CONTAMINATION OF WHEAT AND MAIZE GRAINS BY *Fusarium* SPECIES

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J. Ćosić[1], D. Jurković[1], K. Vrandečić[1], B. Šimić[2], B. Svitlica[3], D. Zoretić[1]
[1]*Faculty of Agriculture in Osijek, J.J. Strossmayer University, Osijek, Croatia*
[2]*Agricultural Institute Osijek, Osijek, Croatia*
[3]*University of Applied Science in Požega, Požega, Croatia*

ABSTRACT
Fusarium head blight (FHB) and *Fusarium* ear rot (FER) are very important diseases in all wheat and maize grown areas all over the world. Several *Fusarium* species may be associated with this disease, including species that are potentially toxigenic. A total of 1632 wheat grain samples and 937 maize grain samples were collected and analyzed from 1996 to 2006. Nine *Fusarium* species were isolated from wheat grains and six from maize grains. The most frequent species on wheat grains was *Fusarium graminearum* (49.17%) and the most frequent species on maize grains was *Fusarium verticillioides* (43.75%).

Key words: wheat, maize, *Fusarium*

INTRODUCTION
Several *Fusarium* species are responsible for seedling blight and root, stalk and ear rot of maize [1, 2] and seedling blight, root rot and head blight of wheat and other small-grain cereals [3, 4] all over the world. Diseases can cause partial or total ear premature senescence with reduction of crop yield and grain quality [5, 6]. Infected kernels are important source of inoculum for the next vegetation. Moreover, most of *Fusarium* species, under favourable environmental conditions, can produce mycotoxins which can unfavorably affect human and animal health [7, 8].
F. graminearum and *Fusarium culmorum* are dominant species on wheat ears worldwide. The principal species found on maize ears are *F. verticillioides*, *Fusarium subglutinans* and *F. graminearum*. Except these species other *Fusarium* spp. could also play a role in diseases development.
The objectives of our study were to estimate occurence of *Fusarium* species on wheat and maize grains and their influence on thousand kernel weights.

MATERIAL AND METHODS
Wheat and maize grains were collected during an eleven-year period (1996-2006) in ten sites of Croatia (Vukovar, Zupanja, Vinkovci, Djakovo, Osijek, Beli Manastir, Nasice, Slavonski Brod, Kutjevo, Donji Miholjac).
Sampled grains were disinfected, put in moist chambers and incubated in thermostat

at 20±1°C, in regime of 12 hours light / 12 hours dark. After five days, developed mycelium with its spores was examined with stereomicroscope, and direct microscopic observations were done with light microscope. The mycelia and spores identified as *Fusarium* spp. were used for production basic cultures on potato-dextrose agar (PDA; Difco Laboratories, Detroit, MI). Parts of developed mycelium with and without conidia, which were assumed to belong to Fusarium species, were transferred to PDA, carnation leaf agar (CLA) and water agar. Identification of *Fusarium* species was based on colony and conidial morphology, using dissecting and compound microscopes and a standard identification key [9].

A total of 13 isolates of *Fusarium* species (8 of *F. graminearum*, 3 of *F. subglutinans*, 2 of *F. verticillioides*) were used in testing their pathogenicity to wheat and maize ears.

The wheat heads were sprayed at mid-anthesis with a hand sprayer, ensuring that all spikelets were exposed to the inoculum. The ears of control plants were sprayed with distilled water. For each isolate 4x50 heads were sprayed with 10 ml of suspension and then covered with PVC bags for 24 hours to ensure high relative humidity. At the stage of full ripening, 50 ears were taken per each repetition, they were manually harvested, percentage of *Fusarium* demaged kernels (FDK) was determined, as well as thousand kernels weight (TKW).

Maize ears (20 per isolate) were inoculated 10 to 15 days after silking (R2 stage) by inserting colonized toothpicks in the midle of ears. Ears were manually harvested and percentages of FDK as well as TKW were determined.

RESULTS AND DISCUSSION

A total of 1632 winter wheat samples and 937 maize samples were collected and analyzed from 1996 to 2006. Nine *Fusarium* species were isolated from wheat grains and six from maize grains. The most frequent species on wheat grains was *F. graminearum* (49.17%). According to its occurence *F. graminearum* was followed by *F. verticillioides* (15.97%), *Fusarium avenaceum* (6.69%), *F. subglutinans* (15.32%), *Fusarium poae* (4.62%), *F. culmorum* (3.89%), *Fusarium sporotrichioides* (2.21%), *Fusarium oxysporum* (1.08%) and *Fusarium solani* (1.05%). The predominant *Fusarium* species on maize grains was *F. verticillioides* (43.75%). On maize grains except *F. verticillioides* the following *Fusarium* species were isolated: *F. subglutinans* (31.58%), *F. graminearum* (20.17%), *F. culmorum* (3.02%), *F. oxysporum* (0.97%) and *F. sporotrichioides* (0.51%).

Symptoms of FHB are premature bleaching and blighting of wheat spikelets and shriveled grains. Symptoms of FER are white to pink or salmon-colored mold, beginning anywhere on the ear or scattered throughout. Wheat and maize grains infected with *Fusarium* species are lighter than uninfected and often lose there germination. Table 1 present results of pathogenicity of *Fusarium* spp. isolates on wheat and maize ears.

F. graminearum isolates were more pathogenic to wheat and maize ears than isolates of *F. verticillioides* and *F. subglutinans*. Depending on *F. graminearum* isolates, percentage of FDK on wheat was between 45.85 and 58.25% and on maize between 11.15 and 28.26%. TKW of wheat grains inoculated with *F. graminearum* was reduced from 44.65 to 53.25%, if compared to control. TKW of maize grains inoculated with same isolates was reduced from 15.87 to 32.62%, if compared to control. *F.*

verticillioides and *F. subglutinans* reduced TKW less than 12%. Similar observations were reported by Wong et al., Bagi et al., Akinsanmi et al. and Fernandez and Chen [10, 11, 12, 13].

Table 1. Pathogenicity of Fusarium spp. to wheat and maize ears

Isolate	Wheat		Maize	
	% of FDK	TKW (% of control)	% of FDK	TKW (% of control)
Fgmg1	55.64	46.75	14.69	67.38
Fgmg2	52.75	50.15	19.51	68.61
Fgmg3	49.35	52.70	20.06	74.89
Fgmg4	49.28	55.35	15.94	69.49
Fgwg1	56.15	49.25	17.19	78.41
Fgwg2	45.85	51.33	11.15	84.13
Fgwg3	58.25	48.70	28.26	76.67
Fgwg4	50.05	53.29	26.59	69.28
Fsmg1	5.19	94.15	2.41	91.32
Fsmg2	7.08	90.85	1.68	88.99
Fsmg3	6.50	92.35	4.37	80.82
Fvmg1	4.35	95.50	2.31	95.15
Fvwg1	5.18	93.75	5.20	96.78

CONCLUSIONS

The predominant *Fusarium* species isolated from 1632 wheat grain samples was *F. graminearum*. The most frequent species isolated from 937 maize grain samples was *F. verticillioides*. Pathogenicity test showed that *F. graminearum* isolates were more pathogenic to wheat and maize ears than isolates of *F. verticillioides* and *F. subglutinans*. These isolates reduced TKW of wheat and maize more than 44 and 15%, respectively.

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