THE EFFECT OF FUNGICIDE TREATMENTS ON WHEAT COMMON BUNT (*TILLETIA* SPP.) IN TRANSYLVANIA

Elena Nagy, Vasile Moldovan[1]

ABSTRACT

The complex of soil and seed borne diseases are frequent in winter wheat as a result of a succession of unfavorable temperature or water factors during sowing-emergence or seed formation, favorable to grain infection with particularly harmful pathogens, belonging to genera: *Fusarium*, *Tilletia*, *Helminthosporium* and *Ustilago*, especially when seed is not treated or not adequately treated. The most frequent and damaging are *Tilletia* species: *T. caries* and *T. foetida*, which cause common bunt. Yield losses can reach 40% of yield, and ear parasitism degree 70-80%, depending on climatic conditions and wheat cultivar. The effect of seed treatment with 9 fungicides against common bunt and the reaction of 9 wheat cultivars under artificial infections at ARDS Turda during three years were studied. Bi-factorial split-plot yield trials were organized, with 4 testing conditions: natural infections, artificial infections, artificial infections + seed treatment and natural infections + seed treatment, for 9 genotypes. The genotype reaction and the fungicide efficacy were evaluated by number of diseased spikes, and plant population density in early spring and before harvest. Yield (q/ha) with 86% dry matter, germination energy, germination, inoculum on the kernels and protein content were determined. Under artificial infections all genotypes showed a significant increase of diseased spikes and a substantially reduced yield, protein content, and plant density in early spring. Genotypic differences were observed: the most tolerant to common bunt attack proved to be: Turda 56/95, Turda 81 and Turda 95 and the most susceptible Turda 18/94 and Transylvania. Fungicides containing difenoconazole (Dividend 030 FS 1.0 l/t), tebuconazole (Raxil 060 FS 0,5 l/t), fludioxonil + epoxiconazole (Maxim Star DS 1.5 kg/t), tebuconazole + thiram (Raxil T 515 FS 2.0 l/t) had a very good efficiency in controlling common bunt, even under artificial infections. Seed treatment was economically efficient, seed treatment cost merely representing 2-4% of profit value. Common bunt attack affected grain quality. Treatments increased protein content to 11.2% and wet gluten to 19.6%, improving baking quality, as compared with the untreated plots.

Key words*:* wheat common bunt, *Tilletia* artificial infections, seed fungicidal treatments.

INTRODUCTION

Wheat crops are damaged by numerous diseases which cause quantitative and especially qualitative yield losses in Transylvania. The complex of soil and seed borne diseases are frequent in winter wheat, as a result of a combination of unfavorable thermal or humidity factors during sowing-emergence or seed formation, high grain infection with particularly harmful pathogens, belonging to genera: *Fusarium*, *Tilletia*, *Helminthosporium* and *Ustilago*, especially when using untreated or inadequate treated seed (Baicu, 1971; Nagy and Moldovan, 2001; 2006).

The most frequent and damaging are *Tilletia* species: *T. caries* and *T. foetida*, which cause common bunt, yield losses reaching up to 40% and ear parasitism up to 70-80%, depending on climatic conditions and wheat cultivar. *Tilletia* pathogens contaminate the seed in the field during harvesting, by spores deposited in the hairy zone on the top of the seed or in seed ventral channel (Dumitras et al., 1985). The first symptoms appear after heading, when the ears are blue-greenish, with fragile awns, having a unpleasant odor caused by thrimetyl-amine. The wheat genotype, by reaction type and cultivated area has a major influence on diseases structure and size of losses.

This paper presents results on: the behavior of some wheat genotypes to the attack of common bunt (*Tilletia* spp.); the fungicides efficacy in preventing and control of the disease and the relationship between the number of diseased spikes, yield and plant population density.

MATERIAL AND METHODS

The experiments were carried out at ARDS Turda during two years. The reaction to common bunt of 9 winter wheat genotypes: Transilvania, Turda 81, Ariesan, Apulum, Turda 95, Turda 2000, Turda 12/93, Turda 56/95 and Turda 18/94, was examined in 4 testing conditions: natural infection, artificial infection, artificial infec-

1 Agricultural Research and Development Station Turda, 401100 Turda, Cluj County, Romania. E-mail: nagyln@yahoo.com

tion + seed treatment, and natural infection + seed treatment. For artificial infection, we used 4 g teliospores per 1 kg wheat seed. Chemical treatment was made with Raxil T 515, containing tebuconazole 15 g/l and thiram 500 g/l, in rate by 2 l/t. We also tested the efficacy of some fungicides with various formulation recommended for common bunt control.

