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GRAIN WEIGHT PER SPIKE OF WHEAT USING DIFFERENT WAYS OF SEED PROTECTION

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Abstract

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The research was conducted in field conditions with seven different treatments of seed protection and three winter wheat varieties. The varieties PKB-Christina, Pobeda and Vizija were different according to tillering type, stem height, leaf position, duration of vegetation, genetic potential for grain yield and quality. The micro trial was set up during 2004-2006, using split-plot system with four variants of chemical protection plus electronic protection of plasma electrons with positive and negative control. The way of seed protection is the factor that significantly has influence upon grain weight per spike. The variety Vizija had smaller grain weight per spike (1.81 g) than the varieties PKB-Christina (1.99 g) and Pobeda (2.09 g). Difference is highly significant. By comparing grain weight per spike from the aspect of applied protection, highly significant difference was proven between control (1.95 g), +c/+control (1.95 g), difeconazole (1.95 g), and variants being treated with diviconazole (2.04 g), carboxine + tiran (2.11 g) and tebuconazole + triazoxine (1.88 g). Then, highly signifficant difference was determined between variants being treated by fungicides diviconazole, carboxin + tiran and tebuconazole + triazoxin. Plasma electrons treatment was on the level of the control. The highly significant interaction was determined between variety x year x treatment.

Key words: wheat, variety, grain weight per spike, fungicide

Introduction

Grain weight per spike, as the last yield component, is the final in the development of many components that occur in the early ontogenic stages. Grain weight per spike plays a significant role in the yield formation, because it directly affects harvest index. Grain weight per plant directly reflects the efficient use of nutrients and their translocation into generative parts of plant (Borojevich, 1983).

Grain weight can be influenced by cultural practices, if there is genetic base. It could be expected that grain weight per spike is in correlation with parameters whose activity decreases in the period after heading, so the selection of these traits (main leaf area, internodes, spikes and duration of their

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photosynthetic rates) (Protich, 1980, 1982, 1983), at the same time, from leaves and stem to grain is of special importance for the producing of grain weight, because there are genetic differences between varieties, so it is necessary to find genotypes in which that translocation is efficient and to incorporate their genes into a new variety model.

Many varieties are developed and they differ according to many traits as well as according to grain weight per spike. For these reasons, the aim of this study is to determine the inheritance mode of grain weight per spike in five winter wheat varieties, inheritance in hybrids of F_1, F_2 generation and backcross generations. This research should help us in breeding programme aiming to increase grain weight i.e. to achieve even higher yields than previous ones.

Material and Methods

Three winter wheat varieties (PKB-Christina, Pobeda and Vizija), which are different according to tillering type, stem height, leaf position, duration of vegetation, genetic potential for grain yield and quality, were used in this trial. The experiment was set up in trial field of "Tamis" Institute in Panchevo (2003/04 - 2005/06) using split-plot system, four replications, including five variants of chemical protection plus plasma electron protection, with positive and negative control. The size of elementary plot was 5 m^2 (1 x 5 m). Mechanical sowing was done in mid-October. Sowing density was 600 germinating kernels/m^2 and row spacing was 10 cm. Seed was previously artificially inoculated with teleutospores *Tilletia tritici* (1g/kg seeds). After that, seed was treated with the following active substances: difeconazole (30 g/l), diviconazole (20g/l), combination of carboxin (200g/l) and tiran (200g/l), combination of tebuconazole (20g/l) and triazoxin (20g/l). The fifth variant was plasma electrons seed protection which was done at Schmidt Seeger AG, Beilngries, Germany.

The sample size for counting number grain weight per spike is 30 spikes in the stage of full maturity.

Data were processed statistically using analysis of variance by MSTAT - C program, Michigan State University, Version 1. Year, variety and ways of seed protection were taken as factors in the analysis. The results were shown as triennial average.

Results and Discussion

Grain weight per spike is another important component of yield. Change in grain weight per spike drastically influences the final yield. In this research, the biggest grain weight per spike had the variety Pobeda (2.09 g), then PKB-Christina (1.99 g) and Vizija, which had the smallest grain weight per spike (1.81 g). Differences are statistically highly significant (Tables 1 and 2).

The variance analysis determined highly significant difference between years when the research was performed, which is often seen in this region (Table 1).

