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INHERITANCE OF PLANT HEIGHT AND SPIKE LENGHT IN 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 plant height and spike length, using 5 females, 3 testers and 15 F_1 hybrids of wheat. 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. Estimation of the genetic components of variation as well as ratio of GCA/SCA showed that plant height in the first year and spike length in the second year of research were predominantly controlled by additive gene action. Non-additive gene effects have been found to be more important than additive ones in the inheritance of plant height in the second year and spike length in the first year of research. The estimates of general combining ability (GCA) pointed out that the best general combiner for the plant height in the first year was line NS 31/96, while in the second year the best combiner was variety Fundulea 490. For the spike length the best general combiner in the both years was line NS 31/96. The line NS 31/96 was the best general combiner in this research and it can be used in wheat breeding.

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

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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; MENON and SHARMA, 1994; MENON and SHARMA, 1995; PEROVIĆ, 1995; PETROVIĆ *et al*.,1995; JOSHI *et al*.,2002).

This study was therefore, undertaken to obtain information regarding the combining ability, mode of inheritance and gene effects of plant height and spike length in wheat using line x tester analysis.

MATERIALS AND METHODS

Five wheat genotypes: Fundulea 490 (ROM), NS 31/96 (SCG), Obrij (UKR), Madison (USA) i Sreća (SCG) were crossed with each of the three testers: Tiha (SCG), Florida (SAD) and Bezostaja-1 (RUS). The parent varieties and their F_1 hybrids were examined in randomized block design, with three replications. 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: plant height and spike length. Both traits were determined in 5 plants per replication. The combining ability and gene effects were studied using GEN software package (Program for quantitative genetic analysis) - line x tester analysis, described by SING and CHOUDHARY (1979)

RESULTS AND DISSCUSION

The analysis of variance for plant height and spike length showed highly significant differences amongst genotypes in both years. The genotype x environment interaction was also highly significant in both years of investigation.

Analysis of variance - line x tester for plant height in both years showed that significant differences existed between parents, interaction parents vs crosses, crosses, lines, testers and interaction line x tester. The analysis of variance for spike length indicated that significant differences existed between parents (both years), interaction parents vs crosses (both years), crosses (second year), lines

(both years), testers (second year) and interaction line x tester (both years) (Table 1).

Table 1. ANOVA line x tester for plant height and spike length in wheat

Source of variation	DF	Mean squares			
		Plant height	Spike length	Plant height	Spike length
		2001	2002	2001	2002
Replication	2	3.25	12.55	0.28	0.03
Treatments	22	389.40**	242.25**	1.67**	2.05**
Parents	7	356.15**	267.46**	1.48*	2.89**
Parents vs. Crosses	1	2702.24**	139.06**	13.22**	7.88**
Crosses	14	240.83**	237.02**	0.94	1.22**
Lines	4	660.92**	413.33**	1.89*	3.38**
Testers	2	301.55**	676.15**	0.35	0.86*
Line x testers	8	15.60	39.08**	0.61*	0.23
Error	44	7.80	5.17	0.24	0.13
Total	68				

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

In the first year of research dominant inheritance of spike length was observed in four combinations while in the second year dominance occurred in six combinations. In the inheritance of plant height in the first year dominance occurred in nine combinations, positive heterosis in three combinations, while partial dominance and intermediate inheritance occurred in one combination. In the second year dominance was observed in four combinations, positive heterosis in one combination, partial dominance in three combination, while intermedediate inheritance was observed in two combinations. In most cases the mode of inheritance of plant height was dominant which is in agreement with earlier studies of KRALJEVIĆ-BALALIĆ and BOROJEVIĆ (1985) and PETROVIĆ *et al*. (1995), while KNEŽEVIĆ *et al*. (1993) concluded that positive heterosis was dominant mode of inheritance.

Table 2. Components of genetic variance in wheat

Variance	Plant height		Spike length	
	2001	2002	2001	2002
GCA	7.963	6.998	0.012	0.035
SCA	2.600	11.304	0.126	0.032
GCA/SCA	3.063	0.619	0.095	1.09

The estimation of the genetic components of variation, as well as the ratio of GCA/SCA showed that the additive component was lower than the dominance component which suggests that inheritance of spike length in the first year and plant height in the second year of investigation were predominantly controlled by non-additive gene action. Similar results were obtained by SRIVASTAVA *et al*. (1981), KNEŽEVIĆ *et al*. (1993) and SHARMA *et al*. (2003). Inheritance of spike

length in the second year and plant height in the first year were predominantly controlled by additive gene action, which is in agreement with studies of KRALJEVIĆ-BALALIĆ and BOROJEVIĆ (1985), KNEŽEVIĆ *et al*. (1993), and JOSHI *et al*. (2002) (Table 2).

