

Everything changes, or does it?



“By working at multiple sites of action it makes resistance harder to evolve, which may explain why after 60 years, tri-allate hasn’t failed.”

DR DANA MACGREGOR

With autumn comes an urgency to talk all things grassweed control. *CPM* reports on some of the latest research and advice to bolster existing knowledge about this pivotal aspect of cereal crop management.

By Janine Adamson and Rob Jones

For some, it may feel like there’s little new to report on how to manage grassweeds in cereal crops. And while on the face of it, the fundamentals indeed remain the same, nuances about how best to use certain products and processes are continuing to come to light.

For one, work has been taking place by Rothamsted Research to better understand the role of Avadex (tri-allate) and its mode of action. This was

initiated after the Herbicide Resistance Action Committee (HRAC) placed tri-allate in Group 15 alongside flufenacet, prosulfocarb and ethofumesate, as part of a classification overhaul in 2020.

Naturally, this has raised questions whether these active ingredients should be used together in herbicide programmes, given increasing concerns regarding resistance management. However, while Group 15 herbicides are based on

physiological action – whereby they inhibit very long chain fatty acid synthesis – Avadex manufacturer Gowan believed there were differences between the Group 15 molecules.

“We required clarity to understand if they shouldn’t be used together anymore,” says global herbicide asset manager for Gowan, Laurent Cornette.

To undertake this critical work, Rothamsted Research’s Dr Dana MacGregor conducted initial experiments in a controlled environment to compare the effects of flufenacet, tri-allate and a third active, EPTC (not registered in the UK) on blackgrass development. Critically, it found that tri-allate and EPTC impacted shoot growth in contrast with flufenacet, that altered both root and shoot growth. ►

► “Following application, the plant grows in a different way – its biology is impacted,” highlights Dana. “This shows that even with the Group 15 active ingredients, the biological effects are different depending on the specific herbicide being used.

“To investigate further, we then took this beyond ‘dead versus alive plant’, to look deep into the weed’s biology to know exactly what pathway tri-allate is affecting, and why it’s having this different effect.”

To achieve this, researchers used biochemical techniques to understand what was happening at the tissue and cellular levels in the plant. They found that tri-allate inhibits fatty acid synthesis – crucial for building cellular structures and enabling plant growth – but at two different places and stages, early in the chloroplast and later in the endoplasmic reticulum.

Conversely, flufenacet and EPTC affect only the latter part of the pathway that happens in the endoplasmic reticulum.

“This makes tri-allate unique,” raises Dana. “And in working at multiple sites of action, this makes resistance harder to evolve, which may explain why after 60 years, the chemistry hasn’t failed.

“Furthermore, while the HRAC system is useful guidance, this work does highlight that there’s further complex

biology underpinning Group 15.”

Laurent adds that Gowan had always suspected Avadex was particularly robust, delivering added staying power. “We’ve never known any single-site resistance to occur and we now know why – tri-allate offers multi-site activity.”

While these results are clear, this critical research must continue, urges Dana. “The experiment focussed on application of the actives at pre-emergence stage, but new questions have arisen as the work progressed. For the future, we may also investigate the impact on ryegrass, although we’re relatively confident it’ll have a similar action to what we’ve seen in blackgrass.”

MULTI-SITE ACTION

Gowan’s UK country manager, Hank King, believes the new research should influence how farmers and agronomists perceive tri-allate. “Growers often rely on a single active to do the bulk of the heavy lifting for autumn grassweed control. In those cases, that active has to be protected, which can be achieved by using tri-allate as a robust partner that acts at multiple target sites in the weed,” he says.

“It’s so important to be informed by robust scientific evidence. As such, Gowan is continuing the research with Rothamsted Research to ensure messaging is justified and backed up.”

Looking at this season in particular, Hank adds that when considering Avadex Excel (granule) versus Avadex Factor (liquid), it’s all about timing. “Avadex Excel performs best in drier, warmer conditions, aligning with an application earlier in the season. In contrast, we see Avadex Factor is more suited to cooler situations where there’s more moisture present.

“Timing is key – a well-timed application of Avadex Factor can offer better results than a poorly-timed application of granular tri-allate. Either way don’t hesitate, it still delivers the same mode of action effect.”

Choosing tactics based on conditions is also critical for ADAS’ John Cussans. He says research has shown that if seedbeds are dry, it’s best to leave weed seeds on the surface. “This is critical to manage newly-shed seeds post-harvest because predation occurs as well as direct mortality.



