

# **Fusarium mycotoxins in UK oat production: Update on recent research**

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## Presentation

- 1. Fusarium mycotoxins in UK oats at harvest**
- 2. Impact of agronomy on fusarium mycotoxins in oats**
- 3. Impact of processing on fusarium mycotoxins in oats**
- 4. Further studies on fusarium infection and mycotoxin production in oats**

# Investigation of fusarium mycotoxins in UK barley and oat production

## Objectives

Determine the range of trichothecene, zearalenone and moniliformin contamination within harvested barley and oat grain over the four year period (2002 – 2005).

Determine how agronomic factors affect trichothecene, zearalenone and moniliformin contamination of grain. These included region, variety, cultivation method, previous crop and fungicide usage (including organic production).



## Methods - Sampling

100 grain samples and related agronomic data was collected at harvest by crop consultants and conventional and organic growers each year.

A similar number collected from each region.

A similar number collected from range of fungicide regimes including organic.

## Results - Oats

458 samples analysed over four years

All fusarium mycotoxins at low levels except HT2 and T2

Mean value for HT2+T2 of 550 ppb, maximum 9990 ppb.

	%>10ppb	Mycotoxin concentration (ppb)				
		Mean	Median	90th%	95th%	Max
DON	32	11	<10	24	50	282
NIV	72	49	24	120	176	847
HT2+T2	92	570	213	1492	2160	9990
ZEAR	1	<3	<3	<3	<3	29
MON	0	<10	<10	<10	<10	<10

EC limit for discussion was 500 ppb HT2+T2

UK sample average is higher than this.

## Fusarium mycotoxins in UK oat production

### 2. Impact of agronomy on fusarium mycotoxins in oats

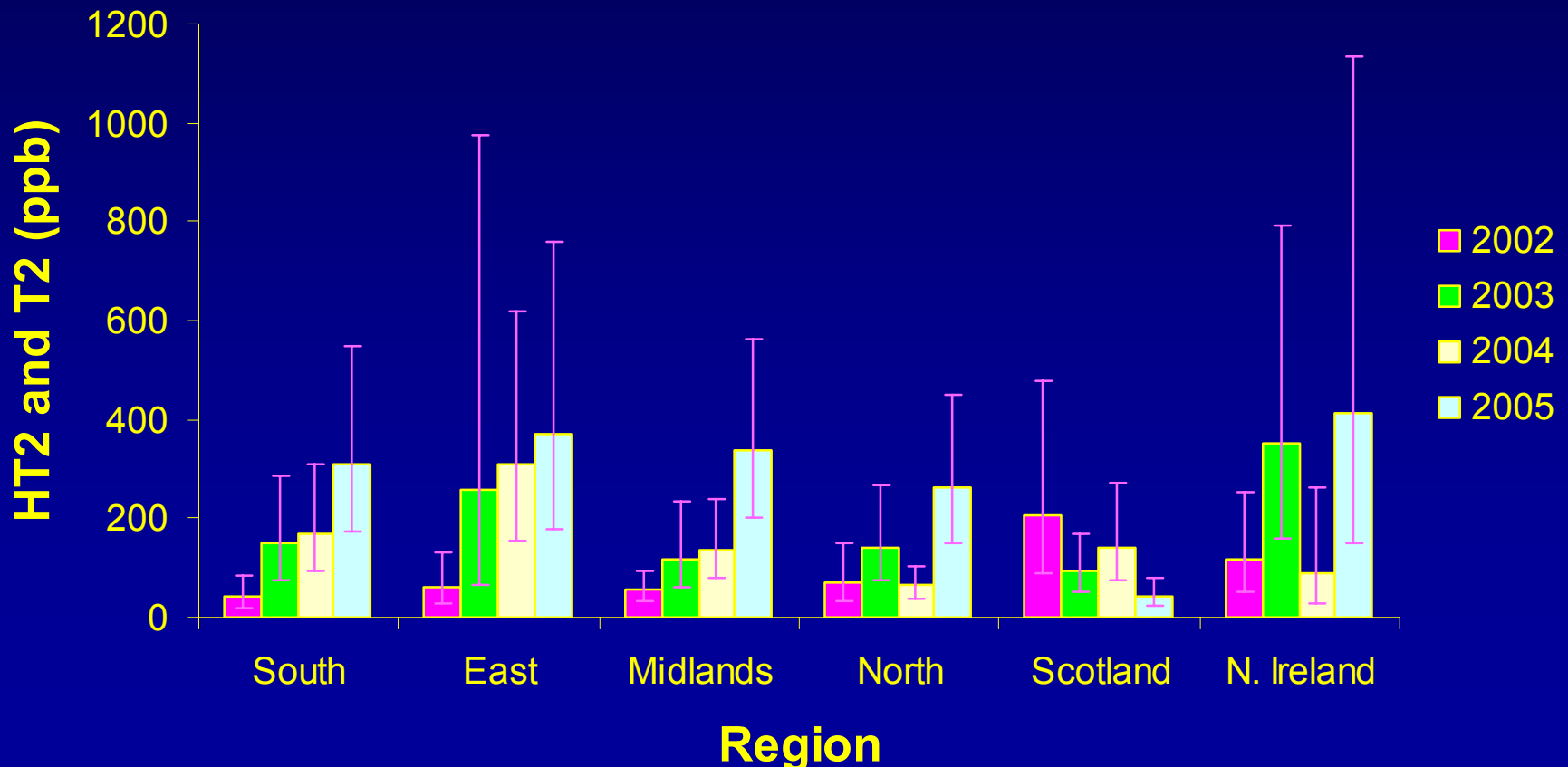
Statistical analysis indicates that variety, previous crop and practice (organic v conventional) are important, but analysis cannot distinguish between factors as largely interrelated (ie Organic growers do not tend to use min-till, follow wheat or grow Gerald).