Wheat genotypes reaction and efficacy of fungicides were evaluated by attacked ears (%), plant population density in the early spring, ears number at harvesting and yield expressed in q/ha with 86 % dry matter.

In the laboratory we determined the germination energy, the germination and the pathogenic agents on the seeds. ANOVA, correlation, regression and Duncan test were used.

RESULTS AND DISCUSSION

ANOVA for diseased ears, grain yield and emerged plant densities of 9 genotypes showed high and significant variations due to testing conditions and genotypes. Interactions between conditions x genotypes was significant only for diseased ears (Table 1). Testing conditions caused a large amplitude of variation ranging from 0 to 35.4 % diseased ears, 45.2 to 62.5 q/ha grain yield, and from 373 to 490 plants/m^2 (Table 2).

Table 1. ANOVA for diseased ears, grain yield and emerged plants densities of 9 wheat genotypes

Source of variation	Degrees of freedom	s^2		
		Diseased ears (arc sinv%)	Grain yield	Plant density (no. of plants/m^2)
Total	71			
Replicates	1			
A. Testing conditions	3	5340.18***	1082.92***	75674.89*
Error (A)	3	39.71	10.99	3378.0
B. Genotypes	8	68.99***	67.48*	23582.50***
A x B	24	31.93***	7.05	5189.39
Error (B)	32	11.10	26.41	3493.2

Table 2. Effect of treatments and genotypes on the number of bunt diseased ears, grain yield and early spring plant density

Factor	Diseased ears				Grain yield			Plant density in early spring		
	%	Arc sin v%	Diff.	Signif.	q/ha	Diff.	Signif.	No.pl./m^2	Diff.	Signif.
A. Testing conditions										
Natural infection	3.9	11.4	0	Ct.	56.1	0	Ct.	374	0	Ct.
Artificial infection	35.4	36.5	25.1	**	45.2	-10.9	oo	373	-1	-
Artificial infection + seed treatment	0	0	-11.4	o	60.5	4.4	*	481	107	*
Natural infection + seed treatment	0	0	-11.4	o	62.5	6.4	*	490	116	**
LSD	6.7				3.5			62		
B. Genotypes										
Transilvania	6.4	14.7	0	Signif.	55.8	0	Signif.	494	0	Signif.
T 18/94	8.6	17.0	2.3	-	57.9	2.2	-	451	-43	-
Apulum	5.5	13.5	-1.2	-	56.1	0.3	-	482	-12	-
Ariesan	5.1	13.1	-1.6	-	55.2	-0.6	-	472	-22	-
Turda 2000	4.5	12.3	-2.4	-	60.0	4.2	-	418	-76	o
T 12/93	3.5	10.8	-3.9	o	54.0	-1.8	-	340	-154	ooo
Turda 81	23.1	10.1	-4.6	oo	51.6	-4.2	-	412	-82	oo

Turda 95	2.2	8.6	-6.1	ooo	60.4	4.6	-	442	-52	-
T 56/95	1.9	7.9	-6.8	ooo	54.4	-1.4	-	352	-142	ooo
LSD	3.4				5.2			60		

There were significant differences among genotypes for diseased ears and plant densities in early spring.

Interaction of genotypes and testing conditions showed high increases of bunt common attack varying from 17.9 to 46.7 % diseased ears under artificial inoculations (Figure 1).

High reductions of yielding ability were observed under artificial inoculation as compared with natural infection. Seed treating with tebuconazole + thiram reduced disease attack almost to zero, and high yields and plant densities were observed when the disease was completely controlled.

