



The big questions answered

Weed Control

Slow herbicide discovery, resistance development and a rapidly changing farming landscape are all threats to sustainable weed control in UK arable systems. *CPM* attended a recent debate to see what leading experts view as potential solutions.

By Janine Adamson and Rob Jones

A warning about new weed threats and the call for speedier adoption of alternative control methods were some of the take home messages from a recent 'Question Time' grassweed control discussion.

Held at the Association of Independent Crop Consultants (AICC) annual conference and chaired by AICC director Matthew Paterson, a panel of three renowned researchers were quizzed by agronomists on the rapidly changing weed control landscape.

The panel included Rothamsted Research's weed ecologist Richard Hull, who's been central to extensive herbicide resistance work during recent years, particularly in blackgrass populations.

He was joined by weed biologists Lynn Tatnell of ADAS and NIAB's John Cussans, who is also a research member of AICC.

Both are experts in the implementation of practical integrated weed control strategies in agriculture and horticulture.

To begin, John points out the reasons behind why weed control has become trickier, particularly during the past 20 years. He explains that while herbicide discovery hasn't stopped, with new actives like cyclopyrimorate from Japanese company Mitsui and tetraflupyrolimet from FMC being recent examples, it has slowed significantly.

Access to innovation

John outlines that the cost of developing and registering such actives has doubled between 1995 and 2014, limiting the sources of discovery to just a few major players, and there are further issues on the horizon that could limit herbicide availability or use.

He says Northern Europe, including the UK, is a small market for those major players and growers may not get access to innovation as quickly as it requires to replace older chemistry identified as a risk by regulators and coming off the market.

"Producing a new grassweed herbicide for use in a crop which isn't globally important may not be commercially viable and we're already beginning to see the effects of that. It's going to get more difficult for us from an herbicide availability point of view," warns John.

He adds that the upcoming microplastics

“Rotations have to be longer and more diverse, and the adoption of non-chemical approaches should be accelerated.”

ban across many countries in Europe, including the UK, will also affect availability or dose of herbicides utilising microencapsulation technology.

According to Richard Hull, resistance ▶



John Cussans says while herbicide discovery hasn't stopped, it has slowed significantly.



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Weed control



According to Richard Hull, resistance has also become a lot more complicated, particularly as scientists have learnt more about non-target site or enhanced metabolism resistance.

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He says of the two types of herbicide resistance, target site resistance is relatively simple and well understood, with a single genetic mutation in the target weed stopping the active substance from binding to its

target site, rendering it ineffective.

Examples include ALS-inhibitor and ACCase herbicide target site resistance, which are now widespread in UK blackgrass populations and in some broadleaf weed populations, including chickweed, mayweed, and poppy.

But with non-target site resistance, weed populations can cope with a range of herbicide modes of action and recent work at Rothamsted has shed light on the mechanisms behind it.

Richard says two of the 'toughest to control' blackgrass populations from Peldon (Essex) and Oxon were tested, with researchers looking at the phenotypic response to a range of pre- and post-emergence herbicides and broad-spectrum glyphosate.

Both populations responded to sprays in the same way, being less sensitive to all the herbicides applied in glasshouse pot tests, he explains.

However, latest molecular techniques revealed that the genes associated with this non-target site resistance were very different in each population, exposing a complexity that should be better understood in order to manage it.

In response, Lynn states 'the time is now'

for farmers to adopt alternative weed control strategies, which will reduce reliance on existing chemistry, slow non-target site resistance development, and prolong herbicide efficacy. However, she says she accepts there are barriers.

Furthermore, Lynn explains there's a 'huge mountain' of evidence on the efficacy of herbicides, but not on the alternatives — at least in a modern context — and this is something ADAS and other research groups are trying to address within the European Oper8 project (www.oper-8.eu).

The Europe-wide network aims to gather and share information on alternative weed control strategies, including cultural controls and mechanical or technological solutions.

"We'll hopefully use this network to put forward policy recommendations for the future, bringing alternative weed control higher up the agenda," concludes Lynn.

Question one: Are regenerative farming and sustainable weed control compatible?

According to Richard, from a resistance point of view, it's concerning that there's such a big reliance on one active substance. "Glyphosate is the only herbicide option



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for controlling weeds between crops in regenerative systems and the more it's applied, year after year, the greater the chance of selecting for resistance.

"With no soil movement, there's also no burying of seed and mixing of the seedbank, so you're selecting from the same population each time. We've done modelling at Rothamsted and found that without glyphosate, either through regulation or resistance, it would be very difficult to control weeds in a no-till situation," he answers.

Question two: What are the biggest barriers to adoption of alternative weed control methods?

"Cost is the major factor — there's already been a significant uptake of mechanical weeders, robotic weeders and precision application kit by big high value field veg producers where the economics make sense," says Lynn.

"Other sectors can learn a lot from those situations, but there'll have to be help for farmers to invest in the technology and that's coming through SFI and the Farm Equipment & Technology Fund.

"The Oper8 project's recommendations will hopefully continue pushing policy makers to offer attractive funding options

in the future," she adds.

