Biological control of mycotoxigenic fungi in cereals: A successful step to food safety

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Problem Statement

Over the last decade, several BCAs for management of Fusarium diseases such as Fusarium Head Blight (FHB) & Fusarium Ear Rot (FER) have been well documented in literature. Although, FHB and FER are caused by mycotoxigenic Fusarium species, the potential biocontrol effect on mycotoxins is underexplored (1). Fusarium graminearum, the main pathogen involved in FHB & FER in cereals, produces multiple mycotoxins such as DON and ZEN. The effect of BCAs on multiple mycotoxins as well as fungal growth has not been studied before.

Aim & Experimental Setup

- Screening for novel BCAs (focus on fungal endophytes).
- Test their ability to effectively suppress the fungal growth and infection (different in vitro and in planta assays for accurate selection of the best performing BCAs).
- Test their ability to effectively suppress the production of different mycotoxins (validated LC-MS/MS method for each matrix for toxins quantification).
- Identification of potential biocontrol molecules that exert or contribute into the biocontrol effect (HR-LCMS/MS).

1. Isolation of BCAs from Maize Stubble And Soil

Several maize stubble and soil samples

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<tr>
<th>Strain</th>
<th>Isolated from</th>
<th>Method</th>
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<tr>
<td>F. graminearum (CBS 1257)</td>
<td>Soil</td>
<td>PCR</td>
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2. In Vitro Plating Assay

F. graminearum was cultured at 22 °C for 10 days on sterile rice. Each BCA was cultured in PDB at 25 °C for two weeks. Mycotoxin (12.5 mg ± 1) was mixed thoroughly with the soil. F. graminearum grown on rice was added to soil. Maize was grown for 2 weeks at RT, 12 h light/12 h darkness.

3. In Vitro Volatile Assay

Conclusion: The volatile assay showed an inhibition of Fusarium graminearum growth which may be assumed due to the presence of some fungal volatile(s) or bioactive molecules produced by BCAs. Similar to plating assay, the biocontrol effect is more clear in ZEN than in DON. However, the effect on the mycotoxins exceeds the reduction in fungal growth which point to an active inhibition of mycotoxin production.

4. In Planta (Maize) Assay

Conclusion: The biocontrol effect is present for the majority of endophytic BCAs, although the effect on symptom development is minor and highly variable. The effect of the endophytic BCAs on mycotoxin production in plants is clear and more proliferated than the effect on the symptom development. In plants, the BCAs result in an active reduction of mycotoxin production by the pathogens.