

SPIKE STABILITY PARAMETERS IN WHEAT GROWN ON SOLONETZ SOIL

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Phenotypic variability of the number and grain weight per spike, as well as the spike length of wheat varieties NSR-5, Evropa 90 and Pobeda creation of the Institute of Field and Vegetable Crops in Novi Sad was studied. The trial was conducted at the village Kumane locality in Banat on solonetz soil. Control and two levels of amelioration (25t/ha and 50t/ha of phosphor gypsum) in three vegetation periods were followed. The variety Evropa 90 exhibited maximal values of all examined spike traits in all years of study. Significant value of the first PCA was denoted for the grain number and the grain weight per spike, using AMMI model.

Key words: solonetz, spike parameters, stability, wheat

INTRODUCTION

Wheat (*Triticum aestivum ssp. vulgare*) has great economic importance being essential in human diet. In Serbia the wheat is grown on about 700-800000 ha, that represents 15% of total agricultural production (DIMITRIJEVIĆ *et al.*, 1997). A permanent growth of human population, as well as, agriculturally available land

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lessening, a demand for wheat production is increasing. Consequently, a main goal in wheat breeding programs is to obtain varieties of high yield potential.

To achieve high yield, wheat requires suitable land in respect of productivity, physical and chemical characteristics. The other way of increasing wheat production is putting in use less productive land. Commonly, in that case ameliorative measures are required. In Vojvodina there is about million hectares of good productive black soil, but about 80000ha is less productive soil of solonetz type, in Banat area, mostly (BELIĆ, 1999). Solonetz is often used as a pasture, but by applying ameliorative measures it is possible to enhance productivity and usability of that land for more intensive agricultural production (BELIĆ *et al.* 2003).

The behavior of variety in different agro-ecological conditions represents important information for varietal regional distribution. Contemporary breeding programs investigate phenotypic variability of wheat varieties in different production conditions including the influence of soil type variation, as well. General behavior of wheat variety in given environment depends of genetic background and the genotype by environment interaction. Successful breeding for targeted growing areas largely depends on identification of the main sources of phenotypic variation in that region. To obtain variety possessing diminished genotype by environment interaction for those predominant sources of variation means good ratio between the stable and high yield. Selection pressure established on the results of genotype x environment interaction analysis is needed for target selection, that leads further to varieties capable to give the best response to ecological, agro-technical and economical requirements and to realize it's genetic potential to the best (DIMITRIJEVIĆ and PETROVIĆ, 2005).

The aim of this study is to investigate genotype by environment interaction of spike parameters in wheat varieties grown on halomorphic soil of solonetz type.

MATERIAL AND METHOD

The trial was conducted at the locality of village Kumane (45°31'19"N and 20°11'42"E) in Banat. Randomized block design in three replications and three treatments was applied in three years, from 2004. to 2007. The trial covers control of grassland with no ameliorative measures applied, and two levels of amelioration (25t/ha and 50t/ha of phosphogypsum (tab.1).

The variation of three spike traits was followed, namely spike length (cm), grain number per spike, grain weight per spike (g) for three bread wheat varieties, NSR-5, Evropa 90 and Pobeda. The plot was designed in 2m long rows, with 20cm between rows and 10cm within row. All analyses were conducted at full maturity of ten plants per replication.

Table 1. Labels of nine environments consisting on three years trial on solonetz soil with amelioration

Label	Vegetation period	Treatment
E1	2004/2005	Control
E2	2004/2005	25 t/ha P-gypsum
E3	2004/2005	50 t/ha P-gypsum
E4	2005/2006	Control
E5	2005/2006	25 t/ha P-gypsum
E6	2005/2006	50 t/ha P-gypsum
E7	2006/2007	Control
E8	2006/2007	25 t/ha P-gypsum
E9	2006/2007	50 t/ha P-gypsum

AMMI model (Additive Main Effects and Multiplicative Interaction) was used for sources of phenotypic variability quantification (ZOBEL *et al.*, 1988). Data were processed by GenStat 8th Edition (trial), VSN International Ltd.

RESULTS AND DISCUSSION

Spike length- The highest mean values in all vegetation periods were denoted for variety Evropa 90, that reached the highest average in 2005/06 of 8,7cm. In the first year of study the lowest spike length mean value had variety NSR-5 (6,4cm), while in second and third year variety Pobeda overtook the last position having averages of 7,5cm and 6,7cm, respectively (tab. 2).

