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TEST WEIGHT OF SEVERAL WINTER WHEAT GENOTYPES USING DIFFERENT WAYS OF SEED PROTECTION

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ABSTRACT

The trial was set up in field conditions during 2003/04-2005/06 with seven different treatments of seed protection and three winter wheat varieties. According to analysis of variance, the years and the interactions between variety x years, variety x treatment, year x treatment and variety x year x treatment had highly significant effects on test weight. Variety Vizija had significantly lower test weight in comparison with Pobeda and PKB-Christina varieties. Highly significant difference was proven between control and treated variants. Test weight in plots where the electronic way of protection using plasma electrons was used was at the level of control and significantly lower in comparison to fungicidal protection, in tested varieties.

Key words: wheat, variety, seed, fungicide, test weight.

INTRODUCTION

Successful seed production of field and vegetable grain crops implies knowledge of many seed (grain) traits, among which test weight is very important. Test weight is especially important in the case of some alimentary grain crops and especially in the case when this trait is agreed upon by the market and measured obligatorily. It is the first measurable qualitative trait of cereal grain in the history, started in XIX century. Since then, more and more attention has been paid to it. In the regulations, it became common during XX century, but it is hardly mentioned in the regulations on seed.

Test weight varies generally from 60 to 84 kg/hl. Good wheat should have test weight above 76 kg/hl, while wheat of bad quality is below this level.

Šarić et al. (1996) stated that demanded minimum for bulk density, according to the criteria for evaluation of processing quality of *Triticum aestivum* varieties intended for processing of whole grain, is 800 kg/m^3.

Jevtić (1981, 1992) defined test weight of seed, mentioning its dependence upon density, shape and size of seed. This author emphasized that test weight is important indicator of quality and that it is possible to estimate quantity of goods in the warehouse by means of it.

Adequate seed protection is the only way of providing high production level. In Serbia, unprotected seed is sown on about 50% of areas under small grain cereals. This percentage should be significantly lower. In developed countries, such as Denmark, nearly 85% of total planted winter cereals and 90% of total planted spring cereals is sown by protected and certified seed (Nielsen et al., 1998). Inadequate seed protection against diseases, or its omission, could cause big problems occurring in the case of infection with *Tilletia caries, Drechslera graminea, Ustilago nuda* and *Urocystis occulta*.

In the developed countries of Europe, it is considered that certified seed of spring and winter cereals, as well as a high percent of discarded seed from production (85-90%) is treated with fungicides (Nielsen and Scheel, 1997).

Tilletia caries occurring on wheat is an especially significant pathogen because its presence makes impossible the use of grain in nutrition. Ergot of wheat used to be the most

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significant wheat disease in Serbia, but nowadays it is successfully suppressed by chemical means (Ivanovic, 1992). This pathogen is very common in Denmark since 1989, especially on the areas where the seed had not been treated (Nielsen and Jorgensen, 1994).

The aim of this work is to study the impact of seed protection and variety on the test weight, in order to establish optimal production model for obtaining highest wheat test weight.

MATERIAL AND METHODS

Three winter wheat varieties (Pobeda, Vizija and PKB-Christina), 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 Pančevo (2003/04-2005/06) using split-plot design in 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 of *Tilletia tritici* (Rajković, 1999). After that, seed was treated with the following active substances: difeconazole (30 g/l), diviconazole (20 g/l), combination of carboxin (200 g/l) and tiran (200 g/l), combination of tebuconazole (20 g/l) and triazoxin (20 g/l). The fifth variant was plasma electrons seed protection which was done at Schmidt Seeger AG, Beilngries, Germany.

Hand harvest was done during full ripeness phase, and threshing was done by a thresher. After that, test weight was determined.

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 averages.

RESULTS AND DISCUSSION

Test weight of wheat kernel depends upon kernel size, shape and filling. In our testing, obtained results unequivocally showed that the influence of certain agronomic practices and climatic factors was not identical in the case of all three varieties (Table 1).

According to the research results on different winter wheat genotypes, Protić et al. (1996), Šarić et al. (1997), Mihajlović and Protić (1997) established that test weight ranged from 76.1 to 82.1 kg/hl.

Based upon a long-term experiment, Protić (1993, 1994), Protić et al. (1995) concluded that test weight of winter wheat kernels ranged from 80.0 (PKB-Padinka) to 86.4 kg/hl (BG-Maksima) in the respective cropping conditions.

Jevtić and Malešević *(*1984) determined the highest values for test weight when wheat was harvested at full ripeness phase. Ivanovski et al. (1987) showed that lodged wheat crops produced grains of lower test weight and 1000-kernel weight. Crop lodging affected less test weight than 1000 kernel weight, and reduced sowing seed traits and processed kernel quality.

