Occurrence and prevention of T-2 / HT-2 and some other *Fusarium* toxins in Norwegian cereals

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Samples collected 2004-2008

Approximately 600 samples of grain samples from oats and spring wheat harvested in the major cereal growing regions of Norway have been analysed for mycotoxins (18 different compounds)

Data on climatic conditions from a network of local weather stations and information regarding each single sample have been collected (location, species and cultivar, tillage, agronomic cultivation practice, previous crops, soil etc.)
*Fusarium avenaceum,*  
*F. poae,*  
*F. culmorum*

have been the most prevalent *Fusarium* species in Norwegian grain

*F. graminearum* is now more prevalent

*F. langsethiae* is also widespread (especially in oats)
Mycotoxins (µg/kg) in Norwegian oats and spring wheat 2004-2008:

- DON
- Enniatins
- HT-2/T-2

Species:
- Fusarium avenaceum
- Fusarium culmorum
- Fusarium graminearum
- Fusarium langsethiae
- Fus. sporotrichioides
- Fusarium poae
- Fusarium tricinctum

Graph shows mycotoxin levels from 2004 to 2008, measured using LC-MS/MS (EVIRA, Finland).
HT2+T2 (µg/kg) in oats
HT2+T2 (µg/kg) in different cultivars of oats

Note toxin levels in Belinda
Effect of previous crop on HT2+T2 (µg/kg) in oats

Note toxin levels when oats grown after oats.
Surveillance system: Three-step screening to identify highly contaminated grain lots

1: **Prediction models** estimate the risk of *Fusarium*/*mycotoxin* development in cereal fields

2: **Rapid screening methods** for *Fusarium* or mycotoxins in grain lots from ‘high-risk’ fields (step 1)

3: **Chemical mycotoxin analyses** of grain lots if needed (step 1 or 2)
1: Prediction models

600 samples of Norwegian oats and spring wheat collected from farmers fields in 2004-2008

Data on environmental factors (cultivation practice and weather data) collected

Chemical analysis of mycotoxins (DON, HT2, T2, Enniatins, etc.) performed by LC-MS/MS (EVIRA, Finland)

Relationship between environmental factors and Fusarium - mycotoxins studied
• Prediction models for DON in wheat and oats and for T2/HT2 in oats are developed

• So far the prediction model does not fit for all growing areas
  - Local models for the different areas are necessary

• 50 - 70% the variation in DON and T2/HT2 is explained in the models
Surveillance system 1: Prediction models

Prediction models for HT2+T2

Predicted vs. observed (LC-MS/MS)

\[ R^2 = 57.1\% \]
\[ p<0.001, N=164 \]

Prediction based on:
- previous crop
- soil type
- relative humidity after flowering
2: Rapid screening methods (DON, T2, HT2)

- FAST ELISA test
- Standard ELISA test
- Lateral flow test

have been compared with chemical analysis
**ELISA vs. chemical analysis (DON)**

- Number of samples: 291 (156 oats and 135 wheat)
- \( r^2: 95.7\% \)
- ELISA - results are higher
ELISA vs. chemical analysis (T-2)

- Number of samples: 190 (145 oats and 45 wheat)
- $r^2$: 25%
Relationship between DON and HT2+T2 concentration in Norwegian oats (2004-2008)

DON concentration cannot be used to predict HT2+T2
No reduction of HT2/T2 or ENNs in oats after prothioconazole (Proline) treatment
Prothioconazole (Proline) can reduce DON and ENNs, and *Fusarium* (real-time PCR analysis) content in spring wheat.
Mycotoxin contamination in oats -
characterization of the infection process
by the major T-2 / HT-2 toxin producer
Fusarium langsethiae

Project leader: Sonja Sletner Klemsdal
Post doc: Hege Hvattum Divon
Period: 2008 - 2012
Main Objective:

- Enhance the understanding of fundamental processes of *F. langsethiae* colonization of oats
- Reduce the mycotoxin content in oats

1. Characterization of *F. langsethiae* growth on the plant
2. The role of T-2/HT-2 toxins in *F. langsethiae* establishment on the plant
3. Characterization of fungal genes involved in the colonization process
Summary

- DON, HT2/T2 and Enniatins was recorded in several samples of oats and spring wheat (2004-2008)
- Some samples of oats (mainly cultivars Bessin and Belinda) had a mycotoxin content well above recommended maximum limits
- Especially high levels of HT2/T2 was recorded when oat was grown after oats
- Samples of spring wheat with DON above maximum limits was recorded, also when potato was grown as the previous crop
- Fungicide treatment did not have an effect on the development of T-2 and HT-2
Reduced risk of *Fusarium* and mycotoxin contamination in Norwegian cereals by the development of a rapid screening system (2006-2009)

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