The Effect of Fungicides Treatments on the Wheat Common Bunt (*Tilletia* spp.) in Transylvania (Romania)

E. Nagy and V. Moldovan

Agricultural Research-Development Station Turda, Agriculturii street 27, 401100 Turda, jud. Cluj, Romania, e-mail: nagyln@yahoo.com

Abstract: Wheat crops are damaged by numerous diseases which caused quantitative and especially qualitative yield losses in Transylvania conditions. The complex of soil and seed borne diseases is frequent in winter wheat crops as a result of a succession of unfavorable thermal or hydric factors during sowing-emergence or seed formation, favorable grain infection with pathogens particularly harmful, belonging to genera: *Fusarium, Tilletia, Helminthosporium* and *Ustilago*, especially when using untreated seed or unadequately treated. The most frequent and damaging are *Tilletia* species: *T. caries and T. foetida* which cause common bunt, yield losses reaching to 40% from yield value depending on climatic conditions and wheat cultivar, ear parasitism degree being by 70–80%. The effect of 9 fungicides seed treatment against common bunt and the reaction of 9 wheat genotypes under artificial infections at ARDS Turda during three years were studied. It was organized bi-factorial trials after block split type with 4 testing conditions: natural infections, artificial infections, artificial infections + seed treatment and natural infections + seed treatment for 9 genotypes. The wheat genotypes reaction and the fungicides efficacy were evaluated by diseased spikes, plant population density in the early spring and before harvested. Also determined was the yield (q/ha) with 86% dry matter. And in the laboratory, germination energy, germination, inoculum on the kernels and protein content were analyzed. In artificial infections in all genotypes a significant increase of diseased spikes and a substantially diminishing of yield ability, protein content, and of plant density in early spring were observed. There are genotypic differences; the most tolerant to common bunt attack (*Tilletia* spp.*)* proved to be: T56/95, T 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 the common bunt even under artificial infections. Calculation of economic efficiency of seed treatment showed a good profits, while the seed treatment cost merely represented 2–4% of profit value.

Keywords: fungicides; common bunt; *Tilletia* spp.; Romania

Wheat crops are damaged by numerous diseases which cause quantitative and especially qualitative yield losses in Transylvania conditions. The complex of soil and seed borne diseases is frequently in winter wheat crops as a result of a succession of unfavorable thermal or humidity factors during sowing-emergence or seed formation, favorable grain infection with pathogens particularly harmful, belonging to genera: *Fusarium*, *Tilletia*, *Helminthosporium* and *Ustilago*, especially when using untreated seed or inadequate treated (Baicu 1971; Nagy & Moldovan 2001). The most frequent and damaging are *Tilletia* species: *T. caries* and *T. foetida* which cause common bunt, yield losses reaching to 40% from yield value depends on climatic conditions and wheat cultivar, ear parasitism degree being by 70–80%. *Tilletia* pathogens agents have contaminated the seed in the field during harvesting by spores which conserve in the hairy on the top on the seed or in seed ventral canal (Dumitraş *et al*. 1985). The first symptoms appear after heading, the ears are colored in blue-greenish, with fragile awns, having a unpleasant odor by thrimetyl-amine. The genotype, by reaction type and area extending determine in major measure diseases structure and size losses.

In this paper are presented aspects concerning: the behavior of some genotypes to common bunt attack (*Tilletia* spp.); the fungicides efficacy used in preventing and control of disease and the relationship between diseased spikes and yield and plant population density.

MATERIAL AND METHODS

The experiments carried out at ARDS-Turda during two years. It was examined the reaction to common bunt for 9 winter wheat genotypes: Transilvania, Turda 81, Arieşan, Apullum, Turda 95, Turda 2000, Turda 12-93, Turda 56-95 and Turda 18-94, in 4 testing conditions: natural infection, artificial infection, artificial infection + seed treatment, and natural infection + seed treatment. For artificial infection, were 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. It was also tested the efficacy of some fungicides different as formulated mode and advised for the common bunt control. Wheat genotypes reaction and efficacy of fungicides were evaluated by attacked ears (%), plant population density in the early spring and ears number at harvesting and yield expressed by q/ha with 86% dry matter. In the laboratory were determined germination energy, the germination and the pathogenic agents on the seeds. Statistical methods ANOVA, correlation and regression and Duncan test were used.

