CORELLATION BETWEEN INCIDENCE OF *FUSARIUM* SPECIES AND MYCOTOXINS OCCURRENCE IN DIFFERENT CLIMATIC REGIONS OF SLOVAKIA

KORELÁCIA VÝSKYTU HÚB Z RODU *FUSARIUM* A MYKOTOXÍNOV V RÔZNYCH KLIMATICKÝCH REGIÓNOCH SR

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ABSTRACT

Fusarium head blight is a destructive disease of wheat and barley in environment with prolonged wet climatic conditions from flowering through the soft-dough stage of kernel development. These fungi produce dangerous mycotoxins, which accumulation is harmful for health of animals and people. The aim of this work was evaluation of incidence of *Fusarium* species at different locations of Slovakia and different growth stages. Heads of wheat were collected every week from growth stage end of flowering to the harvest, in order to determine the *Fusarium* species composition and the level of mycotoxins. Species composition of the genus *Fusarium* was identified by the specialist after cultivation. The concentration of mycotoxins in kernels was evaluated by ELISA method. *Fusarium* species isolated from wheat kernels collected at different locations were following: *F. poae, F. graminearum, F. sporotrichioides* and *F. avenaceum.* Level of DON was relatively constant in all samples. Its concentration ranged from 0.171 ppm to 0.225 ppm. Level of T-2 toxin in wheat kernels varied between 0.587 ppb and 1.516 ppb, and was in correlation with incidence of *Fusarium poae*. Concentration of ZEN ranged from 0.731 ppb to 1.55 ppb. Correlation between incidence of *Fusarium* spp. and mycotoxins was confirmed at each locality. Regulatory limits of mycotoxins in foods were not exceeded.

Key words: *Fusarium*, mycotoxins, incidence, wheat, kernels

INTRODUCTION

The information about incidence of Fusarium on wheat and other cereals is known from all Europe (Bottalico et Perrone, 2002). Some species of these fungi prefer tropic and subtropics regions, other species prefer colder climatic zone. Actually some of them have a cosmopolitan incidence (Burgess et al., 1988). Hudec et Roháčik (2005) observed wider spectrum of Fusarium in infected grains in locality with higher altitude and closer spectrum in less infected grains in dry years. The new species of Fusarium has a high degree of variation within physiological, morphological and pathogenic properties. From this reason these fungi are able to exist in variable ecological conditions in different geographical areas (Leslie et Summerell, 2006). A mycotoxin is a toxic secondary metabolite produced by organisms of the fungus kingdom, commonly known as molds. Mycotoxins can contaminate foods and also feed. A low amount of mycotoxins is toxic for vertebrates, including people (Tančinová, 2009). These substances cannot be destroyed neither by baking nor malt and ethanol production (Bailey, 2007). Fusarium produces a lot of secondary metabolites, ZEA, trichothecenes and fumonisins (Sorensen, 2009). Production of mycotoxins is influenced by several factors. The amount and type of mycotoxins depends on species of Fusarium. Their production is influenced also by a stress (Chrpová et al., 2007). Andersen et Thrane (2006) claimed that the incidence of metabolites from these fungi and their toxicity is a serious problem for the future and the scientists should pay attention in this direction.

MATERIALS AND METHODS

The samples were collected in weekly intervals from localities in Komárno, Veľké Úľany, Špačince and Jacovce (Table 1). Heads of winter wheat (Triticum aestivum) were collected from growth stage end of flowering to the harvest. Grains were separated from head and cultivated on PDA medium. Fusarium species spectrum was determined by cultivation methods according to the manual from Nelson et al. (1983) and Leslie et Summerell (2006). Subsequently the frequency of species of Fusarium was determined by formula (González et al., 1996):

Fr – frequency of incidence, ns – number of samples with Fusarium, N – total number of samples

Quantitative evaluation of mycotoxins DON (deoxynivalenol), ZEN (ZEA) and T-2 toxin was carried out by ELISA Reader machine (NOACK, SR), working on spectrophotometry principle.

