HGCA

from theory to field

New ways around resistance

Combating resistant blackgrass is one of farming's most bitter-fought battles. *CPM* finds out how grower-funded research is making progress.

By Tom Allen-Stevens

Is it the end of the road for winter cereal crops? This is a question many growers with bad blackgrass may be asking. Factor in the very different conditions thrown up by the last three autumns, and increasing levels of resistance to ALS inhibitors, such as Atlantis (mesosulfuron+ iodosulfuron), and finding a strategy for consistently good control becomes an ambitious task.

But some clear pointers are now surfacing from recent HGCA-funded blackgrass research, according to the organisation's Caroline Nicholls. "Good levels of blackgrass control from using non-ALS herbicides in combination with non-chemical control has been achieved. The research is highlighting both the potential and the limitations of different combinations of control methods. Finding how these interact is the key to keeping blackgrass populations at an acceptable level."

She highlights two projects currently underway (see panel on pxx). "The winter cropping project is looking at how best to use alternatives to ALS inhibitors in combination with delayed drilling and varying seed rates.

"The other project investigates how we can exploit the natural weed-suppressing ability of cultivars, and how this differs between varieties, to support an integrated weed management strategy."

But there's no end of blackgrass research currently being carried out by commercial organisations. So how does grower-funded research differ?

Independent research

"This is independent research looking at how a combination of cultural and chemical control techniques can help growers stay ahead of the game. It'll provide viable alternative options for those who are in a situation where ALS herbicides are being beaten by blackgrass," explains Caroline Nicholls.

"Although the competitive crop cultivars project is still in the early stages, it'll hopefully find a way of assessing the natural suppressive ability of new cultivars submitted for National Listing and candidate varieties for the HGCA Recommended Lists."

The winter cropping project is led by Rothamsted Research, with additional work carried out by NIAB TAG. The rising tide of herbicide resistance has become a real problem, notes Rothamsted's Richard Hull. "Around 70-80% of the blackgrass population has ACCase target-site resistance (i.e. to 'fops', 'dims' and 'dens'). What's more, the last CRD-funded survey of randomly collected blackgrass samples found clear evidence of resistance to ALS herbicides in nine of the 19 sites assessed," he points out.

"A sustainable winter cropping rotation is becoming an increasing challenge for a growing number of arable farmers."

So the project looks at specific cultural control methods, and how these could be used with herbicides to win back some of this lost control. "Non-chemical methods fall into two categories — those that offer a high

> *"A sustainable winter cropping rotation is becoming an increasing challenge for a growing number of arable farmers."*

level of control, such as spring cropping and delayed drilling, and those that provide additional, lower levels of control, such as increasing seed rates and choice of cultivar."

Delayed drilling and seed rates were the two methods chosen for the project — three sowing dates (mid Sept, early and late Oct) and three drilling rates (175, 350 and 525 seeds/m^2) have been put to the test in fully replicated trials of the variety Oakley. All the plots at Woburn in Beds and Morley in Norfolk were ploughed and treated with glyphosate prior to drilling. The blackgrass at both sites has ACCase target-site resistance and low to moderate levels of enhanced metabolism resistance.

Robust treatment

A "fairly robust" non-ALS treatment was applied, reports Richard Hull — 0.6 l/ha Liberator (diflufenican+ flufenacet) and 2 l/ha of Defy (prosulfocarb) was followed by 3 l/ha Auxiliary (clodinafop-propargyl+ prosulfocarb) and 2 l/ha Crystal (flufenacet+ pendimethalin).

"It's a flufenacet-based programme because this is the next strongest active after the ALS inhibitors. The Auxiliary is in there because it gives good control in early post-emergence situations on small blackgrass — despite the target-site resistance."

Over the two years (autumn 2010 and 2011), delayed drilling in the untreated plots gave completely contrasting results, he points out. "In autumn 2010, delaying until early Oct reduced the blackgrass population by 78%, and in early Nov by 90%. But in the following, drier year, the populations actually rose by 40% and 17% respectively."

But the most significant result came in the treated plots — in those drilled early, 80% control of plants was achieved in 2010, with a poorer 65% in 2011. However, delayed drilling boosted control of plants to 88% in 2010, and a much more respectable 85-87% in 2011.

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Finding how different control methods interact is the key to curbing blackgrass populations says Caroline Nicholls.

"A critical finding was that, even in a year when there was no advantage from delayed drilling on its own, there was an advantage from the later-applied herbicides in the delayed plots. We've always known these herbicides work better with more moisture. Delayed drilling probably gives better results because the herbicides are applied later into more moist soils, but cooler soil temperatures may also help."

There was a greater effect on seed return from delayed drilling. In 2010/11, the blackgrass in the early drilled plots ▸

Richard Hull says 70-80% of the blackgrass population has target-site resistance to 'fops', 'dims' and 'dens'.

