

*6th EC Forum on Fusarium toxins.
Brussels, February, 2009*

T-2, HT-2 and deoxynivalenol (DON) in malting barley and malt

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Outline of presentation

- What is Euromalt
- Summary of evidence presented to 5th Fusarium Forum
- Data from the 2008 barley harvest
 - Occurrence of T-2 and HT-2 toxins in malting barley
 - Changes in incidence
 - T-2 and HT-2 toxins in commercial malts
- Studies on loss of T-2 and HT-2 during malting of barley

Euromalt



- Euromalt was established in 1959 and represents the interests of the EU malting industry
- Around 8.8 million tonnes of malt (42% of the world total) are produced annually in the EU
- Around one quarter of this is exported
- 94% of total malt production is used for beer brewing
- 4% is used for whisky distilling
- 2% is used in the food industry

Summary of data presented at 5th Fusarium Forum

- Occurrence and concentrations of T-2 and HT-2 toxins in barley appear to be increasing across Europe
- Occurrence of toxins appears to be related to an increase in the incidence of *F langsethiae*
- Data from France suggest that levels in Winter barley may be lower than in Spring barleys
- Pilot malting studies suggest that T-2 and HT-2 can be leached out of barley during steeping
- Levels of T-2 and HT-2 in malt are almost always lower than in barley
- However, the relationship between levels in malt and those in barley is not constant



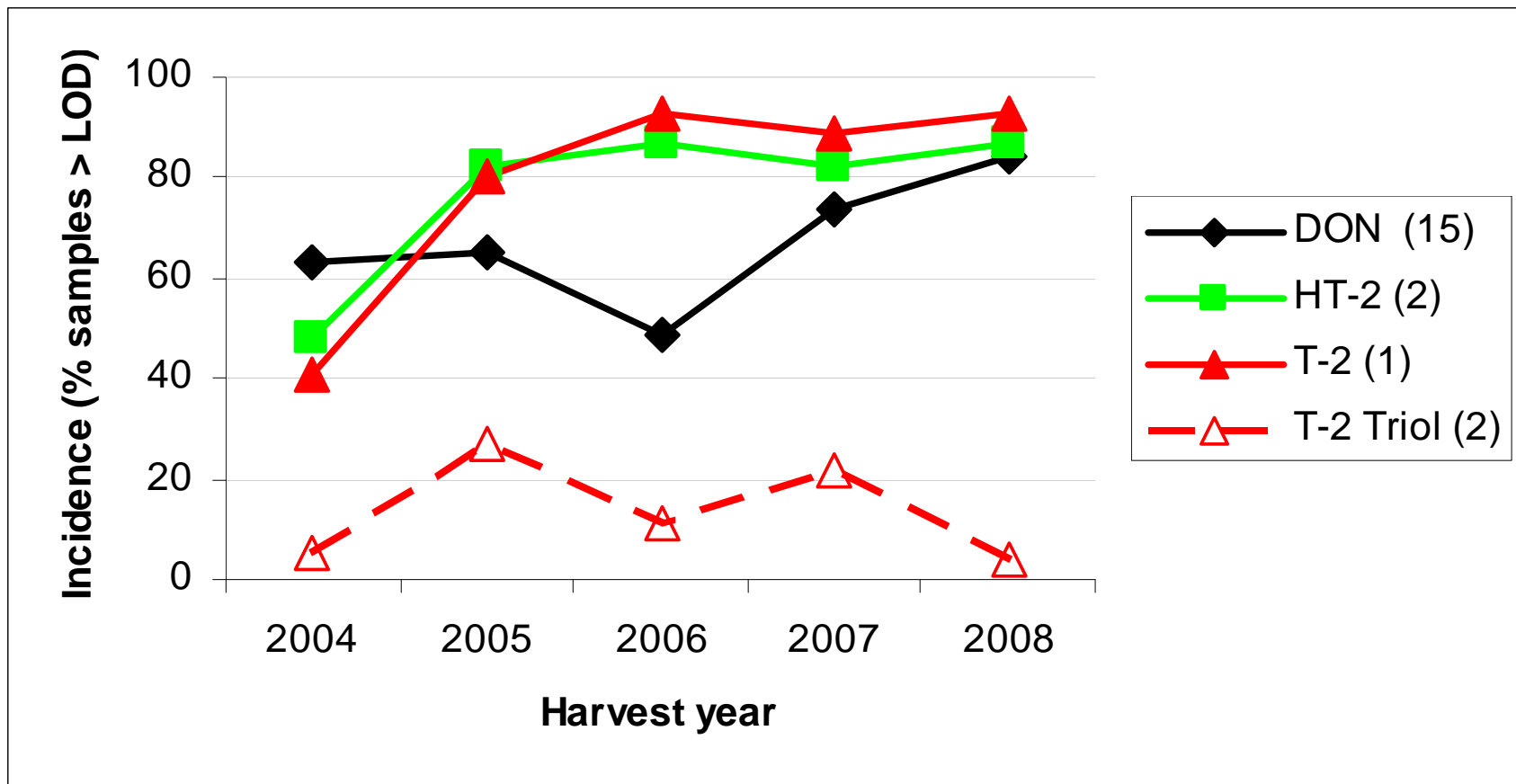
- Euromalt has been surveying mycotoxins in European malting barleys and malts since 2002

