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GENETIC ANALYSIS FOR GRAIN WEIGHT PER SPIKE AND HARVEST INDEX IN MACARONI WHEAT

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Using the line x tester analysis (SING and CHOUDHARY, 1979), we studied the combining ability, gene effects and mode of inheritance of grain weight per spike and harvest index, using 5 females, 3 testers and 15 hybrids of durum wheat. The results of the study show that non-additive genes play the more important role than additive in the inheritance of grain weight per spike and harvest index. The mode of inheritance of characters under study depended on the cross combination and the year of growing. In most cases the mode of inheritance was dominant. The estimates of general combining ability (GCA) pointed out that none of the genotypes in the first year of research had the significant GCA for grain weight per spike, while in the second year the best combiner was Kunduru. For the harvest index the best general combiner, in the first year, was Monodur, while in the second year the best combiner was Mexicali 75. In majority of the cases positive specific combining ability (SCA) effect were usually associated with crosses of two genetically divergent parents having at least one parent as a good general combiner.

Key words: wheat, combining ability, mode of inheritance, gene effects, yield components

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INTRODUCTION

The choice of parents is a very important task in a breeding program. Combining ability studies are used by plant breeders to select parents with maximum potential of transmitting desirable genes to the progenies. In autogamous crops like wheat, where the ultimate aim is to develop pure line varieties, the estimates of general combining ability (GCA) are very useful because the variance due to general combining ability is attributable to additive gene action and A x A interaction which can be fixed in further generations, while the variance due to specific combining ability is attributable to non-additive gene action. The gene effects and combining ability of yield components were already studied by a number of scientists using diallel analysis (KNEŽEVIĆ and KRALJEVIĆ-BALALIĆ, 1993; MANON and SHARMA, 1994; MENON and SHARMA, 1995; PEROVIĆ, 1995; PETROVIĆ *et al*., 1995; JOSHI *et al*.,2002).

Present study was therefore, undertaken to obtain information regarding the combining ability, gene effects and mode of inheritance of grain weight per spike and harvest index in macaroni wheat using line x tester analysis.

MATERIALS AND METHODS

Five *durum* wheat genotypes: Mexicali 75 (MEX), Yantar odeskij (UKR), Belfugito (ITA), Monodur (FRA) and Kunduru (TUR) were crossed with each of the three testers: Durumko (SCG), Yavaros 79 (MEX) and Alifen (CHL). The parent varieties and their F_1 hybrids were examined in randomized block design, with three replication. All parents were selected on the basis of different phenotypic expression and geographic origin.

The experiment was conducted at the experiment field of the Institute of Field and Vegetable Crops, Novi Sad, during 2000-2002 period. 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. Two traits were studied at full maturity: the grain weight per main spike (g) and harvest index. All traits were determined in 5 plants per replication. The mode of inheritance was examined using the test of significance of mean generation values in relation to the parental means. The combining ability and gene effects were studied using line x tester analysis described by SING and CHOUDHARY (1979).

RESULT AND DISSCUSION

The analysis of variance for grain weight per spike and harvest index showed highly significant differences amongst genotypes in both years. The genotype x environment interaction was also highly significant in both years of investigation.

The analysis of variance for line x tester analysis for grain weight indicated that no significant differences existed between replications, hybrids, lines and testers, in the first year, and between replications, parents and testers in the second

year of the investigation. Differences between parents, hybrids vs. parents and line x tester interaction, in the first year, and hybrids vs. parents, hybrids, lines and line x tester interaction, in the second year were significant. Analysis of variance for harvest index revealed that the differences due to parents, hibrids vs parents, lines and line x tester were significant in the both years of research, while the hybrids were significant only in first year of research (Table 1).

