum* wheat genotypes. Plant height was in both years positively correlated with number of spikelets per spike and negatively correlated with spike length. grain weight per spike. number of grains per spike and harvest index. Spike length was positively correlated with grain weight per spike and number of grains per spike. in both years and with harvest index only in the first year. while it was negatively correlated with number of spikelets per spike in the first year. Number of spikelets was in negative correlations with grain weight per spike and number of grains per spike in the first year. and with harvest index in both years of investigations. Grain weight per spike was positively correlated with number of grain per spike and harvest index in both years. Number of grains per spike was in positive correlation with harvest index in both years of investigations.

Key words: durum wheat, yield components, variability, correlation

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INTRODUCTION

The production of high yield wheat cultivars is one of the main goals in wheat breeding. Indirect selection based on one or more grain yield components has been considered to be more effective than the direct selection for grain yield since grain yield has low heritability. The main reason that makes breeding for the main yield components difficult is that they are in negative correlation with each other, i.e. when one component is increased. the other is decreased. According to GRAFIUS (1964) the maximum grain yield is a realization of the most favorable relation between yield components.

Numerous researchers have studied relations between yield and different yield components in order to find dependable selection criteria. For example, AUSTIN (1994) believes that selection for lower stem, larger number of ears per surface unit and larger number of grains per ear have made a major contribution to the wheat grain yield increase. BAHADUR and LODHI (1995) established that the indirect selection for grain yield trough a larger number of grains per ear might increase wheat grain yield, while CALDERINI *et al.* (1995) established that the latest high yield cultivars had an increased seed weight in relation to older cultivars. MC NEIL *et al.* (1978) claims that the selection for 1000 seed weight and number of grains per plant or ear, was more successful in increasing grain yield of wheat then the selection for one component.

The goal of this paper is to estimate the variability and correlations between yield components in order to try to make the breeding more efficient.

MATERIAL AND METHODS

The experiment was conducted at the experiment field of the Institute of Field and Vegetable Crops, Novi Sad, during 2000-2002 period, using the randomized block design. with three replications. Sowing was done in the beginning of the October, in 1.2 m^2 plot, with a 10-12 cm space inside the row and a 20 cm space between rows. The experiment was conducted on twelve *durum* wheat genotypes selected on the basis of different phenotypic expression and geographic origin: Mexicali 75 (MEX), Yantar odeskij (UKR), Belfugito (ITA), Monodur (FRA) and Kunduru (TUR), Durumko (SCG). Yavaros 79 (MEX), Rubezh (BUG), Novinka (SCG), Herkules (CAN), Vindur (DEU) and Alifen (CHL). Six traits were studied at full maturity: plant height, main spike length, number of grains per main spike. grain weight per main spike, number of spikelets per main spike and harvest index. All traits were determined in 5 plants per replication.

The arithmetic mean (X), standard error of mean (Sx). standard deviation (S). minimum values (Min). maximum values (Max) and coefficient of variation (CV) were calculated as indicators of trait variability. Correlation analysis using Pearson's simple correlation coefficients was used to determine the interdependence of the traits. Statistical calculations were done using the SPSS program.

RESULTS AND DISCUSSION

The analysis of variance showed highly significant differences among genotypes for all traits. Differences among years were also significant for all traits except for number of grains per main spike. The genotype x environment interaction was also highly significant for all traits (Table 1).

Table 1. - ANOVA for yield components in durum wheat

	Df	Mean squares					
		Plant height	Spike length	Number of spikelets/spike	Grain weight/spike	Number of grains/spike	Harvest index
Year	1	4516.46**	3.66**	102.25**	3.74**	95.68	0.008**
Genotype	11	2236.61**	2.18**	13.57**	0.67**	330.81**	0.03**
Replication	2	11.41	0.39	3.51	0.08	36.03	0.0007
E x G	11	122.50**	0.46**	1.52**	0.27**	48.23**	0.008**
Error	46	9.71	0.08	0.48	0.06	17.51	0.0007

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

In the first year of investigation. the coefficient of variation was highest for grain weight per main spike. followed by harvest index. Number of spikelets per main spike had a lowest value. followed by main spike length. Plant height and number of grains per main spike showed moderate values for the coefficient of variation. In the second year the highest coefficient of variation had a plant height. while the spike length had a lowest value followed by number of spikelets per main spike. Grain weight per main spike. grain number per main spike and harvest index showed moderate values for the coefficient of variation (Table 2).

Table 2. - Basic statistic parameters for yield components in durum wheat: mean values (x) standard error (Sx) standard deviation (S) coefficient of variation (CV) minimum values (Min) maximum values (Max)

	Year	X	S_X	S	CV (%)	Min	Max
Plant height	2001	104.57	3.41	20.46	19.57	72.2	141.60
	2002	88.73	3.06	18.33	20.66	67.3	132.00
Spike length	2001	8.14	0.14	0.83	10.20	6.92	9.66
	2002	7.69	0.09	0.52	6.76	6.80	8.98
Number of spikelets/spike	2001	22.65	0.31	1.83	8.08	19.20	27.40
	2002	20.27	0.25	1.49	7.35	18.20	23.60
Grain weight/spike	2001	1.83	0.09	0.51	27.87	0.62	3.12
	2002	2.28	0.06	0.35	15.35	1.38	3.04
Number of grains/spike	2001	47.83	1.60	9.61	20.09	24.20	66.40
	2002	45.53	1.20	7.20	15.81	30.25	59.50
Harvest index	2001	0.40	0.02	0.10	25.00	0.20	0.55
	2002	0.42	0.009	0.05	11.90	0.30	0.50

