Metabolomics to decipher biochemical defence of cereals against Fusarium and mycotoxin accumulation

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EFS 14

EUROPEAN FUSARIUM SEMINAR

April 8 – 11, 2018
Minoritenkloster
Tulln, AUSTRIA

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MB-05 How do abiotic factors influence growth, fumonisin biosynthesis and stress response in *Fusarium proliferatum*?

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Fusarium proliferatum is a *major* agricultural *plant pathogen* that synthesizes toxic secondary metabolites, known as mycotoxins or fusariotoxins. Identification of the factors affecting basic metabolism of *F. proliferatum* allows for better understanding of the regulation of mycotoxin biosynthetic pathways during the process of infection and fungal spread across the host plant organism. Here we examined the effect of abiotic factors, namely osmotic stress, salinity and extreme temperatures, on growth and fumonisin biosynthesis by diverse *F. proliferatum* strains.

Four *F. proliferatum* strains originating from garlic, asparagus, maize, and pineapple plants were grown *in vitro* in 100 ml flasks containing 50 ml fumonisin-inducting liquid medium (malt extract 0.5 g/l, yeast extract 1 g/l, mycological peptone 1 g/l, KH_2PO_4 1 g/l, $MgSO_4 \cdot 7H_2O$ 0.3 g/l, KCl 0.3 g/l, $ZnSO_4 \cdot 7H_2O$ 0.05 g/l, $CuSO_4 \cdot 5H_2O$ 0.01 g/l and D-fructose 20 g/l). Abiotic stress factors were applied on the fifth day of culture in different culture variants: temperature of 35°C, sorbitol (0.5-2M), and sodium chloride (0.2-1.5M). Subsequently, samples of liquid media were collected in 2-day intervals and subjected to fumonisin quantification. After 14 days of still incubation, the cultures were transferred into the pre-weighted falcons, the mycelia were centrifuged and freeze-dried for dry weight measurements. In all variants fumonisins B (FBs) were analyzed using UPLC/MS/MS method.

All strains yielded amounts from 42 to 286 mg of dry weight of mycelia after 14 days of culture. Strains biomass showed similar changes under experimental conditions. The sorbitol-induced osmotic stress had the highest biomass increase effect of the three abiotic factors tested (top values of over 4.3-fold increase for 0.5M sorbitol). NaCl was also strong inductor for most of the stains (top values of over 1.4-fold increase for 1.2M NaCl). Culturing of strains at 35°C had a repressing effect on growth; a 1.3-fold decrease in biomass amount was recorded for two strains. Concentrations of FBs varied and depended on type and level of stress factor, strain and time of incubation. Our results demonstrated that abiotic factors might play important roles in the development of diseases caused by *F. proliferatum* by increasing fungal biomass, altering fumonisin synthesis as well as influencing the expression of genes involved in pathogenesis.

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MB-06 Metabolomics to decipher biochemical defence of cereals against *Fusarium* and mycotoxin accumulation

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Fusarium graminearum is the main causal agent of *Gibberella ear rot* (GER) and *Fusarium* Head Blight (FHB), two important fungal diseases affecting maize and wheat, respectively. GER and FHB lead to significant economic losses and serious health issues due to the ability of *F. graminearum* to produce mycotoxins such as type B trichothecenes. Many factors including environmental, agronomic or genetic ones may contribute to high levels of accumulation of mycotoxins in the grains and there is an urgent need to implement efficient and sustainable management strategies to reduce mycotoxin contamination. Fungicides are not far enough efficient to control the mycotoxin risk and, in addition, because of negative effects on human health and environment, their use will be seriously restricted in the near future. To durably solve the problem of mycotoxin accumulation, the breeding of tolerant genotypes is one of the most promising strategies for cereals. However, this objective cannot be achieved without a better understanding of plant resistance mechanisms to both *Fusarium* and mycotoxin accumulation. *Fusarium* resistance depends on the plant ability in preventing initial infection and containing the development of the toxigenic fungi. Resistance to mycotoxin is also related to the capacity of plant tissues in reducing mycotoxin accumulation. This capacity rests on two mechanisms: metabolic transformation of the toxin into less toxic compounds and inhibition of toxin biosynthesis. This last mechanism involves host metabolites able to interfere with mycotoxin biosynthesis. Several non-targeted, and targeted studies have highlighted biochemical rearrangements in both primary and secondary metabolisms, that cereals employ to counter *Fusarium* and its mycotoxin production. These latest metabolomics advances will be detailed in the present communication. In addition, recent studies performed in our research group that aimed to characterize new sources of resistance to both FHB in durum wheat and GER in maize through the combination of targeted and non-targeted metabolomics approaches will be developed. Lastly, the ability of *Fusarium spp.* to metabolize plant metabolites potentially involved in resistance will be discussed.