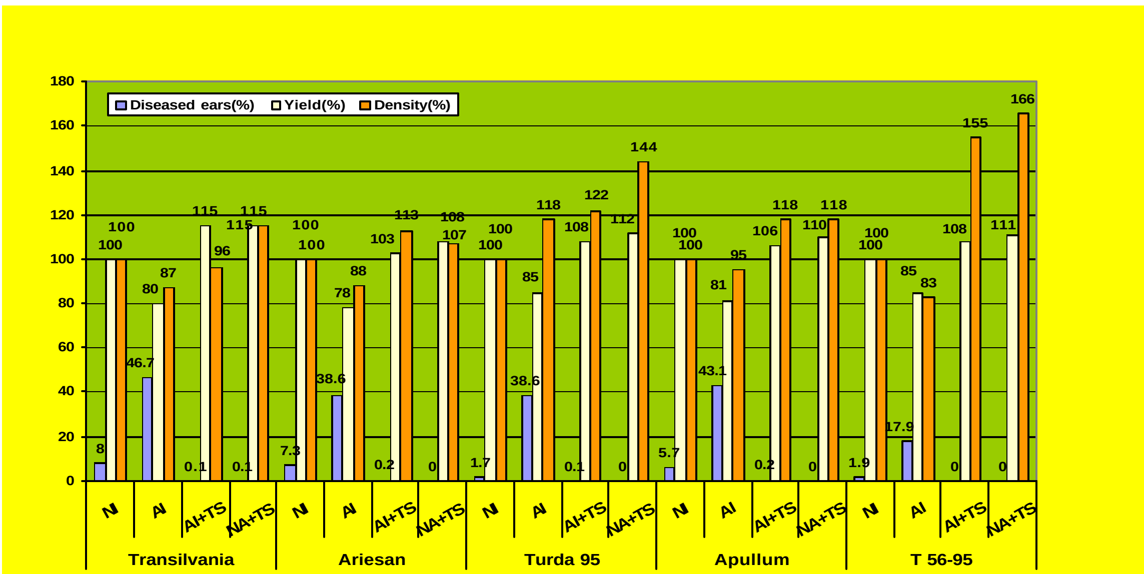

Figure 1. Interraction of genotypes and testing conditions on diseased ears, yield and plant density

Table 3 presents the deviations (+,-) of diseased ears and grain yield from natural infection conditions for all tested genotypes. An increase of disease of up to four times, in Turda 12/93 genotype was observed. By applying seed treatment, the common bunt attack is reduced to zero even under artificial inoculation. Yield losses varied from 5.4 to 13.9 q/ha, average losses being 11.0 q/ha.

Table 3. Common bunt attack and grain yield expressed as deviations (+,-) from natural infection conditions

Genotypes/testing conditions	Diseased ears (+,-)				Grain yield (+,-)			
	AI	NI	AI+TS	NI+TS	AI	NI	AI+TS	NI+TS
Turda 18/94	16.6	34.7	-16.6	-16.6	58.3	-11.9	4.5	5.7
Transilvania	14.5	29.8	-14.5	-14.5	54.1	- 8.6	8.2	7.4
Ariesan	14.5	23.6	-14.5	-14.5	56.8	-13..8	2.1	5.6
Apulum	14.3	25.3	-14.3	-14.3	56.4	-12.7	6.1	5.6
Turda 2000	13.3	22.5	-13.3	-13.3	61.0	-10.7	8.0	11.2
Turda 81	9.7	20.8	-9.7	-9.7	49.1	-5.4	5.6	9.6
Turda 12/93	7.3	28.8	.-7.3	-7.3	51.4	-10.7	2.7	4.1
Turda 56/95	6.9	17.7	.-6.9	-6.9	58.1	-13.9	1.8	1.0
Turda 95	5.7	23.1	.-5.7	-5.7	60.1	-10.9	4.4	7.4
Average	11.4	25.1	-11.4	-11.4	56.1	-11.0	4.0	6.4

LSD 5%	6.8	10.5
LSD 1%	9.1	14.1
LSD 0,1%	12.1	18.6

The values of dis eased ears are in arcsinv%. AI = artificial infection; AI + TS = artificial infection + seed treatment; NI = natural infection; NI + TS = natural infection + seed treatment

Duncan test permitted a classification of reaction to common bunt of the 9 genotypes as: susceptible (Turda 18-94), medium-susceptible (Transilvania, Apulum, Ariesan), medium-resistant (Turda 12-93, Turda 2000), resistant (Turda 81 and Turda 95) and very resistant (Turda 56-95). Common bunt attack amplitudes varied between 4.5 and 18.7 % bunted ears (Table 4).

The increase in number of bunted ears determined a decrease of grain yield and plant populations density (Table 5).

Table 4. Classification by Duncan test of reaction to common bunt of 9 wheat genotypes

Variety	Diseased ears (*)		
	%	arcsin v%	Reaction
Turda 18-94	18.7	25.65a	Susceptible
Transilvania	11.9	22.15b	Medium - susceptible
Apulum	11.5	19.80b	Medium - susceptible
Ariesan	10.6	19.05b	Medium - susceptible
Turda 12-93	9.6	18.05c	Medium - resistant
Turda 2000	9.5	17.90c	Medium - resistant
Turda 81	6.9	15.25d	Resistant
Turda 95	6.2	14.40d	Resistant
Turda 56-95	4.5	12.30e	Very resistant

Note (*) – average diseased ears values (natural infection + artificial infection)

