Survey of Incidence of Bunts (*Tilletia caries* and *Tilletia controversa*) in the Czech Republic and Susceptibility of Winter Wheat Cultivars

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Abstract

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Bunts (caused by *Tilletia caries* and *T. controversa*) belong to very important diseases of winter wheat because contaminated commodities (seeds, foods and feeds) affect the marketability of the crop on both domestic and export markets. They can be relatively easily controlled by chemical seed treatments. Due to the availability of effective chemical control, the reaction of wheat cultivars to bunts has so far not been an important trait for plant breeders in some areas of the world. However, if synthetic chemicals are not allowed, like in organic farming, untreated seed may quickly lead to a build-up of bunt to levels that render the crop unmarketable. The use of wheat cultivars partially or fully resistant to bunts could greatly contribute to ease the bunt problem. The reaction of winter wheat cultivars was evaluated in field tests. Seeds of winter wheat were inoculated with teliospores of *T. caries.* The reaction to *T. controversa* was studied under heavy natural infestation with spores in the soil. With *T. caries,* the heaviest infection was found in cvs Drifter and Ebi, while cvs Nela, Brea and Samanta had the lowest. The average level of infection with *T. controversa* was higher than that of *T. caries*. The cvs Niagara, Brea and Versailles had significantly lower numbers of bunt ears of *T. controversa* in 2002. The incidence of both bunts in grain samples that had not been cleaned and sorted after harvest was monitored for 4 years. A total of 1 058 samples collected from various locations in the Czech Republic were analysed for the presence of bunt spores and the species determined. The investigation demonstrated a rather widespread occurrence of bunts across the Czech Republic, with *T. controversa* being more frequent.

Keywords: bunts; *Tilletia caries*; *Tilletia controversa;*, cultivars; winter wheat; incidence of bunts; Czech Republic

In the past, common bunt, caused by *T. caries* (DC.) Tul. and dwarf bunt, caused by *T. controversa* Kuhn, were controlled primarily by seed dressing. Spores contaminating the surface of the grain are relatively easy to disinfect with chemical seed treatments. If used regularly, the bunt diseases are of no economical importance.

Chemical seed protectants against *T. caries* are toxic contact agents affecting the germination of teliospores on the seed surface. The time during which they are active can be short since spores germinate over a few days.

Chemical seed protectants against *T. controversa* must have long-term systemic effects (4 to 6 weeks)

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due to the fact that the seed germinates in the soil at a depth of 3–4 cm while the spores have a delayed germination at or near the soil surface. The seed protectant must penetrate from the kernel into the coleoptile and stop infection of emerging plants by mycelium of the fungus.

Tilletia caries is characterised by regular distribution of infected plants in crop stands because the source of infection is contaminated seed and conditions for spore germination are similar within the field.

In contrast, *T. controversa* is distributed irregularly because spores germinate only on or near the soil surface, at favourable low temperature, with sufficient moisture and availability of light. Furthermore, the level of infection depends on the stage and rate of growth of wheat. The highest level is usually found on field margins and in thin stands.

Since the late 1990s, seed treatment against bunts of wheat has been limited by economic and environmental impacts and farmers again experienced very severe attacks by bunts. Northern and western European countries faced the same problems. Growing environmental awareness and an increase in organic farming over the last 15 years have led to demands for reduction in chemical seed treatments. This is causing serious problems for producers (Kristensen & Borgen 2000; Josefsen & Christiansen 2002). Partial resistance reduces the level of actual infection (Bartoš *et al.* 2002) however it does not solve the problem of a gradual increase of the infection potential from the soil in the case of *T. controversa*.

Due to the availability of effective chemical seed treatment, the reaction of wheat cultivars to bunts has not been an important trait for plant breeders in the CR and information on the reaction of even the registered wheat cultivars to bunts is in many cases not available.

In this work, we present the results obtained in 2000–2004 in field tests with 15 winter wheat cultivars registered in the CR and the results of a 4-year monitoring of bunt incidence in grain samples that had not been cleaned and sorted after harvest.

MATERIALS AND METHODS

Reaction of winter wheat cultivars to bunt disease in field trials. The seed of winter wheat was artificially inoculated with teliospores of *T. caries*. Infected ears had been collected from experiments in Kroměříž in the preceding year. Germination of teliospores was tested on water agar. Using 1 g of spores in 20 ml water per kg seed, the inoculum was sufficient for regular infection. The amount of teliospores which adhered to seeds was assessed. Single seeds were shaken with a little water, the suspension was centrifuged and teliospores were counted in the given amount of water. A similar method was used by Polisenska *et al.* (1998). Using 1 g of spores, 256 teliospores (n = 10, s_x = 39) were found per seed, on average. Inoculated seed was sown in plots of 10 m^2 in four replications between October 5 and 10 at Kroměříž (220 m above sea level, average temperature 8.7°C).

