AHDB

from theory to field

The rise of bromes

"Growers should be alert to the risk of rapid herbicide resistance evolution."

Could bromes be the next super weed? Results from a four-year AHDB project reveal that they certainly deserve careful management to avoid them becoming increasingly problematic to control. *CPM* finds out more.

By Lucy de la Pasture

On many farms it's blackgrass that drives herbicide strategies and over the past decade the active ingredients and timing have evolved to counter this increasingly difficult to control weed. One of the effects of the move towards stacking residuals early in the season, instead of relying on post-emergence herbicides, and increased use of minimal cultivations has been that brome species appear to have taken advantage.

AHDB's Dr Paul Gosling says that bromes were reported to be a growing problem by agronomists and growers but there was little data available on the distribution of the five species of brome or the effect it was having on cropping systems. Equally there was no evidence to suggest whether incidences of poor brome control were due to management practices or were the first signs of resistance developing.

The outcomes of several pieces of research work led to the latest AHDB project on brome, which is due to report its conclusions this spring. The four years of research aims to provide growers with information on the potential for herbicide resistance evolution in UK brome weeds and identify methods to help slow or prevent resistance evolution of these grasses in UK arable farming.

Experimental work

Led by ADAS, the work has drawn on field surveys and experimental work using pot and container studies in the glasshouse and outdoors. The initial stage of the project looks at all five UK brome weed species but later focuses on the two species identified as being most at risk of developing herbicide resistance — sterile brome (*Bromus sterilis*) and rye brome (*Bromus secalinus*).

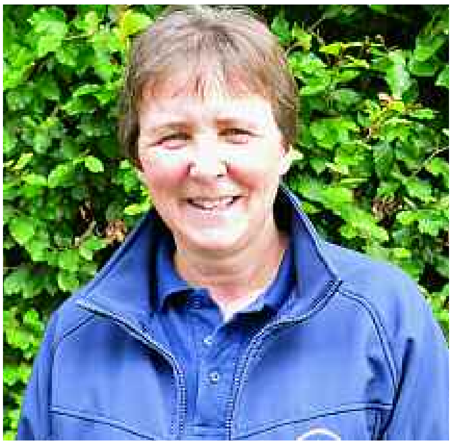
The brome project picks up on previous AHDB-funded work carried out by ADAS which looked at the dormancy of the different brome species as well as investigating their sensitivity to ALS-herbicides, explains Dr Sarah Cook.

"During the dormancy project it became clear that the different brome species are very difficult to distinguish from one another. In the vegetative growth stages, they're all hairy and even when the panicles are present, identification isn't easy," she explains.

The first stage of the project was to conduct a nationwide survey to pinpoint the distribution of the different brome species. Over 200 agronomists and growers responded to the survey call and the results confirmed that bromes were more widespread than had been previously thought.

"We had thought that sterile brome was present mostly in the West and that rye brome was rare and present in the South-East of the country. However, the survey showed that the bromes are actually widely present across all cereal growing areas."

As part of the survey, respondents sent in samples of brome to ADAS to confirm the identification. Sterile brome and great brome (*Bromus diandrus*) can be grouped together and are sometimes referred to as the Anisantha bromes. The other three species



Sarah Cook says it's likely that the way grassweed herbicides are being used to manage blackgrass is also selecting for brome resistance.

are soft brome (*Bromus hordaceous*), meadow brome (*Bromus commutatus*) and rye brome (*Bromus secalinus*) — collectively termed Serrafalcus bromes.

The survey highlighted the difficulties in distinguishing between brome species, says Sarah. "Correct brome identification was low, with 38% of samples misidentified in the field. However there wasn't any confusion between the two groups of brome species and here the distinction is important because their different dormancy characteristics require different cultural control methods."

Sterile brome was found to be the most common species in the UK — with the North, South-East, West Midlands and South West the worst affected areas. It also reported that there was a perceived problem with control using ALS herbicides, so the brome seed samples sent in were grown on and put through herbicide screening to assess their sensitivity to different groups of chemistry.

The 'soft' brome species – rye brome, meadow brome and soft brome – can be particularly hard to identify.