Very different to DON in wheat

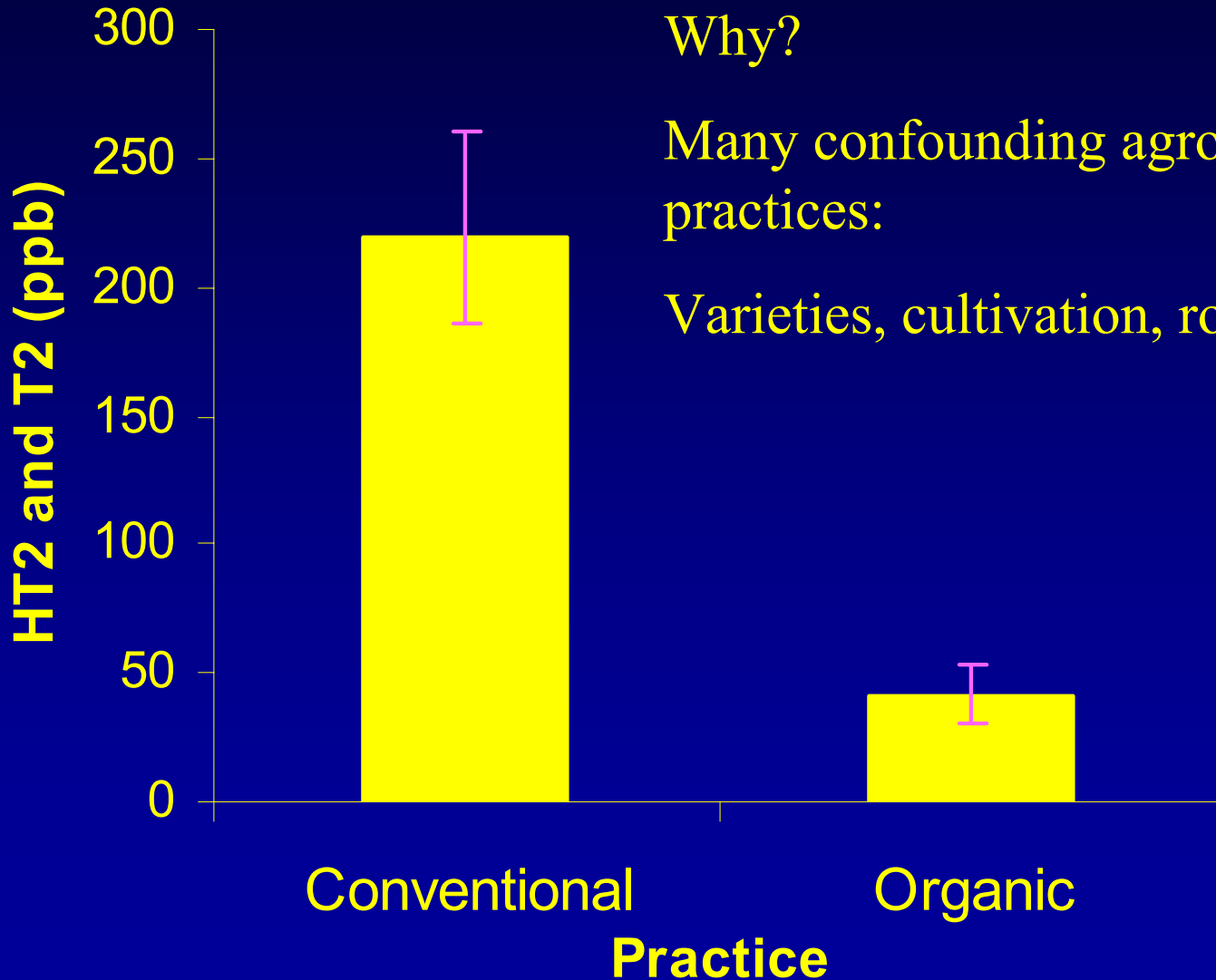
## Year X Region interaction

High levels can occur in all regions

Weather is having an impact but infection not dependant on temperature



## Practice



Why?