Ivanovski (1991) proved that test weight is heritable, but is also susceptible to the influence of climatic and edaphic factors. Mišić et al. (1995) stated that a test weight of kernel of at least 80 kg/hl should be the aim in breeding new winter wheat varieties. The variety Vizija had significantly lower test weight in comparison to Pobeda and PKB-Christina varieties.

The years when the researches were carried out had a highly significant effect on test weight, and highly significant interactions were found between variety x year, variety x treatment, year x treatment and variety x year x treatment (Table 1).

A highly significant difference was found between control and fungicide treated variants. Test weight in plots protected by the electronic way, using plasma electrons was at the level of control and was significantly lower in comparison to fungicidal protection, in tested varieties (Table 2).

Table 1. Analysis of variance of test weight in different wheat varieties and different ways of protection of seed artificially inoculated with *Tilletia tritici*

Source of variance	Degrees of freedom	The sum of squares	Mean square	F value exp. ** ≤1%
Replication	3	3.35	1.12	0.08
Variety (V)	2	402.30	201.15	14.93**
Error	6	80.81	13.47	
Year (Y)	2	27656.90	13828.45	13811.45**
Interaction (V x Y)	4	202.73	50.68	50.62**
Treatment (T)	6	364.58	60.76	60.69**
Interaction (V x T)	12	805.58	67.13	67.05**
Interaction (Y x T)	12	988.15	82.35	82.24**
Interaction (V x Y x T)	24	1153.89	48.08	48.02**
Error	180	180.22	1.00	
Total	251	31838.51		

Table 2. Test weight in different wheat varietes and different ways of protection of seed artificially inoculated with *Tilletia tritici*

Year (Y)	Way of protection (T)	Variety (V)			
		PKB-Christina	Pobeda	Vizija	Average (Y x T)
2004	Difeconazole	77.050	77.175	74.900	76.375
	Diviconazole	77.575	75.925	75.100	76.200
	Carboxine + Tiran	78.025	78.775	73.700	76.833
	Tebuconazole + Triazoxine	76.200	76.200	71.100	74.500
	+C/+ Control	75.150	78.275	74.475	75.900
	Control	75.250	77.175	73.850	75.425
	Plasma electrons	76.850	79.000	74.825	76.892
	Average (VxY)	76.586	77.504	73.993	
2005	Difeconazole	92.700	82.725	82.750	86.108
	Diviconazole	94.825	94.300	92.575	93.900
	Carboxine + Tiran	91.575	87.800	82.900	87.425
	Tebuconazole + Triazoxine	83.325	90.875	85.825	86.675
	+C/+ Control	93.875	87.725	86.575	89.392
	Control	84.400	88.975	86.925	86.767
	Plasma electrons	94.375	91.325	82.500	89.400
	Average (VxY)	90.725	89.125	85.721	
2006	Difeconazole	65.900	61.025	67.400	64.775
	Diviconazole	62.825	62.275	69.200	64.767
	Carboxine + Tiran	64.725	61.975	68.050	64.917
	Tebuconazole + Triazoxine	61.825	69.675	68.275	66.592
	+C/+ Control	65.475	61.625	53.875	60.325
	Control	62.200	66.825	54.950	61.325
	Plasma electrons	52.625	64.550	54.900	57.368
	Average (VxY)	62.225	63.993	62.379	
	Average		(V x T)		(T)
	Difeconazole	78.550	73.692	75.017	75.753
	Diviconazole	78.408	77.500	78.958	78.289
	Carboxine + Tiran	78.108	76.183	74.883	76.392
	Tebuconazole + Triazoxine	73.783	78.917	75.067	75.992
	+C/+ Control	78.167	75.875	71.642	75.228
	Control	73.950	77.658	71.908	74.506
	Plasma electrons	74.617	78.292	70.742	74.550
	Average (V)	76.512	76.874	74.031	
	Average (Y)	2004	2005	2006	
		76.027	88.524	62.865	

LSD	V	Y	T	V x Y	V x T	Y x T	V x Y x T
0.05	1.386	0.305	0.465	0.528	0.806	0.806	1.396
0.01	2.099	0.402	0.614	0.696	1.063	1.063	1.842

Results shown above demonstrate a significant impact of different ways of seed protection upon test weight in several winter wheat varieties.

In our scientific literature, there are many works dealing with efficiency of different fungicides against *Tilletia tritici.* But efficiency of applied fungicides was determined only according to the obtained percent of infection (Matijević and Rajković, 1995; Matijević et al., 1993; Matijević et al., 1994; Milosević et al., 1998), or to their influence upon germination and seed germination viability (Matijević, 1993a, 1993b).

CONCLUSIONS

The varieties Pobeda and PKB-Christina had significantly higher test weight in comparison to Vizija variety. 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. The difference between the electronic way of protection using plasma electrons and control was not significant. Wheat seed protected with fungicide Diviconazole had significantly highest values of test weight.

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