Effects of different ways of seed protection on some yield components and grain yield winter wheat

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Abstract

Research was done in the field conditions with three winter wheat varieties and seven ways of seed protection. Researches showed that the way of seed protection was factor that have significant influence on examined characteristics. Our research showed that there had not been significant difference between examined wheat varieties in the number of plants and spikes per square meter, coefficient of productive tillering and grain yield within the same way of protection. The number of plants per square meter ranged from 484 at PKB – Christina variety to 520 at Vizija cultivar. According to the way of protection, the number of plants per square meter ranged from 487 at treatments with Diviconazole to 517 at electronic way of protection. The number of spikes per square meter ranged from 721 at PKB-Christina variety to 732 at Pobeda variety. According to the tested ways of protection, it was determined that the number of spikes ranged from 711 at control to 746 at treatment with +C/Control. It was also determined that coefficient of productive tillering ranged from 1.43 at Vizija variety to 1.49 at Pobeda variety. According to the way of seed protection, it was determined that coefficient of productive tillering ranged from 1.44 at control to 1.50 at treatments with Diviconazole. It was also determined that grain yield ranged from 7.03 t/ha at Vizija variety to 7.69 t/ha at Pobeda variety. According to the way of protection, grain yield ranged from7.19 t/ha at control to 7.56 t/ha with Difenoconazole protection.

Keywords: wheat, variety, seed, fungicide, yield components, grain yield.

Introduction

By intensifying the factors of wheat production (new varieties, higher plant density and mineral plant nutrition) in order to produce more grain yields, the importance of plant diseases, which are caused by fungi, and their control keep growing. Unavoidable consequence of technology of high wheat yields is the appearance and spectrum of diseases and then those diseases become limited factor of such technology, unless they are controlled. By their elimination, the mentioned factors of production can give the expected results.

The only way to provide the high production level and seed quality is seed protection and elimination of pathogens. Nowadays, 50 % of land planted with grain crops is based on the production without protected seed, which represents very low level and it is necessary to eliminate it in as a short period of time as possible using different ways and to come to the level of more developed countries.

For example in Denmark, it is estimated that approximately 85 % of total sowed winter grains and 90 % of total sowed spring grains were sown with protected and certified seed, (10).

Outbreak of more serious seed diseases could be quickly spread if grains are grown without efficient control methods. This could finally lead to significant yield loss and drastic reduction of seed quality. If seed protection is not done, diseases could cause big problems in our country like *Tilletia caries* of wheat, barley leaf stripe (*Drechslera graminea*) and barley loose smut (*Ustilago nuda)* and stem smut of rye (*Urocystis occulta*).

Grains production with limited use or omitting of seed treatment had to be based on the other equally efficient control measures in order to preserve healthy seed.

In principle, resistance could replace seed protection by chemical measures but in that way it would not result in better conditions concerning disease resistance and knowledge is still limited in that scope of activity. To have varieties which are resistant to a larger number of pathogens is very difficult to combine and blend into one, besides that to possess high genetic potential for yield and seed quality.

Most of the certified spring and winter grains on one hand and separated seed from production on the other hand (85 % – 90 %) are protected against disease outbreak with fungicides recommended by Danish Institute of Agricultural Sciences, (9).

Tilletia caries (common bunt) of wheat is very important disease which leads to exclusion of such production for making bread and for food industry which could cause discarding of infected crop. This disease is often seen in Denmark from 1989, mostly on farms where the seed was not treated (7). The situation becomes more complicated taking into consideration the fact that common bunt can be soil-borne disease (7; 8; 1).

Fifteen specific resistance genes (Bt) to common bunt of wheat (*Tilletia caries)*, known from literature, but with separated resistance was described by (3).

Many spring and winter varieties were tested and the results showed different variations in resistance. A certain number of varieties showed full resistance as Swedish Tjelvar and Stava varieties which showed resistance to smut spores originating from soil (6). However, resistance is based on specific resistance genes where there was risk that new virulent breeds spread from. Fungal smut varies a lot and the efforts are made to introduce unusually specific resistance which was not successfully carried out in the USA because of infesting with new virulent breeds (5).

In recent years, development of biological disease control and biological control of several products is potentially suitable for seed protection. However, the products are not wholly developed and they require testings on efficiency and their practical application. The other alternative control measures are suitable, including warm water, warm air, electronical control, seed puring from disease like smut which is present on the surface. Organic products like acetic acid, butter and dairy products showed certain influences against common smut of wheat (1; 2).

Researches of (4) showed that treatments with natural strain of bacteria MA-342 (*Pseudomonas chlororaphis*) in controlled conditions in the cases of wheat, barley and oats are efficient on disease development in over a hundred of traits like in the cases of standard fungicides.