Table 2. Mean values of three studied traits in nine environments for three wheat genotypes: NSR-5 (G1), Evropa 90 (G2) and Pobeda (G3)

Environment	Traits								
	Spike length (cm)			Grain number/spike			Grain weight/spike		
	G1	G2	G3	G1	G2	G3	G1	G2	G3
E1	6.6	7.6	7.0	33.4	32.4	34.3	1.4	1.3	1.4
E2	7.6	7.8	6.9	33.2	40.2	34.2	1.3	1.5	1.3
E3	6.4	8.0	6.7	28.6	36.1	32.3	1.2	1.3	1.3
E4	8.6	7.9	7.5	33.7	28.4	14.6	1.3	1.2	0.7
E5	8.4	8.5	8.2	33.5	36.5	29.8	1.5	1.5	1.2
E6	8.6	8.7	8.1	30.9	31.1	35.1	1.2	1.3	1.5
E7	7.2	6.9	6.9	11.8	12.1	8.3	0.5	0.4	0.3
E8	7.8	8.2	8.1	19.6	23.5	21.7	0.8	1.0	0.9
E9	7.6	8.0	6.7	20.1	24.6	18.3	0.9	1.0	0.8
	LSD _{0.05} =0.4			LSD _{0.05} =3.2			LSD _{0.05} =0.04		
	LSD _{0.01} =0.5			LSD _{0.01} =4.3			LSD _{0.01} =0.56		

Analysis of variance showed that all three sources of variation (genotypes, treatments and environment) had significant influence on phenotypic variation. Genotype by environment interaction expressed no significant mean square, leading to the conclusion that no cross interaction was expressed for the spike length. However, discussing trends in two-dimensional graph, varieties were not differing in main effect, but some differences could be denoted in multivariate effect. Variety Pobeda, expressed the most stable reaction showing PCA1 score close to 0. Variety NSR-5 had better reaction to more favorable production conditions, while variety Evropa 90 appears to be more durable in less favorable growth conditions (fig. 1).

Grain number per spike - Variety Evropa 90 had the highest values of the trait and all three vegetation periods, reaching the absolute maximum average of 40.2 grains in 2004/05., on amelioration of 25t/ha phosphogypsum. The lowest mean values of the trait had NSR-5 in the first growing season (28, 6), and Pobeda in second (14, 6) and the third (8, 3) vegetation period on control grassland (tab.2).

Analysis of variance showed significant genotype by environment interaction, where all agronomical explainable variance was brought out by the first PCA. This result is in accordance to results obtained by PERLAKI (2004). Variety Evropa 90 had the smallest GE interaction, having mean value of grain number per spike at overall mean. Variety Pobeda expressed better reaction in more favorable growing conditions, with the average somewhat higher than overall mean. Variety NSR-5 appeared to be better adapted to less favorable conditions keeping its average at the level of overall mean (fig.1).

Grain weight per spike - Variety Evropa 90 had the highest average values of the trait. However, in 2006/07., significantly lower mean value was obtained (1,0g) comparing to the first (1,5g) and second (1,5g) vegetation period. That could be due to unfavorable meteorological conditions and periodic water stagnation that abruptly overlies dense, slowly permeable subsoil with significantly more clay than the surface horizon. Variety NSR-5 in 2004/5., the lowest average for the studied (1,2g), while variety Pobeda exhibited the lowest means in second (0,7g) and the third (0,3g) year of study on control variant (tab.2).

All sources of variation, additive, as well as, non-additive expressed significant or highly significant variation. The first PCA carried out whole agronomical variation (fig. 1). This result is expected, since grain weight per spike is an important grain yield component, controlled by a number of minor genes, and as a quantitative trait under the influence of environmental conditions. The variation expressed is similar to results reported by KRALJEVIĆ-BALALIĆ and SCHILL (1998) and DIMITRIJEVIĆ *et al.* (2005). Variety Evropa 90 had the smallest GE interaction. Variety Pobeda showed better reaction to ameliorative measures, with the average at the trial average level. Variety NSR-5 was better adapted to unfavorable growth conditions, with higher GE interaction level and total mean value at the trait average level (fig.1).