RESULTS AND DISCUSSION

ANOVA for diseased ears, grain yield and emerged plant densities at 9 genotypes has evidenced high and significant variations due to testing conditions and genotypes. Interactions testing conditions × genotypes is significant only for diseased ears (Table 1).

Analyzing the testing conditions has resulted large amplitude variations ranged between 0 and 35.4% of diseased ears, between 45.2–62.5 q/ha grain yield, respectively between 373–490 plants per m^2 (Table 2). Among genotypes, there are significant differences for diseased ears and plant densities in early spring.

Interaction of genotypes and testing conditions has showed the high increases of bunt common attack varying 17.9–46.7% diseased ears under artificial inoculations (Figure 1). It also observed high decreases of yield capacity and plant, comparative with natural infection. By seed treating with tebuconazole + thiram, it reduced disease attack almost by zero, and it registered high yield and density, controlling the disease completely.

In the Table 3 are presented the deviations (+, –) to natural infections conditions of diseased ears and grain yield for all tested genotypes. It has remarked an increase of disease degrees till four times, at Turda 12-93 genotype. By applying seed treatment, the common bunt attack is reduced at zero even under artificial conditions. The yield losses varying between 5.4–13.9 q/ha, average losses are by 11.0 q/ha.

Using Duncan test, it has permitted a classification of reaction to common bunt of 9 genotypes

Table 1. ANOVA (s^2) for diseased ears, grain yield and emerged plants densities at 9 wheat genotypes

Source of variability	Freedom degrees	Diseased ears (arcsin√%)	Grain yield (q/ha)	Plant density (plant/m^2)
Total	71			
Replicates	1			
A. Testing conditions	3	5340.18***	1082.92***	75 674.89*
Error (a)	3	39.71	10.99	3378.0
B. Genotypes	8	68.99***	67.48*	23 582.50***
A × B	24	31.93***	7.05	5189.39
Error (b)	32	11.10	26.41	3493.2

Different small letters indicate statistically significant differences

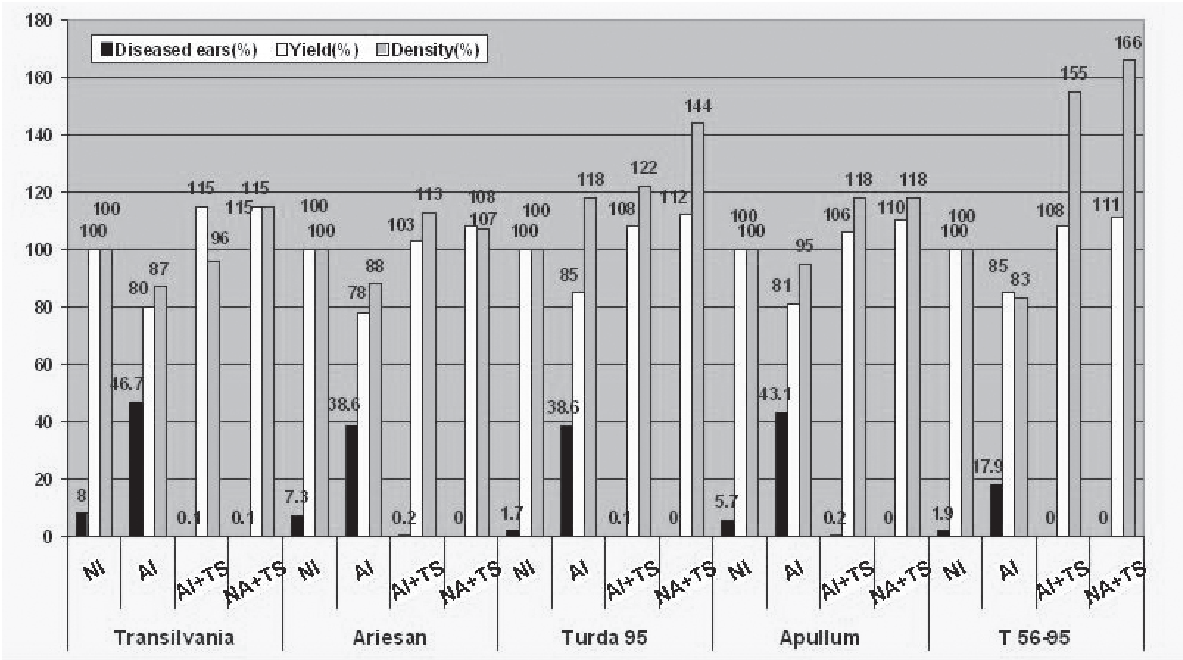

Figure 1. Interaction of genotypes and testing conditions on the diseased ears, yield and plant density