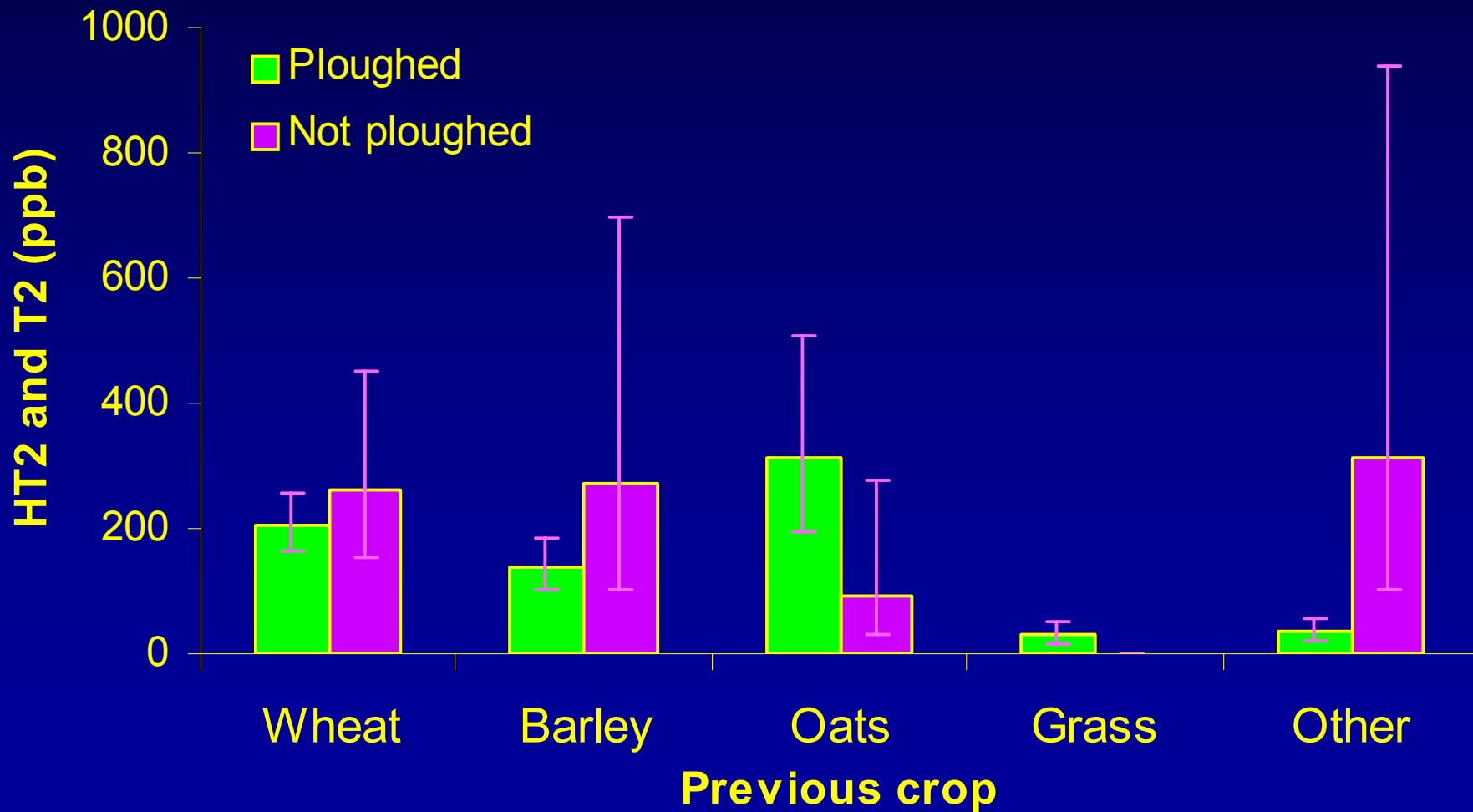
Many confounding agronomic practices:

