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EFFECTS OF WINTER WHEAT SEED PROTECTION AGAINST *TILLETIA TRITICI* ON THE GRAIN YIELD

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Abstract

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The researches were done in the field conditions using three winter wheat varieties and seven ways of seed protection. Varieties are different according to the tillering type, stalk height, leaves' position, length of growing season, genetic potential for yield and grain quality, and they are PKB-Kristina, Pobeda and Vizija. Variety trial was set up in test field of "Tamis" Institute (2003/04 - 2005/06) in Pancevo using split-plot method with four protection variants with fungicide, plus electronic protection of plasma electrons with positive and negative control. It was determined that the way of seed protection was the factor that has a significant impact on the grain yield. Vizija variety had lower grain yield (6.59 t/ha) than Pobeda variety (7.02 t/ha) and PKB-Kristina variety (7.07 t/ha). The difference is highly significant. Comparing the yield from the aspect of the applied way of protection, highly significant difference between the control (6.61 t/ha) and variants, being treated by diviconazole, difeconazole, carboxine + tiran and tebuconazole + triazoxine, was proven. Significant difference was not established between variants being treated by diviconazole and difeconazole, whereas significantly lower yield than they had, had the treatment with ed carboxine + tiran and tebuconazole + triazoxine. Significant difference was not establish between them. Treatment with electronic way of protection of plasma electrons showed significantly lower grain yield than the protection with fungicides and it is controlled. In the case of all tested 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 the research was done as well as variety x year interaction.

Key words: wheat, variety, seed, fungicide, grain yield

Introduction

Intensive wheat production (introduction of new varieties, greater density and application of mineral nutrients) with the aim to achieve higher grain yields results in the increase of disease significance, especially those mycotic ones, thereby the need of control of their pathogens. The occurrence of broad spectrum of diseases is direct result of the technology application of high wheat grain

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yields, because in that way diseases become the limited factor of production in the case of inadequate protection.

The only way of providing high level of production is the adequate seed protection. In Serbia, unprotected seed is sown on 50 % areas under small grain cereals. This percent has to be significantly lower and it has to be achieved by intensive work in order to reach the level of developed countries, such as Denmark where nearly 85 % of total planted winter corns and 90 % of total planted spring corns is sown by protected and certified seed, Nielsen et al. (1998) .

Adequate seed protection against disease pathogens, or its omission, could cause big problems occurring in the case of infection with *Tilletia tritici*, *Drechslera graminea, Ustilago nuda* and *Urocystus occulta.*

Selected varieties concerning the increased disease resistance could exclude chemical seed protection, but for the time being, it could be only done on the account of yield and seed quality.

It is considered that certified seed of spring and winter corns and high percent of discarded seed from production (85 – 90 %) is treated with fungicides in the developed countries of Europe, Nielsen and Scheel (1997).

Tilletia tritici occurring on wheat is very significant pathogen because its presence makes impossible the use of that seed in nutrition. Ergot of wheat used to be the most significant wheat disease in Serbia, but nowadays it is successfully suppressed by the use of chemical means, Ivanovic (1992). This pathogen is very common in Denmark since 1989, especially on the areas where the seed had not been treated, Jorgenesn (1994); Nielsen and Nielsen (1994).

In the case of wheat, 15 specific genes define separated resistance (Bt) to common stripe disease (*Tilletia tritici*), Gaudet et al. (1993).

A lot of winter and spring wheat varieties were tested and results showed different variations concerning resistance. A certain number of varieties had full resistance such as Swedish varieties Tjelvar and Stava being resistant to smut spores from soil, Jonsson and Sevensson (1990). However, resistance is based upon specific genes for resistance, and there is a risk that new virulent race propagate. Fungal smut pathogen varies a lot (virulent race), so taken efforts concerning introduction of rarely specific resistance were not successful in the USA either, Hoffmann and Metzger (1976).

Application of biological disease control is very suitable for seed protection, however, biological agents have not been standardized yet, so further testings for efficiency are necessary in order to introduce it in practical application. Other, alternative control methods such as application of warm water, warm air, electronic protection, seed clearing of disease whose reproductive organs are placed on the surface, could be applied in the combination with classic seed protection methods by using chemical means. Application of organic products such as acetic acid, butter and dairy products showed certain results in the suppression of common smut in the case of wheat (Borgen et al., 1997 ; Borgen, 1997).

Certain results concerning application of some bacterial strains *Pseudomonas chlororaphus* (MA-342) in the protection of wheat, barley and oats, are achieved, Gerhard et al. (1998) .

It is important to point out that it is possible to apply fungicides foliarly, in the situations when seed protection is inadequately done or when it is omitted, but wheat seed protection has impact upon increase of total biomass, retention of increased green area, significant increase of wheat grain yield which can be even 0.47 t/ha, Spink et al. (1998).

