# Strategic approach for persistent pests

AHDB CEREALS & OILSEEDS

*from theory to field*

**Resistance to a shrinking chemical armoury is piling the pressure on growers to prevent pests gaining the upper hand. *CPM* explores the research set to stack the odds back in farming's favour.**

*By Tom Allen-Stevens*

**Just two years ago, you'd probably have reckoned aphid and other invertebrate pests weren't too much of a bother to your combinable crops — a combination of seed treatments and targeted sprays kept the likes of the peach-potato aphid *(Myzus persicae),* grain aphid *(Sitobion avenae)* and cabbage stem flea beetle (CSFB) under check.**

Well what a seismic shift there's been. You could argue that a number of regulatory changes, coupled with resistance developments, have tipped the odds somewhat in favour of these meddlesome mites. As you apply your umpteenth spray of the season to control CSFB in your oilseed rape crop, you may be asking whether our understanding of these pests has actually moved on.

## UK research

Thankfully it has, as a result of ongoing research funded by AHDB and other industry partners. "We're fortunate in the UK to have a lot of research into insect pests, particularly aphids," notes Caroline Nicholls of AHDB Cereals and Oilseeds.

"Recent AHDB-funded work has focused more on resistance issues and particularly on screening aphids for resistance to alternatives to neonicotinoid seed treatments, to provide reassurance on the level of control growers can expect. A test has also been successfully developed to determine if *M. persicae* are carrying turnip yellows virus (TuYV), which can be used in future to identify levels of the virus in the population."

> *"With regulatory restrictions, we're losing our armoury, and that's exacerbating the resistance situation."*

Understanding of CSFB has progressed in the last two years, she says. "We're continuing to collect as much information as we can, and Information Sheet 43 has recently been updated with the latest advice. This includes guidelines following recent work on a crop's ability to withstand CSFB damage and resistance monitoring."

The monitoring work was carried out last year by Rothamsted Research and identified pyrethroid resistance in all of the samples tested, which were sent in mainly from farms in the east of England. "A bioassay and genetic test have been developed to quickly test CSFB for resistance, but researchers found some survived treatment in the absence of the usual resistant genes."

This suggests there's a level of enhanced metabolic resistance in the population, as well as target-site knock-down resistance (kdr). "The advice is not to make repeat applications of pyrethroids," she notes. "If you don't achieve a good level of control, use a product with a different mode of action — acetamiprid has just been granted emergency-use approval for one application only before five leaves."

Monitoring work is continuing at Rothamsted and growers are encouraged to send in live samples for testing.

*Testing suggests there's a level of enhanced metabolic resistance in the CSFB population, as well as target-site kdr.*

More strategic work on resistance is also underway at both Rothamsted and ADAS, she adds. "With fewer insecticides available, there's a greater risk of resistance developing and many different ways this can come about. It can develop slowly or quickly, and is markedly different for indoor and outdoor pests. So you need a resistance management system tailored to the situation at hand.

## Industry-wide consortia

"Within AHDB, Cereals and Oilseeds is working with Potatoes and Horticulture in industry-wide consortia on two projects in particular that will deliver reliable guidelines for growers (see panel on p49). The Chemicals Regulation Directorate (CRD) is involved to ensure that any label changes to preserve efficacy are based on good evidence. We're also working closely with the Insecticide Resistance Action Group (IRAG) to ensure growers get clear guidance."

Keeping tabs on the resistance status of the UK aphid population has been the job of Dr Steve Foster and colleagues at Rothamsted Research. As part of an AHDB and industry-funded ongoing project, together with core funding from

*Recent AHDB-funded work has focused more on resistance issues, notes Caroline Nicholls.*

BBSRC, they have developed bioassays, and DNA tests, they use to assess aphids captured from the insect surveys carried out at Rothamsted and SASA. The tests can quickly assess the resistance status of the pest in question, and so provide a barometer on how the national picture is evolving.