Varieties, cultivation, rotation

## Previous crop X Cultivation interaction

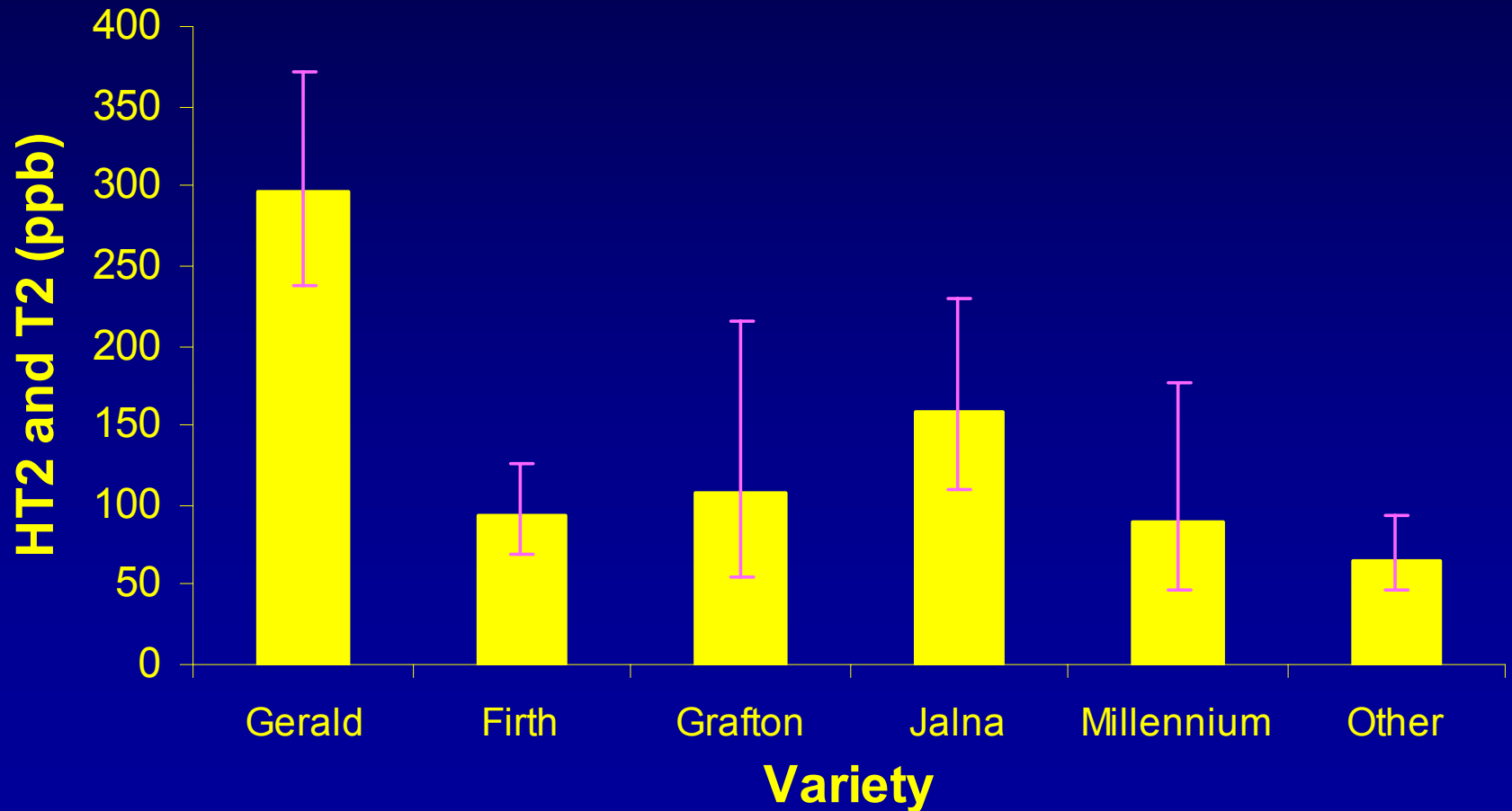
Most following wheat

Most following ploughing



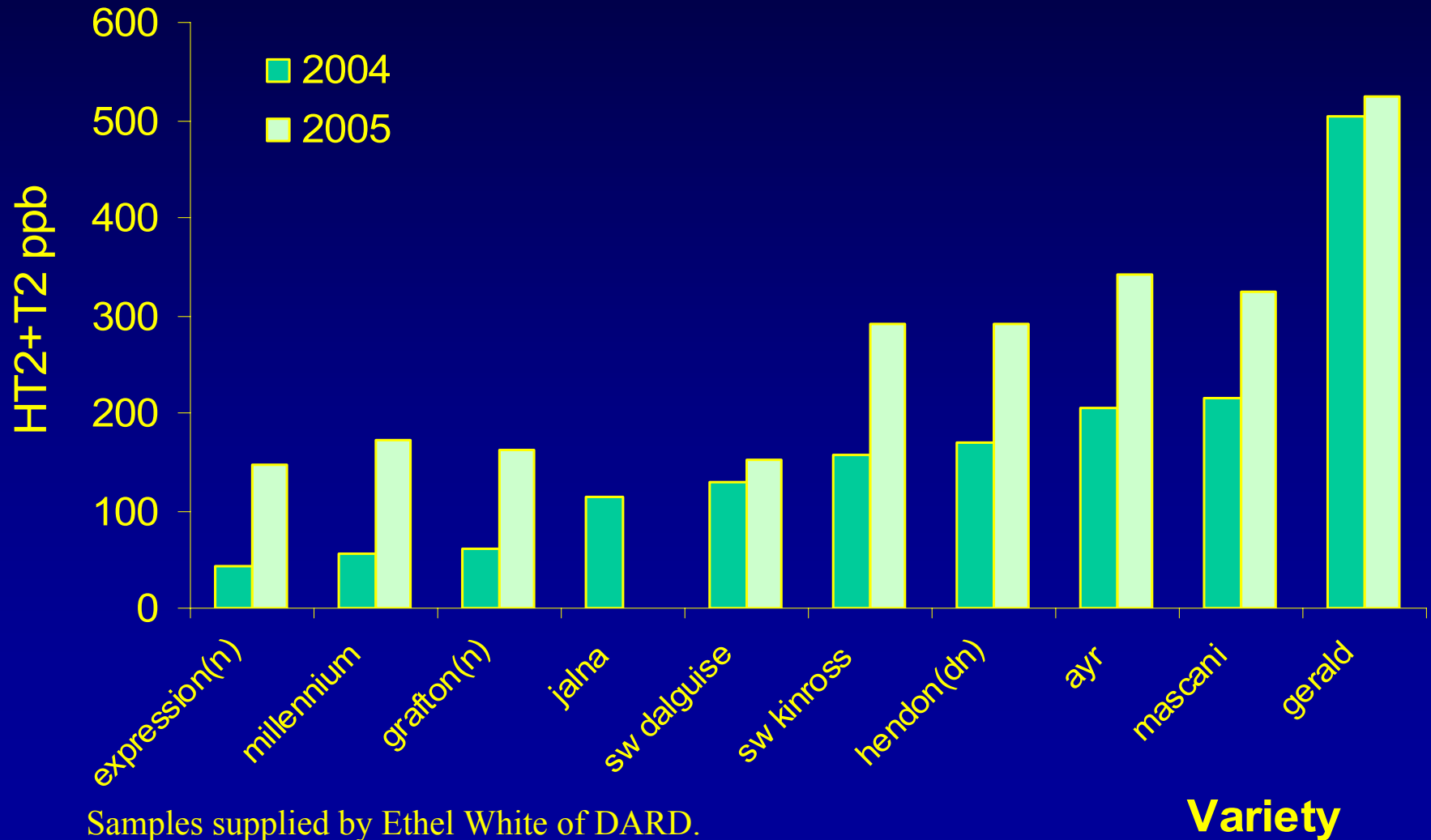
## Variety

Limited number of varieties with high number of samples



## Fusarium mycotoxin content of winter oat varieties

Values are predicted means from 5 HGCA variety trial sites from across UK



## 3. Impact of processing on fusarium mycotoxins in oats

Identified high levels in raw oats.