Investigative work

Rothamsted Research’s Dr Dana MacGregor conducted initial experiments to compare the effects of flufenacet, tri-allate and a third active, EPTC, on blackgrass development.

“If growers are drilling cereals particularly, then doing nothing in that instance would benefit weed management considerably, while cultivation consistently increases the germination of freshly-shed blackgrass seeds.”

He notes that work undertaken by Jasper Kanomanyanga, as part of his PhD studies, has compared weed seed predation in no-till versus cultivated situations. “The predation in no-till is astonishing, with nearly 100% predation rates in blackgrass by carabid beetles and small mammals.”

John further urges growers to hold their nerve this season, particularly if grassweeds are a reoccurring issue. “As well as delayed drilling decreasing grassweed densities, we also understand that it can have a positive effect on pre-emergence herbicide efficacy. Ultimately, herbicide effectiveness improves and the chance of requiring a top-up is reduced. This will not change.

“Everyone is feeling the pressure to adapt, but when it comes to grassweed management, nothing has changed. Remember the basics, consider each field, and don’t kid yourself that the weeds are changing because they aren’t,” he stresses.

Despite this strong message, he notes that one aspect has shifted during recent years – herbicide resistance. “We’re working harder to achieve the same goal and using more



Multi-site action

Tri-allate should be used as a robust partner for other key active ingredients, because it acts at multiple target sites in the weed, advises Gowan’s Hank King.

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pre-em to compensate for a lack of activity in spring contact herbicides. Complicated pre-em stacks do incur selectivity risk; complex mixes mean additional interactions,” he warns.

For North Lincolnshire grower Pat Thornton, this coming season the challenge will be ensuring every input delivers on ROI to help fill an impending financial void post-BPS. He says the farm grows continuous cereals including spring barley, and blackgrass is the main weed challenge.

“Autumn 2025 we did drill in early

October, which was probably 10 days early, purely due to temptation. But ordinarily, we’d delay drilling and use spring cropping as part of our core cultural control methods.

“Understanding the fundamentals and established research is helpful in tackling problem weeds, and really, herbicides are the last step. In terms of product choice, it’s actually knowing the value it offers rather than what it costs,” he explains.

Noting the farm’s blackgrass problem, Pat says Luxinum (cinmethylin) forms the base of pre-em applications,



Integrated approach

According to grower Pat Thornton, understanding fundamentals and established research is helpful in tackling problem weeds, and really, herbicides are the last step.

as part of a strategy of using both the best quality practices, and best quality chemistry. “We’re always looking for that additional 1% control, so everything requires that level of detail to step up to the challenge of current finances,” he explains.

“Subsequently, blackgrass populations are decreasing considerably and we’re making improvements. However, you just can’t take the risk, so it’s a no brainer to always do the best you can.”

RYEGRASS

Of course, when it comes to winning the grassweed war, it isn’t all about blackgrass. Italian ryegrass is becoming increasingly troubling due to its evolving herbicide resistance status and extended, sporadic germination.

As such, spring cropping isn’t a robust tool, highlights John. “Unlike blackgrass, ryegrass plants that emerge in the spring can set seeds profusely. So sometimes, spring cropping isn’t quite so effective, whereas for blackgrass you always have that spring crop backstop.”

Ryegrass also has a prolonged germination pattern, meaning herbicide sequencing and multiple application timings generally provide the best level of control, while the weed has an innate ability to develop resistance to herbicides, he adds.

Resistance to post-emergence

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chemistry is becoming more widespread in ryegrass populations, significantly reducing the reliability of contact herbicides. In some situations, growers are also beginning to see reduced performance from residual programmes.

John notes that despite this, new herbicide release Fundatis (bixlozone (Isoflex active)+ beflubutamid) could be a useful option. Furthermore, rather than simply rotating herbicide groups between seasons, he says the priority should be maximising diversity within individual programmes.

"Options like cinmethylin offer very good activity, but we'd rather growers didn't rely on it too heavily. The objective is to build programmes with multiple modes of action applied at different timings.

"Fundatis is different because it has some foliar uptake on cotyledons. It also has more persistency and should remain active for a long period of time. Because of the foliar uptake as well as root uptake, it performs better pre-em, although also has good activity relatively speaking early post-em.

"It's a different mode of action so all of these elements combined make it quite a contrasting option. Rather than putting on more similar herbicide, applying a contrasting option on is always best advice."

Fundatis can be used at pre- and peri-emergence in winter wheat, and pre-emergence in winter barley.