as: susceptible (Turda 18-94), medium-susceptible (Transilvania, Apullum, Arieşan), medium-resistant (Turda 12-93, Turda 2000), resistant (Turda 81 and Turda 95) and very resistant (Turda 56-95). Common bunt attack amplitudes are varying between 4.5–18.7% bunted ears (Table 4).

Correlations between studied parameters are defined by negative and significant correlation

Table 2. The reaction of some wheat genotypes testing to common bunt, grain yield and realized plant density

Factor	Diseased ears				Grain yield			Plant density in early spring		
	%	arcsin√%	diff.	Ct.	q/ha	diff.	Ct.	plants/m²	diff.	Ct.
A. Testing conditions										
Natural infection	3.9	11.4	0.0	Ct.	56.1	0.0	Ct.	374	0.0	Ct.
Artificial infection	35.4	36.5	25.1	**	45.2	–10.9	00	373	–1	–
Artificial infection + seed treatment	0	0	–11.4	0	60.5	4.4	*	481	107	*
Natural infection + seed treatment	0	0	–11.4	0	62.5	6.4	*	490	116	**
LSD		6.7				3.5			62	
B. Genotypes										
Transylvania	6.4	14.7	0.0	Ct.	55.8	0.0	Ct.	494	0.0	Ct.
T 18/94	8.6	17.0	2.3	–	57.9	2.2	–	451	–43	–
Apullum	5.5	13.5	–1.2	–	56.1	0.3	–	482	–12	–
Arieşan	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	0
T 12-93	3.5	10.8	–3.9	0	54.0	–1.8	–	340	–154	000
Turda 81	23.1	10.1	–4.6	00	51.6	–4.2	–	412	–82	00
Turda 95	2.2	8.6	–6.1	000	60.4	4.6	–	442	–52	–
T 56-95	1.9	7.9	–6.8	000	54.4	–1.4	–	352	–142	000
LSD		3.4				5.2			60	

Table 3. Common bunt manifestation degree and grain yield expressed by deviations (+, –) to natural infections 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
Apullum	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
Medie	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	

AI – artificial infection; NI – natural infection; AI + TS – artificial infection+seed treatment; NI + TS – natural infection + seed treatment

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

During of two years the efficacy of 9 fungicides against common bunt attack, under artificial infections, were testing. Compared with untreated

