"Fusarium spp. on maize in Belgium, from biodiversity to biocontrol"

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ABSTRACT

Numerous Fusarium species are important mycotoxin-producing pathogens affecting maize in Belgium. Crop quality is often reduced by Fusarium rot diseases, and mycotoxin contaminations can pose a serious problem for animal health. As several of these mycotoxins are integrated into European legislation, field monitoring and accurate identification of the Fusarium species remain important tasks, allowing relevant preventive or curative measures. Impacts of environmental factors, cultural practices and hybrid selection were analyzed in the frame of an integrated disease management system. Although climatic conditions are the major factor affecting Fusarium rot diseases, adequate crop rotation with a non-cereal culture and the selection of a less susceptible maize hybrid offered a significant reduction of Fusarium infestation and associated mycotoxin contamination at the end of the growing season. As seedling protection is essential under temperate climate, biologically-based inputs can be...

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**Fusarium spp. on maize in Belgium, from biodiversity to biocontrol**

J. Scauflaire1, C. Liénard1, M. Gourgue1, G. Foucart2, M. Mary1, F. Renard1, A. Callebaut1, A. Legrède1, F. Munaut1

1Université catholique de Louvain, AgroBioTech, B-1348 Louvain-la-Neuve, Belgium. 2Centre d'Étude et de Recherches Vétérinaires et Agrochimiques (CODA-CERVA), Direction Opérationnelle Sécurité Chimique de la Chaîne Alimentaire, Leuvensesteenweg 17, B-3080 Tervuren.

*E-mail: jonathan.scauflaire@uclouvain.be, francois.munaut@uclouvain.be*

**Context**

Numerous Fusarium species are important mycotoxin-producing pathogens affecting maize in Belgium. Crop quality is often reduced by Fusarium rot diseases, and mycotoxins contaminations can pose a serious problem for animal health. As several of these mycotoxins are integrated into European legislation, field monitoring and accurate identification of the Fusarium species remain important tasks, allowing relevant preventive or curative measures. Impacts of environmental factors, cultural practices and hybrid selection were analyzed in the frame of an integrated disease management system. Although climatic conditions are the major factor affecting Fusarium rot diseases, adequate crop rotation with a non-cereal culture and the selection of a less susceptible maize hybrid offered a significant reduction of Fusarium infection and associated mycotoxin contamination at the end of the growing season. As seedling protection is essential under temperate climate, biologically-based inputs can be used to mitigate with damping-off diseases caused by Fusarium species. Therefore, fungicidal rhizobiotic isolates were collected from Belgian maize fields and screenings are in progress for the selection of biological control agents (BCA) of *F. avenaceum, F. crookwellense* and *F. temperatum*. Such fungal BCA should improve crop health, minimize the economic and environmental costs of controlling plant pathogens and promote sustainable agricultural production.

### The contribution of scientific research...

#### **The » Fusarium diversity on maize » project**:

- Assess the biodiversity of the fungal flora on the maize plant.
  - Collection of more than 7000 isolates; 24 *Fusarium* species including 1 new species (Fig. 1), complete data for each isolate (growing season, location, plant, date, etc.).

- Define the conditions allowing reduction of Fusarium and mycotoxin contaminations in the field.
  - Significant effects for climatic conditions, maize hybrid and crop rotation. No significant effect for tillage.

- Compare the pathogenicity of *Fusarium* spp.
  - *F. avenaceum, F. crookwellense* and *F. temperatum* involved in damping-off diseases. *F. crookwellense* (maize stabs) and *F. graminearum* (maize ears) always involved in rot diseases at the end of the growing season.

- Identify the major mycotoxins produced by *Fusarium* spp.
  - Attention must be paid to 15-NIV, DON, ZEA and ENNs that are potentially produced in maize plants but are not included in European recommendations yet.

**Why screen for Biological Control Agents (BCA)?**

- Natural resource
- Allowed in organic farming
- Few negative impacts for the environment and for public health
- Capital gain of pesticide-free culture
- Sustainable agriculture including integrated disease management system (Fig. 3)

**Useful tools developed for rapid diagnosis**

- Detection and quantification of *Fusarium* spp. by LightCycler® Real-Time PCR method
- Detection and quantification of mycotoxins by kit ELISA Version 3/2012

**To reduce soil pathogen populations (Fusarium, Pythium and Rhizoctonia) and to enhance soil beneficial organisms:**

- Apply a BCA at seed germination.

**To reduce Fusarium ear and stalk rot diseases and mycotoxin accumulations:**

- Select an hybrid less susceptible to Fusarium diseases (http://www.dpt.br/variety.html).
- Avoid monoculture.
- Prioritize crop rotation with a non-cereal culture.
- Avoid wheat culture used as preceding crop.
- Harvest as soon as possible if climatic conditions become optimal for Fusarium development at the end of the growing season.

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![Figure 1. Distribution and characterization of the Fusarium species isolated from maize in Belgium](image-url)

![Figure 2. Evaluation of the in vitro antagonistic activity against *F. avenaceum* using a dual-culture assay](image-url)

**Maize biological protection » project (PROBIOM)**:

- Collect fungal isolates that occurs naturally in the maize seedling rhizosphere.
  - Up to now, the collection comprises 1091 isolates, more than 20 *Fusarium* genera, with complete data for each isolate (growing season, location, plant, etc.).

- Test the fungal isolates, assess their potential BCA (in vitro) and select the best candidates.
  - Ganna, Trichoderma and Bionectria demonstrated strong antagonism against damping-off *Fusarium* pathogens (Fig. 2).

- Validate the potential BCA of the selected candidates (in planta) and define the optimal interactions BCA – soil pathogen – culture
  - Greenhouse and field tests planned in 2014 and 2015.

- Optimize the R&D for the production of the BCA (bioreactor, formulation, field application, environmental effects,…) in association with agricultural biotechnology company
  - R&D planned from 2015.

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... towards more sustainability in agriculture