Table 1. ANOVA line x tester for grain weight and harvest index in durum wheat

Source of variation	DF	Mean squares			
		Grain weight per spike		Harvest index	
		2001	2002	2001	2002
Replication	2	0.04	0.02	0.00	0.00
Treatments	22	0.54**	0.53**	0.01**	0.00**
Parents	7	0.88*	0.14	0.03**	0.01**
Parents vs. Crosses	1	1.54**	2.33**	0.01**	0.01**
Crosses	14	0.31	0.59*	0.01*	0.00
Lines	4	0.35	1.06**	0.01**	0.01**
Testers	2	0.26	0.89	0.00	0.00
Line x Testers	8	0.30**	0.28**	0.00**	0.00**
Error	44	0.08	0.07	0.00	0.00
Total	68				

p<0.05; ** p<0.01

In the first year of research dominant inheritance of grain weight per spike was observed in five combinations, while positive heterosis occurred in two combinations. In the second year dominance occurred in five, and positive heterosis in one combination. Similar results were obtained by BEDE and MARTINČIĆ (1982) and KNEŽEVIĆ and KRALJEVIĆ-BALALIĆ (1993). In the inheritance of harvest index dominance occurred in seven combinations in the first year, and in four combinations in the second year of research. Negative heterosis and partial dominance occurred in one combination in the first year, while intermedediate inheritance and positive heterosis were observed in one combination in the second year of research. These results are in agreement with earlier studies of PETROVIĆ *et al*. (1995) and DENČIĆ and KOBILJSKI (2000).

Table 2. Components of genetic variance in durum wheat

Variance	Grain weight per spike		Harvest index	
	2001	2002	2001	2002
GCA	0.000	0.01	0.000	0.000
SCA	0.074	0.07	0.001	0.000
GCA/SCA	0.000	0.14	0.000	0.000

Estimation of the genetic components of variation as well as ratio of GCA/SCA showed that additive component was lower than the dominance component which suggests that grain weight per spike and harvest index were predomi-

nantly controlled by non-additive gene action, in both year of investigation (Table 2), which is in agreement with earlier studies of BEDE and MARTINČIĆ (1982); KNEŽEVIĆ and KRALJEVIĆ-BALALIĆ (1993); MENON and SHARMA (1995) and PETROVIĆ *et al*. (1995). However, some other authors (MENON and SHARMA, 1994; PEROVIĆ, 1995; JOSHI *et al*., 2002) reported that this trait was affected mainly by additive gene action. These differences could be the result of the choice of parents in crosses.

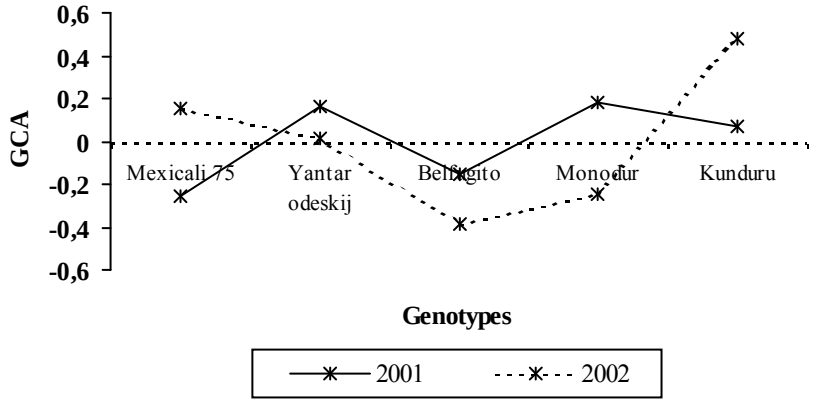

Fig. 1. GCA for grain weight per spike in durum wheat

The estimates of general combining ability pointed out that none of the lines had the significant GCA for grain weight per spike, while in the second year the best general combiner was Kunduru (Fig. 1). For the harvest index the best general combiner in the first year was Monodur, while in the second year the best combiner was Mexicali 75 (Fig. 2).