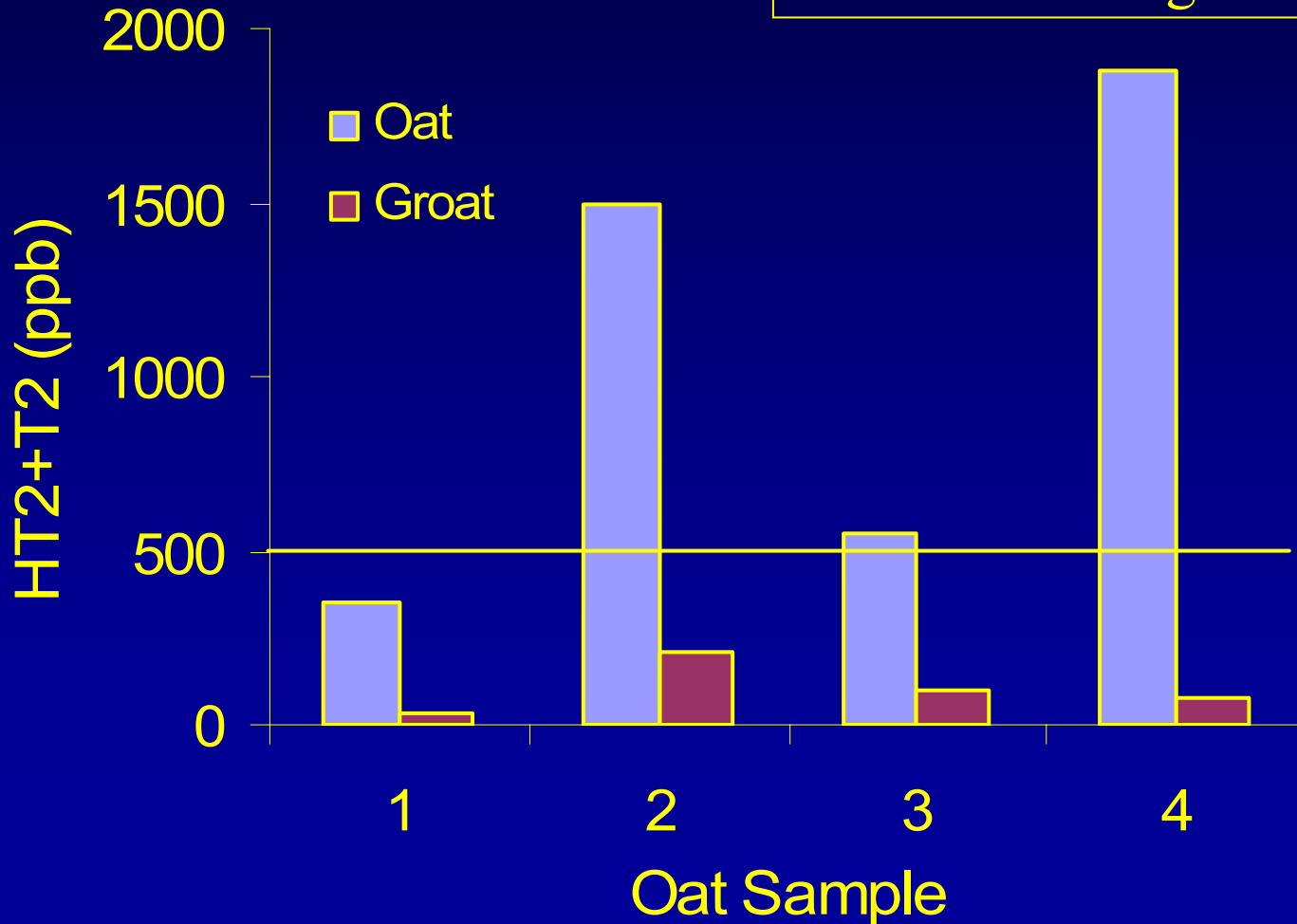
Needed to identify if high levels in finished products.

FSA commissioned a survey of fusarium mycotoxins in retail oat products and found mycotoxins present at concentrations which were “not of concern”.

Harper Adams did a small lab-scale de-hulling experiment where four samples with moderate to high HT2 and T2 were de-hulled and the resulting groats and hulls analysed for HT2 and T2.

## Laboratory scale de-hulling experiment of four oat samples

90-95% of mycotoxin removed during de-hulling



Needed further evidence on the impact of processing on fusarium mycotoxins in oats, ideally at industrial scale.