Lynn says the other major problem is a perceived lack of reliability and the hassle of these options, which leads growers to stick with herbicides, which are still relatively reliable and cheap.

"Using mechanical methods or changing rotations requires considerable planning and management. To push things forward, farms will require help from experts before it really takes off," she says.

Question three: Should growers reconsider late drilling to control grassweeds given the proportion of winter crops undrilled?

John says in weed management, it can be easy to overcomplicate things. "Fundamentally, it's all about preventing seed return and depleting the seedbank at the same time, using a variety of methods.

"One thing we've learnt through our challenges with blackgrass and, more recently, ryegrass, is that a longer gap between crops, the greater the natural seed loss. Application of residual herbicides in later drilled crops also helps maximise their efficacy," he explains.

"These factors have driven us to an



The slow uptake of alternative weed control techniques is first due to cost and then a perceived lack of reliability, says Lynn Tatnell.

obsession with late drilling as a tactic to manage these grassweeds, but the risks are getting so high now, as we've seen in recent seasons where winter crops have not been established at all."

According to John, growers shouldn't rely on that one tactic in isolation across the rotation, particularly as arable businesses increase in size. "There'll have to be an ▶

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No-till weed control

The transition to a reduced tillage system can have an impact on weed pressure — whereas those who follow a min-till approach report a difference in species compared with those who use the plough, a similar shift can also occur when switching from min-till to no-till.

However, this doesn't mean it's not possible to achieve effective weed control in regenerative-type systems, even if the commonly appearing species are a change from what would usually be expected.

George Fraser farms and runs contracting business A&R Fraser in Dorset and says he's started to see such changes in his weed populations. The farm has been operating a no-till system for more than eight years, currently using a strip tine drill for seedbed preparation and then running a subsoiler through where required.

"I've had a really good experience with no-till so far and fortunately haven't seen yield reductions since transitioning to a regen-ag based system," he says.

"Being no-till requires more attention to detail than traditional seedbed preparation and it's presented a few different challenges, primarily, there's greater pressure from slugs. But when it comes to weeds, we've noticed a difference in the species cropping up," he explains.

The first change to note is blackgrass pressure. George says the farm had issues with the grassweed in the past but deploying a no-till system has helped to reduce it. "Brome, however, has become more of a problem for us since switching systems.

"To control grassweeds, we use a stubble rake where required and in higher risk areas we'll go in with a disc drill slowly to reduce the level of disturbance to the soil as well as use pre- and post-emergence herbicides to help clean up the weeds," he adds.

Like many arable farmers, George says much of his spring weed control is targeted at broadleaf species.

"Broadleaf weeds haven't become worse or uncontrollable since going no-till, but we've seen different populations cropping up," he confirms. "We farm in quite a high charlock area, with many neighbouring farms having issues and we've dealt with it ourselves since becoming no-till.

"I've seen cleavers appear over the years too, but the biggest difference since moving towards a regenerative system has been the presence of burdock and hemlock, which are more common in no-till systems," says George.

George explains that to control these weeds, he uses a standard procedure for broadleaf weed control centred around spring applied

sulfonylurea herbicides (SUs). He aims to apply as early as possible when the weeds are small to help to optimise control.

"One standout positive about no-till is that we can get our herbicide applications on much earlier than when we operated in a plough-based system," he says.

"If you've ploughed and then drilled a spring cereal, you often have to wait a while before making spray applications as the ground can be too soft to travel. This means you could risk missing the weeds when they're at the ideal timing to be controlled.

"With no-till we have more opportunities to travel as the soil isn't as soft, meaning you have that extra opportunity to apply the herbicides before weeds become too big," he comments.

For growers following in similar footsteps and moving towards a regenerative-based system, George advises that it's key to pay attention to detail.

"Ensure you make well-timed applications of herbicides with the correct water rate and the right nozzles. Make sure everything adds up and focus on the small percentages which can make a significant difference when it comes to weed control," he says.

According to FMC's Mat Hutchings, the key to controlling weeds in regen ag is being aware of the different species and having the appropriate tools to control them.

"In theory, in regen ag there shouldn't be as many weeds as you're disturbing the soil less and aren't bringing as many viable seeds to the surface to establish. However, perennial weeds can become more of a problem as you're not cultivating and these types tend to be less familiar to growers and agronomists," he explains.

Mat says species can also vary across the country and between systems. "Willowherb in particular seems to be common in no-till systems — we commonly receive enquiries from farmers about this weed.

"Glyphosate is not reliably effective on willowherb, which is why it can become prevalent in systems where glyphosate is often the cornerstone of control.

"If farmers have concerns, I'd recommend an application of glyphosate and Shark (carfentrazone) which will improve the efficacy against the weed, before following up with an SU in the spring if required."

Mat explains that burdock and hogweed tend to be hedgerow plants, so in many fields that have been cultivated it's rare to see large populations of them. "However, they're starting to creep into no-till systems from the hedgerows. This is likely because people are less familiar with them, and



George Fraser says being no-till requires more attention to detail than traditional seedbed preparation.

they can become large very quickly.