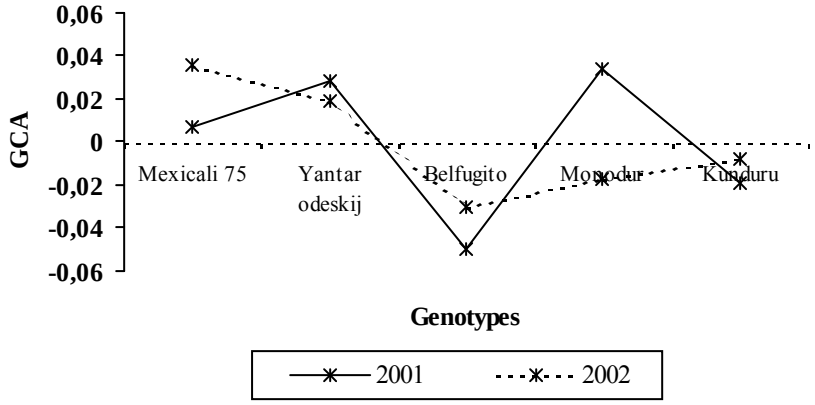

Fig. 2. GCA for harvest index in durum wheat

The crosses which showed high SCA for grain weight per spike are Yantar odeskij x Durumko and Belfugito x Alifen in the first year, and Monodur x Durumko in the second year. For harvest index the best specific combiner in the first year was Mexicali 75 x Alifen, while in the second year of research the best combiner was Belfugito x Alifen (Table 3). In majority of the cases positive SCA effect

Table3. Specific combining ability for grain weight and harvest index in durum wheat

Hybrid	Grain weight per spike		Harvest index	
	2001	2002	2001	2002
1.Mexicali 75 / Durumko	-0.16	0.09	0.00	0.03*
2.Mexicali 75 / Yavaros 79	0.16	-0.36*	-0.04*	-0.03*
3.Mexicali 75 / Alifen	0.00	0.27	0.04*	0.00
4.Yantar odeskij / Durumko	0.32*	-0.16	0.00	0.01
5.Yantar odeskij / Yavaros 79	0.16	0.08	0.03	0.01
6.Yantar odeskij / Alifen	-0.48*	0.08	-0.03	-0.02*
7.Belfugito / Durumko	-0.29	-0.28	-0.01	-0.03*
8.Belfugito / Yavaros 79	-0.14	0.16	-0.01	0.00
9.Belfugito / Alifen	0.43*	0.13	0.03	0.03*
10.Monodur / Durumko	-0.09	0.40*	0.00	0.01
11.Monodur / Yavaros 79	-0.01	-0.14	0.01	0.00
12.Monodur / Alifen	0.10	-0.27	0.00	-0.01
13.Kunduru / Durumko	0.22	-0.05	0.02	-0.01
14.Kunduru / Yavaros 79	-0.17	0.27	0.01	0.01
15.Kunduru / Alifen	-0.05	-0.21	-0.03	0.00
S.E. (SCA)	0.16	0.15	0.02	0.01

* $p<0.05$

were usually associated with crosses of two genetically divergent parents having at least one parent as a good general combiner, what is in agreement with studies of KRALJEVIĆ-BALALIĆ and BOROJEVIĆ (1985). The crosses involving high x low and low x low combiners genetic interaction might be additive x dominance and dominance x dominance type in nature, respectively. Therefore, the heterosis observed in these crosses will be not-fixable and possibility of good segregants will be rare (SING *et al*.,1980). The combinations of two good general combiners not showing positive SCA may be due to the fact that parents were not diverse, while in those crosses with high SCA involving high x high general combiners, the genetic interaction might be additive x additive, which is fixable in further generation and can be used in wheat breeding.

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GENETSKA ANALIZA MASE ZRNA PO KLASU I ŽETVENOG INDEKSA KOD DURUM PŠENICE

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I z v o d

Primenom metode linija x tester (SING and CHOUDHARY, 1979) proučavani su efekti gena, kombinacione sposobnosti i način nasleđivanja mase zrna po klasu i žetvenog indeksa, kod 5 majki, 3 testera i 15 F1 hibrida durum pšenice. Rezultati istraživanja ukazuju na veći značaj neaditivnih od aditivnih gena u nasleđivanju mase zrna po klasu i žetvenog indeksa. Način nasleđivanja ispitivanih svojstava zavisio je od kombinacije ukrštanja i godine ispitivanja. U većini slučajeva nasleđivanje je bilo dominantno. Na osnovu ispitivanja opštih kombinacionih sposobnosti može se zaključiti da nisu bile značajne OKS za masu zrna po klasu u prvoj godini, dok je u drugoj godini najbolji opšti kombinator bio Kunduru. Za žetveni indeks najbolji opšti kombinator u prvoj godini bio je Monodur, dok je u drugoj godini najbolji kombinator bio Mexicali 75. U većini slučajeva hibridi sa dobrim posebnim kombinacionim sposobnostima su nastali ukrštanjem jednog dobrog i jednog lošeg opšteg kombinatora.

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