EFFECTS OF FHB TOLERANT WINTER WHEAT VARIETIES (PETRUS, SAKURA, SIMILA) ON YIELD AND QUALITY PARAMETERS UNDER HIGH PATHOGEN PRESSURE

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Abstract

Winter wheat is the most important crop in the Czech Republic; it is grown in one half of the area of cereals. Fusarium head blight (FHB) causes severe yield losses and decreases baking and food quality. Most of registered winter wheat varieties are middle or high susceptible to FHB. Many results show that it is difficult to reach high resistance level and simultaneously high yield and necessary food quality. Six winter wheat varieties were used in three years 2005-2007 and differed into 2 groups: a) tolerant group (with medium resistant varieties – Sakura, Simila, Petrus), b) susceptible group (Darwin, Mladka, Sulamit). Symptomatic evaluation, yield reduction and deoxynivalenol (DON) accumulation is discussed both from the view of susceptible and medium resistant varieties and by application of different fungicide treatment. Tolerant varieties have with strong infectious pressure significantly ($P < 0.05$) lower occurrence of pathogen and less DON contain then susceptible varieties. Targeted fungicidal treatment significantly ($P < 0.05$) influenced mycotoxin accumulation and yield especially in susceptible varieties. These results clearly advert to importance of developing resistant varieties.

Key words: *Fusarium* head blight, deoxynivalenol, fungicide, yield, quality

Indtroduction

Food safety is nowadays the priority for cereal producers and grain-processing industry. Fusarium head blight causes severe yield losses and decreases baking and food quality (Mesterházy, 2003). The most frequent species in Europe are now *F. graminearum* and *F. culmorum* (Logrieco et Bottalico, 2001; Mesterházy, 2003), both of which produce mycotoxins (Joffé 1986, Abramson 1998, Chelkowski 1998). The basic toxins are deoxynivalenol (DON), zearalenone and nivalenol (Logrieco et al., 2003).

Most of registered winter wheat varieties are middle or high susceptible to FHB. The results of many researches show us that it is difficult to reach high resistance level and simultaneously high yield and necessary food quality (Mesterházy, 2003).

The object of this work is to assess Fusarium Head Blight (FHB) impact on winter wheat symptomatic evaluation, yield reduction and deoxynivalenol (DON) accumulation. These parameters are discussed both from the view of susceptible and medium resistant varieties and by application of different fungicide treatment.

Materials and methods

The small-parcel experiment was based in the breeding station Stupice in years 2005-2007 and Uhretice in 2007. The experiment used complete randomized blocks in 3 replications; each parcel area was 10m^2. Six winter wheat varieties was used and differed into 2 groups: a) susceptible varieties (Darwin, Mladka, Sulamit), b) medium resistant varieties (Sakura, Simila, Petrus). Part of the project was 4 various fungicide treatments: **1) control** – without artificial infection and fungicidal treatment, **2) infection** – with artificial infection of *F. graminearum* and *F. culmorum*, without fungicidal treatment, **3) fungicide** - in growing stage DC 37 – 39 spraying with Tango Super (1l/ha, active substances epoxiconazole 84g/ha and fenpropimorph 250g/ha), artificial infection in the flowering period. Tango Super is commonly used preparation without the target of *Fusarium* suppression. **4) targeted treatment** - in DC 37-39 Tango Super, 24 hours before *Fusarium* infection was used targeted fungicide Caramba (1l/ha, active substance metconazole 60g/ha). Caramba was the most applied fungicide against *Fusarium*.

Inoculum with spore concentrations of 6-7 x 106 spores/ml was prepared and each parcel was infected with 1 liter of inoculum. Infections run up in full flowering period according to each variety term. Symptomatic evaluation was carried in 21st day after the infection. The experiment was harvested by plot harvester. The grain was analyzed; mycotoxin was determined immunochemically using ELISA.

Results and discussion

Symptomatic evaluation - Head blight symptoms were evaluated on a 1-9 scale (9 - without symptoms, 1 - 100% disease development) (Table 1). The difference between infection and non-targeted fungicide is not significant, while targeted fungicide lead to significantly ($P < 0.05$) less presence of symptoms. Medium resistant varieties have with strong infectious pressure significantly ($P < 0.05$) lower occurrence of pathogen then susceptible varieties. The best symptom score of infection variant was evaluated at variety Sakura (7,5).

Table 1: Head blight symptoms on a 1-9 scale (9 - without symptoms, 1 - 100% disease development), varieties comparison

SYMPTOMATIC	susceptible varieties						medium resistant var.					
EVALUATION	MLADKA		DARWIN		SULAMIT		SIMILA		PETRUS		SAKURA	
CONTROL q	8,09	a	8,55	ab	8,50	ab	8,93	b	8,91	b	8,73	b
TARGETED T. q	5,45	a	5,73	a	6,27	ab	7,21	bc	7,86	c	8,14	c
FUNGICIDE q	4,36	a	4,77	ab	5,36	b	7,14	c	7,45	c	7,77	c
INFECTION q	4,00	a	4,14	a	5,18	b	6,79	c	7,41	c	7,50	c

Yield reduction – The difference between infection and non-targeted fungicide is not significant. Targeted treatment was significantly ($P < 0.05$) effective in susceptible varieties and increased their yield about 13 % compared to infection variant. In medium resistant varieties there is not significant difference between targeted, non-targeted treatment and infection variant; but their yield (compared to susceptible varieties) was about 5 % higher ($P < 0.05$) with targeted treatment, about 11 % in fungicide variant and about 15 % in infection variant (Fig 1). Yield reduction in the susceptible varieties was 17 % in the targeted treatment, 26 % in the fungicide variant and 30 % in the infection variant. Yield reduction in medium resistant varieties was 14 % on the average irrespective of the treatment (Table 2). Petrus and Sakura have significantly ($P < 0.05$) higher yield than susceptible varieties, however Simila was somewhere between these two groups (Fig 2).

