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EFFECT OF SOME AGRONOMY PRACTICES ON MAIN TRAITS OF GRAIN YIELD IN WINTER WHEAT VARIETIES OF DIFFERENT QUALITY

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Abstract

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The significance of wheat as a major cereal crop constantly provokes the interests to search for means and methods of increasing the productivity and the quality potential of wheat grain. A three-year field trial (2004 2006) analyzed the effect of some main agronomy practices (previous crop and fertilization norm), as well as the specific year conditions on main grain yield traits of 14 common winter wheat varieties. The investigated genotypes were divided into two groups according to their officially registered grain quality. The following traits were studied: grain yield, test weight and 1000 kernel weight, length of main spike, number and weight of grains per spike. The varieties were grown after four previous crops (bean, sunflower, grain maize and fodder maize) and under three nutrition regimes.

The mineral fertilization was applied according to the type of previous crop as follows: $N_6P_6K_0$ and $N_{10}P_{10}K_0$ after bean, and $N_{10}P_{10}K_0$ and $N_{14}P_{14}K_0$ after the other previous crops, the check variant being $N_0P_0K_0$. The multifactor analysis of variances showed highest effect of the year on most of the investigated traits (plant height, test weight, length of main spike, number and weight of grains per spike) for the varieties of both group A and group B. Mineral fertilization was the most important agronomy practice for formation of higher grain yield and productive tillers in both groups. Thousand grain weights is a varietal mark; it was affected most by genotype itself. It was found out that the varieties from group B gave higher grain yield, which was on the whole due to the higher grain weight per spike as a result from the combination of more grains of larger size per the spike; although the productive tillering in this group was significantly lower in comparison to group A. The varieties from group A had stems with 2 cm longer, showed significantly higher productive tillering and formed more compact grain of higher quality.

Key words: wheat, traits, year conditions, previous crop, fertilization

Introduction

Wheat is a crop of microclimate and the phenotypic value of the individual traits often differs considerably from the genotype potential. Therefore the expression of each quality and property is directly related to the specific growing environment. The vegetation period of the winter wheat type is very long and this is a prerequisite for the tangible environmental impact on the formation of productivity and grain

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quality (Tsenov et al., 2004). There are numerous researches on the effect of the agronomy factors on the traits related to grain yield formation of the different wheat varieties (Donmez et al., 2001; Ma et al., 2004; Girma et al., 2007; Fallahi et al., 2008; Tsenov et al., 2008; Lazaro et al., 2010).

The role of the agronomy practice and the meteorological conditions for the realization of the genetic productivity and grain quality of various wheat varieties has been the object of enormous research work (Brancourt-Hulmel and Lecomte, 2003). There is a permanent interest to the problems of wheat productivity and quality due to the multiplicity of factors which affect their formation. Wheat quantity and quality are formed during the entire vegetation period and are a function of the genetic potential of the variety, the agroecological conditions and the technology of growing (Kolev et al., 2004; Koteva et al., 2005). Grain quality is expressed through a complex of indices including its physical properties, chemical composition and bio-chemical and technological characteristics, which are variety-specific. The researches of a number of authors as Zhang et al. (2005); Roozeboom et al. (2008) and Williams et al. (2008) show that grain yield is an annual sum of the complex *genotype x environment* interaction, especially in those climatic regions where the seasonal changes during vegetation are common.

The appropriate choice of a previous crop and fertilization are some of the most important elements of wheat agro technology for the realization of the genetic potential with regard to the quantity and quality indices of each variety. The different previous crops affect not only the fertilization efficiency but also the nutrition regime of soil and hence the quality and quantity of the obtained produce. Mineral fertilization is a significant and dynamic part of the growing technology and has to be combined with the other agronomy practices under the specific agro ecological conditions (Ma et al., 2004; Malesevic et al., 2008; Anderson, 2010).

The aim of this investigation was to determine the effect of previous crop, fertilization norm, and year conditions on the main traits of grain yield and to find out a possible variation between wheat varieties which are genetically different by grain quality.