Table 1: Description of collected samples, 2011

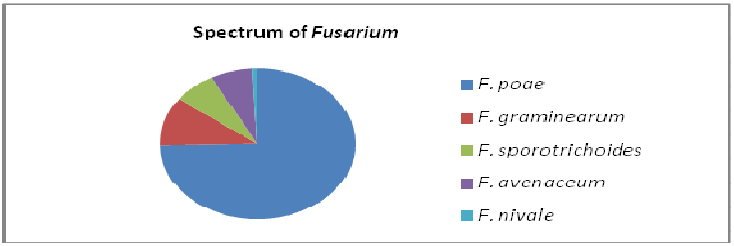
Code of clim. region	Localities	Date of collection									
		15.6	21.6	22.6	22.6	28.6	7.7	10.7	11.7	13.7	20.7
0	Komárno		X		X			X			
0	V. Úľany	X		X		X	X		X		
1	Špačince	X		X		X	X			X	X
1	Jacovce			X		X	X			X	X

00 – very warm, very dry, lowland
01 – warm, very dry, lowland

RESULTS AND DISCUSSION

During vegetation in the year 2011 5 species of the genus *Fusarium* were found at observed localities (Graph 1). From total amount of evaluated heads the share of infected grains was 1.7%. Calculation of incidence frequency revealed as the most dominant species *F. poae* (6, 4%), followed by *F. graminearum* (0.9%), *F. sporotrichoides* (0.6%), *F. avenaceum* (0.6%) and *Monographella nivale* (0.075%). Šrobárová and Vašková (1987) defined during their research as the most frequent species *F. culmorum*, followed by *F. graminearum*, *F. avenaceum*, *F. oxysporum*, *F. moniliforme* and *Monographella nivale*. These results indicate change in the composition of *Fusarium* species over the years. Mašková et al. (2008) collected samples from 7 regions of Slovakia. They found out that the most frequent species was *F. poae*. These results are identical with our results. Roháčik and Hudec (2005) also found the highest incidences of *F. poae* during the vegetation period of the years 1999, 2000, 2002 and 2003. Increased share of *F. poae* was observed also in France (Ioos et al., 2004). Xu et al. (2008) claimed that *F. poae* prefers dry and hot climatic conditions. The higher incidence of *F. poae* can be justified by change of climatic conditions and low rainfall in Slovakia in 2011.

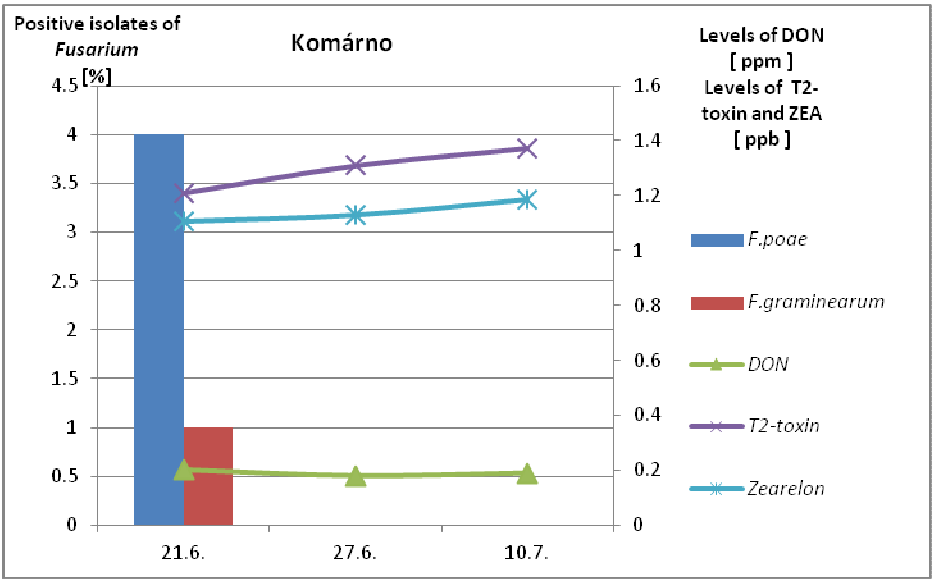
Graph 1: Share and spectrum of Fusarium species at all observed localities in year 2011