Euromalt mycotoxin survey

- 100 - 200 samples per year in total, from all EU member states with significant malt production
- Number of samples per country is proportional to malt production
- 10kg samples are collected and analysed according to EU protocol (Regulation EC No. 401/2006)
- Samples are collected as pairs: a barley sample and the malt produced from that barley
- Samples analysed for a wide range of Fusarium toxins by validated GC-MS or LC-MS/MS methods



Incidence of trichothecenes in barley

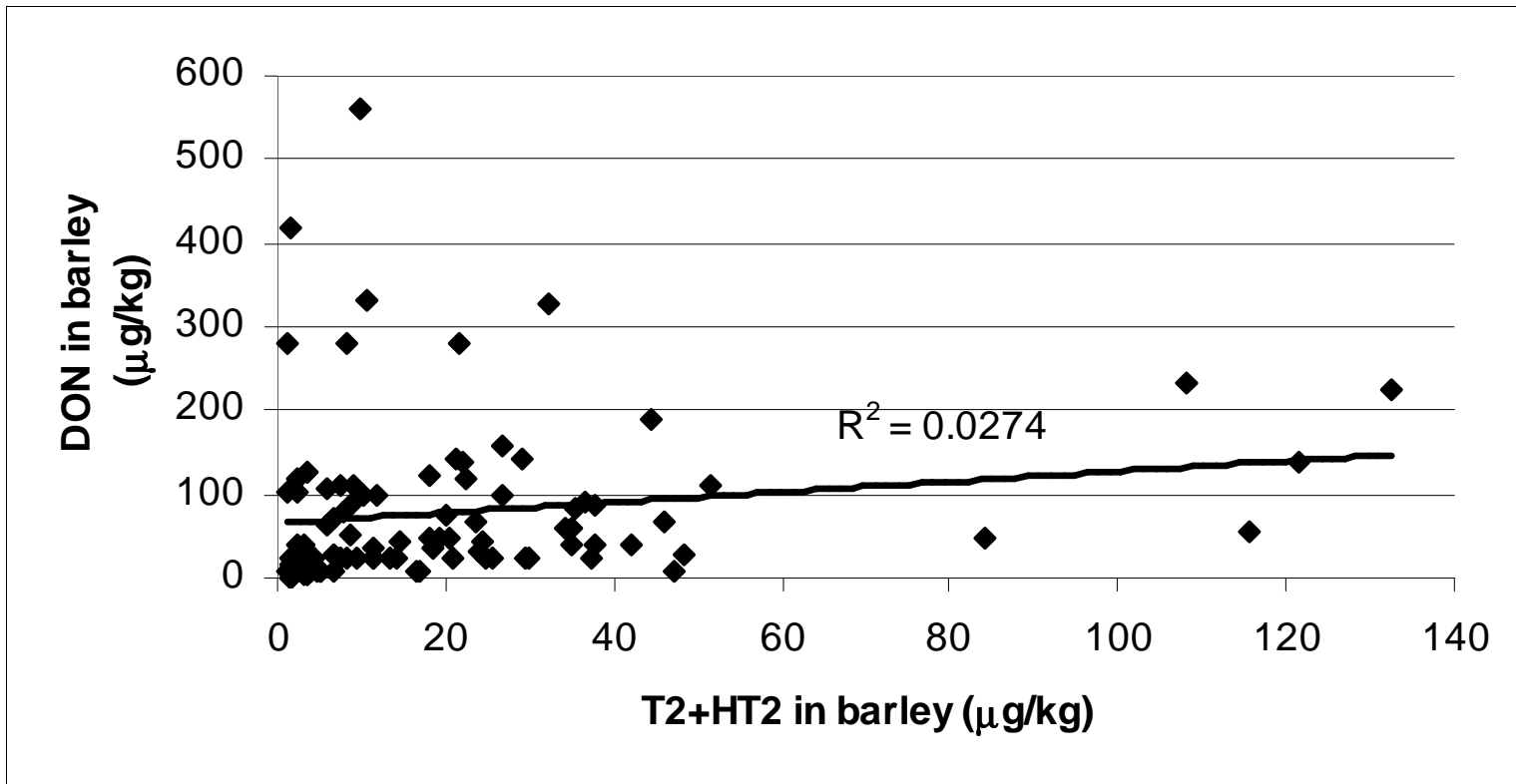


80 to 95 samples per year

Incidence: Effect of limit of detection

- LODs have not changed significantly since 2004
- year-on-year changes in apparent incidence therefore not due to lower limits of detection
- some differences between LODs for different trichothecenes
 - LOD of T-2 is lower than HT-2: likely to explain apparent higher incidence of T-2
 - LOD for DON is high compared with other LODs: true incidence of DON is almost certainly higher

