



“ Even those who don't believe the risk exists should nonetheless follow the WRAG guidelines. ”

# Grassweed resistance to glyphosate looms

## Technical Weed control

Thinking of spraying stubbles with a field rate of glyphosate below 540g/ha? Think again, say experts, as that's exactly what'll lead to resistance. *CPM* assesses what the research means for post-harvest stubble management.

By Tom Allen-Stevens

**With reduced sensitivity to glyphosate now confirmed in populations of both blackgrass and sterile brome, grassweed researchers have stressed the critical importance that all arable farmers in the UK adopt Weed Resistance Action Group (WRAG) guidelines in their stubble management this year (see panel on p12).**

“Growers who are blasé about glyphosate resistance are the ones most at risk of being the first in the UK to suffer from grassweed populations that develop it,” warns Lynn Tatnell of ADAS, who leads the five-year, AHDB and industry-funded project on managing resistance risk to glyphosate.

“Even those who don't believe the risk exists should nonetheless follow the WRAG guidelines — glyphosate is such a critical aspect of grassweed control, the industry cannot afford to allow resistance to develop.”

The warning follows research led by

Rothamsted Research and published in the March 2019 issue of *New Phytologist*. This presents findings from the UK's widest ever and most thorough screening of blackgrass for its sensitivity to glyphosate, conducted as part of the joint AHDB and BBSRC-funded Blackgrass Resistance Initiative (BGRI).

### Wake-up call

The results should be a wake-up call for growers, according to research lead Dr David Comont. “At 540g/ha of glyphosate, equivalent to a standard field rate, all populations tested were adequately controlled. But at 405g/ha there was a lot of variability. It's critical that growers don't rely too heavily on glyphosate to control blackgrass.”

Where it's used, the applied field rate must be at 540g/ha or above, which is 1.5 l/ha for a standard 360g/l formulation, he stresses, and this should take account of application procedure. “If travelling too fast, in hard-to-reach field corners or where conditions aren't ideal, these circumstances give rise to compromised efficacy, and could encourage resistant populations to develop.”

Working with collaborators at the University of Sheffield, the Rothamsted team collected blackgrass seed from 132 farmers' fields across 11 English counties, from Herts to Yorks, as well as collecting extensive datasets on historical field management, including glyphosate use.

More than 16,000 seedlings were grown on in glasshouses, and the effectiveness of glyphosate in controlling plants from each

local population was assessed. Plants from nine of these populations were then cross bred to produce 400 new seed lines with known genetic pedigrees, that were also tested for their responses to glyphosate.

Crucially, the team showed that the degree of sensitivity was something plants inherited from their parents, and that the variation in sensitivity between populations was a result of historical glyphosate exposure — both prerequisites for pesticide resistance evolution.

“We wanted to be sure there is a genetic, heritable component and there is,” notes David. “What's more, blackgrass populations with greater historic exposure to glyphosate are now the populations least sensitive to the herbicide.”

The greenhouse experiments were carried out on plants at the 3-4 leaf growth stage, ▶



The industry cannot afford to allow resistance to develop to glyphosate says Lynn Tatnell.



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# Weed control



At doses below standard field rate, David Comont found there was a lot of variability of control.

► but there's a greater risk of tolerance if spraying larger plants, he says. "If you spray at a sub-optimal growth stage and you see survivors, it's critical these are removed by some other method before they shed their seed."

So does pre-harvest use increase the risk? "We did test for that, relating sensitivity to when fields had historically been sprayed, assuming any applications made after June were pre-harvest. Here we found no evidence for pre-harvest use affecting glyphosate sensitivity, which is logical as in

## WRAG key messages on minimising the risk of glyphosate resistance

1. **Prevent survivors:** Avoid repeat applications to surviving plants
2. **Maximise efficacy:** Apply the right dose rate (reduced rates increase the risk of reduced efficacy), at the right timing, in the right conditions
3. **Use alternatives:** Use non-chemical options (such as cultivation), where practical, and use other herbicides in sequence
4. **Monitor success:** Remove survivors and report potential resistance issues to your advisor and/or the product manufacturer.

Source: AHDB Information Sheet 03, in conjunction with WRAG, autumn 2017.

most cases blackgrass will have completed flowering by that date, so will be unaffected by the application anyway."