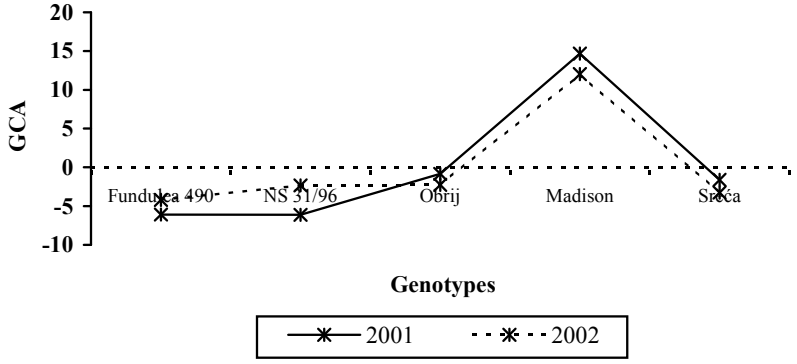

Fig. 1. GSA for plant height in wheat

The best general combiner with maximum number of favorable alleles for spike legth in the both years of investigation was the line NS 31/96 (Fig. 1). For the plant height the best general combiners in the first year were line NS 31/96 and variety Fundulea 490, while in the second year the best combiner was variety Fundulea 490 (Fig.2). These genotypes may be exploited in the crossing programs in obtaining superior segregants.

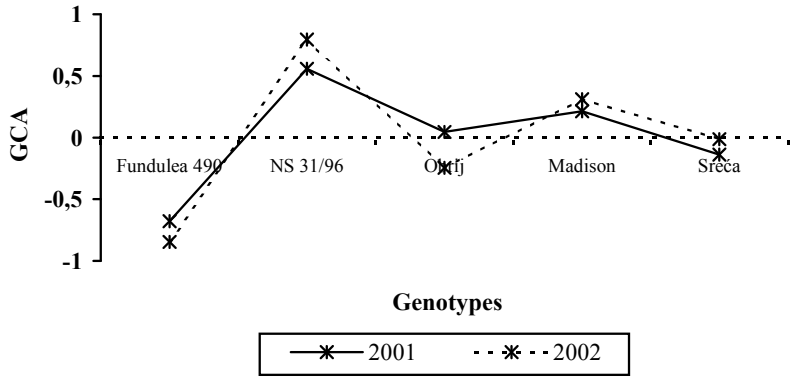

Fig. 2. GCA for spike length in wheat

Hybrid with best specific combining ability for the spike length in the both years was NS 31/96 x Tiha. For plant height in the first year there were no significant SCA, while in the second year the best specific combiner was hybrid Obrij x Tiha (Table 3). In majority of the crosses positive SCA effect were associated with crosses of two genetically divergent parents having at least one parent as

a good general combiner, which is in agreement with studies of KRALJEVIĆ-BALALIĆ and BOROJEVIĆ (1985).

Table 3: Specific combining ability for plant height and spike length in wheat

Hybrid	Plant height		Spike length	
	2001	2002	2001	2002
1.Fundulea 490 / Tiha	1.60	5.26	-0.26	-0.29
2.Fundulea 490 / Florida	-2.43	-2.27	-0.16	0.24
3.Fundulea 490 / Bezostaja-1	0.84	-2.99*	0.42	0.05
4.NS 31/96 / Tiha	-1.02	-1.90	0.68*	0.44*
5.NS 31/96 / Florida	1.52	1.39	-0.09	-0.40
6.NS 31/96 / Bezostaja-1	-0.51	0.51	-0.59*	-0.04
7.Obrij / Tiha	-1.37	-5.26*	-0.54	-0.02
8.Obrij / Florida	2.04	0.99	0.33	0.21
9.Obrij / Bezostaja-1	-0.66	4.27*	0.21	-0.18
10.Madison / Tiha	2.56	-0.51	-0.11	-0.11
11.Madison / Florida	-0.30	0.83	0.04	-0.05
12.Madison / Bezostaja-1	-2.26	-0.32	0.07	0.16
13.Sreća / Tiha	-1.77	2.41	0.24	-0.02
14.Sreća / Florida	-0.83	-0.95	-0.13	0.01
15.Sreća / Bezostaja-1	2.60	-1.47	-0.11	0.02
S.E. (PKS)	1.61	1.31	-0.26	-0.29

* $p<0.05$

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NASLEĐIVANJE VISINE STABLJIKE I DUŽINE KLASA KOD PŠENICE

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I z v o d

Koristeći linija x tester analizu (SINGH i CHOUDHARY, 1979) proučavane su kombinacione sposobnosti, efekti gena i način nasleđivanja visine stabljike i dužine klasa, koristeći pet majki, tri testera i 15 F_1 hibrida pšenice. Analiza komponenti genetičke varijanse kao i odnos OKS/PKS ukazuju da su u nasleđivanju visine stabljike u prvoj godini i dužine klasa u drugoj godini najveći značaj imali aditivni geni. Neaditivni geni su preovlađivali u nasleđivanju visine stabljike u drugoj godini i dužine klasa u prvoj godini ispitivanja. Način nasleđivanja ispitivanih svojstava zavisio je od kombinacije ukrštanja i godine ispitivanja. U većini slučajeva nasleđivanje je bilo dominantno. Analizom opštih kombinacionih sposobnosti (OKS) može se zaključiti da je najbolji opšti kombinator za visinu stabljike u prvoj godini bila linija NS 31/96, dok je u drugoj godini najbolji kombinator bila sorta Fundulea 490. Za dužinu klasa najbolji opšti kombinator u obe godine ispitivanja bila je linija NS 31/96. Linija NS 31/96 je generalno bila najbolji opšti kombinator zbog čega se preporučuje za korišćenje u programima oplemenjivanja pšenice.

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