Diversify to spice up weed control

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Technical
Grassweed control

Variety may be the spice of life, but it's also said to be the best way to get the most out of grassweed herbicides and avoid resistance problems. *CPM* looks a little closer.

By Lucy de la Pasture

There's a saying that strength lies not in similarities but in differences, and the same is true when it comes to herbicides. In many areas of crop protection there are limited options to choose from. But when it comes to pre-emergence herbicides for winter wheat, they somewhat buck the trend.

In fact, even though it may not feel like it when considering difficult weeds like blackgrass, there's a plethora of products and five modes of action which could potentially be stacked and sequenced together.

Using several modes of action in a herbicide programme improves control and prevents resistance, says NIAB weed scientist John Cussans. And he's keen to spread the word about how this diversity can be used to advantage.

"A herbicide contains one or more active substances. For example, Liberator contains two — flufenacet and diflufenican (DFF). Simply put, the mode of action is the molecular basis for how these actives kill or damage the plant," he explains.

"Flufenacet inhibits cells from making very long-chain fatty acids, disrupting cell division. Triallate and prosulfocarb do the same, so they're all in the Herbicide Resistance Action Committee (HRAC) Group 15.

Resistance risks

"DFF is different, it inhibits the enzyme phytoene desaturase, which is important in photosynthesis. It's in HRAC Group 12. Using two or more chemical processes to kill a weed increases overall control and reduces the risk of it rapidly developing resistance," he says.

The greatest resistance risks are seen when herbicides have a single mode and site of action, explains John. Site of action or target site refers to where in the plant the herbicide binds to take effect. Fops and dims, and ALS inhibitors are examples of active ingredients with a single target site. Other single site actives have a lower resistance risk but without careful stewardship, there may still be problems.

"One of the biggest issues for blackgrass, and all grassweed management, is the over-reliance on flufenacet. Where flufenacet has been used extensively, there is research which is showing sensitivity shifts in blackgrass and even some resistance in Italian ryegrass. But it should be noted that mixes and co-formulations with other modes of action are still providing control in the field."

According to John, prevention is the only real tactic for managing herbicide resistance. In most instances, there's no significant fitness penalty to a weed for being resistant. Once resistance is in the population it takes a long time to disappear, so on a practical timescale the population remains resistant. This differs from fungicides and insecticides where fitness penalties are more evident and careful use of chemistry in rotation can help prolong an active substance's working life.

"Weed management has to harness the

One of the best ways to maintain herbicide activity is to make use of chemistry with different modes of action.

Common herbicide modes of action

HRAC Group	Name	Common actives		
Group 2	Inhibition of acetolactate synthase	mesosulfuron	iodosulfron	pyrosulam
Group 3	Inhibition of microntubule assembly	pendimethalin	propyzamide	
Group 5	D1 serine 264 binder (and other non-histidine 215 bnders	metibuzin		
Group 9	Inhibition of enolpyruvl shikimate phosphate synthase	glyphosate		
Group 12	Inhibition of phytoene desaturase	diflufenican	picolinafen	
Group 15	Inhibition of very long-chain fatty acid synthesis	triallate	flufenacet	prosulfocarb
Group 32	Inhibition of sollanesyl diphosphate synthase	aclonifen		

diversity in herbicides that we have, rather than use more and more of singles active or herbicides from single active groups. For blackgrass and ryegrass, there are currently five modes of action available for use as a pre-em."

These belong to HRAC Groups 3, 5, 12, 15, 32. Taking a wider view, across the season, adds in glyphosate (Group 9) and the ALS-Inhibitors (Group 2), so it's possible to build a very diverse programme using widely available products, he says.

"Farmers and agronomists know their own situation best, but there are some basic principles to follow when choosing the actives in a herbicide programme. There's more danger of cross-resistance within active groups than between groups. If possible, herbicide programmes should diversify across active groups, otherwise diversify within groups.

"How you do this depends on the level of risk. In low-risk situations, let's say a small wild oat population, diversify over time by alternating actives each season. In high-risk situations, diversity should be included within the programme each year. Moreover, there has to be diversity which includes cultural controls too. If you are wholly reliant on chemistry, eventually the system will break."

The options at pre-em increased last year with the launch of Proclus (aclonifen) from Bayer. It's a new active for cereals, but has an established record in potatoes, and is unique because it's the only active available from HRAC Group 32.

Aclonifen is always applied with flufenacet and diflufenican (Liberator), which means three different modes of action are working together — good for weed control and good for resistance management. Any follow up sprays should aim to use include different modes of action to diversify the programme even more, according to advice from the company.

Bayer say farmer feedback has been positive from the first year of use, including good control of difficult ryegrass where flufenacet control has been on the wane. One of these is Simon Adney, who farms 220ha of arable crops in Shropshire. Both ryegrass and blackgrass cause problems for Simon on different parcels of land and last season a spray miss highlighted the level of ryegrass control provided by Proclus plus Regatta (flufenacet + diflufenican), which was applied as a pre-em in autumn 2020.

"Ryegrass has always been the most prevalent grassweed on the farm, more so with the increased use of min-till cultivation in recent years. In some patches, it will smother the wheat to the extent that a glyphosate application is needed."

His agronomist Mark Orton of Hutchinsons agrees. "Ryegrass has become more and more difficult to control over the past decade or so, with confirmed resistance to Axial (pinoxaden) and Falcon (propaquizafop) on this specific field. We have also seen reduced efficacy from Atlantis (mesosulfuron+ iodosulfuron) -type products."

Despite stacking actives at the pre-em and early post-emergence timings, some areas of the field still ended up with high ryegrass populations. But control last autumn was very good where Simon applied Proclus with Regatta.

"The accidental spray miss around a telegraph pole showed a real difference compared with the rest of the field. Crops always get a pre-em but the results are not usually so impressive," says Simon.

Using several modes of action in a herbicide programme improves control and prevents resistance, says John Cussans.

Mark nods in agreement. " It has given the most promising autumn control of ryegrass that we've seen for many years. Unfortunately some fields missed the pre-em application timing due to the weather and poor travelling conditions."

According to Mark, the block of land affected by blackgrass has also shown good results from the same pre-em combination. As well as herbicides, Simon relies on minimum disturbance, disc cultivation to 5cm to control blackgrass. This keeps the weed's seeds near the soil surface where germination can be successfully controlled with pre-em herbicides, he says.

"We appear to be keeping blackgrass under control, if anything it has reduced, but you can't be complacent and I don't think you'll ever get rid of it entirely." ■

A spray miss in winter wheat at Simon Adney's farm highlights the performance of Proclus plus Regatta on ryegrass.

Difference between site and mode of action

All herbicide interactions with the plant, from application to final effect, are considered the mode of action. The MoA involves absorption into the plant, translocation or movement in the plant, metabolism of the herbicide, and the physiological plant response. In other words, the mechanism by which a herbicide kills a plant is known as its mode of action.

Herbicide site of action is the specific process in plants that the herbicide disrupts to interfere with plant growth and development. The SoA is the most important aspect of herbicides when dealing with prevention and control of herbicide-resistant weeds.