The effect of the use of glyphosate at field margins, spraying sterile strips to define the crop edge, was not assessed, however. "We know from experience in Australia that frequent spraying of glyphosate to amenity



More than 16,000 seedlings were grown on in glasshouses to test the effectiveness of glyphosate.

areas and fence lines can cause resistance to build, so growers should be wary of these practices. Thankfully, we're talking about relatively small areas, though."

Lynn notes there's nothing in the research that should affect how growers implement the WRAG guidelines. "It does underline the importance of maintaining a robust field rate of glyphosate — that

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## Watch brome in resistance struggle

Brome is likely to require a more robust rate of glyphosate than blackgrass to avoid the risk of resistance, according to AHDB and industry-funded work, led by ADAS.

Populations of the grassweed tested four years ago revealed up to a 50% survival rate at 810g/ha — almost one and a half times the standard applied field rate — says Dr Laura Davies of ADAS.

“We’ve since returned and tested the same populations where lower susceptibility had been found. The good news is that the levels of tolerance haven’t moved, which shows this is an issue that can be contained through good management,” she notes.

The farm in question is following a no-till cultivation regime on brackish soil, she says, and has now fully implemented WRAG guidelines to minimise the risk of the brome becoming more tolerant. “Situations most at risk are where glyphosate has been repeatedly used on stale seedbeds without the additional use of

non-chemical control,” warns Laura.

ALS and ACCase chemistry are also under scrutiny in the project, with brome populations being tested for their sensitivity. “So far we haven’t found any cases of resistance to these groups within the UK, but some populations are showing reduced sensitivity to ALS herbicides and we know resistance to ALS and ACCase chemistry exists elsewhere, so no one should rely on chemistry for their brome control,” she advises.

Laura reiterates the advice of others when it comes to post-harvest management of seed shed from brome grasses. “Great and sterile brome species germinate in the dark. But just a covering of chopped straw would do — you don’t have to cultivate. If you do decide to cultivate post-harvest, a shallow cultivation of 3-5cm will cover the seeds and promote germination, any deeper and the seeds may become dormant and cause further problems.

“If you have meadow, soft or rye brome, however, the seed must be left undisturbed on the



*Great and sterile brome species germinate in the dark, but just a covering of chopped straw would do — you don’t have to cultivate.*

surface — they need to ripen on the surface for at least a month and need light to germinate. Leaving them on the soil surface also often leads to seed predation.”

Germination of brome grasses is usually less protracted than blackgrass, she adds, so good stale seedbed techniques, delayed drilling, and spring cropping, implemented for blackgrass should also keep brome populations in check. “They’ll tend to germinate more uniformly, given adequate moisture,” notes Laura.

should be no lower than 540g/ha for plants up to four leaves or GS 13-14. Any larger and the minimum rate should be 720g/ha.”

No-till farmers are in the high-risk

category for resistance to develop, she points out. This is because part of good practice is to cultivate following application, to remove any survivors through

non-chemical means. “That course of action isn’t available if you’re direct drilling, so it’s important for these growers to monitor results of any applications they ▶

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\*2 14 independent replicated trials (2016 - 2018), average population in untreated = 201 heads/m<sup>2</sup>.

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# Weed control

► make — plants that survive should be an absolute red flag and should be removed with non-chemical control.

“But my feeling is that this won’t be a problem for the more informed direct drillers — the conversations and discussions at the recent Groundswell event show there’s a

body of growers who are taking a leading stance on glyphosate usage and pro-actively developing innovative ways to reduce dependence on the herbicide. Those growers who are engaged with this community of farmers will be the ones least likely to suffer problems.”

Where growers suspect resistance, they should alert their advisor and get samples tested, she adds. “There is funding in the project for testing of submitted samples, but we only receive one or two a year. We’re not yet clear whether that’s down to lack of problems in the field or lack of awareness.” ■

## Strategic approach encouraged on stubbles

As soon as the combine’s out of the field, chances are you’re itching to get cultivations underway.

But why? There’s a growing body of opinion that the best strategy for nearly all grassweeds and situations is to leave the stubble untouched.