The reaction of cultivars to *T. controversa* was tested at Vsetín (450 m above sea level, average temperature 6.7°C), a location where the level of natural infection had previously varied between 50 and 150 infected ears per m^2. Here, winter wheat had been harvested with a combine harvester in mid-August, leaving chopped straw and spores on the ground. The field was shallowly ploughed and at the end of September the trials were sown. Untreated seed of the cultivars was sown in plots of 10 m^2 in four replications.

At the end of the growing season (GS 85-80, Zadoks *et al.* 1974), the middle part of each plot was harvested by hand. The ears were visually inspected for bunt infection. Teliospores were identified as to species by microscope. The percentage of diseased ears was calculated as an indicator of varietal reaction. Results were assessed using correlation analysis.

Bunt incidence in grain samples from various locations of the CR. Immediately after harvest, 1 058 grain samples were collected from farms. Species determination and quantification were done by microscopic examination on spores deposited in the sediment after centrifugation. This way was preferred to a method where the spores are trapped on filter paper (Cockerell & Rennie 1996) for easier and faster determination.

RESULTS AND DISCUSSION

There was high variation in the number of infected ears, depending on both cultivars and density of the plants in plots. The levels of infection caused by *T. caries* in 2001, 2002 and 2004 in tests at Kroměříž are listed in Table 1, together with the ranking of the cultivars from high to low infection. The levels of infection by *T. controversa* in

Table 1. Levels of infection in winter wheat cultivars artificially inoculated by *T. caries* in 2001, 2002 and 2004

Rank	2001		2002		2004	
	cultivar	infection (%)	cultivar	iInfection (%)	cultivar	infection (%)
1	Drifter	29.99 a	Ebi	34.34 a	Ebi	36.04 a
2	Ebi	12.61 a b	Estica	24.47 a	Drifter	24.03 a
3	Windsor	11.62 a b c	Drifter	20.43 a	Contra	20.00 a
4	Sulamit	8.61 b c	Clever	14.14 a b	Versailles	17.48 a b
5	Saskia	5.98 b c	Niagara	9.91 b	Niagara	12.79 b
6	Estica	5.16 b c	Contra	9.78 b	Šárka	11.49 b
7	Astella	3.47 b c	Sulamit	6.06 b	Estica	11.33 b
8	Contra	3.15 b c	Windsor	5.88 b	Samanta	11.03 b
9	Versailles	3.79 b c	Versailles	2.75 b c	Sulamit	9.35 b c
10	Samanta	2.79 b c	Šárka	2.68 c	Saskia	8.94 b c
11	Vlasta	3.41 b c	Saskia	1.83 c	Brea	5.15 c
12	Niagara	2.53 b c	Brea	1.16 c	Astella	2.92 c
13	Šárka	2.07 c	Samanta	1.01 c	Nela	1.39 c
14	Brea	2.07 c	Astella	0.93 c	Complet	0.82 c
15	Nela	1.18 d	Nela	0.00 d	Bill	0.00 d

There is no significant difference between the variants marked with the same letter. Tukey $P = 0.05$

2002 and 2004 at Vsetín, and the ranking of the cultivars are shown in Table 2.

In the plots with *T. caries,* the highest infection on average of the 3 years was found in cvs Drifter and Ebi, whereas the cvs Nela, Brea and Samanta had the lowest numbers of bunted ears. In the field trials with natural infection by *T. controversa,* the level of infection was higher on average than in the case of *T. caries*. There were no significant differences among the first 12 cultivars. Significantly lower numbers of bunted ears were found in cvs Niagara, Brea and Versailles.

A large problem of these and similar trials is the wide variation in infection level. A comparison of the results showed the strong influence of temperature on the outcome of the experiments. According to Swinburne (1963), it seems probable that the post-emergence environment will only influence the incidence of bunt in a crop up to the time of elongation of the internodes. The sowing date,

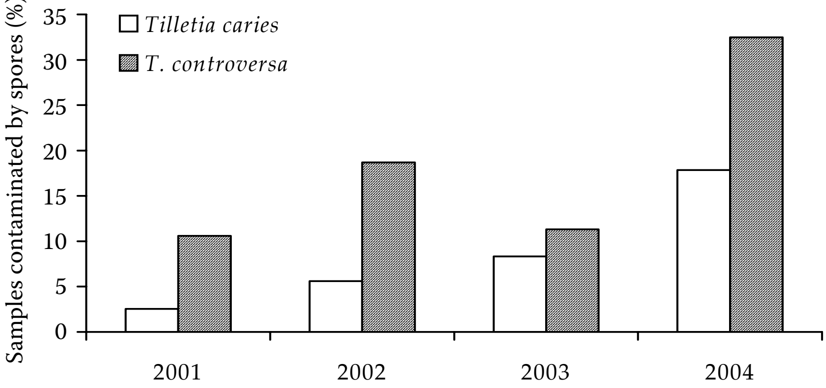

Figure 1. Incidence of *Tilletia caries* and *T. controversa* spores in winter wheat samples in the Czech Republic in 2001–2004