By comparing grain weight per spike from the aspect of applied protection, highly significant difference was proven between control (1.95 g), +c/+control (1.95 g), difeconazole (1.95 g), and variants being treated with diviconazole (2.04 g), carboxine + tiran (2.11 g) and tebuconazole + triazoxine (1.88 g). Then, highly signifficant difference was determined between variants being treated by fungicides diviconazole, carboxin + tiran and tebuconazole + triazoxin. Plasma electrons treatment was on the level of the control (Table 2).

During the years of research, the variety Pobeda had the biggest grain weight per spike (from 1.43 to 2.60 g), while the variety Vizija had the smallest one (from 0.87 to 2.52 g). This interaction is highly significant (Tables 1 and 2).

Grain weight per spike of the variety Pobeda ranged from 1.88 g (in the variant being treated with fungicide diviconazole) to 2.35 g (the variant

being treated with carboxine + tiran). Grain weight per spike of the variety PKB-Christina ranged from 1.73 g (difeconazole tratment) to 2.22 g (diviconazole treatment), whilst grain weight per spike of the variety Vizija ranged from 1.60 g (plasma electrons treatment) to 2.05 g (difeconazole treatment). Differences are highly significant (Tables 1 and 2).

The highly significant interaction was established between variety x year x treatment (Table 1).

The production of organic matter per spike and spike weight are directly related with a grain number and grain weight per spike. A grain number per spike depends on a spikelet number, a flower number per spike, the success of pollination and the success of the early organogenetic stages of flowers (Kraljevich-Balalich, 1978).

Kobiljski et al. (1996), pointed out that there was a highly significant positive correlation between grain yield and grain weight per spike (r = 0.90). This shows that it is possible to make new wheat genotypes that would achieve high grain yield by, simultaneously, increasing grain weight.

Treatment of electronic seed protection by means of plasma electrons showed significantly lower mass of 1000 grains than it is the case with fungicidal protection by diviconazole and it is on the level of control. Highly significant difference was established between years when the research was performed, then high interaction between variety x years, variety x treatment, year x treatment and variety x year x treatment, is established. Strong positive correlation is established between mass of 1000 grains and wheat yield (Protich et al., 2011).

Protich et al. (2011) obtained results demonstrate a significant impact of different ways of seed protection on test weight in three winter wheat varieties. Highly significant differences were found between control and fungicide treated variants.

Protich et al. (2007) according to the way of protection, grain yield ranged from 7.19 t/ha at control to 7.56 t/ha with difenoconazole protection.

It was determined that the way of seed protection is the factor that significantly has influence upon grain yield. By comparing the yield from the aspect of applied protection, highly significant difference was proven between control and variants being treated with diviconazole, difeconazole, carboxine + tiran and tebuconazole + triazoxine. Significant difference was not established between variants being treated with diviconazole and difeconazole, while treatment with carboxine + tiran and tebuconazole + triazoxine had significantly lower yield. Difference was not established

Table 1
Analysis of variance of the research results of grain weight per spike in the case of different wheat varieties and different way of protection of artificially inoculated seed with *Tilletia tritici*

Source	Df	Sum of squares	Mean Square	F Value	Significance
Repetition	3	0.070	0.023	0.3292	
Variety (V)	2	3.292	1.646	23.3631	**
Error	6	0.423	0.070		
Year(Y)	2	64.445	32.223	900.3736	**
V x Y	4	5.604	1.401	39.1451	**
Treatment (T)	6	1.607	0.268	7.4842	**
V x T	12	7.218	0.601	16.8071	**
Y x T	12	7.657	0.638	17.8297	**
V x Y xT	24	8.128	0.339	9.4630	**
Error	180	6.442	0.036		
Total	251	104.885			

Table 2
Grain weight per spike in gr winter wheat varieties and different way of protection of artificially inoculated seed with *Tilletia tritici* (2003/04 – 2005/06)