According to the researches of (11), Fluquinconazole is a fungicide used in foliar application and for seed treatment of grains. Especially, it protects grains infested by *Gaeumannomyces graminis var. tririci*, then by diseases like *Puccinia spp., Septoria spp., Tilletia spp*. and *Ustilago spp.*

Seed protection of wheat results into increase of total biomass, containment of increased green area, significant increase of wheat grain yield averagely to 0.47 t/ha, then there comes significant interaction between genotypes and treated seed (12).

Material and Methods

Three winter wheat varieties, different according to the tillering type, stem height, leaves position, length of growing season, genetic yield potential and grain quality, was used as a material. PKB-Christina variety is a mid-season variety, lower plant, of good disease resistance and cold hardiness, with high genetic potential for grain yield and grain quality. It was released in Romania in 2004. Pobeda variety is a mid-season variety of good winter hardiness, lodging and cereal mildew. It is momentarily the main crop in production and it is known according to its broad adaptability with high yielding potential. Vizija variety is a mid-season variety of good seed quality. It is suitable for breeding in intensive and less intensive production conditions. It is extraordinarily adaptable and it has high genetic potential for grain yield.

The seed is infested with teleutosporas of *Tilletia tritici* (3 g/kg) at all variants of researching (+Control) except for Control (it is not protected) and Electronic way of protection. Then, the seed is protected with Difenoconazole (30 g/l), Diviconazole(20 g/l), combination Carboxyn (200 g/l) + Tiran (200 g/l), Tebuconazole (20 g) + Triazoxyn (20 g) and Electronic seed protection was done in Schmidt Seeger AG, Beilngries, Germany.

A trial was set up in the experiment field of "Tamis" Institute (2003/04- 2005/06) in Pancevo. Calcareous chernozem was the type of soil. Methodology of setting up a trial was split-plot system with four replications. Sunflower was a pre-cultivar, with common agrotechnique for wheat in Vojvodina and with the use of about 120 kg/ha nitrogenous fertilizers. The size of elementary plot was 5 m^2 (1 x 5 m). Sowing was done mechanically in the middle of October. Planting density was of 600 germinated grains / m^2 and with 10-cm row spacing.

The number of overwintered plants was determined in the spring and the number of productive spikes was determined before harvest. Harvest was done by hand in the phase of full maturity, and threshing was done by wheat threshing machine. After that, grain yield was determined.

Data were statistically processed, using analysis of variance. Year, variety and the way of seed protection were taken into consideration as the factors in the analysis. The results are showed as triennial average for all examined traits.

Results and Discussion

The number of overwintered plants. Since wheat seed and its quality, correctly protected and with good fungicide, represent the important factor in plant number insurance per area unit, it is significant to achieve the same things in optimum performance for certain varieties.

The same number of overwintered plants per m^2 was approximately achieved in the cases of different varieties within different ways of protection and different fungicides which allows comparison of examined traits (Table 1).

The number of overwintered plants per m^2 ranged from 484 in the case of PKB-Christina variety to 520 in the case of Vizija variety. According to the way of protection, the number of overwintered plants per m^2 ranged from 487 at treatments with Diviconazole to 517 at Electronic way of protection treatment. Difference is not significant in the number of overwintered plants between examined varieties while significant difference was determined between electronic way of protection treatment and treatments with combination Tebuconazole + Triazoxyn and it is of very great importance in comparison to treatments with Difenoconazole, Divicnazole, combination Carboxyn + Tiran and Control. Significant difference was not determined between other examined treatments of seed protection in the number of overwintered plants per m^2. Difference of very great importance was found between years of researches when research was done (Table 1).

The number of spikes. Stand density is the first step in providing high yield and because of this it is important to achieve optimal number of spikes per area unit. In order to achieve optimal number of spikes, optimal number of plants per area unit is necessary for certain varieties, because tillering conditions are very variable. That is why tillering could not be safely relied on in the intensive production.

Table 1. The number of overwintered plants per m^2 in the case of different wheat varieties at different ways of seed protection and fungicides (2003/04 – 2005/06)**

Way of protection	Variety			
	PKB-Christina	Pobeda	Vizija	Average
Difenoconozole	481	486	504	490
Diviconazole	477	483	501	487
Carboxyn + Tiran	484	489	526	500
Tebuconazole + Triazoxyn	502	488	522	504
+Control	474	540	517	510
Control	505	479	505	497
Electronic	462	520	567	517
Average	484	498	520	501
LSD 5%		37,0		12,0
1%		40,O		16,0

** Difference between years of researches is of very great importance.

The number of spikes per m^2 ranged from 721 in the case of PKB-Christina variety to 732 in the case of Pobeda variety. Difference is not significant. According to the examined ways of protection, it was determined that the number of spikes ranged from 711 at Control to 746 at treatment with +Control what is very great difference.