Table 2. Levels of infection in winter wheat cultivars naturally infected with *T. controversa* in 2002 and 2004

Rank	2002		2004	
	cultivar	infection (%)	cultivar	infection (%)
1	Samanta	32.61 a	Estica	62.74 a
2	Nela	31.32 a	Nela	59.97 a
3	Windsor	30.30 a	Saskia	33.97 b
4	Šárka	28.03 a	Šárka	33.58 b
5	Sulamit	27.01 a	Vlasta	31.57 b
6	Ebi	25.00 a	Ebi	24.05 b
7	Saskia	24.96 a	Contra	20.20 b
8	Vlasta	24.95 a	Samanta	18.75 b
9	Drifter	23.47 a	Sulamit	16.00 b
10	Contra	23.17 a	Drifter	15.29 b
11	Astella	21.25 a b	Niagara	15.05 b c
12	Estica	17.16 a b	Brea	11.06 c
13	Versailles	8.31 b	Astella	10.38 c
14	Brea	7.83 b	Versailles	6.26 c
15	Niagara	5.02 b	Bill	5.48 c

There is no significant difference between the variants marked with the same letter. Tukey $P = 0.05$

soil type and soil conditions may all influence the level of bunt infection. According to Hoffmann (1982), loss of resistance due to the development of new races has been frequently observed. The reaction of a variety to the bunt species may not be the same at other locations and may change over time (Koch & Spiess 2002).

The incidence of bunt spores in grain samples from various locations in the CR in 2001–2004 is given in Figure 1. The results show the apparent increase in incidence of both bunts. A considerably higher incidence was found in *T. controversa*. Such an increase is related to a number of changes that force farmers to grow winter wheat at a higher percentage in crop rotations, under reduced crop management practices and in short-term crop rotations where winter wheat prevails. Another reason is that seed had not been microscopically examined for presence and identity of the species of the bunt spores before chemical treatment. For sound decison making it is important to know what seed protectant should be used. In addition, it is also necessary to keep records on the incidence of *T. controversa* in individual fields, and to treat the seed for such fields with a seed protectant effective against that species.

Implications of the incidence of *T. controversa*

For germination of *T. controversa* spores, a certain humidity and temperature are needed along with exposure to light. The spores may come into the soil with treated seed but do not germinate in the dark in the sowing year. Will some of them germinate in the next years after coming to the soil surface and be exposed to light even though they had been in contact with an effective seed disinfectant in the year of seeding? The reaction of cultivars should in particular be studied with *T. controversa* due to the large variability in results with this species. It is a challenging objective because trials with *T. controversa* are difficult to set up. Only fields in higher elevations, where this bunt occurred during last years, can be used, but there is no guarantee of a sufficiently high, uniform and reproducible level of infection.

References

Bartoš P., Šíp V., Chrpová J., Vacke J., Stuchlíková E., Blažková V. (2002): Achievements and prospects of wheat breeding for disease resistance. Czech Journal of Genetics and Plant Breeding, **38**: 16–28.

Cockerell V., Rennie W.J. (1996): Survey of seed-borne pathogens in certified and farm-saved seed in Britain between 1992–1994. HGCA Project Report No. 124. London, Home Grown Cereals Authority.

Hoffmann J.A. (1982): Bunt of wheat. Plant Disease, **66**: 976–986.

Josefsen L., Christiansen S.K. (2002): PCR as a tool for the early detection and diagnosis of common bunt in wheat, caused by *Tilletia tritici.* Mycological Research, **106**: 1287–1292.

Koch E., Spiess H. (2002): Characterization of leaf symptoms of common bunt (*T. caries*) and relationship to ear attack in nine wheat cultivars. Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz, **109**: 159–165.

Kristensen L., Borgen A. (2000): Reducing spread of spores of common bunt disease (*Tilletia tritici*) via combining equipment. Biological Agriculture and Horticulture, **19**: 9–18.

Polisenska I., Pospisil A., Benada J. (1998): Effect of sowing date on common bunt (*Tilletia caries*) infection in winter wheat at lower inoculum rates. Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz, **105**: 295–305.

Swinburne T.R. (1963): Infection of wheat by *Tilletia caries* (DC) TUL., the causal organism of bunt. Transactions of the British Mycological Society, **46**: 145–156.

Zadoks J.C., Chang T.T., Konzak C.F. (1974): A decimal code for the growth stages of cereals. Weed Research, **14**: 415–421.

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