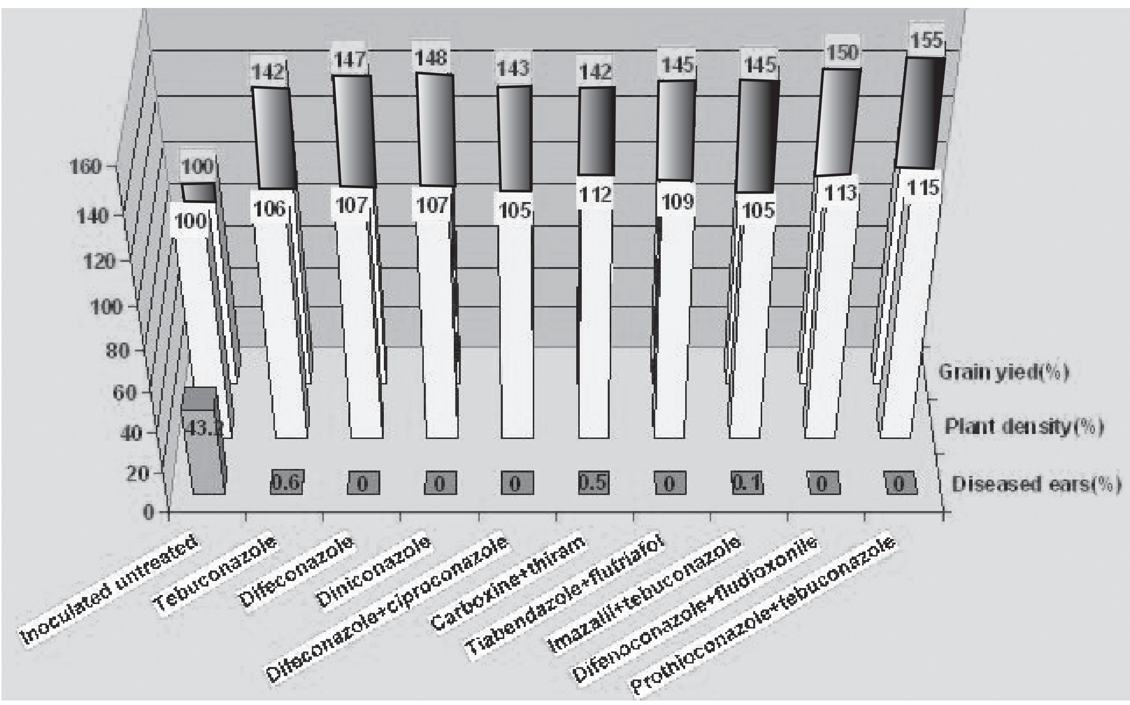

Figure 2. The influence of seed treatments on the common bunt attack, plant population density and grain yield (ARDS-Turda, 2004–2005)

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

CRT. No.	Variety	Diseased ears (*)		
		%	arcsin √%	classification
1	Turda 18-94	18.7	25.65[a]	susceptible
2	Transilvania	11.9	22.15[b]	medium–susceptible
3	Apullum	11.5	19.80[b]	medium–susceptible
4	Arieşan	10.6	19.05[b]	medium–susceptible
5	Turda 12-93	9.6	18.05[c]	medium-resistant
6	Turda 2000	9.5	17.90[c]	medium-resistant
7	Turda 81	6.9	15.25[d]	resistant
8	Turda 95	6.2	14.40[d]	resistant
9	Turda 56-95	4.5	12.30[e]	very resistant

*average diseased values (natural infection + artificial infection); the values of diseased ears are in arcsin√%

Table 5. Phenotypic correlation among diseased ears, plant density and grain yield obtained at 6 wheat genotypes.

Cultivar/correlated traits	No. of cases	Diseased ears and grain yield	
		correlation coefficient	regression equation
Simple regressions			
1. Transilvania	4	–0.987*	$Y = 61.26 - 0.37x$
2. Apullum	4	–0.999**	$Y = 62.44 - 0.47x$
3. Ariesan	4	–0.968*	$Y = 61.13 - 0.46x$
4. Turda 95	4	–0.987*	$Y = 65.28 - 0.57x$
5. Turda 2000	4	–0.987*	$Y = 64.78 - 0.39x$
6. Turda 18-94	4	–0.998**	$Y = 63.49 - 0.33x$
Multiple regressions			
1. Transilvania	4	0.988	$Y = 65.68 - 0.38_{x1} - 0.008_{x2}$
2. Apullum	4	0.999	$Y = 69.78 - 0.49_{x1} - 0.001_{x2}$
3. Ariesan	4	0.999	$Y = 93.55 - 0.59_{x1} - 0.006_{x2}$
4. Turda 95	4	0.999	$Y= 53.63 - 0.55_{x1}x - 0.003_{x2}$
5. Turda 2000	4	0.996	$Y= 71.83 - 0.45_{x1} - 0.15_{x2}$

variant, almost all fungicides had a very good efficiency in controlling the common bunt (Figure 2). It has been registered the plant density increases between 6–15%, respectively by grain yield ranged 42–55%. The newest systemic fungicides control containing prothioconazole + tebuconazole provide outstanding control of common bunt with essentially no adverse environmental impact and a minim cost to the growers (Dutzman & Suty-Heinze 2004).