Beyond specific product choices, John warns that growers should adopt a zero-tolerance approach to ryegrass as soon as it appears. "That initial stage where ryegrass has escaped from cultivated ryegrass, or come in on a baler, is a vital stage to



Taking no prisoners

ADAS' John Cussans warns that growers should adopt a zero-tolerance approach to ryegrass as soon as it appears.

take the problem seriously and address it before it becomes established.

"There are so many farms with a story of how ryegrass appeared in a gateway one year and a few years later it's across the whole farm and costing a fortune. They wish they had a time machine and had done something about it.

"The challenge with ryegrass, even more than blackgrass, is that it'll move around the country with straw residues and harvest equipment. And because you don't know where it was last, you don't really know what's come onto the farm."

His universal advice is to have a zero tolerance approach from the outset. "Other people's ryegrass could be very problematic compared with the ryegrass you're used to. You'll save so much effort and expense in the long run if you just destroy the crop as soon as you see the problem come onto the farm – it's really that important," stresses John. ●

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Ensuring effective weed control from residual herbicides

Grass weeds can cause significant yield and financial losses in wheat. Understanding the different physical and chemical properties of residual herbicides helps build an effective programme to control weeds and preserve yield potential.

The foundation of successful weed control is an effective programme of cultural controls. Stale seedbeds, delayed drilling and ploughing can all reduce germination of black grass, Italian rye-grass, brome and other weeds in the crop. Higher seed rates help suppress weed growth.

The main priority must be a healthy, well-established crop which is more able to compete with weeds and can deliver the all-important yield. When planning weed control make sure all cultural and chemical controls support good establishment.

Once the cultural programme and drilling is complete, it is

time to consider the herbicide programme. **Residual herbicides** remain in or on the soil and are effective against target weed species for a certain period of time, this could range from a few days to several months. This characteristic allows them to be applied before weed germination. These herbicides are usually taken in by the roots or the shoots of emerging weeds but most have limited post-emergence activity.

Actives like flufenacet and metribuzin are soil mobile. They require moisture to reach the weed germination zone for uptake by the roots. Dry conditions and physical barriers in the seedbed can both limit efficacy.

It is important to drill crops to at least 32 mm to keep them beyond the usual zone of herbicide activity to avoid crop effects. Avoid pre-emergence applications when heavy rain is forecast and be particularly cautious on lighter

soils. Using a sequence rather than a stack is also a sensible precaution if crop effects are a concern.

Other actives like Proclus® (aclonifen) and diflufenican are relatively immobile and remain on the soil surface for uptake by the emerging shoots. They tend to be more tolerant of drier weather than soil mobile actives but any soil disturbance after application has a detrimental effect on performance.

Aim for a pre-emergence spray with a mixture of root and shoot activity such as a metribuzin co-form like Alternator® Met, Cadou® Met or Octavian® Met (all flufenacet + diflufenican + metribuzin) plus Proclus®. This tank-mix can cope with a range of conditions and contains four different modes of action (MoA).

Diversity is key

The herbicide's mode of action is the chemical basis for how it disrupts essential

plant processes to kill the weed. Different actives can have the same mode of action. The international Herbicide Resistance Action Committee (HRAC) groups herbicides according to the MoA to help programme planning and resistance management.

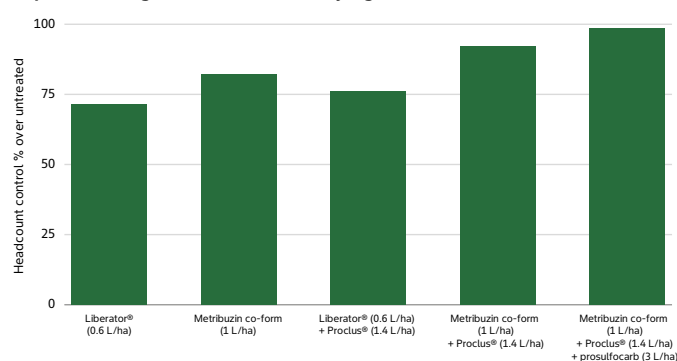
In wheat, there are actives from seven HRAC groups (Group 3, 5, 12, 13, 15, 30 and 32) to choose from for the residual herbicide programme. Aim to range modes of action for efficacy and resistance management purposes.

Trials continue to demonstrate the gains in control from including different MoA in the programme.