“For good grassweed control, you should drill as late as possible, if possible,” advises Lynn Tatnell. “It’s best to get two stale seedbeds in before the crop is drilled with a light cultivation pass between them. But cultivations following the combine are unlikely to help your grassweed strategy.”

The obvious exception here is where cover or catch crops are established. “These tend to help blackgrass by suppressing the weed,” notes Lynn. Given the tight turnaround, cultivations for OSR would also want to follow the combine and applied organic matter may need to be incorporated.

“Good stubble management is an example of where there’s plenty of anecdotal guidance but little hard evidence. So it’s an area we’re looking into as part of the resistance-management project,” she continues.

“The challenge, though, is that every season and situation is so different, it’s very difficult to define a clear set of guidelines.”

This year, spring barley was included as a crop within this area of the project. “The interesting aspect is that the vast majority of your blackgrass kill still takes place in the preceding autumn, which is where cultivations should be remain. The only operation worth leaving until spring is the final glyphosate before drilling,” notes Lynn.

*A light roll to maximise seed-to-soil and seed-to-straw contact should be quite sufficient to ensure the best initial weed flush possible.*



Bayer Roundup specialist Tom Scanlon believes the most appropriate stubble management strategy for the farm will depend on two main things, alongside the particular weed burden — the main establishment regime and the current cropping pattern.

“The amount of care and attention you need to put into managing your stubbles will depend on the scale of your grassweed challenge,” he notes.

“Blackgrass, brome and ryegrass problems can essentially be addressed by the same overall approach — leaving shed seed on or very close to the soil surface to be predated by birds and small mammals or germinated and eliminated with Roundup (glyphosate) ahead of planting the next crop.

“Meadow, soft and rye bromes do differ from other brome species in needing a period on the soil surface to ripen before cultivation. But, like blackgrass and ryegrass, providing there’s sufficient moisture sterile and great bromes will germinate readily in the autumn if left on the surface or under a straw mulch, as will volunteer oilseed rape.”

So regardless of the weed challenge, or predicted dormancy status, he recommends the best approach is to avoid cultivating the ground immediately after combining. “This may go against current practice for many. But in our experience, even the shallowest of cultivations at this stage will give little or no extra impetus to grassweed germination and, in most cases, only works against soil moisture preservation. Instead, a light roll to maximise seed-to-soil and seed-to-straw contact should be quite sufficient to ensure the best initial weed flush possible for the season.”

Tom accepts that early post-harvest cultivation may be important for seedbed preparation ahead of mid-Sept-sown winter cereals. However, with sowing on grassweed-infested ground delayed until well into Oct there’s more than enough time to achieve good stale seedbed control without the need for early cultivations in most cases.

“Combining should be your first cultivation,” he points out. “Get a good chop of straw and spread it and the chaff evenly and you have a perfect mulch to preserve soil moisture and



*Providing there’s sufficient moisture, most grasses and volunteers will germinate readily if left on the surface or under a straw mulch, says Tom Scanlon.*

stimulate volunteer and weed seed germination.”

Tom suggests the best approach is then to wait until after spraying off the first flush of weed growth for the majority of growers, including those min-tilling, ploughing or using a rotational plough ahead of autumn or spring drilling without a catch or cover crop. And only then cultivate if soil conditions are right.

“If you wait until after your first weed flush in about 3-4 weeks, though, you’ll generally know you have sufficient moisture to do a decent job of cultivating. It will also mean you’ll get in with the Roundup at the ideal 2-3 leaf stage of weed growth, then press and roll to give yourself a further stale seedbed control opportunity just ahead of drilling.”

Bayer’s trial work and experience shows optimum control of blackgrass is achieved with two pre-planting applications of 540g/ha of a quality glyphosate at the 2-3 leaf stage with a cultivation in between. If the blackgrass has tillered or if ryegrass or bromes are present the rate should be increased to 720g/ha to ensure effective control.

“Where you’re only spraying-off stubbles once ahead of autumn drilling after more than six weeks or so (in no till regimes, for instance, or later drilling immediately behind a plough and press) you should increase the glyphosate rate to 720g/ha — again of a quality formulation — to achieve the most reliable and complete kill of very much better established tillered weeds,” he adds.





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