THE REACTION OF THE SELECTED *TRITICUM AESTIVUM*, *TRITICUM SPELTA* AND *TRITICUM DICOCCUM* GENOTYPES TO SPIKE INFECTION BY *FUSARIUM CULMORUM*

Reakce vybraných genotypů Triticum aestivum, Triticum spelta a Triticum dicoccum na cílenou infekci by Fusarium culmorum

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Summary: The artificial inoculation of spikes of the selected genotypes *Triticum aestivum, Triticum spelta* and *Triticum dicoccum* caused significant reduction of the main yield components especially kernel weight per spike. Tested genotypes indicated different susceptibility to the infection. The common wheat cultivars of usually had the greater kernels number and kernel weight per spike in comparison with spelt and emmer, however, the variability of one thousand kernel weight was slight. The common wheat Torka showed particularly weak reaction - a reduction of one thousand kernel weight after infection was on average 18.88 %. Weisser Grannenspelz showed the highest resistance among the five tested spelt cultivars, while Lohnauer Sommerspeltz characterized by the highest kernel weight per spike.

Key words: *Fusarium Head Blight, Fusarium culmorum, Triticum spelta, Triticum aestivum, Triticum dicoccum, resistance*

Souhrn: Souhrn: Umělé naočkování klasů vybraných genotypů *Triticum aestivum, Triticum spelta* a *Triticum dicoccum* způsobilo významné snížení hlavních výnosových komponent, zejména hmotnosti zrna v klasu. Dané genotypy prokázaly významné rozdíly vnímavosti k infekci. Kultivary pšenice obecné měly vyšší počet zrn a vyšší hmotnost zrna v klasu v porovnání s pšenicí špaldou a dvouzrnkou, avšak variabilita hmotnosti tisíce zrn byla mírně nižší. Odrůda pšenice obecné Torka měla slabší reakci- redukce hmotnosti tisíce zrn po infekci byla v průměru 18,88 %. Weisser Grannenspelz měla nejvyšší rezistenci mezi 5-ti kultivary pšenice špaldy, zatímco odrůda Lohnauer Sommerspeltz měla nejvyšší počet zrn v klasu.

Klíčová slova: *Fusarium Head Blight, Fusarium culmorum, Triticum spelta, Triticum aestivum, Triticum dicoccum, rezistence*

Introduction

Fungi belonging to genus *Fusarium* have a particular economic significance as infection with these pathogens leads to significant decrease of grain yield and grain quality. The fusarioses of small grain cereals are diseases caused by about 16 *Fusarium* species (Parry et al. 1995). In the environmetal conditions typical for Poland and central Europe the main cause of *Fusarium* Head Blight (FHB), the most important *Fusarium* disease of small grain cereals, is *Fusarium culmorum* (Bottalico 1998, Perkowski 1999, Kiecana 1986).The infection with this pathogen causes significant yield losses, which in the extreme cases can reach even 70 %. In addition, this pathogen is responsible for the accumulation of toxic secondary metabolites in grain, mainly fusariotoxins belonging to the trichothecenes of group B. The knowledge about *T. aestivum, T. spelta* and *T. dicoccum* reaction to the *F. culmorum* infection is very important both for the resistance breeding of cereals and ecological agriculture. Spelt and emmer are cultivated on many ecological farms in Poland and Europe not only because of higher feeding value in comparison with common wheat, but also due to its higher resistance to some unfavorable environmental factors and lower nutritive and soil demands (Moudry 1999, Ruegger et al. 1990).

Material and methods

The experimental materials comprised cultivars of *Triticum spelta* (Lohnauer Sommerspelz, Roter Sommerkolben, Blauer Samtiger, Weisser Grannenspelz, Spelz aus Tzaribrod) obtained from National Centre of Gene Resources of Plant Breeding and Acclimatization Institute in Radzikow), *T. aestivum* (Hena, Torka, Kontesa, Zebra, Triso) and *T. dicoccum* (a local variety cultivated in Polish ecological farms).