"The good news is that no aphids in the UK are resistant to neonicotinoid insecticides, so these products should ▸

*No aphids in the UK are resistant to neonicotinoid insecticides, reports Steve Foster.*

▸ remain effective," he says. Good news indeed, because pyrethroids and pirimicarb are now effectively useless against *M. persicae*. "You may as well spray them with plain water."

Nearly the whole population has a combination of MACE (resistance to pirimicarb) and super kdr (resistance to pryethroids). "This pattern has continued, despite recent adverse conditions for the pest, so there's no fitness penalty associated with the resistance — it's here to stay."

The significance of *M. persicae* is that it carries TuYV into OSR. "It's a direct consequence of the current moratorium on neonicotinoid seed dressings that we have more TuYV around and more aphids carrying the virus," states Steve Foster.

## Still effective

Other actives are still effective against this aphid, however, including flonicamid, spirotetramat, pymetrozine and thiacloprid, the two latter which currently have approvals for use on OSR. But he advises growers to use the approvals for pymetrozine (as in Plenum) and thiacloprid (as in Biscaya) wisely. "You can only make one application of each, so follow the AHDB Aphid News and don't spray prophylactically."

In cereals, one of the main target aphids is the grain aphid *S. avenae*, a vector of BYDV. "There is kdr prevalent in most of the population, similar to super kdr in *M. persicae*, but it confers only moderate resistance to pyrethroids," he reports.

This means pyrethroids, in most instances, still work. "But you must keep rates up,100% rates of pyrethroid should always be used" advises Steve Foster.

But all this can make for a muddling picture on resistance. Throw in the recent discovery of pyrethroid resistance in CSFB, and other events, and it's hard to know which is the best resistance-management strategy.

"Resistance has become a more pressing issue," notes Dr Sacha White of ADAS. "It's occurring in more and more pests, and we rely very heavily on chemical control to keep most of these in check. So we're losing effectiveness, and with regulatory restrictions, we're losing our armoury, and that's exacerbating the resistance situation."

Maintaining effective control with this armoury is the overall aim of a project due to come to an end next year. "The objective is to equip growers with the appropriate resistance-management strategy. Work in fungicides has shown this can be very

*Nearly the entire population of* M. persicae *has MACE resistance to pirimicarb and super kdr to pryethroids.*

# Difficult decisions highlight need for guidance

*Resistance management is relatively straightforward in cereal fungicides, notes Chris Bean, but harder with pests.*

Growers face a conundrum when it comes to chemical control of CSFB this autumn, reckons Chris Bean of Zantra. "It's likely pyrethroids will achieve very little, and while it's useful to have another mode of action in the armoury, neonicotinoid sprays rely on there being enough green leaf area to take up the active — if the crop reaches that stage, it's probably going to survive all but the very heaviest infestation."

With TuYV, it's a very different, but equally difficult decision process. "Knowing whether your crop is at risk relies on good monitoring and spotting a *M. persicae* population developing, even supposing you know what to look for. There are now good products in the armoury, but although pyrethroids are cheap, they're effectively useless on *M. persicae,*" he notes.

As a member of the IRAG steering group, he's concerned for the implications these difficult decisions are going to have on how resistance develops. "We have a dwindling pool of material to choose from, and as we rely more on the ones that are left, it's inevitable pests will build resistance to them. I've also a big concern for pests such as pea and bean weevil and bruchid beetle."

So developing resistance-management strategies for key pests in which growers can have confidence will be essential, he feels. "But that's easy to say and difficult to do. It's relatively straightforward in cereal fungicides as there are set timings and known threats. Insect pests are often unexpected and can build quickly — the response has to be effective and proportionate, but often resistance management is the least of growers' concerns.

"It's vital we have good research-based guidance that can ensure we maintain effective chemical control of important crops pests, but that's just the start. To implement it effectively requires an understanding of the biology of key pests and a feel for how they're developing in crops, and that's down to individual growers and agronomists," points out Chris Bean.

worthwhile and valuable in terms of guidelines growers can trust."