Table 5. Phenotypic correlations amo ng the number of diseased ears plant density and grain yield, in 6 wheat genotypes

Cultivar/Correlated traits	No. of cases	Diseased ears and grain yield	
		Correlation coefficient	Regression equation
Simple regressions			
Transilvania	4	-0.987*	Y = 61.26-0.37x
Apulum	4	-0.999**	Y = 62.44-0.47x
Ariesan	4	-0.968*	Y = 61.13-0.46x
Turda 95	4	-0.987*	Y = 65.28-0.57x
Turda 2000	4	-0.987*	Y = 64.78-0.39x
Turda 18/94	4	-0.998**	Y = 63.49-0.33x

The efficacy of 9 fungicides against common bunt attack, under artificial infe ctions, was tested during two years. Almost all fungicides had a very good efficiency in controlling common bunt, as compared with the untreated plots (Figure 2).

Plant density increases between 6 and 15 %, and of grain yield between 42 and 55 % were observed. The newest systemic fungicides, containing prothioconazole + tebuconazole provide outstanding control of common bunt, with essentially no adverse environmental impact and a minim cost to the growers (Dutzman and Suty-Heinze, 2004).

Common bunt attack also affects grain quality. The disease has severe impact on wheat marketing. We analyzed the effect of seed treatment on grain protein and gluten content. In almost all cases significant increases were observed (Figure 3).

Protein content increased to 11.2% and wet gluten to 19.6%, improving the baking quality, as compared with the untreated plots.

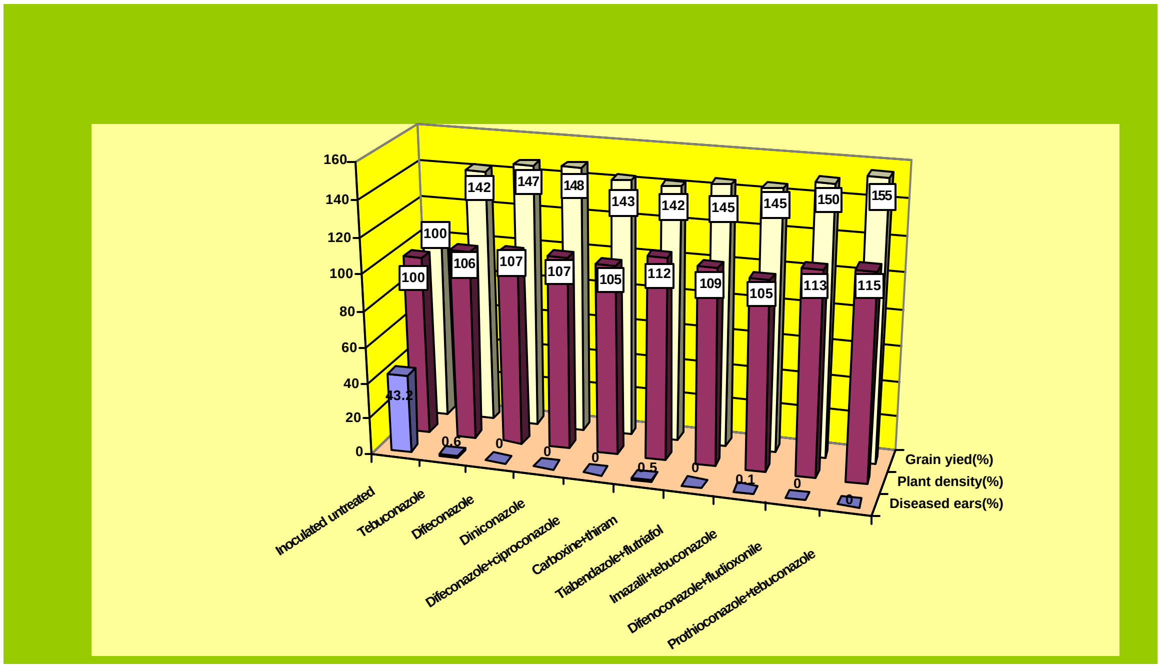

Figure 2.The influence of seed treatments on the common bunt attack, plant population density and grain yield (ARSD-Turda, 2004-2005)