Field experiments

Field experiments were carried out in the years 2003-2005 in Didactic & Experimental Station in Bałcyny, near Ostroda (in the north-eastern part of Poland) The response of the tested cultivars to infection was evaluated in experiment established in a randomized complete block design, in three replications. At full flowering stage (BBCH 65) 30 spikes selected randomly

of each replication were sprayed with an aqueous suspension containing *F. culmorum* conidia at a concentration of 500 000 per cm^3. Inoculated spikes were covered with polyethylene bags for 48 hours. Non-inoculated heads (C) and those after distilled water treatment (Wc) were used as two control objects. In the full ripeness stage thirty heads from every plot were cut by hands. Next the following yield components were biometrically analyzed: spike length (SL), number of spikelets per spike (NSS), spike density (SD), number of kernels per spike (NKS), kernel weight per spike (KWS) and one thousand kernel weight (TKW).

Results

The inoculation of heads led to a considerable reduction of the main yield components of all the tested *Triticum* genotypes (Table 1). Emmer showed the strongest reaction to the infection (NKS dropped by 71.88 %) while cv. Torka reacted the weakest (NKS dropped by 25.49 %).The number of kernels per spike of common wheat changed the least after artificial inoculation as the average reduction of the main yield component was 25.12 % comparing to the control.

After artificial inoculation of spelt spikes with *F. culmorum*, the average reduction of kernel weight per spike was even 57.81 %. As a result of analysis of variance, the significance of interaction was stated, thus the tested cultivars indicated different susceptibility to the inoculation. The strongest decrease of weight and number of kernels per spike was observed by cv. Speltz aus Tzaribrod – the number of kernels dropped by 79 % comparing to the control whereas the lowest decrease of kernels number of after infection occurred to Weisser Grannenspelz (dropped by 47,68 %). Among the three yield components one thousand kernel weight (TKW) changed the least after inoculation. Obtained results have demonstrated the existence of significant interaction a cultivar isolate in the case of NKS, TKW and NSS of wheat as well as spelt. All the tested genotypes characterized by different susceptibility to the infection. This indicates a differentiation of reaction of tested genotypes to infection and potential differences of the resistance mechanisms. Inoculation exerted the strongest influence on the number of kernels per spike. All the tested genotypes differed significantly as for the main yield components and their reaction to inoculation.

Table 1: Mean values of analyzed head and grain features obtained for common wheat, spelt and emmer following heads inoculation with *F. culmorum*

Střední hodnoty znaků rozborovaných klasů a zrn u pšenice obecné, špaldy a dvouzrnky po inokulaci klasů F. culmorum

Feature	Common wheat	Spelt	Emmer	I	C	Wc
SL (cm)	8.84	10.63**	7.59	9.67	9.74	9.51
NSS	18.40	14.88**	20.70	17.07	16.88	16.58
KNS	35.49	20.97**	23.40	19.47[c]	35.48[a]	30.66[b]
KWS (g)	1.28	0.86*	0.79	0.56[c]	1.42[a]	1.13[b]
TKW(g)	34.12	37.38**	32.74	27.60[c]	40.30[a]	37.50[b]

I, C, Wc –Infection, Control, „Water control"; Differences between mean values for common wheat and spelt significant at: * - p=0.05; ** - p=0.01; a – c – homogenous groups according to the SNK test at p=0.01

Conclusion

Obtained results demonstrate that in the conditions of artificial heads inoculation with *F. culmorum* spelt produced more kernels qualified as FDK (*Fusarium* damaged kernels) than common wheat. This cereal showed also a strong reduction of the main yield components what correspond to the earlier results obtained by Wiwart et al. 2004, hence spelt is considered to be more susceptible to spikes infection than common wheat and the strongest reaction was observed in the case of kernel weight per spike. According to cited authors, spelt grain accumulates slightly less amount of deoxynivalenol than grain of common wheat.

Among the five tested spelt cultivars Weisser Grannenspelz appeared the weakest reaction to infection whereas Lohnauer Sommerspelz characterized by the greatest number of kernels in spike. The strong reaction to pathogen observed for all the tested common wheat and spelt genotypes, clearly demonstrate the considerable pathogenicity of applied *F. culmorum* isolate. Tested genotypes of *T. spelta* and *T. dicoccum* manifested on average slightly lower resistance to the *F. culmorum* infection and a lower yielding potential than the most resistant wheat cultivars. Nevertheless these wheat species comprise the remarkably valuable initial material for breeding of new cultivars characterised by high nutrition quality of grain and potential resistance to accumulation of *Fusarium* toxins.

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