Table 2. The number of spikes per m^2 in the case of different wheat varieties at different way of seed protection and fungicides (2003/04 – 2005/06)**

Way of protection	Variety			
	PKB-Christina	Pobeda	Vizija	Average
Difenoconozole	728	737	724	730
Diviconazole	743	717	714	725
Carboxyn + Tiran	704	710	758	724
Tebuconazole + Triazoxyn	712	715	760	729
+Control	753	744	740	746
Control	699	728	707	711
Electronic	704	774	707	728
Average	721	732	730	728
LSD 5%		12,0		8,0
1%		15,0		12,0

** Difference between years of researches is of very great importance.

Significantly greater number of spikes per m^2 was determined in the case of all examined seed protection treatments in comparison to control. Significant difference was not determined in the number of spikes per m^2 between examined seed protection treatments. Difference of very great importance was found between years of researches when research was done (Table 2).

Coefficient of productive tillering. Productive tillering is a wheat characteristic depending on genotypes, mineral nutrition, soil moisture, temperature, plant health and plant density.

It was determined that coefficient of productive tillering ranged from 1.43 in the case of Vizija variety to 1.51 in the case of PKB-Christina variety. That difference is of very great importance while difference between coefficients of productive tillering is not important.

According to the way of seed protection, it was determined that coefficient of productive tillering ranged from 1.44 at Control and Electronic way of seed protection to 1.50 at treatments with Diviconazole, what is very significant difference. Significant difference was not found between other examined treatments of protection in productive tillering (Table 3).

Table 3. Coefficient of productive tillering in the case of different wheat varieties at different ways of seed protection and fungicides (2003/04 – 2005/06)**

Way of protection	Variety			
	PKB-Christina	Pobeda	Vizija	Average
Difenoconozole	1.52	1.52	1.44	1.49
Diviconazole	1.58	1.49	1.44	1.50
Carboxyn + Tiran	1.49	1.46	1.46	1.47

Tebuconazole + Triazoxyn		1.44	1.52	1.49	1.48
+Control		1.60	1.39	1.47	1.49
Control		1.39	1.53	1.42	1.44
Electronic		1.54	1.50	1.27	1.44
Average		1.51	1.49	1.43	1.47
LSD	5%		0,03		0,02
	1%		0,05		O,03

** Difference between years of researches is of very great importance.

Grain yield. Grain yield was determined to be 7.03 t/ha in the case of Vizija variety and 7.69 t/ha in the case of Pobeda variety, difference is important. According to the way of protection, grain yield ranged from 7.19 t/ha at control to 7.56 at Difenoconazole protection, what is highly significant difference. Significant difference was not determined between ways of protection (Electronic way of protection and protection with fungicides) (Table 4).

Significantly higher grain yield was determined at all examined treatments in comparison to Control. Significant difference was not determined in grain yield between examined seed protection treatments. Difference of very great importance was established between years of researches when research was done (Table 4).

Table 4. Grain yield in the case of different wheat varieties at different ways of seed protection and fungicides. (2003/04 – 2004/05)**

Way of protection		Variety			
		PKB-Christina	Pobeda	Vizija	Average
Difenoconozole		7.70	7.73	7.25	7.56
Diviconazole		7.67	7.54	7.43	7.55
Carboxyn + Tiran		7.63	7.49	6.97	7.36
Tebuconazole + Triazoxyn		7.40	7.76	6.99	7.38
+Control		7.44	7.66	6.91	7.33
Control		6.97	7.73	6.87	7.19
Electronic		7.63	7.91	6.77	7.44
Average		7.49	7.69	7.03	7.40
LSD	5%	0,32	0,29	0,16	0,14
	1%	0,35	0,36	0,17	0,16

** Difference between years of researches is of very great importance.

Conclusion

According to the results of effects of different ways of seed protection on some yield components and grain yield, the following could be concluded:

- researches showed that there were not significant differences between examined wheat varieties in the number of plants and spikes per m^2, coefficient of productive tillering and grain yield within the same way of protection.

- the number of plants per m^2 ranged from 484 at PKB-Christina variety to 520 at Vizija variety. According to the way of protection, the number of plants per m^2 ranged from 487 at treatments with Diviconazole to 517 at Electronic way of protection.

- the number of spikes per m^2 ranged from 721 at PKB-Christina variety to 732 at Pobeda variety. According to the examined ways of protection, it was determined that the number of spikes ranged from 711 at Control to 746 at treatment with + Control.

- coefficient of productive tillering was determined to be 1.43 at Vizija variety and 1.49 at Pobeda variety. According to the way of seed protection, coefficient of productive tillering was determined to be 1.44 at control and 1.50 at treatments with Diviconazole.

- grain yield was determined to be 7.03 t/ha at Vizija variety and 7.69 t/ha at Pobeda variety. According to the way of protection, grain yield ranged from 7.19 t/ha at Control to 7.56 t/ha with Difenoconazole protection.

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