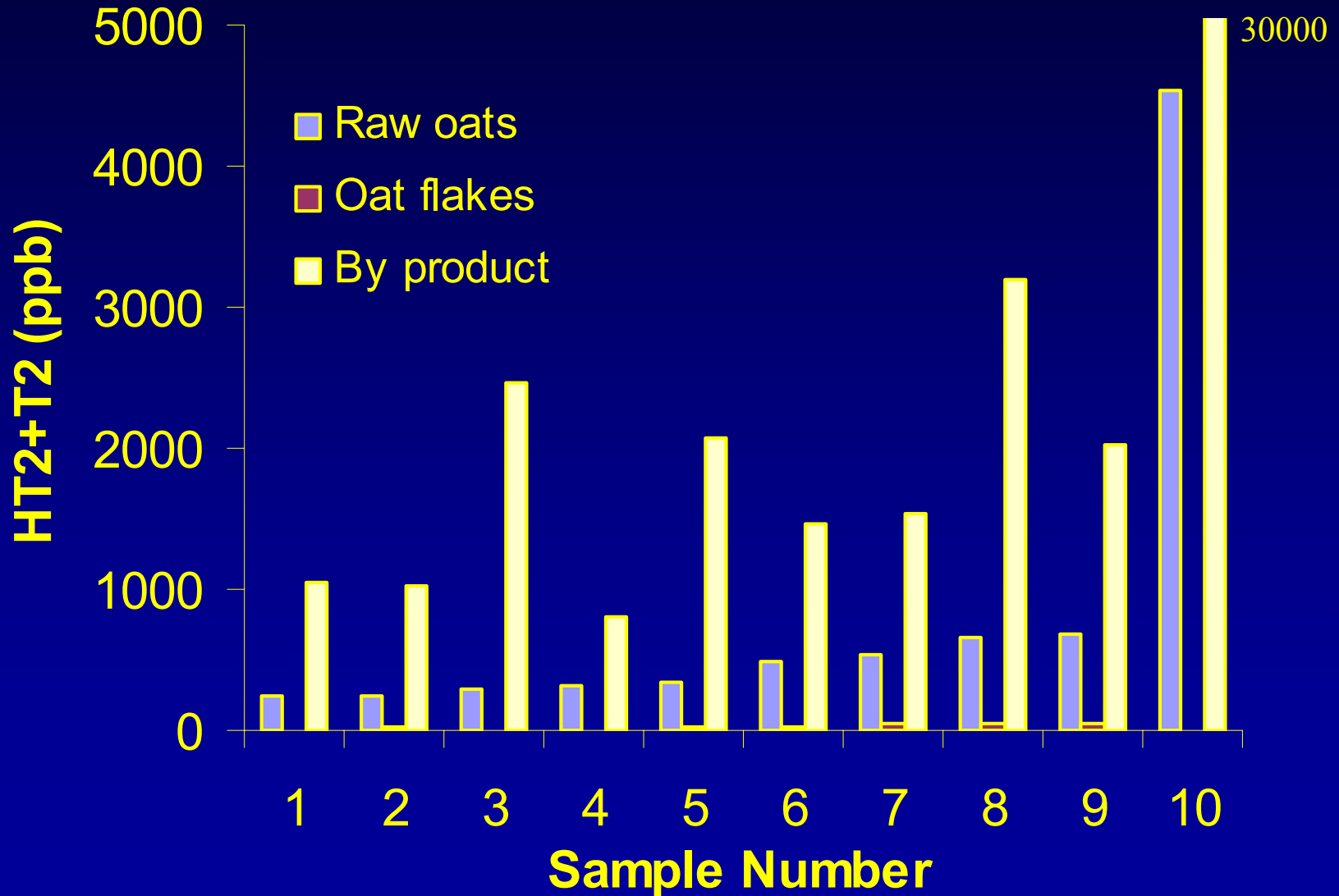
**Link project FQS64 Fate of Fusarium Mycotoxins in the Cereal Food Chain funded by Defra and “linked” to FSA Information Gathering Exercise (project CO3041)**

WP1 Effect of processing at commercial scale including oat flake production in conjunction with Quaker.

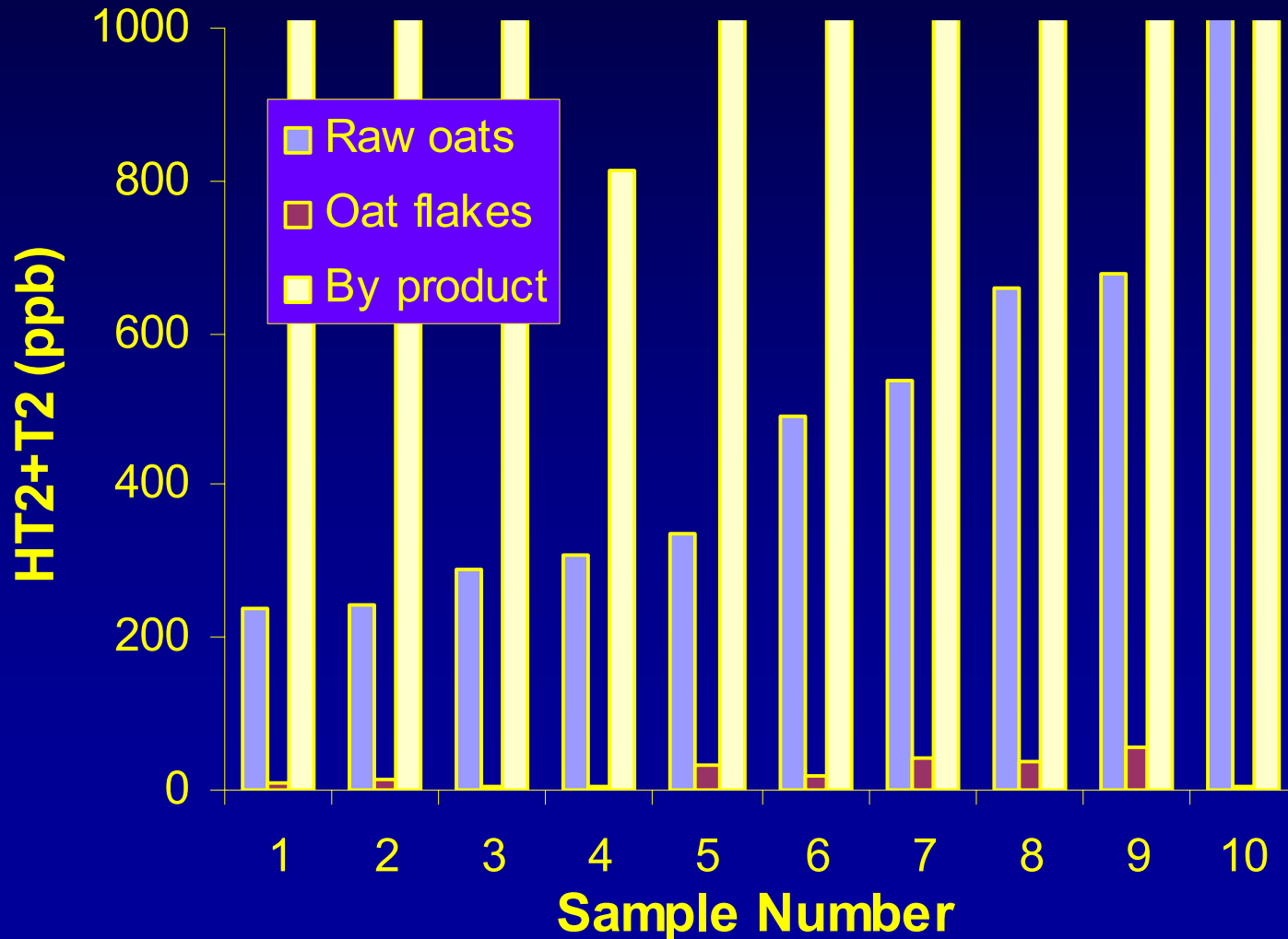
Sample five consignments of oats (50 ton) from mill intake to finished product (oat flakes) and by product (pelleted animal feed) with sampling points throughout the process.

