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AHDB

from theory to field

Staying ahead of BYDV

The impact that viruses can have on root crops has been very evident this season and cereals are no exception to the rule, with BYDV an increasing threat. *CPM* finds out how researchers are developing systems to help growers manage risk to cereal crops.

By Lucy de la Pasture

Aphids may do limited damage to cereal crops themselves, but the viruses that they can carry may prove devastating. One of those is barley yellow dwarf virus (BYDV) which can cause significant economic damage, with yield losses of more than 50% possible. An exciting new AHDB research project is underway that aims to help growers improve BYDV management and it’s entering its second year this autumn.

Two important developments have taken place which mean BYDV management has to change, explains ADAS’s Dr Sacha White, who is leading the project. One of these is the recent loss of the neonicotinoid seed treatments that were so effective at protecting the crop from virus transmission from the moment they emerged in the autumn.

The complicating factor is the development of pyrethroid resistance in aphid species, which is significant because pyrethroid chemistry is the only insecticide option available to growers, he points out.

“Pyrethroid resistance was first detected in grain aphid (*Sitobion avenae)* in 2011 and has now become widespread, with a fair percentage of the population having a partial resistance to pyrethroids.”

Pyrethroid resistance

Sacha highlights that applications at the full label rate should still give control. To further complicate matters, pyrethroid resistance has been recently discovered in Ireland in the other main BYDV vector, bird-cherry oat aphid.

“Reliance on chemical control will lead to further increases in resistance yet management of BYDV hasn’t changed since the 1980s — that’s why this project is so important,” highlights Sacha.

The ADAS researchers are setting out to discover more effective ways of monitoring aphid vectors and aim to develop two decision support systems. These will give support to the decision-making for both cultural and chemical control strategies. One will give a risk prediction of BYDV before drilling and a second system will predict the need for and the timing of any insecticide sprays, he explains.

“It’s vital to time pyrethroid applications effectively so that they’re not over-used. Current guidance for insecticide application is to minimise the secondary spread of BYDV. Primary infection occurs when aphids first migrate into the crop, but it’s when aphids begin to move within the crop that infection spreads to damaging levels.

“The aim of the ‘spray’ DSS is to provide a framework to delay pyrethroid applications until required. In practice sprays are often applied as soon as aphids are seen in crops as an insurance. but this approach can lead to multiple applications, some of which are likely to be unnecessary.”

Currently the number and species of aphids on the wing is monitored using the

Sacha White explains that one DSS will give a risk prediction of BYDV before drilling and a second system will predict the need for and the timing of any insecticide sprays.

Resistance to pyrethroids is widespread in grain aphids, one of main vectors of BYDV.

Rothamsted Research network of suction traps and published weekly in AHDB's Aphid News. During the first year of the project the reliability of suction trap data was assessed, particularly how this related to aphid numbers in crops situated at different directions to and distances away from the suction traps, says Sacha.

As it turned out there proved to be a low number of aphids last autumn, which when combined with the weather wiping out attempts at autumn drilling meant it was a low BYDV year. Even so, Sacha's team established there was some correlation between the suction trap data and aphid catches in the field.

"We established this correlation by comparing the results from aphids caught in suction traps at Newcastle, Starcross and Brooms Barn with aphids collected at field sites in Northumberland, Devon and Suffolk — North, South, East and West of the suction traps and up to 40km away."

However many farms won't be situated near enough to a suction trap for the data to be accurate, so researchers also investigated traps for in-field monitoring that could give reliable results and were easy to use.

"We looked at water traps and sticky traps at several sites last season and we were able to find aphids in them, even though aphid numbers were very low. This is encouraging as it means they work when aphid pressure is low in the field," says Sacha.

The idea is to propose a monitoring scheme for aphids based on the project's findings. "We will be able to guide growers and inform them where suction trap data is reliable for their fields and where in-field trapping will provide more accurate data."

The success of in-field monitoring will hinge on the accurate identification of aphid species. "Because the industry has had effective seed treatments for a very long time, the skills needed to identify different aphid species that transmit BYDV are less common, but we anticipate agronomist training will respond to this."

Alternatively it may be possible for growers to send catches to a lab for accurate identification and potentially for a PCR test to measure the infectivity of the population, giving a measure of BYDV risk, he notes.

Another solution the project is looking at makes use of digital technology. "Teams at Syngenta and xarvio are looking at image analysis for identification of trap contents. It's possible this could entail submitting a digital photo online or it could be a fully automated service using AI."

The second element of the project is to provide DSSs that will help growers make the most effective use of cultural and chemical controls. ▶

The bird-cherry oat aphid is a BYDV vector and control measures are aimed to prevent secondary infection occurring when aphids move around within the crop.

BYDV infection can cause yield losses in excess of 50% in some cereal crops and appears as yellow patches within crops.

▸ "We want to be able to establish the risk from BYDV in the autumn early in the year. This will help plan cultural controls, such as using BYDV-tolerant varieties, adjusting drilling date, managing the green bridge and encouraging natural enemies to help control aphids.

"Aphid numbers are very difficult to predict but we're developing a 'risk' DSS using models based on the predictions gained from many previous experiments. At the moment we have the bare bones of a new risk system established and are integrating further factors," explains Sacha.

The 'spray' DSS is being developed to help guide spray decisions and will predict BYDV levels in the presence or absence of a chemical control. This will provide growers with the potential yield loss under both scenarios and the economics of applying a spray. The model will also take into account the effect of any varietal tolerance to BYDV.