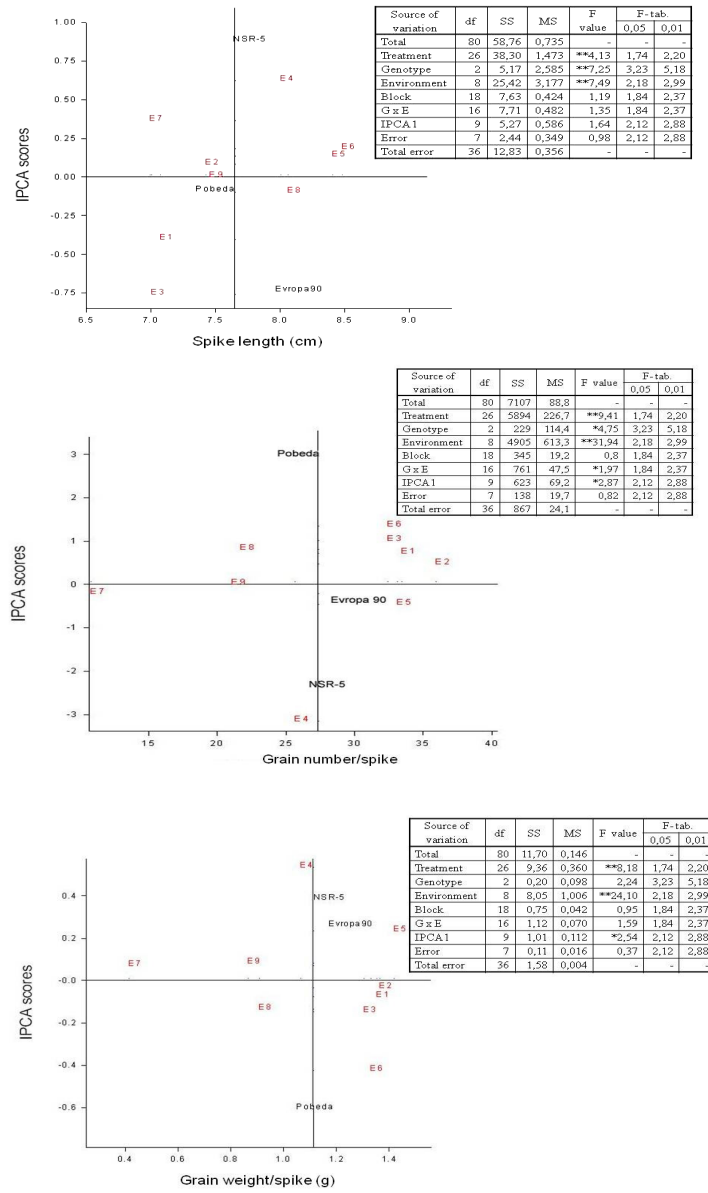


Figure 1. Biplot of the AMMI model of three traits in wheat trial consisting of three genotypes in nine environments. AMMI ANOVA results are given in the top right corner

CONCLUSIONS

According to the results variety Pobeda had the most stable reaction for the spike length, and variety Evropa 90 for the number and the weight of grain per spike. Variety Evropa 90 showed the highest mean values for all three traits in study and at higher GE interaction level, leading to the best reaction to amelioration.

The examination of genotype behaviour in stress growth condition are to be continued in order to select usable genetic variability for better use of solonetz soil, as well as, to establish breeding program *in situ* relying on carefully chosen parental material.

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**STABILNOST PARAMETARA KLASA SORTI PŠENICE NA
SOLONJECU**

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I z v o d

U radu je ispitana fenotipska varijabilnost broja i mase zrna po klasu, kao i dužine klasa novosadskih sorti pšenice NSR-5, Evropa 90 i Pobjeda. Ogled je postavljen na lokalitetu Kumane u Banatu, na zemljištu tipa solonjec, na kontrolnoj varijanti i popravkama uz primenu 25t/ha i 50t/ha fosforgipsa u 3 vegetacione sezone. Sorta Evropa 90 pokazuje maksimalne vrednosti svih ispitivanih parametara klasa u godinama ispitivanja. Primenom AMMI modela je uočena značajna vrednost PCA1 ose za broj i masu zrna po klasu.

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