Herbicide resistance

With brome populations in both France and Germany reported to have resistance to ALS and ACCase herbicides, it's possible that UK populations may also have differing sensitivities, explains Sarah.

Meadow, rye, great and sterile bromes were tested against ALS herbicide — Broadway Star (pyroxsulam+ florasulam) and Pacifica Plus (mesosulfuron+ iodosulfuron+ amidosulfuron) — ACCase-inhibitor herbicides (cycloxydim and propaquizafop) and glyphosate. The results showed a number of cases where control from ALS herbicides was poor, indicating reduced sensitivity in some of the populations. Control using the ACCase herbicides was generally high for all the populations tested, whereas responses to glyphosate showed some variance between populations.

All bromes tested were still controlled by 360g/ha of glyphosate although some populations showed increased tolerance ▸

Paul Gosling says that bromes are reported to be a growing problem by agronomists and growers but there was little data on their distribution or effect.

Weed Resistance Action Group (WRAG) glyphosate guidance 2021

Typically, annual grasses require a minimum of 540g a.i./ha for seedlings up to 2-3 leaves, 720g a.i./ha when tillering and 1,080g a.i./ha when flowering.
ahdb.org.uk/wrag

Research plugs some of the knowledge gaps

There are a number of aspects that have come out of the brome work which Bayer's Roger Bradbury believes will be very useful to the industry. He describes the survey, which is the first to be carried out in the UK since the late 1980s, as an important step to update knowledge of the five different brome species.

"The focus has been on blackgrass for the past two decades, so this is a timely piece of research. It gives a wider perspective on grassweed management, which is important because blackgrass doesn't occur in isolation.

"One of the reasons bromes are perceived as becoming more problematic is that the incidental control which occurred when treating blackgrass with post-emergence ALS herbicides probably went unnoticed. This may be what has led to the shifts in sensitivity and a few cases of resistance in populations noted in the project."

Perhaps one of the most striking finding in the survey was that the identification of brome species in the field is a real problem — with 38% of samples sent in found to be incorrectly identified by a grower or agronomist.

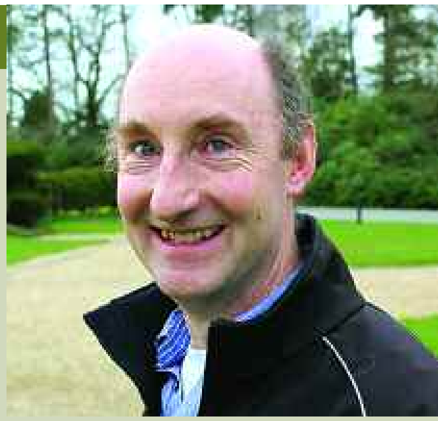
"Distinguishing between brome species is important for successful management. As well as the herbicide timing differences identified in the research, sterile and great bromes need darkness to break dormancy, so post-harvest cultivations will help stimulate germination for control using stale seedbed techniques. Meadow, rye and soft bromes need light to mature the seed so it's best to wait a month after harvest before moving the soil," he says.

The limited chemistry available for brome control and insensitivity to ALS herbicides in some populations mean cultural controls will be a central part in managing bromes and resistance. Just as with blackgrass, the aim is to reduce the weed population and limit seed return.

Roger believes ploughing shouldn't be forgotten — highlighting that it's a very effective way of managing difficult brome populations when used as a once in a while 'reset'.

"Delayed drilling and spring cropping are both important components in a cultural control strategy for bromes as well as blackgrass, which was borne out with lower brome levels last season when drilling was either late or took place in the spring."

Despite the importance of cultural elements, Roger believes herbicides will remain a key part of control strategies though not as the first resort and should be used in a measured way, taking into



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account the whole rotation rather than just one crop. Paying close attention to timing and application practice is another key piece of the jigsaw puzzle, he says.

"It sounds easy but there are often conflicting priorities. If you do get a patch of brome then it's best to take a zero-tolerance approach but patch spraying when in head isn't an effective strategy as seeds are fertile just two to three days after ear emergence. Brome needs controlling with glyphosate much earlier than blackgrass."

Container trials were used to determine the efficacy of different modes of action on different brome species and populations.

