Sensing something in the air

AHDB CEREALS & OILSEEDS

from theory to field

Advances in spore detection are set to take disease monitoring to a whole new level. *CPM* reports on the research that aims to put growers fully in the picture.

By Tom Allen-Stevens

Imagine if you could go into your crop, inhale deeply, and tell there and then whether there was any disease inoculum putting it at risk. Not only that, but imagine if, from just that one sniff, you could tell if the inoculum was resistant to the fungicides you have in the shed.

It sounds far-fetched, but research underway could deliver just that — well, not perhaps through your own nose, but via an electronic nose that sends a signal out to your mobile phone. “It’s a massive step forward in spore trapping,” enthuses Dr Jenna Watts of AHDB Cereals and Oilseeds.

“Currently there’s a delay of around three weeks between the time when spores appear and when the information gets out to growers — that’s how long it takes to process the data from spore traps primarily designed for research purposes. We’ve had to rely on models to give growers a reasonable indication of risk. The difference here is that the trap will deliver in real time information on disease you can’t see, but that’s already getting a toe-hold in crops.”

The new automated detection will use

The new technology will not only detect the presence of a pathogen, but deliver information on specific known strains within the population, says Jenna Watts.

a DNA-based method to identify key pathogens. “One of these will be *Septoria tritici*. The aim with the new technology will be not only to detect the presence of the disease, which at critical treatment growth stages is usually common, but to deliver

information on specific known strains within the population. So we'll have instant feedback on the development of fungicide resistance."

The new project runs concurrently with one that has a similar aim for potatoes and sugar beet, funded by Innovate UK. It also links in with another one that's just started (see panel on p33) that'll improve current reporting on sclerotinia risk in oilseed rape. "We already have a good model that gives information on when to time sprays. This goes a step further and builds in information on what levels of disease are actually present."

The overall aim is not only to improve the level of disease monitoring, but to ensure the information gets to growers when they need it, she says. "We've been developing a disease-monitoring platform on the AHDB website, bringing together localised information on a number of key pathogens, and the risk of development of disease within the crop. We see this research becoming a vital heads-up on actual disease threats for growers, sending out localised alerts in the future they can act on."

The Hirst spore sampler sucks air in through a narrow orifice onto a slowly rotating roll of sticky tape that picks up the spores.

Spore distribution

Prof Jon West of Rothamsted Research, who's leading the automated air-sampling device project, sees it as another form of precision agriculture. "We know quite a lot about how airborne spores are distributed from known sources — given the correct conditions, fruiting bodies will disperse the spores, so there are quite sophisticated models that base the risk of infection for certain diseases, such as phoma and light leaf spot, on weather and crop growth stage.

"For some pathogens, however, you get the right weather for infection, but there are no spores locally. In those instances, a lot of fungicide could be applied to crops unnecessarily."

Jon West sees the advance as another form of precision agriculture.

Sclerotinia and fusarium in particular rely on there being a susceptible host at the right growth stage, suitable conditions, but crucially the presence of the pathogen as well. "So a piece of kit that can detect spores truly completes the picture," says Jon West.

Since the 1950s, the Hirst spore sampler, developed and still manufactured today by Burkard, has provided this ▸

Growers currently have to anticipate the best timing of the first fungicide application, says Caroline Young.

▸ information. It's a simple device that sucks air in through a narrow orifice onto a sticky tape. The tape rotates slowly, which builds a timeline that can be analysed.

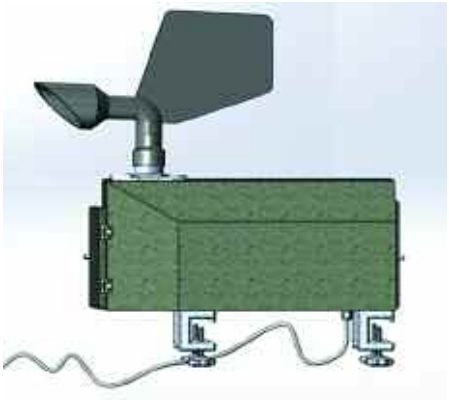
"Until recently, this had to be carried out under a microscope, but nowadays we extract the DNA," explains Jon West. "The beauty of this is that we can detect not only the species of fungus, but also identify genetic traits, such as resistance to fungicides."