Important variable

"We're looking to update previous models rather than 'reinvent the wheel'. An important variable that we are now able to include in the updated models is the percentage of aphids carrying BYDV viruses, which can vary over time and from area to area. For example in 2019, some sites had 10% of aphids carrying virus, whereas other sites had more than 50% — this can have an important impact on the determination of risk," he explains.

"Rothamsted has developed a new PCR test to detect the level of virus present in aphids, which for the first time allows this to be done en masse and in real time.

Sticky traps are being assessed as an in-field monitoring system where image analysis could be used to identify the aphid species present.

This data is being collected from several suction traps and is included in AHDB's Aphid News.

AHDB already have a DSS available (ahdb.org.uk/bydv) which uses a T-Sum model for predicting spray timing. "It is a good tool that is well worth using. However, it

Evidence that decisions are IPM-based

A large proportion of cereal seed planted in areas where BYDV posed a risk was protected by neonicotinoid seed treatment, Deter (clothianidin) before the ban. No one really knows the implications of farming without it, says John Miles of KWS, one of the commercial companies supporting the AHDB project developing DSS for BYDV.

Last year proved to be a damp squib for BYDV, but John points out that no year or location is ever the same where this particular virus is concerned. It may take several seasons for BYDV to make its presence felt or that may happen sooner, he says.

What seems certain is that farming is going to change, with IPM playing a much bigger part. "It seems logical that the Environmental Land Management (ELM) scheme could reward farmers for implementing IPM strategies on the farm. Having a trail of evidence to support agronomy decisions arrived at from using the DSS systems being developed will help growers to back up their thought processes — the spray DSS will answer the question, 'is a pyrethroid application necessary?'"

Risk from BYDV has been always based on historic information, with regions such as the south west of England known to be high risk because the winters are generally warmer than further north or east and cereals often follow grass in the rotation. However, weather patterns have changed and BYDV risk isn't as predictable as it once was.

The DSS will help growers with variety choices as well as spray decisions, says John. "We have BYDV tolerance genetics coming forward in cereal varieties. The tolerance gene has no interaction with the virus or with aphids, which makes its mechanism very robust."

He likens BYDV tolerance in a variety to fungicide resistance. "It's not a clear-cut decision when to grow a BYDV tolerant variety and what that will mean in terms of its agronomy but the DSS will help growers with variety decisions."

Growing a virus-tolerant variety is similar to growing a fungicide-resistant wheat such as KWS Extase, where in a high septoria situation the yield is responsive to fungicides but in a low septoria situation fungicide inputs can be cut back.

"Barley varieties with Yd2 gene are tolerant to BYDV but are still infected by aphids carrying the virus, which means that in a high virus situation there may be a yield penalty in the absence of a pyrethroid application, but this is very small when compared with a susceptible variety.

"Choosing to spray a tolerant barley variety is more about controlling a multiplying aphid population, which could spread BYDV to other crops. In a lower risk situation the tolerance gene will protect yield and a spray won't be necessary."

The Yd2 gene has been around since the

John Miles believes the DSS being developed would help growers know when to choose a BYDV-tolerant variety.

1950s so it's not a new discovery, but by introducing the new trait into breeding programmes there's usually an adverse effect on yield or grain quality, points out John. Breeders at KWS have now broken the link to poorer grain quality so the new barley BYDV-tolerant varieties coming through the pipeline won't be affected.

"If the DSS can predict where aphid infestation will be high and the associated risk of BYDV, then planting a BYDV-tolerant variety will be a cultural strategy that growers can use as part of the IPM approach. Growers wanting to move away from using insecticides altogether may also find tolerance genetics useful where BYDV is a risk."

A PhD project gets underway next month and will look at the relationship between a heritage wheat trap crop and flowering strips to see how natural enemies respond.

assumes that aphids have entered the crop as soon as it has emerged and that all aphids are carrying virus, so the 'spray' DSS being developed refines the system and could potentially reduce the number of insecticide sprays being applied for BYDV control."

The plan is to test this new DSS against the T-sum model and untreated in tramline trials this autumn.

Further BYDV research is about to get under way in an AHDB-sponsored PhD project at Harper Adams University (HAU), supervised by Dr Tom Pope. Maria Elisa Damascena will be looking at ways of improving the IPM of the aphid vectors responsible for BYDV in crops, explains Dr Charlotte Rowley, who manages pest research at AHDB.

"The PhD will build on preliminary work carried out at HAU which looked at cultivars and aphid host plant preferences and this revealed obvious differences between heritage and modern cultivars. Heritage cultivars would have been grown when BYDV was prevalent and the research has opened up the potential for them to be planted as a trap crop around fields, so that aphids colonise them first. This could help limit aphid management strategies to these areas.

"The PhD will also look at planting crops next to flowering strips, which would provide a habitat to harbour natural enemies, and then discover how natural enemies respond to the presence of a trap crop. Maria will also be investigating the volatiles plants give off and how aphids may use these to locate plants, with the aim of developing a lure to help in-field monitoring of aphid populations," she explains. ■

Research roundup

AHDB Project No 2112007a 'Management of aphid and BYDV risk in winter cereals' runs from Aug 2019 to Aug 2022 at a cost to AHDB of £190,000 (total cost £314,500). The project is being led by ADAS in partnership with Rothamsted Research, with additional funds and in-kind contributions from industry partners BASF, KWS, Limagrain and Syngenta.

PhD 'Improving integrated pest management (IPM) of aphid BYDV vectors' will run from Oct 2020 to Dec 2023 at Harper Adams University at a cost of £74,100.

From Theory to Field is part of AHDB's delivery of knowledge exchange on grower-funded research projects. *CPM* would like to thank AHDB for its support and in providing privileged access to staff and others involved in helping put these articles together.