▸ produced six heads/plant, but this was halved for mid Oct, while the early Nov plots produced just one head/plant, says Richard Hull.

"In the early drilled plots, percentage control of plants was much greater than percentage control of seed return. It's because the blackgrass in these plots developed a strong root mass, so grew well in the dry spring of 2011, compared with the weaker plants in the delayed-drilled plots." Percentage control of plants isn't always a good indicator of control of heads or seeds, he adds.

"Delayed drilling was beneficial in both years, although the scale of the benefit varied from 29-99%, but may come at a cost as we didn't take yield penalties from delayed drilling into account.

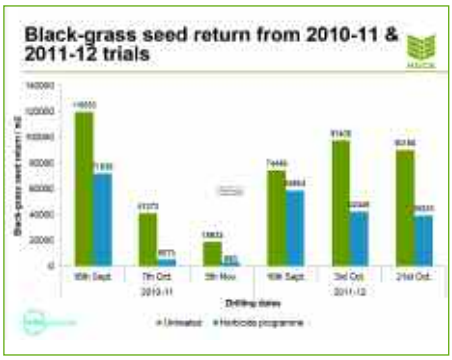
"This data shows that trying to use cultural methods to recoup the control lost by increasing herbicide resistance is possible, but it'll be difficult in unfavourable conditions."

Tests were also carried out to find out how much of the blackgrass germinated in the spring. Despite the dry autumn of 2011, less than 3% of the weed waited until spring to emerge. "So there's no evidence to suggest there's any benefit from delaying herbicide control until the spring," he maintains.

Raising the seed rate had no effect on the number of blackgrass plants that emerged, but it did influence how the weed developed — in turn suppressing seed return. "Increasing from a low to average seed rate reduced seed return by 20%, but raising the seed rate further brought only 10% extra reduction. So while you should avoid low seed rates, raising them too high runs the risk of lodging for little extra benefit." This result was very consistent in both years, he adds.

So what about the wheat varieties

Overall, control of seed return was much higher in the 2010-11 trial compared with 2011-12, mainly due to increased control from delayed drilling and also because of higher efficacy from the herbicide programme. (Source Rothamsted Research)



Strategy change for blackgrass burden

Three years ago, Edd Banks received laboratory results on blackgrass resistance across some of the 1200ha he farms in Cambs that confirmed his worst fears. "We had RRR-resistant blackgrass — for the control we were getting, it simply wasn't worth spending money on post-emergence contact herbicides."

So a change in strategy was needed on the heavy boulder clays and chalks where blackgrass was becoming an increasing problem for the family farm, based at Manor Farm, Harlton. "We usually crop about 700ha of wheat, so the first thing we looked at was delayed drilling on the second wheat and introducing a spring break."

The worst fields are singled out for spring beans. Very light cultivations over the winter encourage a chit which is sprayed off prior to ploughing. "We used to plough much more than we do now, but all it was doing was bringing up the previous year's blackgrass. So now, only the fields destined for spring beans are ploughed — typically on a rotation of about one in six, and certainly no more than one in three."

The spring crop is making the biggest difference, says Edd Banks, but winter crops are the mainstays of the rotation, so drilling is now delayed across the wheats. "The first wheats are delayed from mid Sept to mid Oct, and with the second wheats, we'll go as late as we dare. In 2012, that was 27 Nov, but usually we'd be all drilled up by the end of Oct."

All the wheats are min-tilled. "We're aiming to keep the blackgrass near the soil surface, then spray off with glyphosate at least once before drilling."

Seed rate and variety choice have also been tailored to add extra control. "We're currently growing Gallant and Oakley, as these are supposedly good for blackgrass competition, as well as giving us the yield and quality we're after. We've moved away from the likes of Cordiale and Alchemy.

"Seed rate on the first wheats starts at around 150kg/ha, ending up at around 185kg/ha by the time we've finished the second wheats. We've increased rates, and are now applying the seed at a variable rate. We're looking at mapping blackgrass densities within fields so we can tailor the seed rate accordingly."

The final part of the strategy has been to place greater emphasis on pre-emergence herbicides. "All the wheat gets Avadex (tri-allate) through an applicator mounted on the rolls and full-rate Crystal (flufenacet+ pendimethalin) is then our mainstay. Other residual herbicides are stacked depending on the conditions at the time, and also on blackgrass pressure in specific fields. But we hardly use post-em chemistry for blackgrass control nowadays."

Delayed drilling and a greater emphasis on pre-emergence herbicides were two tactics adopted by Edd Banks.

The fields are getting "cleaner and cleaner" each year, he reports, while his efforts have earned him the title of Grass Weed Manager of the Year 2012 — an award organised by Syngenta. Average yields are around 9t/ha on the first wheats and 8t/ha on second wheats. "I'd hope our yields are steadily increasing, too, although it's difficult to tell with the variable harvests we've had recently.

"But blackgrass is a mind-boggling problem and warrants the extra research — if you have one bad year, it knackers you for the next three. So any information to help achieve more consistent results will certainly be valuable," maintains Edd Banks.