Correlation between T-2 + HT-2 and DON in barley



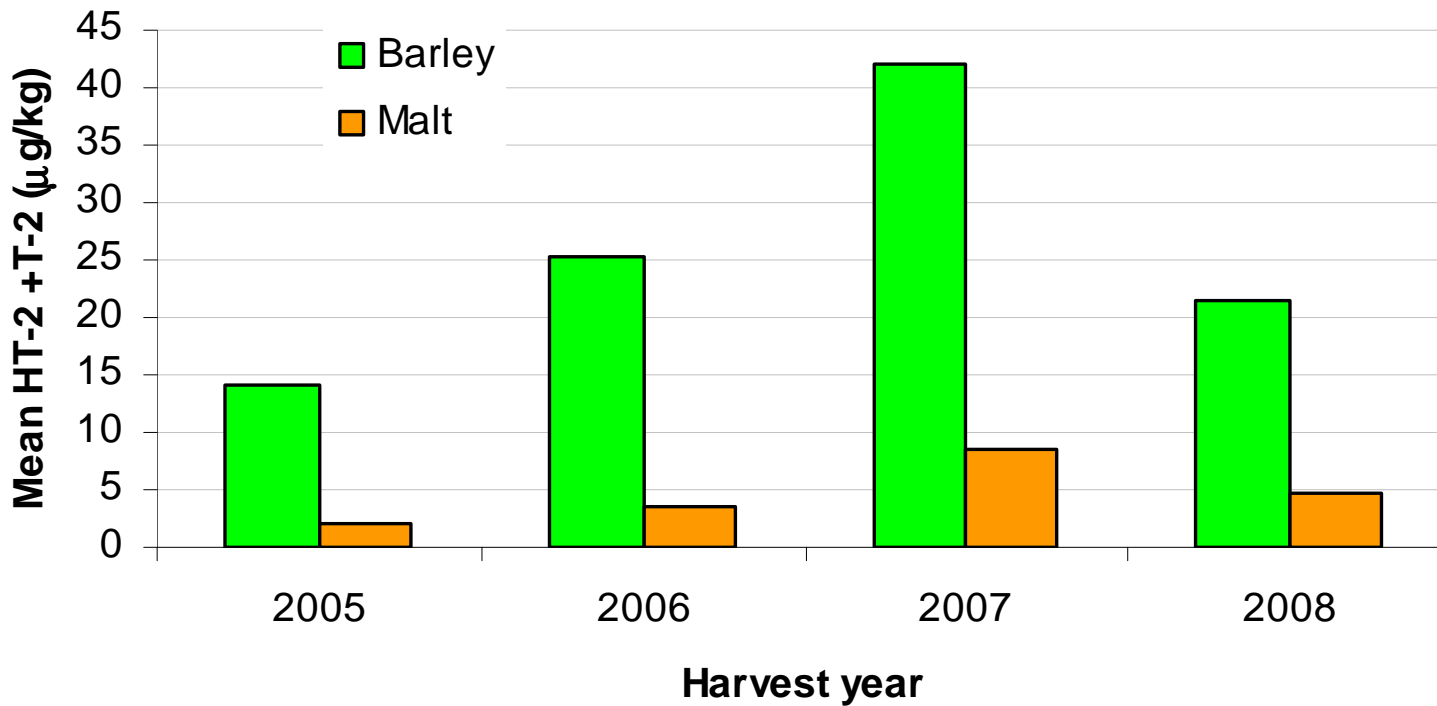
95 samples from the 2008 harvest

Incidence: summary of results

- Incidence of both T-2 and HT-2 in barley appears to have stabilised at about 80% of harvest samples
- Trends for T-2 and HT-2 are different from that of the related trichothecene DON
 - Incidence of DON higher in 2007 and 2008 which were generally wet seasons
 - HT-2 and T-2 stable after 2006: no increase in wetter seasons

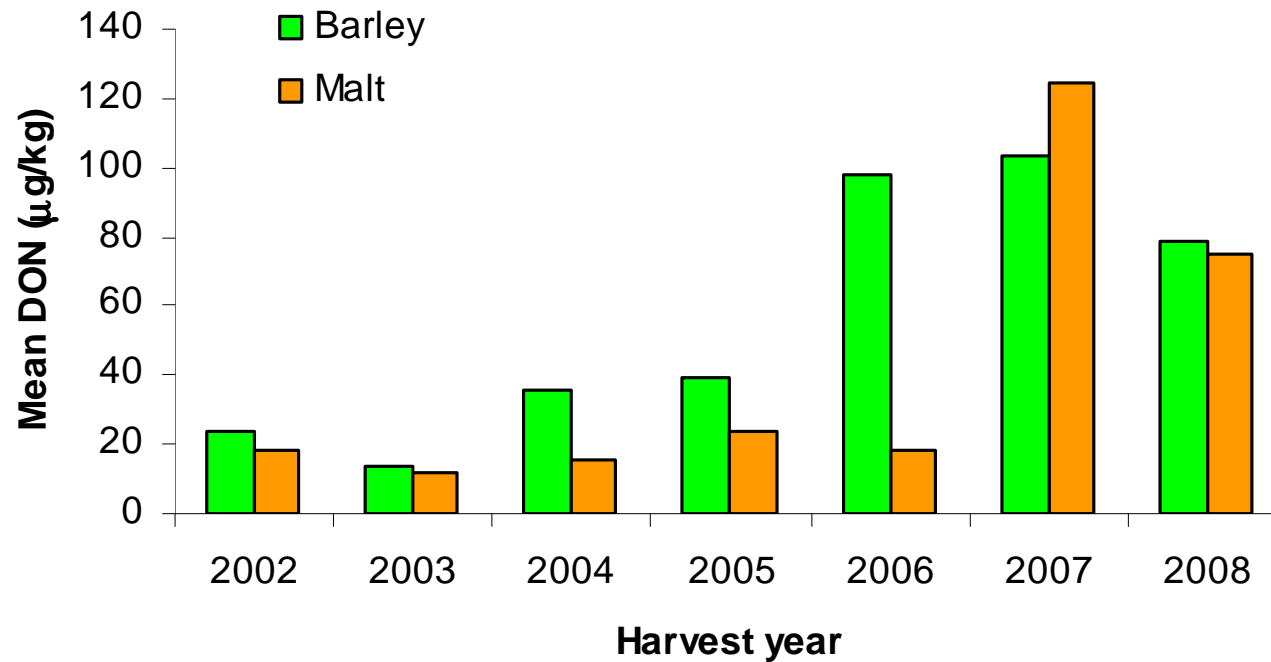
Concentration of T-2 / HT-2 and
DON in barley compared with malt