The aim of this work is observation of the impact of planting date, quantity of nitrogenous fertilizers and variety on the hectoliter mass size of wheat kernel as well as the other factors having influence upon this important kernel trait and to a certain degree even upon seed. However, the basic aim of this article is to find out key factors of forming high hectolitre mass and establishing optimal production model of higher grain yield and the highest hectolitre mass.

Material and Methods

Three winter wheat varieties, being different according to tillering type, stem height, leaf position, duration of vegetation, genetic potential for grain yield and quality, are used in this trial. They are as follows: PKB-Kristina variety being mid-seasonal, of lower height, of good disease resistance and cold hardiness, high genetic potential for grain yield and quality; then Pobeda variety being mid-seasonal, of good winter hardiness, resistance to lodging and powdery mildew, it is currently our leading variety being known according to its broad adaptability, high yielding potential; and Vizija variety being mid-seasonal with good grain quality, suitable for growing in intensive and less intensive production conditions. It is exceptionally adaptable and has high genetic potential for grain yield.

Plot was set up in trial field of "Tamis" Institute in Pancevo (2003/04 - 2005/06) using randomised complete-block-design including 5 variants plus electronic 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 germinated kernels/m^2 and row spacing was 10 cm.

Seed was previously artificially inoculated with teleutospores *Tilletia tritici*, Rajkovic (1999). After that, seed was treated with the following active substances: difeconazole (30 g/l), diviconazole (20g/l), combination of carboxine (200g/l) and tiran (200g/l), combination of tebuconazole (20g/l) and triazoxine (20g/l), and the fifth variant is electronic seed protection, plasma electrons which was done in Schmidt Seeger AG, Beilngries, Germany.

Hand harvest was done during full ripeness phase, and threshing was done by a thresher. After that grain yield was established.

Data were processed statistically using analysis of variance. Year, variety and seed protection way were taken as factors in the analysis. The results were shown as triennial average.

Results and Discussion

Vizija variety had lower grain yield in comparison to Pobeda and PKB-Kristina varieties. Difference is highly significant. By comparing yield from the aspect of applied protection, highly significant difference was proven between control (6.61 t/ha) 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. Significant difference was not established 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 (Tables 1 and 2).

In short, the results shown in this work imply that the way of seed protection is the factor that significantly has influence upon grain yield of 6.61 t/ha in the case of control to 7.08 t/ha in the case of seed protection with diviconazole and 7.07 t/ha with difeconazole (Table 2).

Shown research results of influence of different ways of seed protection in the case of several winter wheat varieties upon grain yield have significant importance because efficiency of protection was determined by mentioned parameters. In our scientific literature, there are many works dealing with research problems of efficiency concerning different fungicides against *Tulletia tritici.* But efficiency of applied fungicides was determined according to the realized percent of infection (Matijevic and Rajkovic, 1995; Matijevic et al., 1993; Matijevic et al., 1994; Milosevic et al., 1998), or to their influence upon germination and

Table 1
Analysis of variance of grain yield

Source variance	Degress of freedom	Mean squares	F value exp.	F - table	
				0.05	0.01
Repetition	3	1.324	2.648	2.65	3.88
Variety (V)	2	5.763	11.523**	3.01	4.71
Error	6	0.500			
Year(Y)	2	85.449	192.693**	3.01	4.71
V x Y	4	3.284	7.405**	2.42	3.41
Tpeatment (T)	6	0.590	2.872**	2.14	2.89
V x T	12	0.615	1.329	1.80	2.27
Y x T	12	0.450	1.387	1.80	2.27
V x Y xT	24	0.443	1.016	1.62	1.97
Error	180				
Total	251				

Table 2
Grain yield in t/ha for different wheat varieties during different method of protection artificially inoculated seed with Tilletia tritici in period from 2003/04 to 2005/06

Method of protection (T)	Variety (V)			T $\bar{x}$
	PKB-Kristina	Pobeda	Vizija	
Difenoconazole	7.36	7.06	6.79	7.07
Diviconazole	7.22	6.95	7.07	7.08
Carboxin + tiran	7.34	6.93	6.69	6.99
Tebuconazole + triazoxine	7.00	7.23	6.74	6.99
+K/+control	7.03	6.91	6.23	6.73
Control	6.50	6.96	6.37	6.61
Plasma electrons	6.93	7.12	6.22	6.76
V $\bar{x}$	7.07	7.02	6.56	6.89

Level of significance

	V	Y	T	V x Y
$LSD_{0.05}$	0.27	0.2	0.31	0.35
$_{0.01}$	0.4	0.27	0.41	0.46

seed germination viability Matijevic (1993a, b), but not upon grain yield.

Conclusion

It was determined that the way of seed protection is the factor that significantly has influence upon grain yield. Vizija variety had lower grain yield (6.56 t/ha) in comparison to Pobeda variety (7.02 t/ha) and PKB-Kristina variety (7.07 t/ha). Difference is highly significant. By comparing

the yield from the aspect of applied protection, highly significant difference was proven between control (6.61 t/ha) 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 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.

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