Research round-up

HGCA project 3647, Sustaining winter cropping rotations under threat from herbicide-resistant blackgrass, runs from Sept 2010 to Oct 2014. Its aim is to provide information on drilling date and plant population that may sustain rotations that contain predominately winter-sown crops and where herbicide resistance prevents high levels of blackgrass control. Led by Rothamsted Research, with partner NIAB TAG, its total cost is £172,000, funded by HGCA.

HGCA PhD project 3757, Competitive crop cultivars: optimising yield and sustainable weed suppression, runs from Oct 2011 to Sept 2015. Its aim is to exploit the natural variability in the suppressive ability of cereal cultivars to support integrated weed management strategies in a way that doesn't compromise weed-free yield. The project is led by Rothamsted Research, with partners Agrii and Syngenta. Its total cost is £75,000, with £37,500 funded by HGCA.

Both projects will feature on the HGCA stand at Cereals, with an opportunity to discuss results to date with Richard Hull, Izzy Andrew and Caroline Nicholls.

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themselves? These are currently under scrutiny in the competitive crop cultivars studentship project. While there's plenty of commercial research that highlights which varieties perform better, less is known about the reasons why, according to Rothamsted's Izzy Andrew.

"We're aware that some cultivars are better than others at suppressing weeds, but there's not much information on the traits responsible. We need a quick, new measure by which to assess new varieties as they come through. The ideal outcome would be a rating on the HGCA Recommended List that would help growers with bad blackgrass choose appropriate varieties," she says.

There are two different kinds of competition a plant exhibits, she explains — suppression, where a plant's growth actually inhibits the growth of its neighbour, and tolerance, which is the crop's ability to withstand weed pressure. "We're more interested in suppression, although some plant traits help both aspects."

A good example is plant height — a taller variety overshadows competing weeds, suppressing their growth, but may also have reduced yield in weed-free situations because of a lower harvest index, explains Izzy Andrew. "Growth form is also a key trait, although there are mixed views on what form promotes suppression. There's also tiller numbers, helping a plant compete for light, and there's the nature of the leaves themselves — the length and angle of the flag leaf, for example."

Wheat plants have been grown next to blackgrass in containers out in the open, with growth assessed every one or two weeks. Although only 18 months into the four-year project, there's already been a key finding that Izzy Andrew believes may help with assessing cultivars.

Important trait

"We've been looking at early season growth, and in particular how tall a cultivar is at around 35 days after emergence. Work so far suggests this is an important trait in terms of weed suppression. Those with a high Green Area Index (GAI) at this stage are likely to be more competitive, and those that tiller faster are more likely to reduce weed numbers.

"The really valuable part of this is that it's easily measured — an assessment of the cultivar at 35 days could tell you a lot about how competitive it will be against weeds later in the season."

Flag-leaf length is also related to a variety's competitive ability, she notes. "It's not necessarily just the flag leaf — its length is an indication of a crop's ability to make a closed canopy later in the season and out-compete weeds."

The cultivars have been assessed in terms of their ability to suppress seed return — for a container with 36 cereal plants, the seed return was measured for the 10 blackgrass plants grown with them. "Initial results showed the best was Suzuka winter barley, returning 700 seeds/m^2, while Gerald oats were the least competitive with a seed return of 3000 — that's quite a difference in terms of blackgrass strategy.

How tall a cultivar is at around 35 days after emergence appears to be an important trait in terms of weed suppression.

"In my research, Duxford performs well — its height early on gives it an advantage — and Conqueror is also good, but we can't establish why as it's not particularly tall."

Measurements have been taken out into the field as well, using Agrii's trials at Stow Longa, as well other trial plots at Rothamsted. "This year, we're including chickweed to see if the same traits help suppress broadleaf weeds," adds Izzy Andrew.

"We're also planning to do some modelling, to see how cultivar competition relates to seed rate and sowing date, so we can produce a protocol for growers. And we're using a crop green area sensor to study how a crop with no weeds produces a canopy and intercepts light.

"Crop cultivars can make a valuable contribution to weed suppression, along with other strategies. The advantage is that it's an easy one to implement with minimal cost," she concludes.

So is it the end of the road for winter cropping where resistant blackgrass is a problem? Richard Hull believes there's hope but reckons you have to be smart.

"If you delay drilling, getting one or two flushes of blackgrass out of the way first, and then use the right herbicides in the right fields, you should make headway, while relying on herbicides alone for blackgrass control is simply asking for trouble. Experiment with what will work best on your farm and, if you can successfully integrate a number of practices that each give modest control, taken together, they'll add up to a significant difference," he advises.

"The benefits and risks of delayed drilling will inevitably vary from year to year, depending on the weather conditions. The aim must be to reduce the risks by having the drilling capacity and equipment to establish at least some of the winter wheat later in Oct." ■