Mean T-2 + HT-2



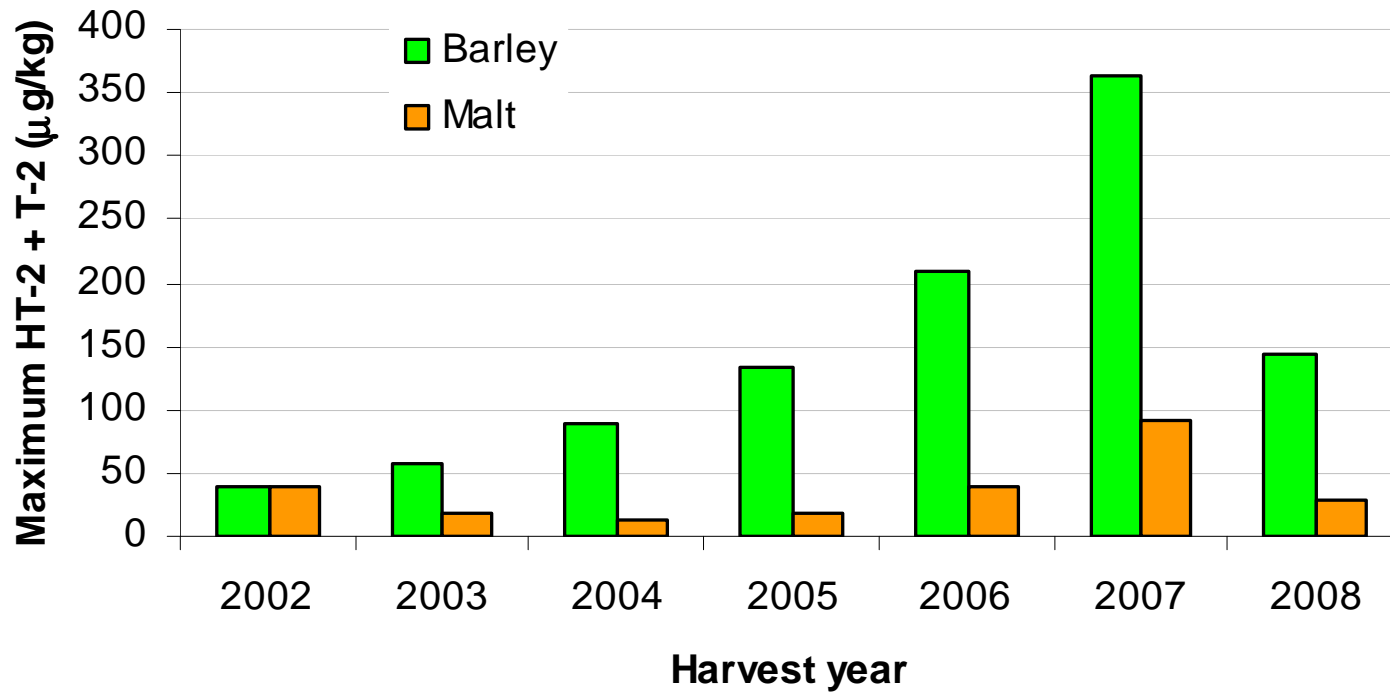
80 to 95 barley & malt pairs per year

Mean DON



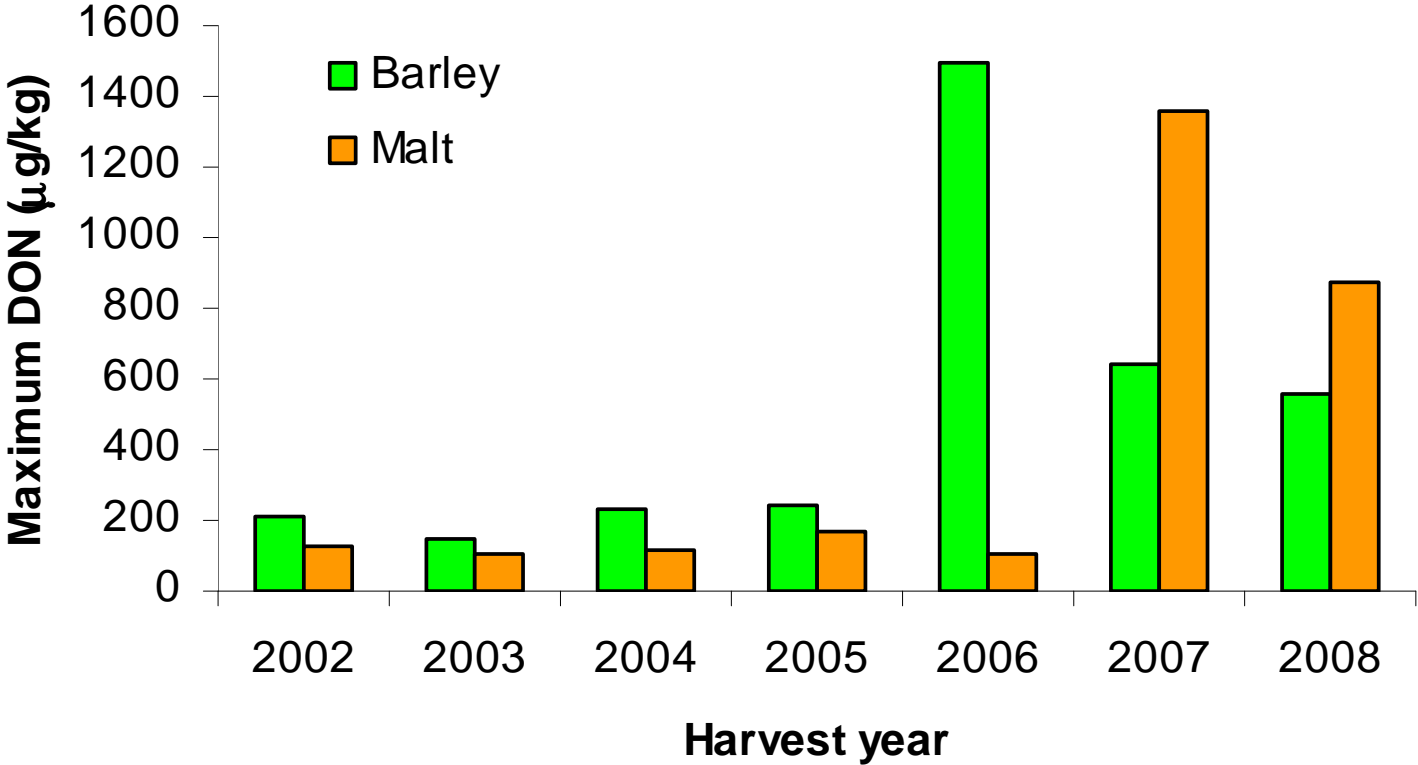
80 to 95 barley & malt pairs per year

Max T-2 + HT-2



80 to 95 barley & malt pairs per year

Maximum DON



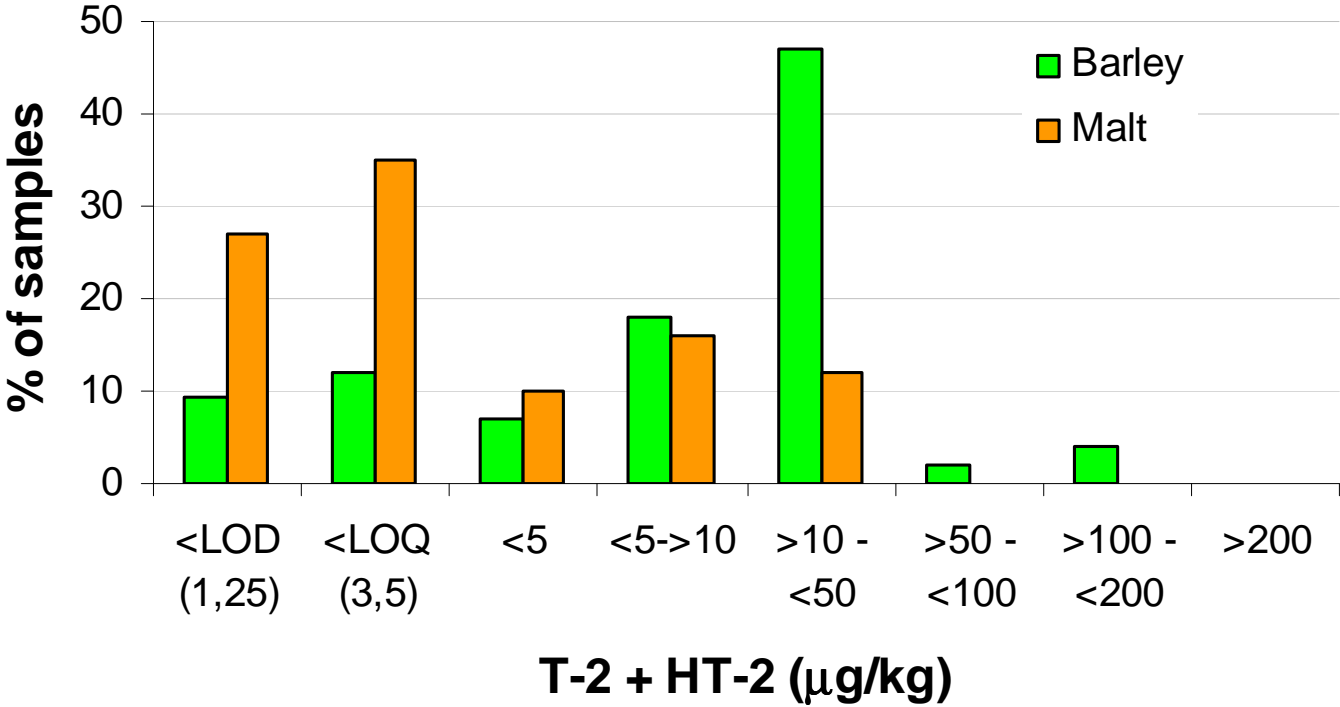
80 to 95 barley & malt pairs per year

Concentration of T-2/HT-2 and DON in barley compared with malt

- Concentrations (both means and maximum levels) of T-2+HT-2 in malt always a lot lower than those in barley
- Concentrations of DON in malt generally lower than those in barley, but may increase in years when DON in barley is high

