HGCA

from theory to field

Trust underpinned

Mycotoxin monitoring is the backbone of maintaining public confidence in UK cereals, but it represents only a small part of grower-funded research into fusarium. *CPM* finds out what we've learned about the disease and the toxins it transfers.

By Tom Allen-Stevens

Any grower who suffered a yield and quality hit with their winter wheat last harvest will likely curse the scourge of fusarium head blight (FHB). But the greater threat to the cereal industry may be the mycotoxins the disease brings into the crop.

Monitoring these mycotoxins, their FHB source and other contaminants in cereals is the main focus of HGCA-funded research in this area, to ensure UK cereals meet EC legal limits and guidance levels. But there's also a drive to find out whether FHB management can be improved, explains Dhan Bhandari of HGCA.

"There's no question that UK cereals are safe — it's largely thanks to the HGCA-funded monitoring work that we know they're well within the limits set at EU level. But the 2012 harvest showed how FHB can have a major impact on grain yield and quality, and the drop in specific weight has been a concern right across the industry. So there are a number of key drivers behind this research."

Part of this is work to improve the modelling of FHB. "It's been a challenge in previous years to know what the risk of FHB is, and how levels of the disease relate to mycotoxin development. The risk assessment growers now use is a step forward, but work currently underway will bring the industry a much better system for assessing risk. It's also bringing us a greater understanding of how the disease and the associated toxins develop."

A major project, funded through the Defra-led Sustainable Arable LINK programme, is looking into the genetic aspects, continues Dhan Bhandari. "There's an association between wheat dwarfing genes and susceptibility to FHB. If we can hone in on that genetic link, it may be possible for breeders to introduce resistance, without compromising yield performance. The project is also looking at how host resistance and fungicide treatments interact."

These projects complement on-going monitoring of cereals for mycotoxins and

"The work not only shows cereals are safe, but underpins public confidence in the industry's ability to keep them safe."

other contaminants. "The monitoring is integral to maintaining public confidence in UK cereals. It's an independent and robust survey of a wide range of contaminants across wheat, barley and oats, but it's also flexible enough to bring in any new threats that may arise."

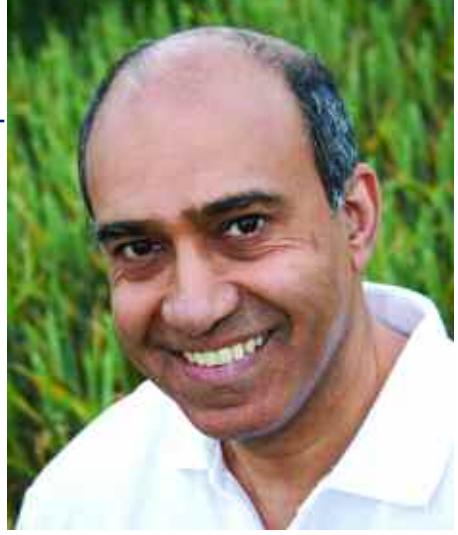
Two new contaminants have recently come on the radar at EU level, and have been incorporated into the research work currently underway. T2 and HT2 are mycotoxins found in wheat, barley and oats, similar to Deoxynivalenol (DON) and Zearalenone (ZON) that are produced by *Fusarium graminearum* and *F. culmorum.*

Two new contaminants T2 and HT2, produced as a result of fusarium, have recently come on the radar at EU level.

"They're closely related to DON, but produced by a different fusarium species," explains Prof Simon Edwards of Harper Adams University (HAU). "The main species responsible in the UK is *Fusarium langsethiae.* It's currently rarely detected in UK wheat, but the mycotoxins it produces are more toxic than DON. There's limited data on it and the European Food Safety Authority (EFSA) isn't currently too concerned. So the EC has issued an advisory limit of 100 parts per billion for T2 and HT2 on wheat and rye, 200ppb for barley and 1000ppb for oats with husks, and advised member states to monitor them."

F. langsethiae causes small glume blotches on the ear, similar to *F. poae*, that transfer infection to individual grains, he continues. "It's a weak pathogen and we don't see symptoms very often in cereals, but a relatively high level of T2 and HT2 has been found in oats."

The main body of work at Fera and HAU has been to monitor fusarium and mycotoxin levels. Research has focused on FHB monitoring at five trial sites across the UK, with samples for mycotoxin analysis supplied by growers as part of the Defra-funded winter wheat disease survey. "We're aiming to improve the predictability of the FHB model by incorporating meteorological data to the agronomic model we already have," says Simon Edwards.



HGCA-funded monitoring work shows that UK cereals are well within the limits set at EU level, says Dhan Bhandari.

"We know that the weather around flowering is critical — wet conditions and heavy rainfall events are conducive to FHB infection. But we're also looking at a wider weather window, to see how that relates. It's a complex model, but once we've completed this window-pane analysis, the ultimate aim is to produce a web-based tool ▸

Simon Edwards is aiming to improve the predictability of the FHB model.