See graph 1: Stacking herbicides for Italian rye-grass control

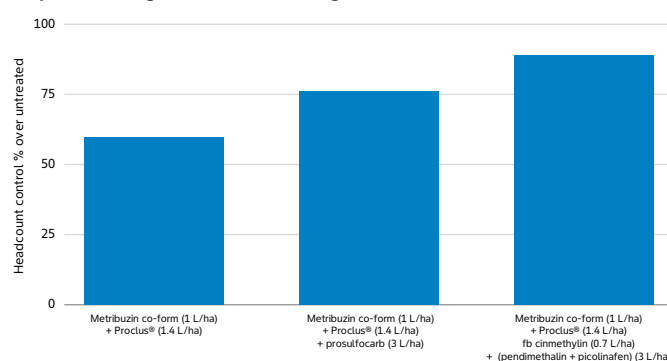
See graph 2: Stacking herbicides for black grass control

Graph 1: Stacking herbicides for Italian rye-grass control



Bayer contracted trials x3 (2022-23) – Pre-em. applied autumn 2022. Average untreated count = 110/m²

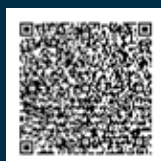
Graph 2: Stacking herbicides for black grass control



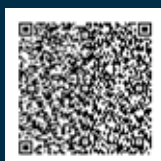
Bayer contracted trials x4 (2022-23) – Pre-em. + sequence applied autumn 2022. Average untreated count = 270/m²

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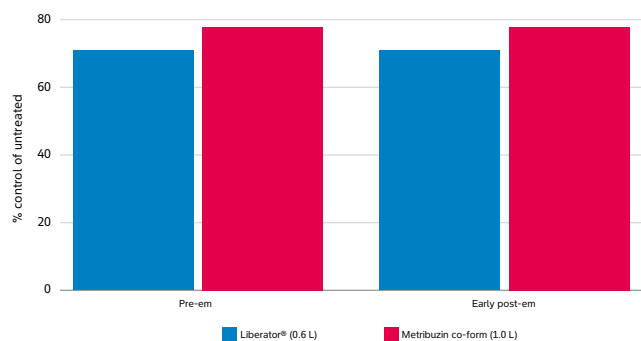
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Graph 3: Benefit of metribuzin at early post-emergence timings



Source: Mean of 5 Bayer black-grass trials in w.wheat Ref. HD14GBR05 (Pre) & B06 (E.Post)

Protection throughout autumn

Soil disturbance from drilling encourages weed germination so the pre-emergence timing is crucial. The ideal spray timing is within 48 hours of drilling so that herbicides can control all emerging weeds. Any greater delay means that some weeds might emerge before herbicide application. Herbicide choice can help mitigate the risks if a delay is unavoidable. Metribuzin co-form products have much smaller drop in control compared to Liberator® (flufenacet + diflufenican).

See graph 3: Benefit of metribuzin at early post-emergence timings

Weeds can continue emerging throughout autumn and into spring. Residual protection helps control any further germination; this comes from the longevity of the pre-emergence spray and additional applications of residual herbicides.

Herbicides degrade in the soil due to chemical reactions (hydrolysis) and microbial decomposition. The speed of decay depends on the active, soil type, moisture

levels and the temperature. For all actives, warm, moist conditions promote degradation whereas dry and cool conditions allow greater persistence. Soil immobile actives like Proclus® tend to take the longest to break down.

Black grass usually has a concentrated germination period in early to mid-October, a second application 1–2 weeks after the pre-emergence spray ensures maximum herbicide levels throughout the main germination period. Italian ryegrass has a more protracted germination, protection for longer is more important so a gap of 2–4 weeks between sprays is better. Brome germination patterns depend on the species but in most cases protection later into autumn is helpful.

Ensure the pre-emergence spray includes actives with good longevity so there is some protection if the follow up is delayed or not possible due to bad weather.

Resistance management

The development of reduced sensitivity and resistance has been much slower in residual herbicides than contact-acting chemistry. However, growing reliance on residual chemistry for grass weed control means resistance management is increasingly important, key steps are:

- Use cultural controls first
- Use actives from different HRAC MoA groups
- Control survivors of residual chemistry with contact-acting chemistry where appropriate
- Use crop rotation to have a wider range of actives to choose from
- Monitor weed control resistance test suspect populations

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1. Bayer UK herbicide trial sites, 2022 – 2023.

2, 3. Pesticide Properties DataBase, University of Hertfordshire, 2026.