Distribution of T-2 and HT-2 in barley compared with malt

Distribution of T-2 +HT-2 in barley and malt from the 2008 harvest



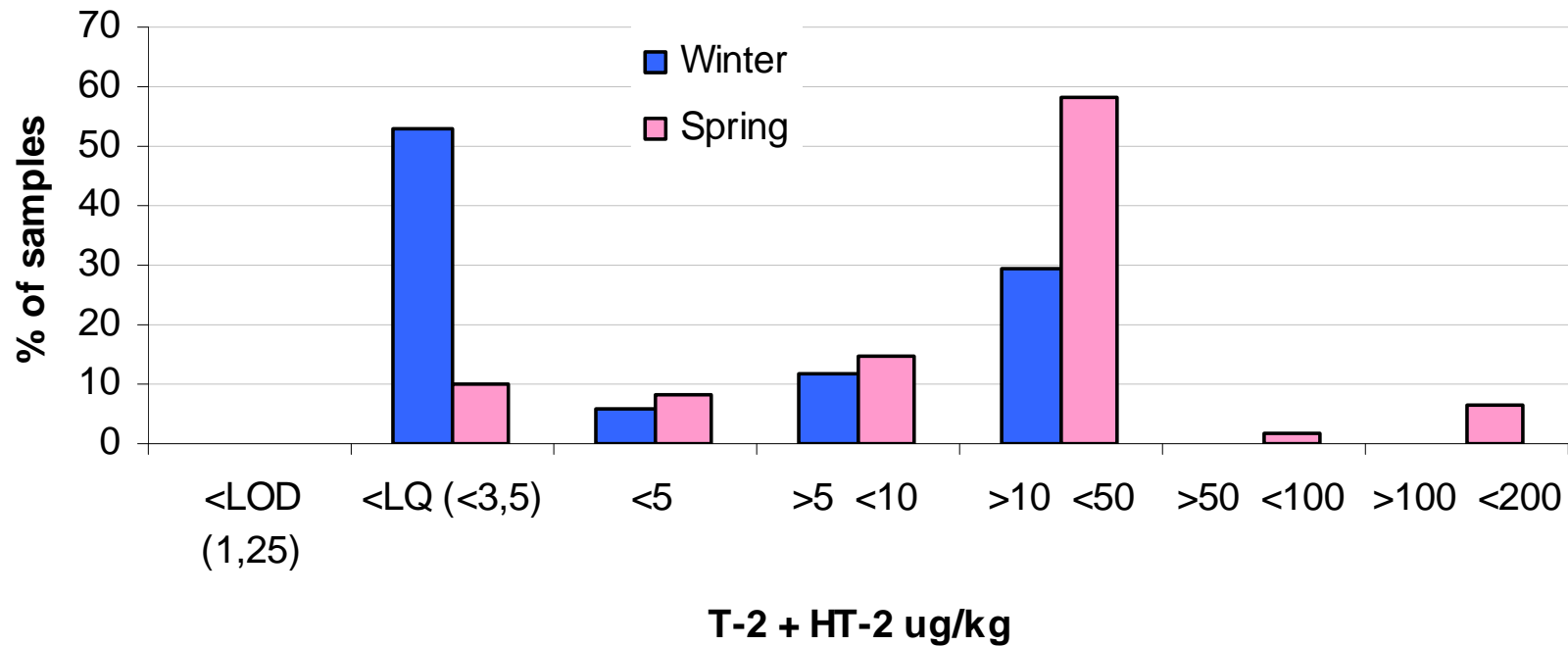
95 barley & malt pairs

Distribution of T-2 +HT-2 in barley and malt from the 2008 harvest

- T-2 + HT-2 is below limit of quantification in most malt samples
- Pattern is same as in previous years