There are two strands to the work, and both involve complex modelling techniques. The first, carried out by Dr Frank van den Bosch and Dr Joe Helps group at Rothamsted, looks at various risk-management strategies, defines the group of pests these relate to and compares their effectiveness. Meanwhile at ADAS, researchers have been developing a risk-assessment scheme to identify where there's a high risk of resistance occurring.

But developing a reliable resistance-management strategy is not as easy as it sounds, explains Sacha White. "Various strategies exist, such as restricting the number of applications, mixing or alternating modes of action, or leaving areas unsprayed. But there are conflicting ideas on which are best, and it can be crop host or pest-specific."

A strategy to use robust rates of insecticide, for example, has generally been advocated as the best approach to keep resistance in check, but in certain circumstances this could actually increase resistance, he notes. "So we're trying to identify groups of pests and the management strategy most suitable for these groups."

Data on 123 cases of resistance in 46 insect pests have been gathered from across Europe, and work has been underway to analyse how and why these cases have come about and the traits of the individual pests that influence resistance development.

"There are many factors that have an influence: it could be basic genetics, whether they fly, the number of host plants they colonise, whether they go through a metamorphosis. There's then the host crop itself — how widely it's grown, its agronomy and how much insecticide is used."

## Resistance development

One interesting aspect that's arisen is how long it takes for resistance to develop. "It takes eight years on average, but this varies from as little as one year to as long as 39. That's a real spectrum, and it has huge implications for management tactics," notes Sacha White.

Another aspect that has an impact is whether there's a fitness penalty. "When MACE resistance in *M. persicae* first arrived, for instance, it was feared there'd be a very rapid spread. But resistant aphids were less able to overwinter. They overcame that penalty, but it influenced how quickly resistance took hold."

Researchers at Rothamsted have developed models to track the frequency of resistant genes over time. "They've concentrated on three species that are archetypal of three different types of pest: pollen beetle, *M. persicae* and western flower thrips."

Although there's still a few months of the project left to run, and there's been plenty of progress, Sacha White is reluctant to issue any early guidance before the work is complete and the research team is confident the models are robust. "There's still a lot of testing we have to do, and we want to look at the effect of alternating or even mixing products with different modes of action."

In the meantime, growers shouldn't underestimate how the biology of different pests and how they're treated, even within the same crop, will influence how resistance develops, he points out. "Consider autumn OSR pests, for example. CSFB has just one generation per year, but on some farms is currently exposed to multiple applications of just pyrethroid sprays. *M. persicae* will go through several generations in the same year, can be sprayed with a wider spectrum of insecticides, but crops often go untreated. It's no surprise then that these pests require a tailored strategy." ■

*There can be conflicting ideas on which resistance-management strategies are best, says Sacha White.*

*Every heterozygote grain aphid found is believed to be a clonal descendant of the one that had the original mutation (picture courtesy Dewar Crop Protection).*

## Research round-up

**AHDB project 3780,** Combating insecticide resistance in major UK pests, runs from Jan 2013 to July 2016. It aims to compare the net benefit of different insecticide resistance management strategies for insects with contrasting life histories and damage implications to develop a method to assess insecticide resistance risk based on objective and measurable criteria. The project is led by ADAS, with partner Rothamsted Research. The total cost is £495,000, funded by Chemical Regulations Directorate, AHDB Cereals and Oilseeds, Potatoes, and Horticulture, with AHDB Cereals and Oilseeds contributing £74,993.

**AHDB project 3768,** Combating resistance to aphicides in UK aphid pests, runs from April 2012 to Mar 2017. Its aim is to monitor the response of field-collected live samples of *M. persicae* and other important aphid pests (including cereal aphids) to a range of novel aphicides and also monitor for established forms of resistance. The project is led by Rothamsted Research and funded by Bayer CropScience, Belchim, DuPont, Interfarm, Syngenta, Nufarm, BBRO, Chemicals Regulation Directorate and AHDB Cereals and Oilseeds, Potatoes, and Horticulture. The total cost is £482,376, with AHDB Cereals and Oilseeds contributing £24,000.

**Information Sheet 43,** Cabbage stem flea beetle has been updated for summer 2015 and is available to download from *http://cereals.ahdb.org.uk*