Modelling *Fusarium graminearum* growth and zearalenone (ZON) production boundary conditions, respiration and dry matter losses for development of a post-harvest Decision Support System in stored cereals

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Introduction

- Cereals are commonly colonised by *Fusarium* species pre-harvest.
- Temperature (T) and Relative Humidity (RH) sensors are being used in silos to monitor grain quality and detect changes that may be related to spoilage and quality deterioration of the grain due to mould growth and insect infestation.
- Increased carbon dioxide (CO_2) levels are a sensitive indicator of biological activity, and could therefore be an early warning of initiation of mould spoilage and mycotoxin contamination.
- ✓ **The aim of this study was to develop data sets for a real time Decision Support System based on T, RH and CO_2 for better post-harvest management of stored wheat by establishing (a) the boundary conditions for growth/ZON production and (b) the relationship between dry matter loss (DML) and ZON accumulation due to colonisation by *Fusarium graminearum*.**

Material and methods

ECOPHYSIOLOGICAL STUDIES ON WHEAT MEDIA

- Central inoculation of 5µL (10^5cfu)/Petri plate of wheat media (2% milled wheat).
- Incubation in the dark at a_w (0.88-0.995) x T (8.5-35ºC) for 30 days.
- Fungal colony diameters measured daily.

RESPIRATION RATE / DMLs / ZON

- Inoculation with 4 plugs (0.5cm Ø) in 10 g of wheat.
- Incubated in the dark at a_w (0.90-0.95) x T (10-25ºC), 15 days.
- One hour of respiration rate (mg CO_2 kg^{-1} h^{-1}) measured every 2 days by means of GC-TCD.
- DML data determined from the respiration rate measurements.
- ZON analysed by LC-MS/MS at day 15.

Results

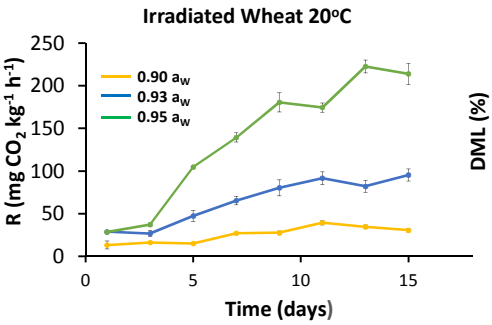

Figure 1. Temporal respiration rate of *F. graminearun* (mg CO_2/kg/h) on irradiated wheat of different a_w levels at 20ºC.

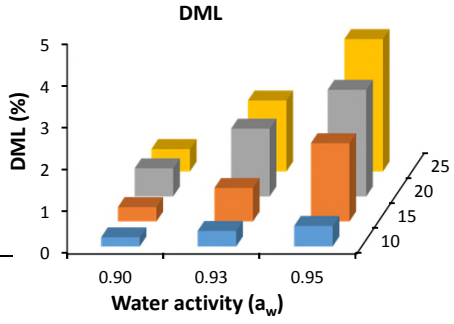

Figure 2. DML percentage in irradiated wheat by *F. graminearum* depending on a_w and T storage conditions over 15-days period

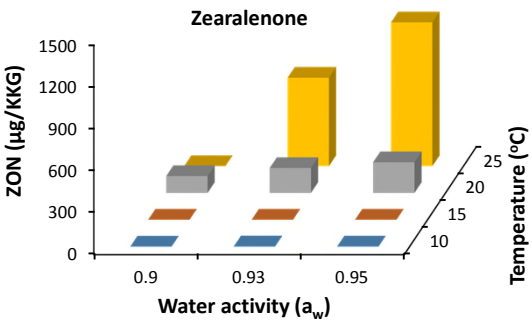

Figure 3. ZON production in irradiated wheat by *F. graminearum* with respect to a_w and T storage conditions over 15-days period

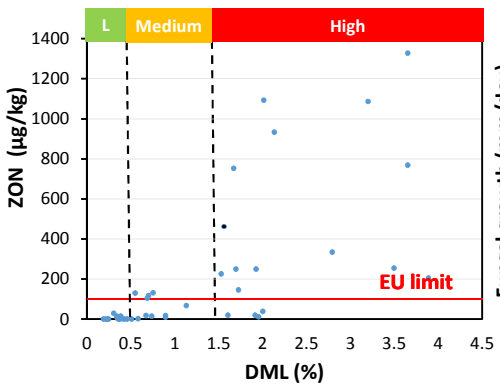

Figure 4. Relationship between DMLs and ZON production

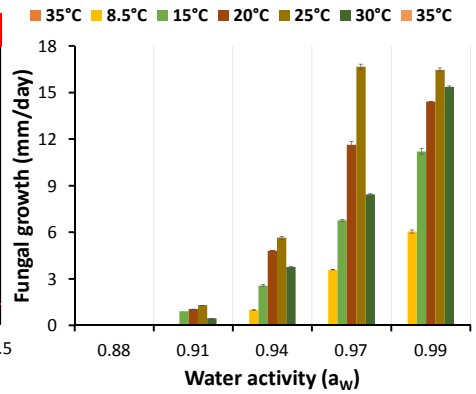

Figure 5. Fungal growth on wheat media agar (3%)

Conclusions

- ✓ *F. graminearum* growth was optimal in the wettest conditions while no growth occurred at 0.88a_w and 35°C.
- ✓ DML increased with increasing a_w and T and correlated with fungal colonisation.
- ✓ DML>0.5% and >1.5% represent a medium and high level of ZON risk relative the EU limit.
- ✓ CO_2 production data during storage can be used to predict the risk of mycotoxin contamination.
- ✓ This could be developed into a real time DSS system for better

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