"For optimum control, these weeds should be targeted with an SU while they're as small as possible yet actively growing," he says.

Mat highlights that growers in regen systems should be cautious of how moving the soil less between the rows could have an impact.

"This can lead to spring weed flushes coming later," he says. "So, it's important for growers to regularly walk fields to monitor emergence and have appropriate control measures in place to tackle weeds once they do emerge to avoid missing such late flushes."

For Mat, he believes applying SU herbicides before T1 spray timings is essential when considering more difficult weeds. "Harmony M SX (metsulfuron+ thifensulfuron) and Ally Max SX (metsulfuron+ tribenuron) both contain the active metsulfuron which has a wide spectrum of control and can be used in combination with other herbicides to pick up a wide range of weeds."



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ALS-inhibitor and ACCase herbicide target site resistance are now widespread in UK blackgrass populations.

► acceptance that some wheat has to be drilled earlier to maximise economic returns from a first cereal.

"To enable that, people will also have to accept that rotations have to be longer and more diverse, and the adoption of non-chemical approaches should be accelerated," he stresses.

Question four: Are integrated control strategies and changes in farming systems applying selection pressure to weed populations?

To answer, John explains that selection is happening on two different levels. "The first is within weed species when using harvest weed seed control (HWSC) options like seed destructors fitted to combines, or weed surfing machines that cut off grassweed

heads as they emerge from cereal crops.

"Seed destructors can select for earlier maturing weeds, or those that are more prostrate within the crop if using a surfer. The concept has been proven by weed researchers in Australia," he says.

However with herbicide resistance, John believes there isn't a significant fitness penalty to resistant weeds, and that's why it's such a challenge.

"We're fortunate that there is a significant fitness penalty when selecting weeds adapting to late season, surfing, or seed capture technologies, so it isn't such a problem. At NIAB, we have a PhD student looking at genetic selection within ryegrass and blackgrass populations through changes in rotation practices and spring cropping.

"There's evidence that selection of different germination patterns or behaviour is happening," he says.

According to John, the second level of selection is on the weed flora level which he believes is the much bigger issue. "There's already a move towards brome grasses after the uptake of some systems.

"Bur chervil is an invasive species widely distributed in natural and semi-natural habitats and where farms are adopting low or no disturbance systems, it will invade from those areas. There are limited herbicide options, with sulfonylurea herbicides giving some control. The worry is that overreliance on that one group would lead to resistant populations," he says.

John wants to 'up' awareness of these potential changes in weed flora. "Biosecurity is also on our radar with the uptake of cover crops, Sustainable Farming Incentive (SFI) options and the creation of new habitats.

"People are bringing all sorts of species

on to farm, even bulking them up themselves and planting the seed. We're seeing different species in crops that we never considered an arable weed."

Question five: Why is there such variation in how ryegrass responds to control measures between farms and fields?

John says ryegrass is like a biological soup of genetics, with wild perennial ryegrass, wild Italian ryegrass, and cultivated Italian ryegrass, which all potentially hybridise. "The complexity that is creating is giving us different problems.

"We started to look at this and found that from populations of ryegrass on the same farm, but different fields, plants could be totally susceptible to totally resistant.

"We're also seeing different traits including vernalisation requirement — some can start to flower in no time at all and others have quite a high requirement, making some populations more problematic in winter crops and others in spring crops."

For John, ryegrass is like blackgrass, but where the dials are turned up to 11/10. "The frequency of herbicide resistance is higher, the rate of development for non-target site resistance is higher, and the diversity in biological traits mean populations respond differently to cultural controls.

"Culturally, everything that works for blackgrass works for Italian ryegrass, but not as well. Using current tools and approaches, where you might be able to reduce bad blackgrass to manageable levels within a relatively standard arable rotation, more fundamental changes — like introducing fallow periods or using non-crop SFI options — might be needed to clean up ryegrass," he concludes. ■

Seedbank management

For this season, Bayer's Tom Chillcott stresses the importance of considering long-term seedbank management and the role of spring weed control. "Usually, the benchmark for a successful programme which is degrading the seedbank is 95% or more total control from cultural and chemical controls. Although, in higher pressure situations, it can be even higher.

"Quite often, spring weed control is crucial in pushing total control beyond 95%, which can make a huge difference in the long-term."

Tom sees three main options on the table for current wheat crops. "You can use a post-em like Atlantis Star (mesosulfuron+ iodosulfuron+ thienclazone) in early spring, wait to patch

spray the worst areas with glyphosate, or hand-rogue in May," he says.

Tom points out that patch spraying wipes out yield entirely and hand roguing is only really viable for mild infestations, so in many situations, spring post-em remains the best option to reduce seed return.

He explains that in Bayer trials last year, applications of Atlantis Star showed a sustained improvement in ryegrass control of 11% compared with a pre-em only programme. This equated to 21 fewer ryegrass plants/m². "Assuming each plant produces 1000 seeds, this means 2,100 fewer seeds per m² that can potentially germinate in subsequent crops," concludes Tom.



In trials last year, applications of Atlantis Star showed an improvement in ryegrass control of 11% compared with pre-em only, says Tom Chillcott.