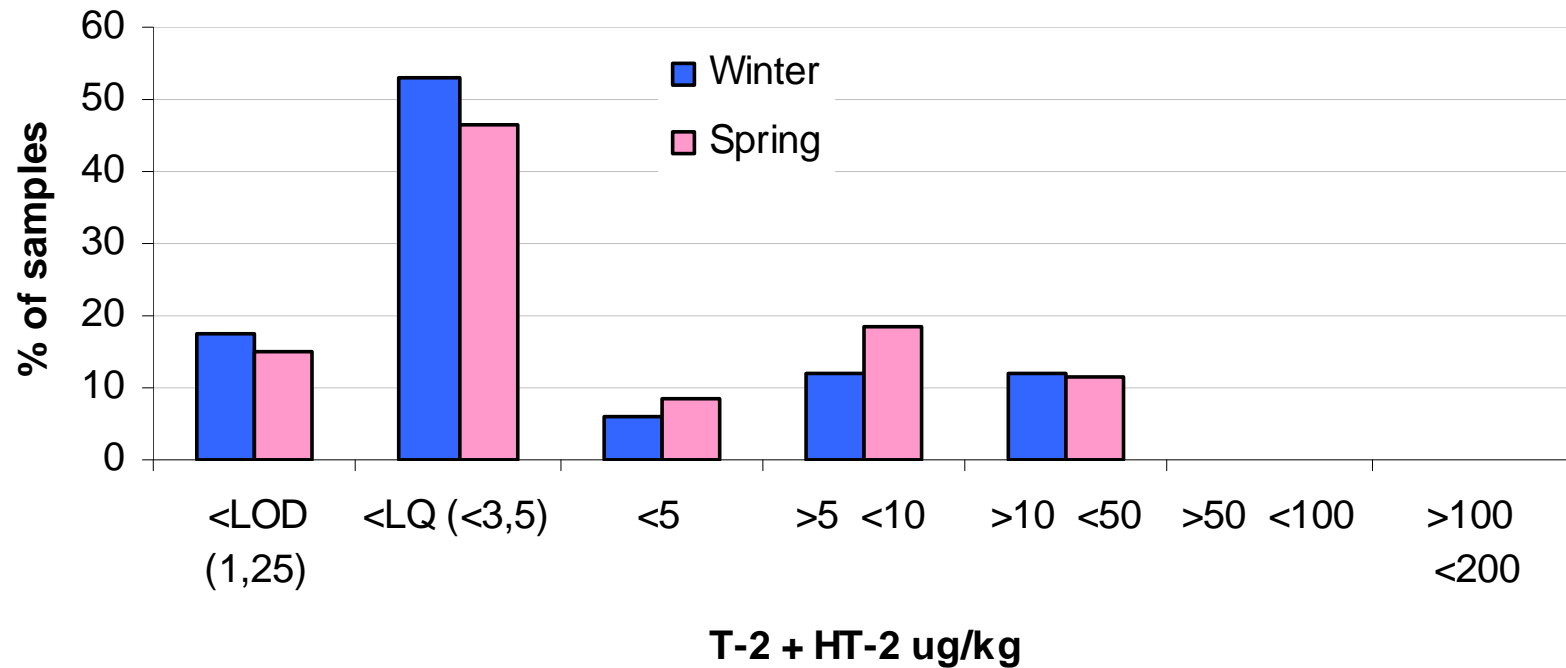
Winter v Spring barleys

T-2 + HT-2 in winter and spring barleys



60 spring barleys & 17 winter barleys

T-2 + HT-2 in malt prepared from winter and spring barleys



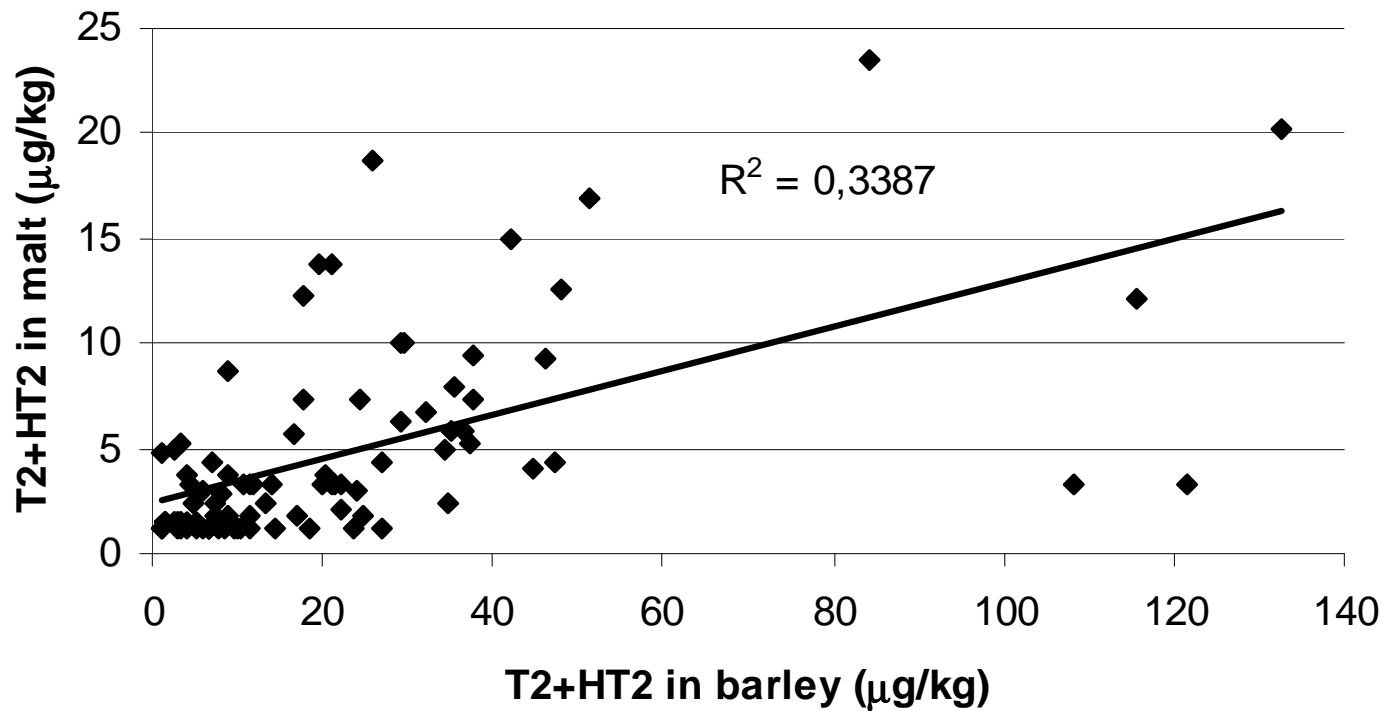
60 malts from spring barleys & 17 malts from winter barleys

Spring v Winter varieties

- French data from the 2006 and 2007 harvests presented at the 2008 Fusarium Forum suggested that T-2 and HT-2 might be lower in winter barley compared with spring barley
- Europe-wide data from the 2007 harvest suggested little difference between winter and spring barleys in occurrence and levels of HT-2: T-2 slightly lower in winter varieties
- Europe-wide data from the 2008 harvest suggest higher levels of T-2+HT-2 in spring barleys but the difference disappears after malting

Is there a correlation between T-2 + HT-2
in barley and in malt?