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Forewarned is forearmed

Although the devil remains in the detail, the EU-UK realignment deal and SPS agreement look to shake things up when it comes to the chemistry toolkit

With so much unknown regarding the future of UK crop protection, proactive research to establish the best herbicide programmes for the future will be critical, suggests Jodie Littleford, technical manager for combinable crops at Agrii.

"Although it's subject to change, we expect the reset with the EU to come into effect next summer," adds Jodie. "And it's likely to mean realignment with the authorisation of plant protection products."

"If that's the case, then the bad news is we'll lose flufenacet ahead of the GB authorisation review, which would mean an accelerated revocation of this key active that's been the cornerstone of most herbicide programmes for many years."

"We've had the introduction of cinmethylin, which is available in products like Luxigard Opti (cinmethylin+ picolinafen). However, that isn't currently registered in Europe, although BASF is confident it'll be authorised by the time the realignment takes effect. But that, of course, is only registered in winter wheat and spring barley, so that leaves quite a gap in winter barley," she explains.

Without flufenacet, cereal herbicide programmes will look very different in the near future. That's why Agrii has been exploring how to put together consistent and cost-effective programmes without it, notes Jodie.

"New products like Fundatis (bixlozone+ beflubutamid) are available, where both actives have an EU authorisation, so our working assumption is that it's safe from the implications of the SPS agreement. It also has a winter barley label for pre-em use, which means it'll be an important tool in this crop in particular when flufenacet goes."

"This autumn is a good opportunity for farmers to use Fundatis and gain some experience with it," she raises.

Considering the remaining herbicide options, Jodie says it's imperative that they're positioned correctly, using both stacked and sequenced approaches, to ensure the best activity

while reducing the risk of resistance.

Consequently, the best place for an application of cinmethylin is at pre-emergence, urges Jodie. "Its mode of action means it's most active on the weed seed before it germinates, stopping grassweeds emerging from the start of crop establishment. That's why we're pushing for the use of cinmethylin at pre-emergence in programmes."

"By the time the grassweed emerges, the efficacy declines. It still works well compared with other actives, but you're losing the benefit of your best product," she suggests.

Then, Jodie believes Fundatis is a good fit as a peri-emergence top-up in winter wheat crops, should flufenacet be no more. "Although we've seen good benefits of Fundatis in pre-em mixtures, we tend to see the best performance in the peri slot, 2-3 weeks after pre-emergence."

"The reason for this is because of the formulation type. It is a ZC formulation meaning it's a mixture of a suspension concentrate and an encapsulated formulation. The benflubutamid is in suspension, along with 30% of the bixlozone. The remaining 70% of the bixlozone is encapsulated."

"That means you have some of the active freely available in solution to hit the weed as soon as you apply it, giving some contact activity on the small emerging weeds, while the encapsulated portion gives prolonged residual activity," she explains.

Good grassweed control isn't just about herbicide choice. With only one chance to get it right per crop, precise application of pre-emergence herbicides is vital, highlights Jodie. In Agrii's farm-scale application work, the team has been examining nozzle choice, water volumes and adjuvant use to boost grassweed control.

"There's always pressure in the autumn to apply a pre-emergence within 48 hours of drilling," she says. "So there can be a temptation to cut the water volume to cover more hectares per sprayer tank."

"We've seen a steady decline in herbicide efficacy once you start



Strategic planning

Considering remaining herbicide options post potential flufenacet revocation, Agrii's Jodie Littleford says it's imperative they're positioned correctly, using stacked and sequenced approaches, to ensure the best activity while reducing the risk of resistance.

going below water volumes of 200 l/ha. Both flat fans and drift reduction nozzles are similarly affected by water volume; water as the carrier is critical to achieve optimum coverage."

Adding an adjuvant like Backrow Max will increase efficacy by reducing drift, increasing spray coverage and holding the herbicide in the top layer of the soil, reports Jodie. She's seen a consistent benefit when using it with pre-emergence herbicides, however, cautions that it won't compensate for a suboptimal water volume.

She adds that Agrii has also investigated the effect that Backrow Max has on increasing the crop safety of herbicides using Agrii's glasshouse research facility at Throws Farm. Pots of newly-sown spring barley were treated with a herbicide mix that'd typically show some crop effect, and measured the subsequent impact with and without Backrow Max.

"Where we didn't include Backrow Max, the herbicide impacted the germination of the barley and its root development. But in including Backrow Max, we kept the herbicide in the top layer of the soil and reduced movement into the seed zone following simulated rainfall events. This successfully mitigated some of the phytotoxic effects of the herbicide, particularly improving root establishment – which we know is critical in setting up crop potential," she concludes.