HGCA

from theory to field

Tools to tackle the toxin threat

A new project is underway to improve fusarium risk reporting, while considerable genetic advances have been made in the quest for cereal varieties with better resistance. *CPM* gets an update on current research.

By Tom Allen-Stevens

In the run-up to harvest, and in the melee itself, how much of a priority is your risk-assessment form for fusarium head blight (FHB)? Be honest — when you set it against the myriad other decisions that need to be made to bring in a quality crop, pulling out a form and filling in how much rainfall landed on the ear at flowering and at harvest to satisfy a European directive on mycotoxins, which have hardly ever been found at high levels on British grain, probably isn't top of mind.

That's just what's worrying the grain trade at the moment, according to Dr Dhan Bhandari of HGCA. "No one's making any suggestion that British grain is unsafe, and indeed it's the robust checks and measures we have in place that ensure that remains the case. The danger is that growers may be complacent about mycotoxins, and in a high-risk year, the consequences could be serious."

Risk assessment

The focus has fallen on the risk assessment itself. A major HGCA-funded project led by Harper Adams University to improve the modelling of FHB and mycotoxin prediction completed recently. The results have been drawn into the risk assessment to ensure it accurately conveys the level of risk from a particular batch of grain.

"Part of the ongoing research has been to compare completed risk assessments with levels of mycotoxins measured. Where the assessments have been made accurately, there's a good correlation between the level of deoxynivalenol (DON) and what you'd expect," he reports.

"But there's a small percentage where that's not the case, and occasionally there's been a 'false negative', where a risk assessment gives the all-clear but mycotoxins are subsequently found. That's a scenario we have to avoid if we're to maintain trust in the system."

The way the risk assessments are used has also evolved. "They were originally designed to help growers understand the threat of FHB. But now they often form part of the grain-trading process — that puts a different slant on how reliable they have to be."

So a new project has just started that'll provide growers with information needed for the risk assessment, to make it easier to complete it accurately (see panel on p19). "It'll combine meteorological data with observations from the field to give some

> *"The monitoring is integral to maintaining confidence in UK cereals."*

standard localised figures that growers can use to help them complete the risk assessment. Grain samples will then be taken to validate the results.

"This should provide some real-time information that growers can act on. But more importantly, it'll raise awareness of the issue, especially in a high-risk year," explains Dhan Bhandari.

Ultimately it's hoped growers will be able to download forms that are already pre-populated with some of the data relevant to their area, although generating such a provision isn't part of the new project.

The risk assessment and the research programme complement ongoing monitoring of cereals for mycotoxins and other contaminants. "The monitoring is integral to maintaining confidence in UK cereals. Along with risk assessments, it also helps grain processors keep their testing at an economically feasible level," he notes.

There's also been progress in the industry-funded INSPYR project (see panel on p19). "The good news is that scientists have identified one of the specific genes responsible for FHB susceptibility. The gene markers have been handed on to breeders, which should bring more resistant varieties in future."

And there's also been further HGCA-funded work on fungicide performance. "The disease ratings for FHB are currently very narrow. We're looking at this rating scale to ensure the scores best reflect varietal resistance and susceptibility differences between varieties."

The new project on FHB risk reporting has only just got underway, explains lead scientist Sarah Wynn of ADAS. "We now know a lot about mycotoxin development and how that relates to the weather at flowering and harvest. This is about the practical application of that knowledge in a form growers can actually use."

Agronomist network

Met Office data on rainfall will be linked to observations from the field on the crop growth stage. "We have a network of 29 agronomists who will be sending in regular reports from ear emergence through to end of flowering. This will be combined with the weather data to give an indication of FHB risk in a particular area for that week, as well as a cumulative measure of risk for the season."

The reports will be available on the HGCA website, and growers and agronomists can request an email alert by contacting HGCA. "The aim is to raise awareness, as well as provide actual data at county level that growers can use to refine their risk assessments. We ran a pilot last year which proved successful," she says.

At harvest, there'll be a validation exercise. "We'll be taking samples of grain from three areas defined through the reporting as being high risk for FHB, low risk and moderate risk. From each area, we'll take 20 samples of grain and assess whether mycotoxin levels correlate with what the results of the monitoring work suggest. We're also receiving samples from Camgrain to supplement these."

The danger is that growers may be complacent about mycotoxins, notes Dhan Bhandari.

In addition, researchers are looking to develop an early mycotoxin risk warning for growers. "We're taking plant samples shortly after flowering, at mid grain-fill and just prior to harvest. We want to see if we can reliably detect DON sooner."

But the thrust of the project is not to build research-based knowledge, she stresses. "Key to its success will be getting ▸

Awareness is key to addressing mycotoxin mystery

Philip Meadley has a closer relationship with the end user of his grain than most growers. Located nine miles south of millers E B Bradshaw and Sons at Driffield, E Yorks, all the wheat produced by Highthorns Farm is delivered there using the farm's own transport.

"We get everything tested at harvest, and grain that's in spec is tested for mycotoxins. It's a real concern for them, so we aim to make sure we do all we can to reduce the risk of it being a problem," he says.

With 230ha of combinable crops and vining peas, winter wheat joins winter barley, oilseed rape, dried peas and beans in the rotation. Group 3 and 4 types Revelation, Zulu, Relay and JB Diego are grown for the biscuit market. "Bradshaws use the bran, as well as the flour, and that's where there's a greater risk of mycotoxins being above the legal limit," he explains.

"We're learning all the time about fusarium, but it's not an exact science — there's only so much you can do to reduce the risk." For Philip Meadley, this includes an earwash spray, which is usually prothioconazole-based. Crops are also assessed as harvest approaches and prioritised in the order they ripen to try to minimise overexposure to adverse weather.