Komárno

The most prevalent species in Komárno was *F. poae* (1.3%). Besides of this one also the *F. graminearum* (0.3%) was identified. No *Fusarium* species was detected from the last week of June (Graph 2), which can be caused by collection of samples from different part of the location. Graph 2 shows incidence of mycotoxins. Level of DON was relatively constant in every date. Total level of DON didn't exceed allowed level according to the Commission Regulation (EC) number 1881/2006 from 19. December 2006. This Commission Regulation sets maximum levels of some contaminants in foodstuffs. Šudyová et al. (2006) reported 32% samples from Slovakia, which had exceeded limit for DON. These high levels of DON can be explained by favorable climatic conditions for *Fusarium* outbreak in 2004 (high rainfall during flowering and temperature 28°C). However level of DON is affected by several factors, the most important are weather conditions during wheat flowering (Xu, 2003). T-2 toxin had increasing tendency because of incidence of *F. poae*, which is dominant producer of this mycotoxin. ZEA has the same tendency as the T-2 toxin, but in lower level.

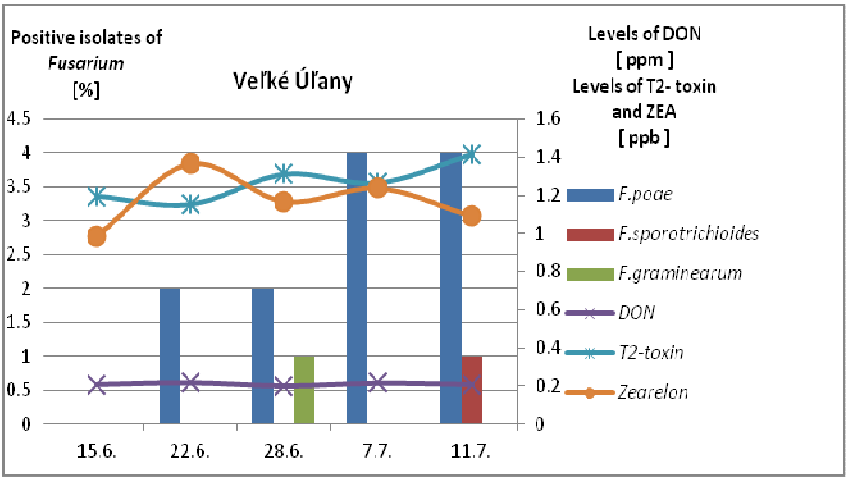
Graph 2: Spectrum of Fusarium spp. and mycotoxins content in wheat kernels in Komárno, 2011



Veľké Úľany

Fusarium poae (2.4%) was also dominant species in Veľké Úľany. Incidence of *F. sporotrichioides* (0.2%) and *F. graminearum* (0.2%) was the same. Mycotoxins were present even during the period when *Fusarium* spp. weren´t visually found. Levels of DON were relatively constant. Levels of the T-2 toxin were in correlation with increasing incidence of *F. poae*. Levels of ZEA were variable.

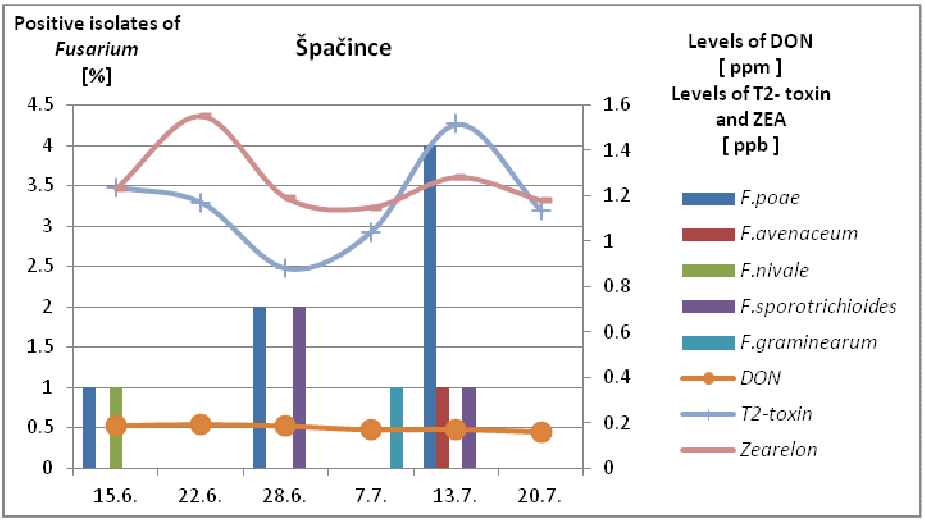
Graph 3: Spectrum of Fusarium spp. and mycotoxins content in wheat kernels in Veľké Úľany, 2011