In correlation study (Table 3 and Table 4). plant height was in both years positively correlated with number of spikelets per spike (r=0.67** and r=0.48**) and negatively correlated with spike length (r=-0.59** and r=-0.34). grain weight per spike (r=-0.63** and r=-0.65**). number of grains per spike (r=-0.67** and r=-0.66**) and harvest index (r=-0.73** and r=-0.77**). BUDAK and YILDIRIM (1999) studied correlations between plant height and spike length in six generations but they didn't find any significant correlations. They also found no significant correlations between plant height and harvest index. while HEITHOLT *et al.* (1990). CALDERINI *et al.* (1995) and PETROVIĆ *et al.* (1997) have found significant negative correlations. PEROVIĆ (1995) has found that plant height and grain weight per main spike were highly positively correlated.

Table 3. - Correlation coefficients among the yield components in durum wheat (2001)

	Spike length	Number of spikelets/spike	Grain weight/spike	Number of grains/spike	Harvest index
Plant height	-0.59**	0.67**	-0.63	-0.67**	-0.73**
Spike length		-0.36*	0.59**	0.62**	0.43**
Number of spikelets/spike			-0.36*	-0.36*	-0.48**
Grain weight/spike				0.90**	0.80**
Number of grains/spike					0.78**

* p<0.05; ** p<0.01

Table 4. - Correlation coefficients among the yield components in durum wheat (2002)

	Spike length	Number of spikelets/spike	Grain weight/spike	Number of grains/spike	Harvest index
Plant height	-0.36*	0.48**	-0.65**	-0.66**	-0.77**
Spike length		-0.06	0.40*	0.52**	0.04
Number of spikelets/spike			-0.26	-0.13	-0.46**
Grain weight/spike				0.75**	0.61**
Number of grains/spike					0.38*

* p<0.05; ** p<0.01

Spike length was. positively correlated with grain weight per spike (r=0.59** and r=0.40**). number of grains per spike (r=0.62** and r=0.52**). in both years and with harvest index only in first year (r=0.43**). While it was negatively correlated with number of spikelets per spike in the first year (r=-0.36*). KOBILJSKI and DENČIĆ (1997) found positive correlations between spike length and number of grains per spike. BUDAK and YILDIRIM (1999) studied correlations between spike length and harvest index in six generations. They found significant positive correlations in F_2 generation. but they found no significant correlations in other generations.

Number of spikelets was in negative correlations with grain weight per spike (r=-0.36*) and number of grains per spike (r=-0.36*) in the first year. and with harvest index in both years of investigations (r=-0.48** and r=-0.46**).

Grain weight per spike was in positive correlation with number of grain per spike in both years (r=0.90** and 0.75**). what is in agreement with results of PETROVIĆ (1995) and KOBILJSKI and DENČIĆ (1997). while MARTINČIĆ and KOZUMPLIK (1997) found negative correlations. Grain weight per spike was also in positive correlation with harvest index in both years (r=0.80** and r=0.61**). Similar results were obtained by PETROVIĆ (1995) and HEITHOLT *et al.* (1990).

Number of grains per spike was in positive correlation with harvest index in both years of investigations (0.78** and 0.38**). which is in agreement with the results of AGUILAR-MARISCAL and HUNT (1991) and PETROVIĆ (1995)

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KORELACIJE IZMEĐU KOMPONENATA PRINOSA KOD *DURUM* PŠENICE

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I z v o d

Glavni razlog koji čini oplemenjivanje na glavne komponente prinosa teškim jeste to što su one u negativnoj korelaciji jedna sa drugom. Brojni istraživači su se bavili proučavanjem odnosa između prinosa i komponenti prinosa kao i između različitih komponenti prinosa, sa ciljem da pronađu pouzdan selekcioni kriterijum. Cilj ovog rada je bio da se odredi varijabilnost komponenata prinosa kao i korelacije među njima. Eksperiment je izveden sa dvanaest genotipova *durum* pšnice. Visina stabljike je u obe godine bila u pozitivnoj korelaciji sa brojem klasića po klasu, dok je sa dužinom klasa, težinom zrna po klasu, brojem zrna po klasu i žetvenim indeksom, u obe godine, bila u negativnoj korelaciji. Dužina klasa je bila u pozitivnoj korelaciji sa težinom i brojem zrna po klasu, u obe godine, a sa žetvenim indeksm samo u prvoj godini. Negativna korelacija se pojavila u prvoj godini sa brojem klasića po klasu. Broj klasića je u prvoj godini bio u negativnoj korelaciji sa masom i brojem zrna po klasu, kao i sa žetvenim indeksom u obe godine istraživanja. Masa zrna po klasu je u obe godine bila u pozitivnoj korelaciji sa brojem zrna po klasu kao i žetvenim indeksom, dok su broj zrna po klasu i žetveni indeks u obe godine bili u pozitivnoj korelaciji.

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