Material and Methods

The investigation was carried out in the trial field of Dobrudzha Agricultural Institute General Toshevo, on slightly leached chernozem soil (Haplic Chernozem, FAO (2002)) during three successive years (2004 2006). The trial was designed by the split plot method, in 4 replications, the size of the plot being 22.5 m^2. Fourteen common winter wheat genotypes of different grain quality were studied. These varieties were sown within the optimal agro technology term for this region with sowing norm 500 germinating seeds / m^2 after four previous crops: bean, sunflower, grain maize and fodder maize. Soil tillage included single disking (10-12 cm) after harvesting of the previous crop and double disking after the main fertilization. The applied fertilization depended on the type of previous crop: $N_6P_6K_0$ (T_2) and $N_{10}P_{10}K_0$ (T_3) after bean, and $N_{10}P_{10}K_0$ (T_2) and $N_{14}P_{14}K_0$ (T_3) after the other previous crops, the check variant being $N_0P_0K_0$ (T_1). Phosphorus was applied before main soil tillage, and nitrogen before the beginning of permanent spring vegetation. Triple super phosphate and ammonium nitrate were the fertilizers used.

The following indices were investigated: Grain yield (t.ha^{-1}) GY, Thousand kernel weight (g) TKW, Test weight (kg) TestW, Height (cm) HOS, Number of productive tillers (number) NPT, Length of main spike (cm) LMS, Number of grains per spike (number) NGS, Weight of grains per spike (g) WGS.

During data processing, the investigated genotypes were divided into two groups according to their officially registered grain quality.

The varieties investigated in group A was: Aglika, Iveta, Milena, Slaveya, Demetra, Albena, Zlatina; and the varieties included in group B were: Sadovo 1, Bolyarka, Kristy, Pryaspa, Karat, Antonovka, and Galateya. The data was processed with software Statistica, ver 7.

Results

Our multifactor analysis of variances showed significant effect of the genotype and of each of the main agronomy elements (previous crop, fertilization, year) on the investigated traits (Table 1). Grain yield formation and productive tillering (regardless of the quality group to which the varieties belonged) depended to a

Table 1
Multifactor analysis of variance, (type III Sum of Squares)

Source	GY	HOS	NPT	TKW	TestW	LMS	NGS	WGS
Corrected Model	38.48 **	44.02 **	6.39 **	45.56 **	195.61**	10.55 **	10.76 *	9.24**
Variety	47.37 **	207.14 **	10.99 **	1250.44**	2730.47**	142.22 **	112.61 **	86.58 **
Pred	475.32 **	620.43 **	76.20 **	128.54 **	965.95 **	20.72 **	7.33 **	17.03 **
Fert	5300.27 **	999.30 **	431.18 **	225.28 **	676.60 **	51.03 **	1.99 ns	18.32 **
Year	1966.18 **	6225.43 **	65.13 **	457.42 **	17932.9**	974.24 **	1257.91 **	1068.80 **
Var * Pred	2.05 **	1.90 *	1.66 *	5.75 **	13.55 **	1.76 *	1.27 ns	1.67 *
Var * Fert	3.51 **	4.73 **	2.72 **	15.04 **	73.02 **	5.38 **	7.39 **	7.00 **
Var * Year	13.24 **	20.82 **	5.41 **	52.05 **	310.59 **	11.21 **	12.81 **	11.19 **
Var * Pred * Fert	1.68 **	1.56 *	2.34 **	3.93 **	7.53 **	1.86 **	1.42 *	1.39 *
Var * Pred * Year	2.78 **	2.03 **	1.60 *	6.66 **	10.03 **	1.58 *	1.73 **	1.59 *
Var * Fert * Year	6.56 **	4.24 **	1.86 **	12.84 **	37.47 **	4.37 **	4.14 **	3.72 **
Var * Pred * Fert	1.32 *	2.00 **	2.10 **	3.73 **	9.03 **	1.38 *	1.47 *	1.12 ns
Adjusted R^2	0.95	0.96	0.73	0.96	0.99	0.83	0.83	0.82

** Significant at p=0.01

Table 2
Direct effect of all factors on group variety means of the traits

Dependent variable	Group of varieties	Mean	Mean difference	Std. Error	Sig.*
GY	A	5.27		2.101	0.000
	B	5.48	0.21	2.972	0.000
HOS	A	82.87		0.265	0.000
	B	84.3	1.427	0.375	0.000
NPT	A	481.57		4.246	0.000
	B	463.46	-18.111	3.002	0.000
TKW	A	46.23		0.14	0.000
	B	49.79	3.552	0.199	0.000
Test W	A	78.6		0.074	0.000
	B	77.23	-1.372	0.052	0.000
LMS	A	8.15		0.03	0.001
	B	8.29	0.147	0.043	0.001
NGS	A	43.3		0.276	0.046
	B	44.08	0.778	0.39	0.046
WGS	A	1.99		0.012	0.000
	B	2.17	0.182	0.017	0.000

** Significant at p=0.05 (Waller-Duncan test) highest degree on the mineral fertilization norm. Similar results have been reported by Kirchev and Stoeva (2004); Malesevic et al. (2008); Sip et al. (2009); Lester et al. (2010). The determining factor for most of the investigated traits such as plant height, test weight, length of main spike, number and weight of grains per spike, were the specific year conditions of growing the varieties from the two quality groups (Baresel et al., 2008; Rooseboom et al., 2008; Kirchev et al., 2009; Anderson, 2010). Thousand kernel weights is a varietal mark which was affected mostly by genotype itself; the other investigated factors were also significant, although their effect was lower.