Mass balance calculation to determine all mycotoxin present in raw oats is accounted for in finished products.

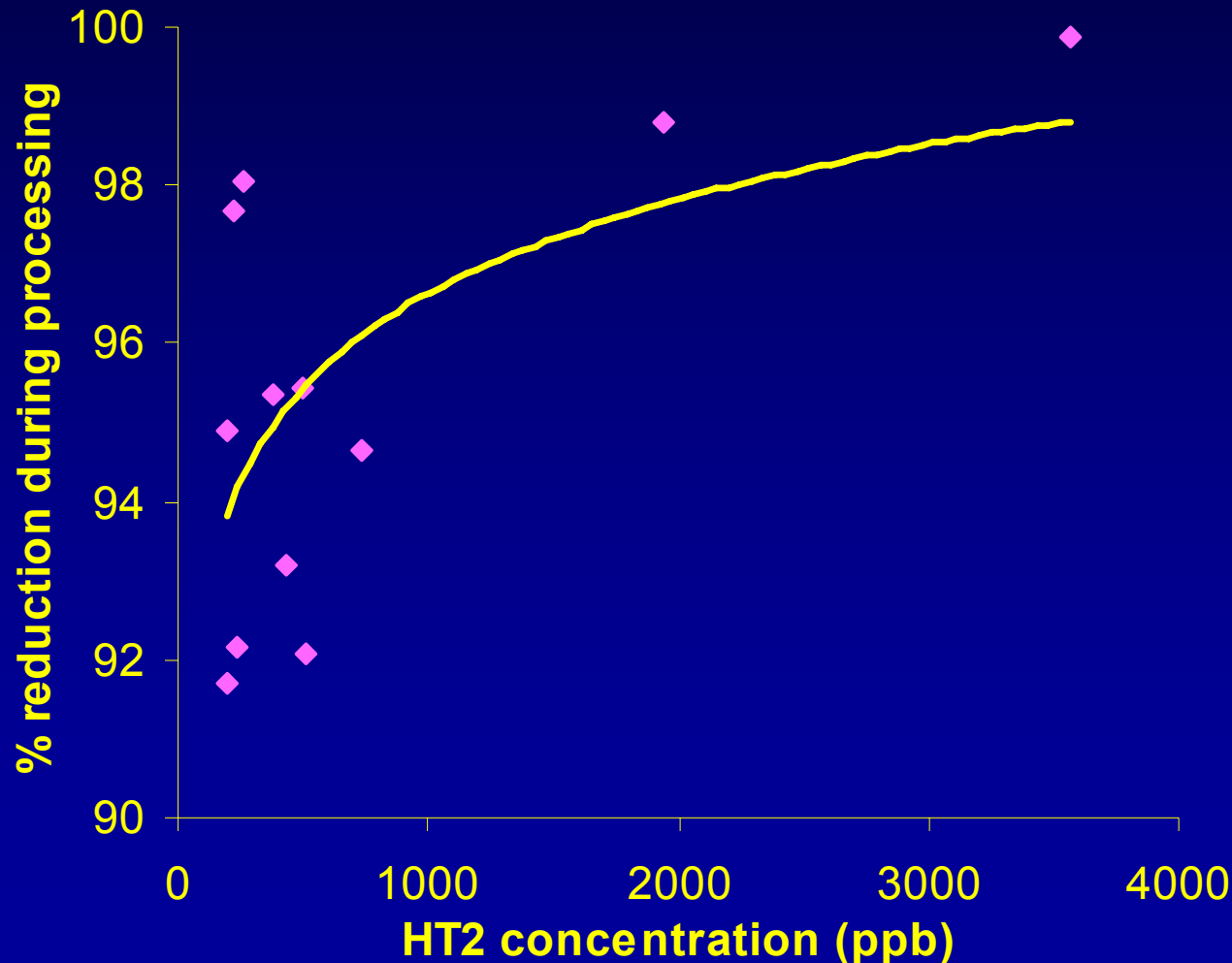
## Fate of HT2+T2 during commercial processing of oats



## Fate of HT2+T2 during commercial processing of oats



## Percentage reduction HT2+T2 during commercial processing of oats



Reduction has been consistently high in all samples to date.

Range of reduction from 90 to 99.9% (10-1000 fold)

Reduction appears to be higher for samples with higher concentrations of HT2 and T2 in raw oats.

Corresponding high levels in by product

Mass balance calculate ca. 100% of mycotoxin in raw oats is accounted for in products (indicates no gain/loss/modification).