Špačince

The highest diversity of *Fusarium* spp. was recorded in Špačince (Graph 4).The most dominant was again *Fusarium poae* (1.17%). Among less frequent species belonged: *F. sporotrichoides* (0.5%), *F. graminearum* (0.17%), *F. nivale* (0.17%) and *F. avenaceum* (0.17%). We didn´t consider the incidence of *F. avenaceum* as important, because this species does not produce mycotoxins DON, T-2 toxin and ZEA (Mašková, 2011). Level of DON was low and relatively constant similarly as in the case of above mentioned localities. This low level can be caused by absence of *F. graminearum* and *F. culmorum*, which are considered as the major producer of these mycotoxins (Bottalico et Perrone, 2002). Špačince was the locality with the lowest level of DON (0.171 ppm). Šudyová et al. (2006) reported minimum level of DON (0.2 ppm) in year 2004. Compared with their results we found even lower level of DON, probably due to the extremely dry conditions during the vegetation period 2011. We can find some correlation between incidence *F. poae* and amount of T-2 toxin. ZEA had no fixed tendency which can be caused by diversity of samples.

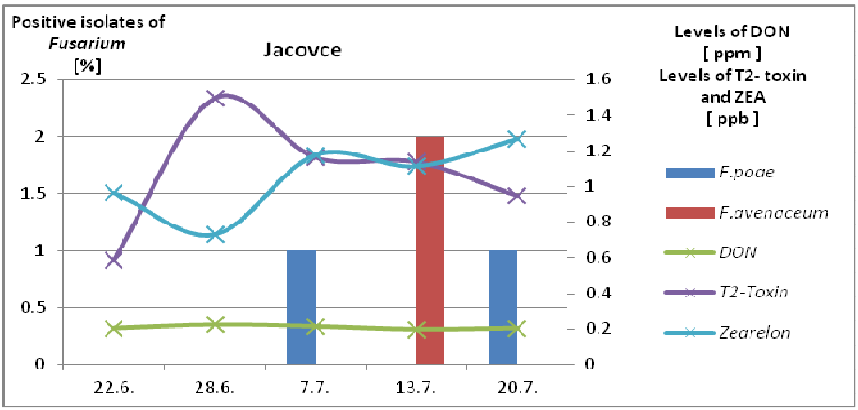
Graph 4: Spectrum of Fusarium spp. and mycotoxins content in wheat kernels in Špačince, 2011



Jacovce

Graph 5 shows incidence of *F. poae* (0.4%) and *F. avenaceum* (0.4%), the only two species identified in Jacovce. The highest level of DON (0.225 ppm) was found in Jacovce, in contrast to previously mentioned location. The incidence of DON was detected even when *Fusarium* was not visually present. T-2 toxin has decreasing tendency by the end of vegetation, because incidence of *F. poae* was low. Levels of ZEA were variable.

Graph 5: Spectrum of Fusarium spp. and mycotoxins content in wheat kernels in Jacovce, 2011



CONCLUSION

In the wheat kernels, following Fusarium species were found in the year 2011: F. poae, F. graminearum, F. sporotrichoides, F. avenaceum, F. nivale. Dominant species was Fusarium poae. Level of DON was relatively constant in all localities and did not change over the time. Incidence of T2-toxin and ZEA was variable and changed with the time. We observed positive correlation between F. poae incidence and level of T-2 toxin in grains. In our samples levels of all evaluated mycotoxins did not exceed levels set according to the Commission Regulation (EC) number 1881/2006 from 19. December 2006.

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