▸ at this rate. All populations were well controlled by 540g/ha of glyphosate — the recommended field rate for annual grassweeds.

Further work looked at the resistance mechanisms involved, and this revealed ALS-target site resistance mutations were present in multiple species of brome. Lateral flow device tests were also conducted, in conjunction with the University of Newcastle, to test whether enhanced metabolic resistance mechanisms (EMR) were also present. These concluded that it was and in some populations both target site and EMR mechanisms were detected.

Push the populations

"Over the three years of the project we tried to push the population towards resistance by using low doses of herbicides on both sterile and rye brome populations. Only one population of sterile brome became less sensitive to glyphosate but there was little selection for resistance in rye brome."

That begs the question, why can blackgrass populations be pushed towards resistance so easily and in brome it appears to happen much more slowly, with differences between the species? Sarah believes the answer lies in the way the different species pollinate.

"Blackgrass is a cross-pollinating species so there's a propensity for genetic diversity in the population, whereas bromes are predominantly self-pollinating, with just a small degree of out-crossing. That means that resistance is likely to develop much more slowly in bromes than in blackgrass.

ALS-insensitive populations have been detected in multiple species of brome and both EMR and target site mechanisms have been confirmed.

"We do see variation in response to herbicides in different brome species. Great brome and rye brome can be harder to control with herbicides in the field. As a self-pollinating weed, there's likely to be natural variation between different populations, which may not be resistance but could indicate an increased insensitivity to herbicides."

Sarah believes that there's likely to be more insensitivity in the brome population than is currently realised. "Brome is often incidentally killed by herbicides intended to control blackgrass. Sterile brome is predominantly found at the field edges and gradually creeps in so, being a marginal weed, many plants are likely to have been exposed to lower then recommended doses of herbicide."

Since all biological and chemical systems are linked, it's also likely that the way grassweed herbicides are being used to manage blackgrass is also selecting for brome resistance, she adds.

"The results indicate that although ALS resistance is evolving in brome populations other modes of action can be used to control these populations in a diverse rotation, but growers should be alert to the risk of rapid herbicide resistance evolution to other modes of action in UK bromes," she highlights, noting that resistance to propaquizafop and cycloxydim in sterile brome was identified in Germany in 2012.

The brome project has also looked at herbicide timings to find the best growth stage to maintain and improve control and prevent resistance evolution. The findings have thrown up some important differences between brome species and herbicide modes of action.

"We looked at applying cycloxydim, pyroxsulam and glyphosate at different growth stages in sterile brome and rye brome. We found cycloxydim controlled all populations at GS12-13 and GS21-23. Pyroxsulam gave better control of rye brome than sterile brome and was most effective in rye brome at GS12-13 and in sterile brome at GS21-23. The optimum timing for glyphosate was GS 21-23. Control dropped off at the late tillering stage for all herbicides.

"This timing difference between brome species is important and means it's crucial to know which species it is you're treating. In a mixed population or if treatment is delayed, then control of rye brome may be less effective because herbicide efficacy is best at an earlier growth stage than for sterile brome."

Correct identification of brome species in the field is important because there are differences when it comes to optimum herbicide timings.

The fact that brome populations are evolving resistance to ALS-herbicides is important to be aware of, adds Paul. "Brome should be controllable with the chemistry currently available if it's well targeted, particularly when combined with the appropriate cultural controls for the species present. If herbicide control is poorer than expected, then it's a good idea to liaise with the supplier and get the brome tested for resistance."

Later this year the results of the project will provide the foundation for updated guidance on best practice and strategies to manage resistance in brome. ■

Research roundup

From Theory to Field is part of AHDB's delivery of knowledge exchange on grower-funded research projects. *CPM* would like to thank AHDB for its support and in providing privileged access to staff and others involved in helping put these articles together.

AHDB Project No 211200059 'Investigating the distribution and presence, and potential for herbicide resistance of UK brome species in arable farming' ran from March 2017 to May 2021 at a cost of £218,000. The project is led by ADAS in scientific partnership with Rothamsted Research and with industry partners — BASF, Bayer, Corteva and UPL.