Year (Y)	Way of protection (T)	Variety (V)			$YT_{\bar{x}}$	$Y_{\bar{x}}$
		PKB-Christina	Pobeda	Vizija		
	Difeconazole	1.63	1.78	1.53	1.65	
	Diviconazole	1.82	1.42	1.06	1.43	
	Carboxine + Tiran	1.81	1.70	1.12	1.54	
2004	Tebuconazole + Triazoxine	2.13	0.27	0.71	1.04	1.27
	+C/+ Control	1.17	1.43	0.31	0.97	
	Control	1.30	1.81	0.85	1.32	
	Plasma electrons	0.82	1.56	0.52	0.97	
	$YV_{\bar{x}}$	1.53	1.43	0.87		
	Difeconazole	1.95	2.16	2.05	2.05	
	Diviconazole	2.23	1.97	2.38	2.20	
	Carboxine + Tiran	2.27	2.48	1.97	2.24	
2005	Tebuconazole + Triazoxine	2.26	2.47	2.10	2.28	2.14
	+C/+ Control	2.32	2.14	2.10	2.19	
	Control	2.00	2.05	1.87	1.97	
	Plasma electrons	2.04	2.31	1.77	2.04	
	$YV_{\bar{x}}$	2.15	2.30	2.03		
	Difeconazole	1.60	2.23	2.58	2.14	
	Diviconazole	2.61	2.26	2.63	2.50	
	Carboxine + Tiran	2.42	2.88	2.30	2.53	
2006	Tebuconazole + Triazoxine	1.91	2.36	2.67	2.31	2.48
	+C/+ Control	2.74	2.76	2.57	2.69	
	Control	2.43	2.86	2.39	2.56	
	Plasma electrons	2.38	2.87	2.52	2.59	
	$YV_{\bar{x}}$	2.30	2.60	2.52	$T_{\bar{x}}$	
	Difeconazole	1.73	2.06	2.05	1.95	
	Diviconazole	2.22	1.88	2.02	2.04	
	Carboxine + Tiran	2.17	2.35	1.80	2.11	
($TV_{\bar{x}}$)	Tebuconazole + Triazoxine	2.10	1.70	1.83	1.88	1.96
	+C/+ Control	2.07	2.11	1.66	1.95	
	Control	1.91	2.24	1.70	1.95	
	Plasma electrons	1.76	2.25	1.60	1.87	
	$V_{\bar{x}}$	1.99	2.09	1.81		

Level of significance

		V	Y	T	VY	VT	YT	VYT
LSD	5%	0.10	0.06	0.09	0.10	0.15	0.15	0.26
	1%	0.15	0.08	0.12	0.13	0.20	0.20	0.35

between them. Treatment with electronic way of protection, plasma electrons showed significantly lower grain yield than protection with fungicides and it is controlled. In the case of all examined variants where seed protection was done, significant difference concerning grain yield in comparison to control, was established. Highly significant difference was established between the years when research was carried out as well as variety x year interaction (Protich et al., 2011).

The efficacy of seed treatment and foliar spray with fungicides in controlling black point incidence of wheat seeds was evaluated in the field. Untreated and unsprayed controls were also maintained. Seed treatment with either Vitavax-200 or Homai-80WP significantly increased plant population and grain yield, but none of them was found effective in reducing black point incidence. However, no significant increase in spike length, spike weight or 1000-grain weight was observed when the seeds were treated with any of the two fungicides. The increase in grain yield due to seed treatment was attributed to increase in number of spikes per square meter and grains per spike (Malaker and Mian, 2009).

The chemical plant protection methods applied, as compared with the control increased the number of spikes per area unit, number of grains per spike and 1000 grain weight, which enhanced the productivity per spike. Wheat grain yield for the seed dressing treatments was significantly higher than the no-protection yields. The plant protection method which involved dressed sowing seed and 2-time fungicide treatment (2x) was more favourable to the grain yield than seed dressing and a single fungicide treatment (Barbara et al., 2009).

Conclusions

The way of seed protection is the factor that significantly has influence upon grain weight per spike. The variety Vizija had smaller grain weight per spike (1.81 g) than the varieties PKB-Christina (1.99 g) and Pobeda (2.09 g). Difference is highly significant. By comparing grain weight per spike from the aspect of applied protection, highly significant difference was proven between control (1.95 g), +c/+control (1.95 g), difeconazole (1.95 g), and variants being treated with diviconazole (2.04 g), carboxine + tiran (2.11 g) and tebuconazole + triazoxine (1.88 g). Then, highly signifficant difference was determined between variants being treated by fungicides diviconazole, carboxin + tiran and tebuconazole + triazoxin. Plasma electrons treatment was on the level of the control. The highly significant interaction was determined between variety x year x treatment

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