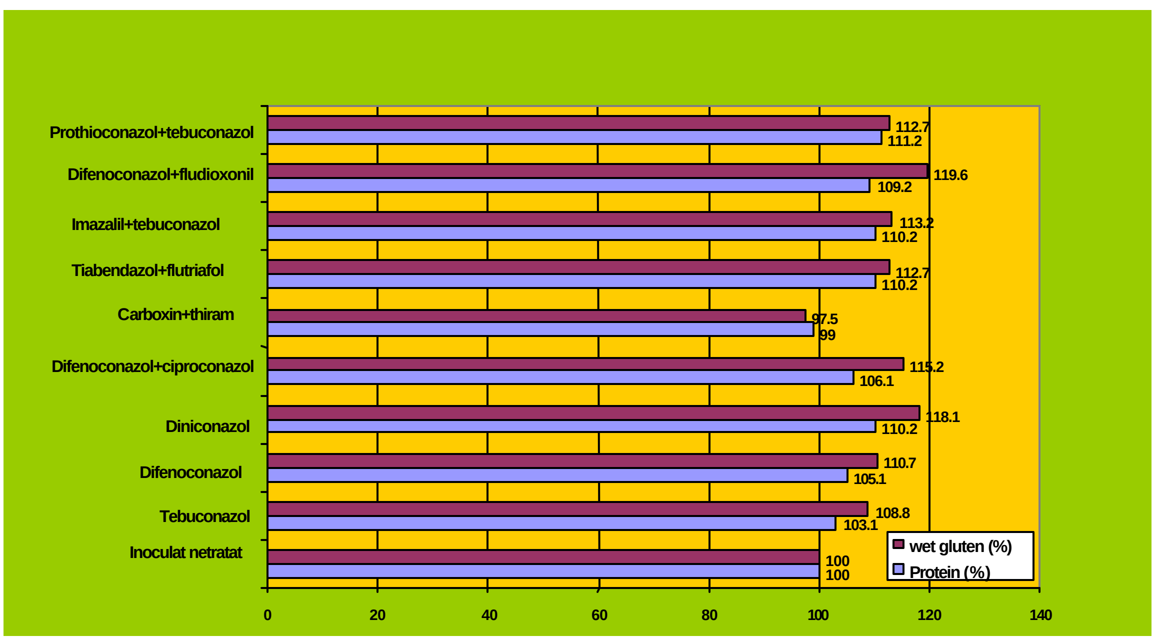

Figure 3. The effect of seed treatment on protein and wet gluten content in the wheat cultivar Ariesan

CONCLUSIONS

Common bunt continues to be damaging when highly infected seeds, untreated or inadequately treated are used for sowing. Average yield losses under artificial infections were on average 11 q/ha.

There are genotypic differences in reaction to common bunt attack, the percentage of diseased ears varying between 4.5 and 18.7%.

Line Turda 18/94 presented the highest average number of bunted ears of 18.7 %, and Turda 95 cultivar and Turda 56/95 inbred line the lowest number (6.2 % and 4.5% respectively).

Highest efficacy in common bunt control among the tested products, was observed in: tebuconazole + thiram (Raxil T 515: 2.0 l/t; diniconazole (Sumi 82 FL: 1.0 l/t); fludioxonile + poxiconazole (Maxim Star: 1.0 l/t); difenoconazole (Dividend 030: 1.0 l/t), prothioconazole + tebuconazole (Lamardor 400 FS: 0.15l/t), which assured significant yield gains and important increases of plant densities. The seed treatment improved the protein and wet gluten content, as compared with untreated and inoculated with *Tilletia* spp. teliospores plots.

There was a strong negative correlation between the degree of attack, and yield capacity or plant population density.

Highest yield losses and lowest number of emerged plants were found at highest attack levels caused by *Tilletia* spp.

REFERENCES

Baicu, T., 1971. Tratarea semintelor împotriva bolilor si daunatorilor, 140 p. Editura Ceres, Bucuresti.

Dumitras, Lucretia, Banita, Emilia, Ilicievici, Stefania, Ciurdarescu, G., Tusa, Corina, 1985. Date privind raspândirea, proportia si prevenirea atacului speciilor de *Tilletia* prezente în culturile de grâu din Câmpia Dunarii. Probleme de protectia plantelor, XIII(2): 135-149

Dutzman, S., Suty-Heinze, A., 2004. Prothioconazole: a broad spectrum demethylation-inhibitor (DMI) for arable crops. Pflanzenschutz-Nachrichten Bayer 57/2004, 2.

Nagy, E., Moldovan, V., 2001. Reactia unor genotipuri de grâu fata de malura comuna (*Tilletia* spp.) în conditiile din Transilvania. Probleme de protectia plantelor, XXIX (2): 189-196.

Nagy, E., Moldovan, V., 2006. The effect on fungicides treatments on the wheart common bunt (*Tilletia* spp.) in Transylvania – Romania. Czech. J. Genet. Plant. Breed, 42: 56-61.