Table 2: Yield reduction (%, t/ha), treatment and genotypes comparison

	CONTROL Ø			TARGETED T. Ø			FUNGICIDE Ø			INFECTION Ø		
	%	t/ha		%	t/ha		%	t/ha		%	t/ha	
SUSCEPTIBLE V.	100	9.43	a	83	7.81	b	74	6.93	c	70	6.64	c
M. RESISTANT V.	100	9.77	a	88	8.57	b	85	8.31	b	85	8.30	b
MEAN	100	9.59		85	8.17		79	7.57		77	7.42	

DON content – Medium resistant varieties contain about 3/4 less ($P < 0.05$) DON than susceptible ones (Table 3). Targeted fungicide treatment takes positive effect both in tolerant and susceptible varieties and reduces the DON content about 2/3. Sakura and Simila have the lowest DON content, Petrus ranges between Sakura and Simila and susceptible varieties (Fig. 3).

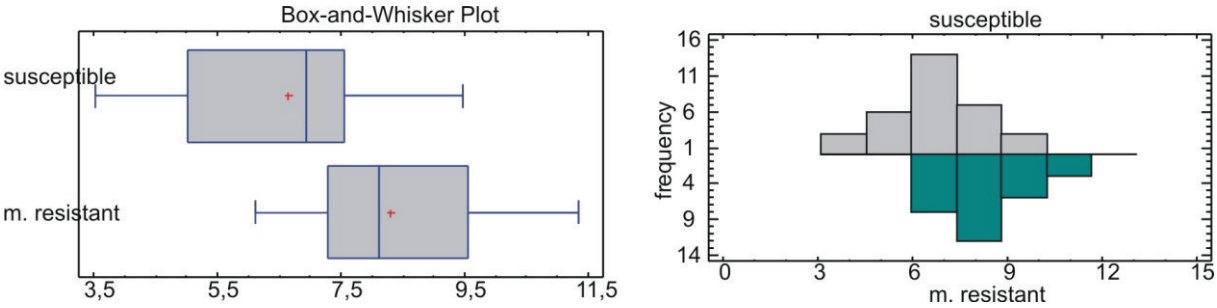

Fig. 1: The yield difference between susceptible and medium resistant varieties in infection variant.

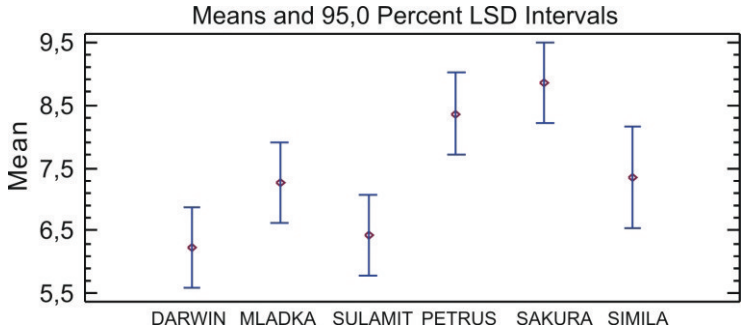

Fig. 2: Yields after artificial infection (without fungicide treatment)

Table 3: DON contend (%, ppm), treatment and genotypes comparison

	INFECTION Ø			FUNGICIDE Ø			TARGETED T. Ø			CONTROL Ø		
	%	ppm		%	ppm		%	ppm		%	ppm	
SUSCEPTIBLE V.	100	13.4	a	70	9.35	a	25	3.34	b	4	0.48	b
M. RESISTANT V.	100	2.35	a	103	2.42	a	29	0.69	b	0	0.00	b
MEAN	100	8.03		75	5.98		26	2.05		3	0.24	

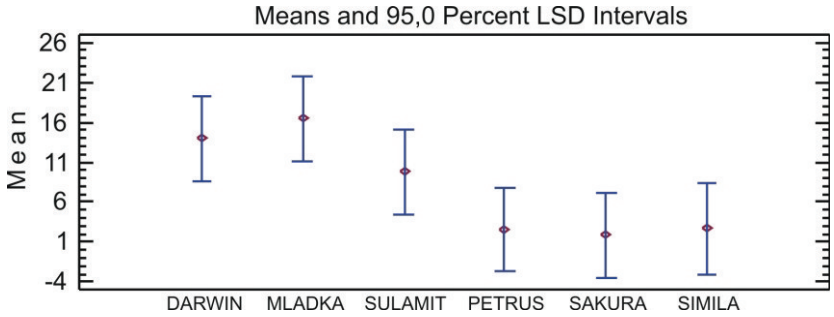

Fig 3: DON content after artificial infection (without fungicide treatment)

Conclusions

Development of tolerant varieties is the most effective protection against FHB infection and mycotoxin accumulation. Targeted fungicidal treatment highly influences mycotoxin accumulation and yield in susceptible varieties. However the application date in this work was accurately determined (24 hours before infection), estimation of the application time is doubtful in practice. Non-targeted fungicidal treatment is not explicit. Varieties Petrus, Simila and Sakura approve medium tolerance to FHB, Sakura was found the best in all parameters.

Acknowledgements

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