But the traditional system still uses the original technique to trap the spores in the Hirst sampler that runs for up to a week. The tape must then be manually removed and taken to a lab for analysis. "Now there are newer DNA-based diagnostic methods that can be carried out in the field. These use isothermal detection to assess the presence of pathogens."

Automated process

So the entire process can be automated — the sample can be trapped, with heat and chemicals added to release the DNA. This is then amplified and quantified, and the results fed into a data file that can transmitted via mobile phone to a central server. "The plan would be to load a cassette that lasts for a month — it could even be battery driven, charged up with a solar panel," he notes.

Once developed, the new sampler will analyse the spore DNA and feed the results into a data file that's sent out via mobile phone.



The project is in its very early stages, and the team is still refining the diagnostic method that will identify the spores. "Burkard has developed a new type of sampler that puts a dry deposit into a tube. It's the downstream, automated processing we're currently working on."

As well as sclerotinia and fusarium, Jon West hopes this will also deliver detailed information on septoria. "This won't be so much to inform on inoculum at the main spray timings. But it may help growers decide whether to apply a more robust T0 spray, or whether the pathogen is still a credible threat at the T3 timing.

"We're also looking to assess where best to place the trap — on a roof might be best to catch spore ingress of some widespread pathogens, but in the field would give a more accurate idea of actual infection," he says.

"But it's extremely exciting to have an automated DNA sampler to provide the information — if we achieve our aims, it may be that these will one day be as common as weather stations."

One pathogen where it pays to know if there really are spores present is sclerotinia. If they are, given the right conditions, they'll be carried on falling petals and stick to OSR latent period, so you apply a T0 spray not knowing whether there's actually any disease present."

He admits that the vagaries of fusarium and sclerotinia control in particular currently force agronomists into a largely unscientific approach to judging risk and making recommendations. "So it's good news that research is being focused in this area, especially with the ever-reducing bank of chemistry," he says.

Cautious approach called into question

When it comes to diseases like fusarium and sclerotinia, Oxon grower James Price tends to err on the side of caution, but he often wonders if he's spending far more than he needs, or whether applications could be targeted better.

"For example, oilseed rape is a very expensive crop to grow these days. Anything we can use to help make a better decision, especially on sclerotinia, would help save wasted applications and it would be good for the environment, too," he says.

With 680ha of arable crops, mainly on Cotswold brash, based at Perdiswell Farm near Woodstock, the wheats are aimed squarely at the milling markets. "That makes fusarium a big concern, so the disease is our main driver for our choice of earwash spray."

This year, with signs early on it was looking likely to be a high fusarium year, he and Farmacy agronomist Ed Brooks decided on a robust dose of Firefly (fluoxastrobin+ prothioconazole) topped up with tebuconazole.

"But in the end, it turned dry and you just wonder whether it was a waste of money," notes James Price. His final risk-assessment score was a comfortably low 7. "Maybe we could have gone for a cheap and cheerful T3, or focused on keeping the leaves green if we'd known the actual fusarium pressure at flowering."

Ed Brooks points out the timing of the T2 and T3 sprays also has a bearing on late season disease. "A late T2 will also offer some ear protection. But if you're aiming for a quality wheat, the T3 has to be geared towards fusarium."

Internal "Insight" agronomy updates he receives through Farmacy, formed around the AHDB service, help Ed Brooks judge risk and decide on strategy. "Sclerotinia is very tricky, however. Much of it is based on feel for the crop — length of flowering, whether there are rain events, and whether the crop justifies the expenditure.

"I've never actually seen a bad sclerotinia infection, but when you have a good crop and you've invested so much in it, you daren't risk the 50% yield loss the disease could bring."

Nor is septoria a disease he'd risk taking hold in wheat crops. "The problem with septoria is the

James Price wonders whether better decision-making tools will help him save on costly fungicide sprays.