But in the end, it's the weather, rather than growers' actions that determines the risk of mycotoxins developing, he points out. "Through testing, Bradshaws have found different levels of mycotoxins turn up on grain from different areas, and no one really knows why."

He reckons the new monitoring project will help by providing regionally focused information that's pertinent to the fusarium risk. "I'd like to see a system like Smith periods in potatoes, where we become accustomed to alerts when certain weather conditions mean there's a high risk," he says.

"Except it wouldn't necessarily inform us whether to spray but make us more aware that fusarium levels may be particularly high. We could then work with end users so that they could target testing in a more informed way."

Philip Meadley would like to see a system like Smith periods in potatoes, that would warn when fusarium levels may be particularly high.

The risk assessment has been updated following recent work on FHB and mycotoxin prediction.

▸ growers engaged. Too often mycotoxin risk in cereals is seen as someone else's problem. Growers are in the best position to do something about it, reduce the risk and reduce the cost to the whole industry."

One clear way to reduce the risk is to choose varieties with a high resistance to FHB, but there's currently a problem with that aim, notes Dr Paul Nicholson from the John Innes Centre. "Unfortunately nearly all commercial lines are highly vulnerable to FHB. They're genetically predisposed to this because FHB susceptibility has long been associated with *Rht2* — the semi-dwarfing gene."

Two forms of FHB resistance are well recognised, he explains — Type 1 confers resistance to initial infection, while Type 2 resists spread of infection within the ear. "The Type 2 resistance is where the association with *Rht2* comes in."

One of the aims of the INSPYR project was to delve deep into the wheat genome and explore whether the association between *Rht2* and the lack of Type 2 resistance could be broken. "We weren't sure whether it was a gene very close to the dwarfing gene that conferred resistance, or the actual dwarfing gene itself."

Genetic markers

It proved to be the former, and scientists have now successfully broken the link. "Breeders now have genetic markers to help them produce resistant varieties that also have the *Rht2* gene. They can use these to screen out from their own material lines that don't have the higher Type 2 resistance. It's a bit like a software company distributing a new security patch, although it'll take some time before the higher resistance appears in commercial lines."

Samples of grain will be assessed to see whether mycotoxin levels correlate with what the results of the monitoring work suggest.

The aim is to raise awareness, says Sarah Wynn, as well as provide actual data at county level that growers can use.

In barley, it works a bit differently, however. "While height is often associated with a greater FHB resistance in wheat, that doesn't appear to be the case for barley. We found several regions of the barley genome associated with resistance to FHB and showed this was independent of height," notes Paul Nicholson.

Fungicide trials showed treatments generally reduced mycotoxin levels by around 50%. "On its own, this may not be enough to bring an infection below the EU threshold. But we found that an integrated approach, using both FHB resistance and fungicides, would achieve this."

Type 2 FHB resistance relates to spread of infection within the ear and is where the association with Rht2 *comes in.*

But researchers noticed a significant difference in the effect achieved in the fungicide trials. "The greatest reduction in symptoms from the fungicide was achieved where a wheat had Type 2 resistance. The fungicide therefore appears to mimic the behaviour of the Type 1 resistance — reducing initial infection."

So real resilience to FHB will come once this Type 1 resistance has been explored further, and that research is currently underway in a separate public-funded project, says Paul Nicholson.

"It's been known for some time that awned wheat has less susceptibility to FHB. We now know that there's an association between the presence of awns and Type 1 resistance.

"The really interesting thing about Type 1 and its association with awns is that the presence of the gene in question actually suppresses awn development. So somehow the fungus may be exploiting that gene — I'd really love to know more about that gene because it'll give us a much greater insight into the fungus itself," he enthuses.

It's a work in progress, but is beginning to come together, he concludes. "It's like a very bad and complex jigsaw puzzle. Now and then we join a few pieces together and find out where they fit, and slowly but surely, we're beginning to see the whole picture." ■

Paul Nicholson is keen to explore the gene that suppresses awn development as he reckons it'll give him a much greater insight into the fusarium fungus.

Research round-up

HGCA project 2130001105, Fusarium risk reporting, based on real-time data collection, runs from Apr 2015 to Dec 2017. Its aims are to improve the information available on fusarium-infection risk during flowering, raise awareness among farmers of mycotoxin risks and to aid accurate completion of mycotoxin risk assessments and increase reliability of information for the supply industry. Led by ADAS, with Camgrain as an industry partner, its cost is £88,421, funded by HGCA.

HGCA project 3779, Monitoring of mycotoxins and other contaminants in UK cereals used in malting, milling and animal feed, runs from Aug 2012 to July 2016. Its aims are to survey the incidence and levels of key contaminants in representative samples of UK-grown cereals and co-products to ensure they meet legal compliance guideline limits and are safe for human consumption and monitor current and emerging legislation and contaminant issues that could impact on the safety of cereal-based foods and their acceptability in key markets. The project is led by Campden Technology, with partners AIC, MAGB and nabim. Its total cost is £636,533, funded by HGCA.

HGCA project 3453, Integrated strategy to prevent mycotoxin risks (INSPYR), ran from Oct 2009 to April 2014. Its aim was to break the association between fusarium head blight (FHB) and the *Rht2* semi-dwarfing gene in UK wheat and enable breeders to produce FHB-resistant *Rht2* varieties. The project was led by the John Innes Centre, with Defra and other industry partners. Its total cost was £1,388,830, with £210,000 funded by HGCA.

Information Sheet 40, Risk assessment for fusarium mycotoxins in wheat can be downloaded from *www.hgca.com/mycotoxins*.