## De-hulling Results:

Low levels entering human food chain

Large levels in by-product used in animal feed

Problem 1: Principle used in setting legislative limits is “safer to start with low levels.”

Can exemption be made for oats? Is it unique in that all oats are de-hulled for human consumption?

Problem 2: Guidelines for animal feed will follow - likely to end use of oat by-product in animal feed.

## 4. Further studies on fusarium infection and mycotoxin production in oats

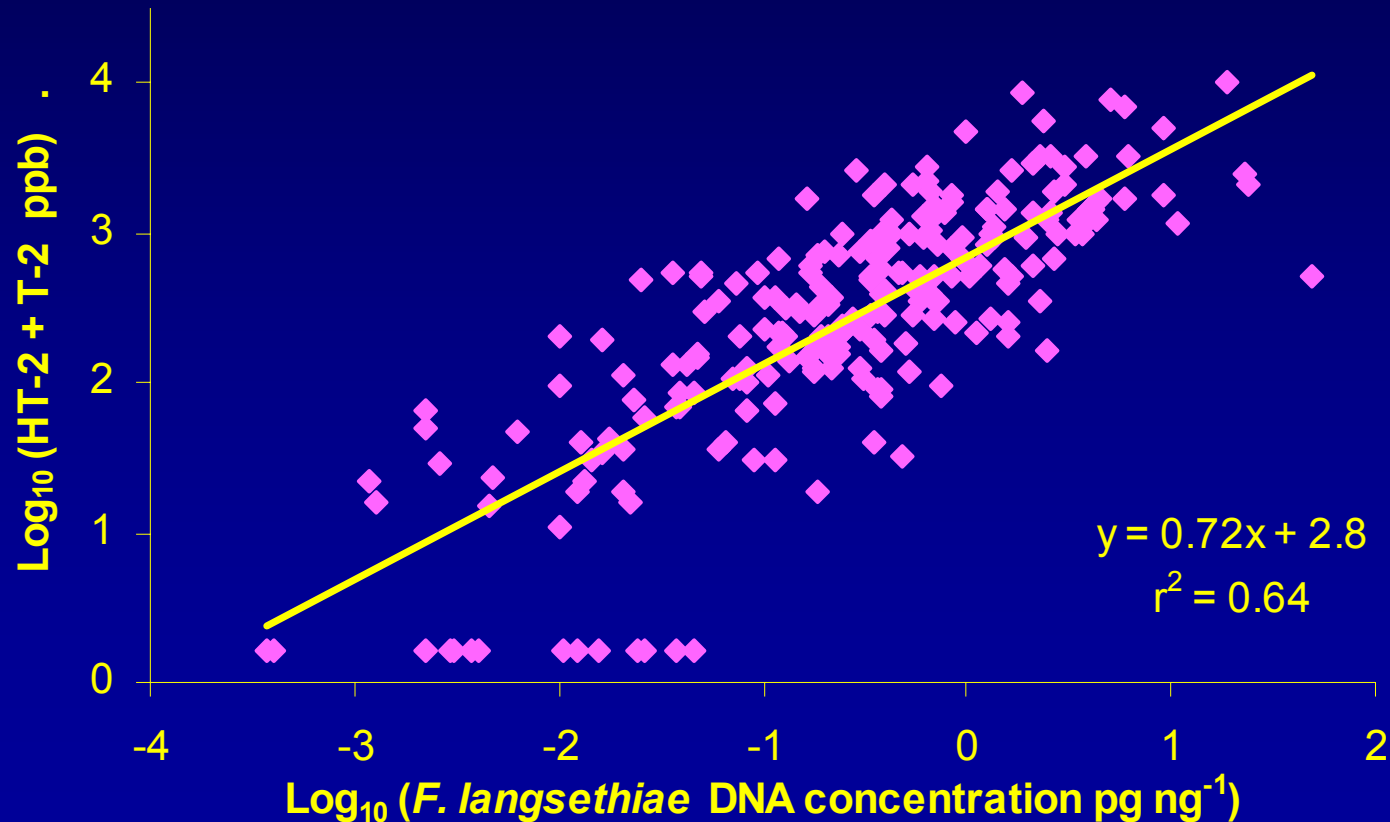
Need to identify fungi responsible and understand their relationship (epidemiology) with oats.

# **PhD studentship funded by HGCA, Quaker Oats and Harper Adams : Fusarium infection and mycotoxin production on oats**

There is vast scientific data on fusarium head blight of wheat. There is practically no data on fusarium head blight of oats by HT2 and T2 producers.

Aim 1 - Identification of *Fusarium* responsible

Result 1 - Sole species responsible identified as *Fusarium langsethiae*. This is a newly identified species so very limited information for it.



Aim 2 - Study its epidemiology on oats.

Result 2 - Unable to cause high infection of oats compared to natural background infection using either point inoculation, spray inoculation or ground-level inoculum. Does not behave like fusarium head blight of wheat.

Problem: Difficult to determine control methods if cannot artificially inoculate plants in glasshouse or field trials.

Current Work:

Identify if crop debris needed for high infection levels

Develop an in vitro plant bioassay for *Fusarium langsethiae* infection of oats using detached leaves

# Overall conclusions: Oats

High levels of HT2 and T2 in UK oats; higher than other countries.

EC timetabled legislation for July 2007.

Discussion limit of 500 ppb - if set UK oat industry will have major cost of large percentage of rejected crops and cost of analysis - No cheap or quick methods to quantify these mycotoxins.

Loss of by-product value as feed in future.

Limited information on what growers can do.

# Acknowledgements

Results detailed were funded by FSA, Defra, HGCA  
Quaker Oats and Harper Adams.

