FUSARIUM HEAD BLIGHT INFLUENCE ON AGRONOMIC AND QUALITY TRAITS OF WINTER WHEAT CULTIVARS

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Introduction

Fusarium head blight (FHB) is an important wheat disease in worldwide production regions. Three species predominate internationally: *F. graminearum, F. culmorum and F. avenaceum*. FHB leads to significant direct yield losses. Moreover, FHB causes decrease in technological wheat quality. Invasion of the kernel by *Fusarium spp.* destroys proteins, starch granules and cell wall and reduces germination (Kerekes, 2004). The cultivation of resistant wheat cultivars is the most promising strategy to reduce the risk of FHB epidemics. Different climatic conditions also greatly affect disease establishment, development and severity, resulting in large genotype-by-environment interactions and variable expression of disease symptoms what leads toward difficulty in the selection of resistant lines (Hudec, 2006). The objective of this study was to evaluate the effects of artificial inoculation with *Fusarium culmorum* on important agronomic and quality traits in order to estimate the levels of *Fusarium* tolerance or resistance of important wheat germplasm developed at the Agricultural Institute Osijek and significantly spread in Croatian production.

Materials and methods

The experiment was set up on eutric cambisol soil type at Osijek location in 2003/2004 year as two-factorial RCBD field trial with three repetitions. First factor was ten winter wheat cultivars (Zitarka, Demetra, Srpanjka, Super Zitarka, Golubica, Panonka, Seva, Zrnka, Janica and Alka) created at the Agricultural Institute Osijek. Cultivars were planted in eight row plots of 7 m length and 1.08 m wide with sowing rate of 650 seeds m^{-2}. Harvested area was 7.56 m^2. Second factor in this study was *Fusarium* treatments: control, artificial inoculation with *Fusarium culmorum*, fungicide treatment (tebuconazole 125+triadimefon 100 g a.i. l^{-1}) and FHB artificial inoculation+fungicide treatment. Artificial inoculation was done with a mycotoxigenic strain of *Fusarium culmorum.* Inoculum was produced on potato-dextrose agar (PDA; Difco Laboratories, Detroit, MI). Seven-day old cultures were used for preparing a suspension. The suspension contained conidia (30000 spores ml^{-1}) and mycelium fragments which are both capable of forming colonies and infecting plants. The wheat heads were sprayed at mid-anthesis assuring that all spikelets were exposed to the inoculum. To ensure high humidity inoculated heads were sprayed four times (in the next two days) with water. The following agronomic traits were measured: grain yield, test weight and 1000 kernel weight. The quality traits considered were: protein content (Infratec 1241, Foss Tecator), wet gluten content, Gluten Index (ICC method No 155) and Zeleny sedimentation volume (ICC method No 116/1). Data analysis was performed using SAS Stat 8e Software procedures, PROC GLM for agronomic and PROC MIXED procedure for quality traits where samples were pooled over repetitions.

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Results and discussion

The prominent differences among treatments and cultivars were found for agronomic traits as well as for quality parameters (Table 1 and 2). Considering agronomic traits the significant negative influence of FHB inoculation was noticed on grain yield and test weight, what is comparable with the results from other authors (Mesterházy, 1995). The 1000 kernel weight showed a slight non significant decrease under FHB treatment *vs.* control, while fungicide treatment caused significant increase of 1000 kernel weight. Mesterházy (1995) reported that FHB infection may cause a significant loss in seed number, which is important to consider for the interpretation of this trait.

Table 1. Agronomic traits under different experimental treatments

Treatments	Grain yield (kg ha^{-1})	Test weight (kg hl^{-1})	1000 kernel weight (g)
Control	8133 b	82.1 ab	33.97 b
FHB inoculation	7082 c	80.0 c	33.67 b
FHB inoculation+fungicide	8371 b	81.0 bc	37.28 a
Fungicide	9359 a	83.3 a	37.22 a

a, b, c–different letters means significant difference among treatments after Duncan's Multiple Range Test at $P \leq 0.05$.

Significant differences were found between the control and fungicide treatment in respect to grain yield and 1000 kernel weight (Table 1) emphasizing the importance of fungicide usage for plant protection purposes in wheat production. For wet gluten content and sedimentation volume significant differences were found among control and all other treatments, while protein content differed significantly between fungicide and FHB treatment.

Table 2. Quality traits under different experimental treatments

Treatments	Protein content (%)	Wet gluten content (%)	Sedimentation volume (cm^3)	Gluten Index
Control	14.4 ab	38.2 b	52a	83a
FHB inoculation	14.5 a	39.4 a	47b	73c
FHB inoculation+fungicide	14.4 ab	39.8 a	46b	71c
Fungicide	14.3 b	39.5 a	48b	78b

a, b, c –different letters means significant difference among treatments after Duncan's Multiple Range Test at $P \leq 0.05$.

For gluten index significant differences were found among control and all other treatments, where control and fungicide treatment obtained higher values (Table 2). These results are in accordance with reports published by other authors (Mesterházy 1995, Kerekes 2004, Hudec 2006). Considering yield losses under FHB treatment *vs.* control, cultivars Zitarka, Zrnka and Janica had shown the least losses, while cultivars Golubica, Super Zitarka, Zitarka, and Panonka with a maximum yield increase, had the best response to fungicide treatment (Table 3).