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Specific roles provide valuable benefits

Strobilurins have suffered from resistance build-up, but still have a place in cereal fungicide programmes

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When strobilurin chemistry was first introduced in the UK towards the end of the 1990s, it was a ground-breaking step forward in disease control. Yield benefits of 3-4t/ha, remarkable control of septoria and physiological benefits secured its place as the mainstay group of actives included at key fungicide timings.

But resistance to strobilurins spread with alarming speed. Their very inclusion in many programmes are now questioned. While they still have a place in the product armoury, perhaps their biggest value are the lessons we can learn from how to look after future advances in fungicide chemistry.

What are strobilurins?

* Strobilurins originally derived from naturally occurring chemicals found in mushrooms. They form part of the group of quinone outside inhibitor (QoI) fungicides and work by inhibiting mitochondrial respiration that prevents spore germination and mycelial growth in plant pathogens.

Their strength was they were highly active on most cereal fungal diseases, including septoria, rusts, mildew, and a host of others. They were also credited with physiological benefits, maintaining green leaf area for longer and delaying crop senescence.

But they have a very specific mode of action, which made the chemistry vulnerable to resistance.

How did diseases develop resistance?

* A number of pathogens developed resistance through a gene mutation that effectively allows them to side-step the strobilurin mode of action. It gives them resistance across all of the QoI group, which includes fenamidone and famoxadone.

REDUCING THE RISK OF RESISTANCE DEVELOPING

The Fungicide Resistance Action Group (FRAG) has issued these general guidelines for reducing reliance on fungicides:

* Control volunteers that may harbour disease
* Select varieties with a high resistance to diseases prevalent in your area
* Avoid growing large areas of one variety
* Only use fungicides if the risk or presence of disease warrants treatment
* Use a dose that will give effective disease control
* Use fungicides with different modes of action in mixtures or sequences
* Ensure mixing partners are used at robust doses
* Monitor crops and treat before infection becomes well-established
* Avoid repeated applications of the same product or mode of action
* Never exceed the maximum recommended number of applications

MALCOLM CASE-GREEN

Strobilurins still have an important role in controlling barley disease.

There are three known types:

* G143A – isolates express complete resistance to QoI fungicides. This was first identified in mildew, then septoria in 2002 and more recently in ramularia and Microdochium nivale. There is no fitness penalty from this mutation, which means the resistant pathogens are just as active and spread as well as their non-resistant counterparts.
* F129L and G137R – isolates express moderate, or partial resistance. The F129L mutation has been identified in net blotch and different strobilurins have been found to have differing levels of activity against the disease. There is a fitness penalty here, so resistant isolates have not taken over the population.

Resistance has spread fast as a result of the widespread use of strobilurin sprays. This takes out the susceptible population and allows the resistant pathogens to thrive.

What is the current resistance status?

* Septoria, mildew, ramularia and Microdochium nivale should be considered to be resistant, as isolates are now widespread across the UK and dominate the population. Net blotch still has some sensitivity to strobilurin fungicides, although resistant isolates are widespread.

Significantly, no resistance has been identified in rusts. It is always possible a mutation will occur, but it is thought that mutation G143A will make the pathogen unviable, which is why resistance in rusts has not yet been an issue.

Resistance was identified in rhynchosporium in France in 2010, but only in one isolate that hasn't been seen since, so the disease is being closely monitored.

Golden rules

* Don't rely on strobilurins for good control of most wheat diseases
* They are still useful to control rusts and barley pathogens
* Follow FRAG guidelines when using all fungicides, especially SDHIs

What physiological benefits do strobilurins have?

* The so-called "greening" effect of strobilurins has been seen as a big advantage of the chemistry. Treated crops have been shown to have delayed senescence, so leaves stay green for longer, resulting in a longer grain-fill period and higher yields.

Views differ as to whether this is simply down to good disease control or whether strobilurins have an additional beneficial effect. But the response of crops has reduced considerably since resistance became widespread. Currently, you could expect a yield benefit in winter wheat of less than 0.4t/ha in the absence of rusts, and may see no benefit at all. Previously when strobilurins were controlling septoria, yield boosts of 1t/ha were typical.

How do strobilurins fit in now?

* Strobilurins are still a useful part of fungicide programmes, but are not essential partners. In wheat, they have good activity on rusts and, therefore, work well in situations where this pathogen is the prime target. They add useful efficacy in situations where the triazole partner is less active on rusts.

In barley, they are still very much an important part of the product armoury. The chemistry has activity on net blotch and currently gives good control of rhynchosporium. Again they should always be used with a triazole partner, either added or as part of the formulation. There are a number of reliable, robust combinations that offer good control of most barley pathogens.

Best timing may be decided by disease pressure. Good practice dictates you shouldn't use strobilurins in more than one or two timings. On wheat, they are moving increasingly to support triazoles at T1 where yellow rust is a threat, or may be used in high rust situations at T2 or T3. Growth stage 31 (T1) applications in barley are still a good option.

Strobilurins do have some activity on take-all. Rotation, sowing date, variety and seed treatment are always by far the best defences. But in a high take-all situation, high rates of azoxystrobin or fluoxastrobin at T1 in wheat can reduce its effect on the crop.

While fungicides appear to have a small but direct affect on this soil-borne pathogen, crop tolerance to take-all is often associated with good early root growth. So applying early nitrogen may be the more reliable route to reducing take-all effects.

How is resistance spread minimised?

* There is little doubt that continued, repeated use of strobilurins, especially without a tank-mix partner, contributed to the development of resistance to this once valuable chemistry.

Currently, resistance to the newer succinate-dehydrogenase inhibitors (SDHI) has not been found in any cereal pathogen. But these fungicides also have a single mode of action. So if they are not used carefully, resistance is likely to develop (see box, far left).

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* Turn to page 19 or go to www.fwi.co.uk/springfungicides