▸ where a grower enters agronomic data and location and receives a better indication of mycotoxin risk."

There's still a lot of work that has to be done before that stage is reached, he admits. But as each harvest goes by, how FHB and associated mycotoxins develop, as well as their impact on the crop, all become clearer.

One of the most startling, recent findings, for example, has been the impact of a delayed harvest. "We thought this would increase DON and ZON levels by perhaps three to four times, but wanted more of a quantifiable risk."

So HAU student Robyn Elliott was tasked with analysing all the data, comparing actual harvest dates with long-term average dates and cross-referencing what mycotoxin levels were found for her final year project.

Harvest delays

"What we discovered was that DON levels increased by a factor of 12 and ZON by 15 if harvest is delayed by as much as four weeks — that's far higher than we'd expected," notes Simon Edwards (see chart right). "It highlights the impact the delayed wet harvest we had in 2008 and the importance of avoiding harvest delays when producing wheat for human consumption.

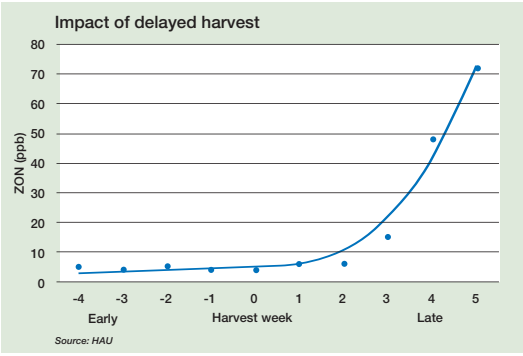
Despite this, mycotoxin levels found in wheat are still comfortably low, although the picture across the UK is changing. *F. graminearum* has only been detected lin UK crops since 1998, but recently levels of the pathogen have overtaken *F. culmorum*. The significance of this is that *F. graminearum* can be transferred through airborne inoculum, while macronidia of *F. culmorum* are only transferred via rainsplash.

"With more of a fungus capable of airborne dispersal, we're likely to see more FHB epidemics," points out Dr Paul Nicholson of John Innes Centre. "Meanwhile, most UK wheat varieties are highly vulnerable to the disease."

This is the background to the industry-funded INSPYR project, led by JIC, which aims to provide breeders with the tools to introduce FHB resistance into UK wheat. "FHB susceptibility has long been associated with Rht2 — the semi-dwarfing gene. It's a very close genetic association, so very difficult, if not impossible to separate the two," explains Paul Nicholson.

JIC researchers have delved deep into the wheat genome to determine whether this association is pleiotropy, in which a single gene — Rht2 in this case — affects more than one trait, or linkage. "If it's linkage, ▸

ZON levels increase by a factor of 15 if harvest is delayed by as much as four weeks.



Mycotoxin research delivers on-farm confidence

For Mike Hambly, mycotoxins aren't just a concern for his own produce. A mixed farmer with 105ha of cereals near Callington in Cornwall, he's also chairman of HGCA's British Cereal Exports, so is aware of the value to the industry of having a robust system in place.

"The key thing is that we have risk-analysis methods in place that are considered by the whole supply chain to be robust and that deliver confidence in UK cereals. The levy-funded work in this area represents a huge saving to the industry in terms of removing the need for unnecessary testing, as well as providing guidelines for managing and minimising the risk."

His four-course rotation on his sandy clay loams includes KWS Cassia winter barley and JB Diego wheat, both grown for livestock feed, and Mascani winter oats, for human consumption, with the oats stored and sold through Kernow Grain.

"The oats are a key concern, and you worry about T2 and HT2 — I need to be confident that the crop I deliver is fit for purpose and won't be rejected. But the feed sector is tightening up now, too — mycotoxins can affect fertility and feed conversion ratios in pigs and dairy cattle in particular. As a livestock farmer, I want to be sure my home-grown feed is safe, too," he says.

Mike Hambly believes it's important that sound scientific research underpins the mycotoxin monitoring work.

He's in a high-risk area with high rainfall, so there's a strong chance of fusarium infection. "This means we think carefully about rotation and cultivations — we still plough and there's no maize, which both help."

The T3 fungicide is also applied at robust rates on the wheat. "We're planning to use Prosaro (prothioconazole+ tebuconazole) with some extra tebuconazole."

It's through following the risk analysis on farm and the robust HGCA-funded monitoring that confidence is delivered throughout the supply chain, he believes. "The industry's worked hard to build a high level of public trust through crop assurance and schemes such as the Voluntary Initiative. Everything's transparent and this puts us in a very good position.

"But it's important that we continue to deliver this based on sound scientific research, so that we aren't set unrealistic parameters that don't bring any real benefit. That's what the HGCA funding provides, and there's a huge potential saving for the industry it represents," concludes Mike Hambly.