T-2+HT-2 in barley compared with malt



95 barley & malt pairs

Conclusions from survey

- Upward trend in the incidence of T-2 and HT-2 toxins observed until 2006 but this has since stabilised
- Incidence of DON does not parallel that of T-2 + HT-2
 - DON varies from year to year; related to climatic conditions
 - T-2 and HT-2 not significantly higher in wet years
- Sample set is too small to pick up significant differences between regions or countries

Conclusions from survey

- Mean and maximum concentrations of T-2 generally lower than those of HT-2 in both barley and malt
- Mean and maximum concentrations of both T-2 and HT-2 are significantly lower in malt than in the starting barley
- But no reliable correlation between T-2 + HT-2 in barley and that in corresponding malt

Preliminary research commissioned by Euromalt

*NB: these partial results are from single
small scale experiments only.*

The malting process

Raw barley grain



Steeping



Germination



Kilning



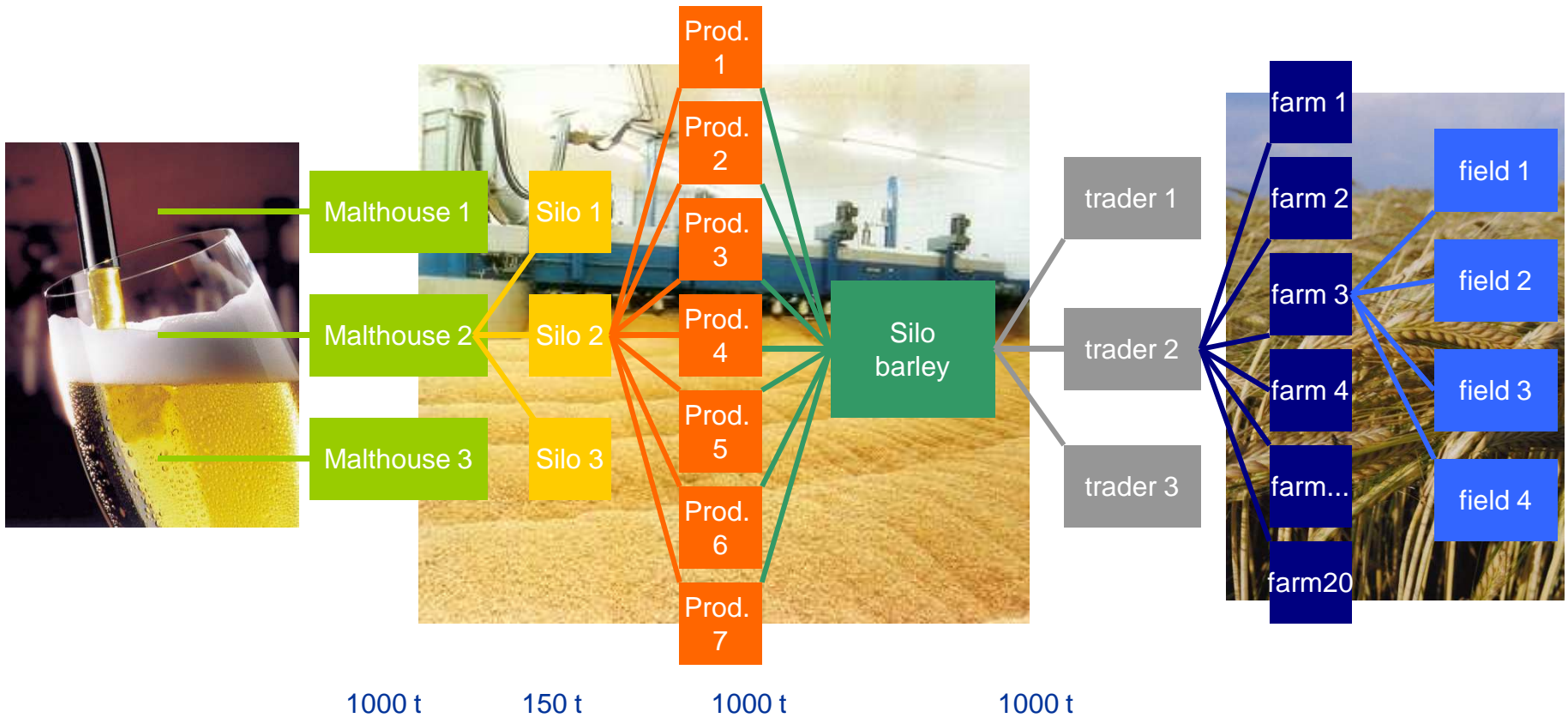
MALT

Factors which could possibly affect loss of T-2 and HT-2 during steeping

- Amount of water used
- Temperature of steep water
- pH of steep water
- Number of steeps
- Duration of steeps
- Extent of mixing / turbulence during steeping
- Thickness of husk
- Others?

Food safety and traceability

Possible toxin dilution from grain to glass



3 Malthouses x 3 Malt silos x 1 Barley silos x 3 Barley originators x 20 Farmers

540 Farmers - 2160 Fields

Euromalt is committed to

Study on the origins as well as means of controlling the development of these toxins, if there are any, in the field (under evaluation):

- To assess why the incidence of *F. langsethiae* is increasing in Europe (biology of the strain, fungi population's ecology in barley fields)
- To identify the main agronomic factors contributing to this increase (tillage, pre-crop, others?)
- To find out if there are any resistant varieties available
- To study what can be done to reduce *F. langsethiae* infection and toxin production in the field (natural and artificial antagonisms, fungicides)