The sclerotinia reporting is based on a weather-based model that quite accurately predicts risk periods, and on testing petals.

leaves, which is where they infect, grow into stems and do their damage, explains Dr Caroline Young of ADAS.

"The difficulty for growers is they have to anticipate the best timing of the first fungicide application, and assess whether they need a second."

The new project that started in March provides growers with a live-reporting system for sclerotinia in OSR. The reporting is based on a weather-based model that quite accurately predicts risk periods, and on testing petals. "What we're really aiming to do is build on our previous work to provide information on the presence of actual inoculum on petals and within fields across the UK — that'll give growers bottom-line risk information."

Across 15 sites, petal samples are taken during flowering and analysed for the presence of spores. "We're also planning to pull in more information using spore traps." This is then fed into the weather-based model to give more localised, accurate information on risk. The results are delivered to growers through the AHDB disease-monitoring platform.

"We've just completed our first season, and generally it was a low sclerotinia year — this was predicted by the weather model and confirmed with the sampling. But we saw some big differences — there were high levels of inoculum at some sites while at others we found no spores at all."

Sclerotinia spores will only be present where there are apothecia fruiting bodies, and conditions are conducive.

Inoculum presence

At one site in the south west of England, the weather-based model suggested perfect conditions for infection, reports Caroline Young. "But there was no inoculum present — that was a real surprise, and shows the disease can vary considerably from field to field."

Analysing these peaks and troughs will shed more light on how the disease spreads through the season, she says. "Sometimes you can detect sclerotinia before the crop starts flowering. Bringing the weather data together with petal tests should help us understand how such anomalies will affect disease risk. We're also evaluating the use of forecast weather data, although predictions of relative humidity — a vital factor for sclerotinia — are very unreliable."

Another disease-monitoring project that's completed its first season is fusarium-risk reporting (see *CPM*, May issue). Met Office data on rainfall is linked to observations from the field, provided by agronomists, on crop growth stage. The data not only raises awareness, but provides growers with accurate information for mycotoxin risk assessments, notes Dr Dhan Bhandari of AHDB Cereals and Oilseeds.

"The weather during flowering is critical for fusarium risk, and particularly for DON mycotoxins. This year, flowering was about two weeks later than average, but the majority of crops were at low risk. These do vary on a regional basis, however, and it's important growers include an accurate idea of the risk their crops faced."

Met Office data on rainfall is linked to observations from the field on crop growth stage, with results available through the AHDB disease-monitoring platform.

Rainfall close to harvest is another factor that will encourage the disease, and the wet end of Aug may have had an impact, especially on ZON mycotoxins. "Lodged crops will be at particularly high risk, but risk assessments should be made on a field-by-field basis. If you get a score of 15 or above, get a sample tested," advises Dhan Bhandari. ■

Aphid control erratum

Contrary to advice relayed on p48 of the Aug 2015 issue, 100% rates of pyrethroid should always be used to control grain aphids (*Sitobion avenae*).

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Research round-up

AHDB project 214-0021, Arable crop disease alert system, runs from April 2015 to March 2018. It aims to produce an automated air-sampling device, which will use a DNA-based method to rapidly detect key pathogens, or genetic traits such as fungicide resistance, and text the result, along with weather data to a web-based information portal, which will be accessible to growers. The project is led by Rothamsted Research with Burkard Manufacturing an industry partner. The total cost is £75,000, funded by AHDB Cereals and Oilseeds.

AHDB project 214-0007, Sclerotinia risk live-reporting system for oilseed rape, runs from March 2015 to Feb 2018. Its aim is to provide a sclerotinia disease-risk reporting system, to help guide fungicide timing, improve control of sclerotinia, and therefore reduce crop losses. The project is led by ADAS with industry partners Velcourt and BASF, and academic partner Warwick University. The total cost is £213,945, with AHDB Cereals and Oilseeds contributing £161,400.

The AHDB disease-monitoring platform can be accessed at http://cereals.ahdb.org.uk/monitoring