The combined interactions of the investigated agronomy factors were significant for most of the analyzed traits. The different combinations had highest effect on grain yield formation, 1000 kernel weight and test weight in both quality groups. The interaction *variety x year* had highest effect on the formation of all investigated traits which allowed characterizing the environmental conditions and the genotypes suitable for them. Similar interactions of factors and the above traits have also have been reported by Yan and Hunt (2001); Brancourt-Hulmel and Lecomte (2003); Mohammadi and Amri (2009); Dechev and Panayotova (2010).

Discussion

The comparison of the mean values of both groups (without considering the effect of each factor of varia-

Table 3
Interaction effect of couple of factors on group variety means of the traits

Var	Factor	GY	HOS	NPT	TKW	TestW	LMS	NGS	WGS
Groups of varieties by Predecesor									
A	1	a #	b	a	a	b	a	a	a
B		b	a	a	b	a	a	a	b
A	2	a	a	a	a	b	a	a	a
B		b	a	a	b	a	a	a	b
A	3	a	a	b	a	b	a	a	a
B		a	a	a	b	a	a	a	b
A	4	a	a	b	a	b	a	a	a
B		b	a	a	b	a	a	a	b
Groups of varieties by Fertilization									
A	T_1	a	a	b	a	b	a	a	a
B		b	a	a	b	a	a	a	b
A	T_2	a	a	b	a	b	a	a	a
B		b	a	a	b	a	a	a	b
A	T_3	a	a	a	a	b	a	a	a
B		b	a	a	b	a	a	a	b
Groups of varieties by Year									
A	2004	a	b	a	a	b	a	a	a
B		b	a	a	b	a	a	a	a
A	2005	a	a	b	a	b	a	a	a
B		b	a	a	b	a	a	b	b
A	2006	a	a	b	a	b	a	a	a
B		a	a	a	b	a	a	a	b
Overall mean		5.38	77.9	473	48	83.6	8.2	43.7	2.08

- the same letter show not significant difference between the values (Waller-Duncan test)

tion) revealed significant variations for all investigated traits, with the exception of number of grains per spike (Table 2). For test weight and number of productive tillers, the variation was in favor of the quality varieties. The varieties of this group possessed markedly higher productive tillering capacity. The variations of test weight (mean values) were not high (1.372) but significant. For all other traits, the varieties from group B demonstrated significantly higher values, especially for grain yield and 1000 kernel weight.

In order to investigate the combined effect of genotype and the agronomy practice elements, a comparison was made between the mean values of traits of both variety groups against the background of each studied factor (table 3). Significant variations between the two groups were found for the traits grain yield, 1000 kernel weight, test weight and grain weight per spike.

There were marked differences between quality varieties of group A and the high-yielding varieties of group B for the indices 1000 kernel weight and test weight, regardless of the used agronomy practices and their direct or combined impact. For the trait grain size, the values of group B varieties were significantly higher than that of the group A varieties for all combinations between the factors. The quality varieties of group A had significantly more compact grain (test weight) even in the combination of the different agronomy practice elements. Similar situation was observed for grain yield, for which there wan no significant difference between the two groups of varieties only after previous crop grain maize during the third year of the investigation; for grain weight per spike the only exception was year 2004.

For number of grains per spike, a significant variation between the two variety groups was not found, with the exception of the second year of the investigation. Similar was the case with stem height variation was observed only for previous crop bean, and in 2004. Regardless of the combination of different factors, the values of the trait length of main spike did not vary between the two groups.

Conclusions

The year conditions had highest effect on most of the investigated traits (plant height, test weight, length of main spike, number and weight of grains per spike) for the varieties from both groups.

Mineral fertilization was the most important agronomy practice for the formation of higher grain yield and productive tillering for both groups of varieties.

The number of grains per spike is being similar, without a significant variation in the length of main spike in both groups, 1000 kernel weight being higher and productive tillering being lower in group B, grain yield was considerably higher in this group. The varieties from group A had stems with 2 cm longer, demonstrated significantly higher productive tillering and test weight and formed more compact grain.

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