The common bunt attack affects grain quality. The disease has an sever impact on the marketing of

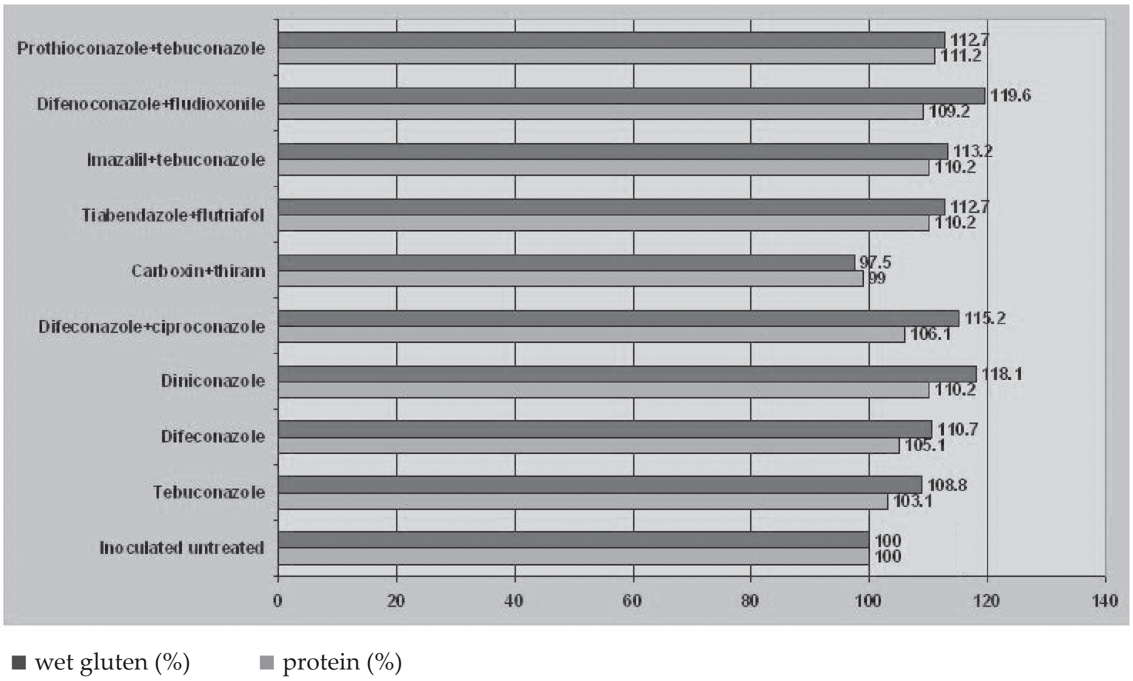

Figure 3. The effect of seed treatment on the protein and wet gluten content, at Ariesan wheat cultivar

wheat. It was analyzed the effect of seed treatment on the protein and gluten content. In almost all cases the significant increases were registered (Figure 3). The protein content had increased to 11.2% and wet gluten to 19.6%, improving of the baking term quality, compared with untreated variant.

CONCLUSIONS

(1) Common bunt continues to manifest damage at sowing of seeds with high infection degrees, untreated or inadequately treated, average yield losses being by 11 q/ha, under artificial infections.

(2) There are genotypic differences in cultivar reaction to common bunt attack, percentage of diseased ears varying 4.5 and 18.7%. Inbred 18/94 presented the highest diseased degree by 18.7%, and Turda 95 cultivar and Turda 56-95 inbred the most reduced by 6.2%, respectively by 4.5%.

(3) Among used products in common bunt control, the most efficacy even under artificial infections, proved to be: tebuconazole + thiram (Raxil T 515 2.0 l/t); diniconazole (Sumi 8 2 FL 1.0 l/t); fludioxonile + epoxiconazole (Maxim Star 1.0 l/t); difenoconazole (Dividend 030 1.0 l per t), prothioconazole + tebuconazole (Lamardor 400 FS 0.15 l/t) which assured significantly yield gains and important increases by plant densities. The seed treatment improved the protein and wet gluten content, comparative with untreated and inoculated variant with *Tilletia* spp. teliospores.

(4) Among diseased degrees, yield capacity, plant population density there are negative and closed correlations, the highest yield losses and emergent plants were registered at attack levels highest caused by *Tilletia* spp.

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