Herbicide resistance in broad-leaved weeds

Information Sheet 54
Summer 2016
AHDB
CEREALS & OILSEEDS

ALS-resistant poppy population treated with ALS herbicides only (left) and with non-ALS herbicides (right)

Latest information

- Populations of herbicide-resistant broad-leaved weeds are still uncommon in the UK but are increasing.
- Resistant poppy is the most common, followed by chickweed and mayweed.
- Most cases of resistance are to the ALS inhibitor group of herbicides.

Action

- Avoid using ALS inhibitors and triazinone herbicides as the sole means of control.
- Investigate cases of poor weed control and keep good spray records.
- If you suspect resistance, collect seed samples for testing.
- Use herbicides with other modes of action to reduce resistance risk.

Always read product labels, consider your local conditions and consult a professional agronomist, if necessary.

Herbicide resistance

Acetolactate synthase (ALS) inhibiting herbicides, such as the sulfonylureas (eg metsulfuron) and triazolopyrimidines (eg florasulam) are fundamental to most broad-leaved weed control strategies in UK cereals. However, increasing occurrence of resistance means it is vital that the resistance risk is better recognised and managed.

Worldwide experience shows that use of ALS inhibitor herbicides poses a high resistance risk. There are now 158 species resistant to ALS herbicides in 44 countries – more than any other herbicide class. Resistance to ALS sulfonylurea herbicides in chickweed, poppy and scentless mayweed was first identified in the UK in 2000, 2001 and 2002, respectively. Resistant plants are almost completely unaffected by herbicides applied at normal field rates. In addition, groundsel populations resistant to triazinone herbicides (eg metribuzin and metamitron) have been recorded in UK asparagus fields.

Key points

To minimise resistance risk:

- Avoid using ALS inhibitors and triazinone herbicides as the sole means of broad-leaved weed control in successive years
- Always use ALS inhibitors and triazinone herbicides in mixture, sequence or rotation with herbicides with different modes of action
- Use cultural control methods, such as non-cereal rotations, competitive crops and cultivations, where possible
- Investigate cases of poor weed control and keep good spray records
- A long history of use of ALS herbicides and declining performance against a broad-leaved weed species when other susceptible weeds are still well controlled, indicates resistance may have developed
- The limited efficacy of most non-chemical control measures, together with the long persistence of broad-leaved weed seeds in the soil (often >10 years), mean that detecting resistance at an early stage is vital

If resistance is suspected:

- Collect seed or plant samples for resistance testing (see back page) – seek advice about the best techniques
- Use alternative herbicides with lower inherent resistance risk as part of a resistance management strategy

Poppy

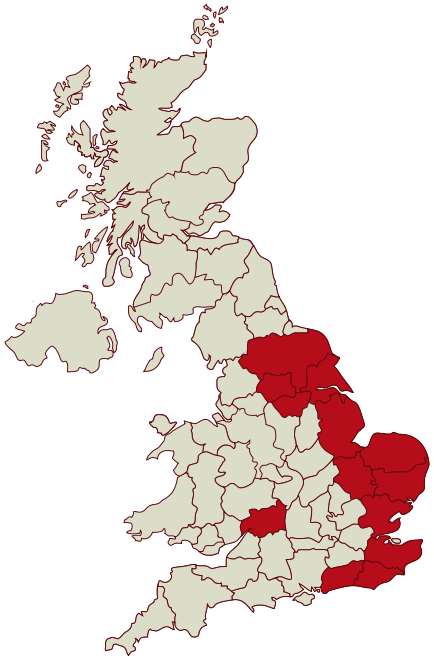
ALS-resistant populations of poppy have been found in 13 counties in England.

Studies of UK populations have shown that resistance is conferred by ALS target site resistance mutations (eg Pro-197-Leu or Pro-197-His), with these mutations conferring high levels of resistance to the sulfonylurea herbicides, metsulfuron and tribenuron.

Pendimethalin gives good control of ALS-resistant poppy and is a good pre-emergence option. MCPA, bromoxynil and the more recently introduced halauxifen-methyl herbicides are all effective post-emergence alternatives in cereals.

Resistant poppy seeds are likely to persist in the soil seedbank for many years (>10 years), so it is unlikely that sulfonylureas will ever be effective again for control of poppy in affected fields.

Maps produced by Rothamsted Research



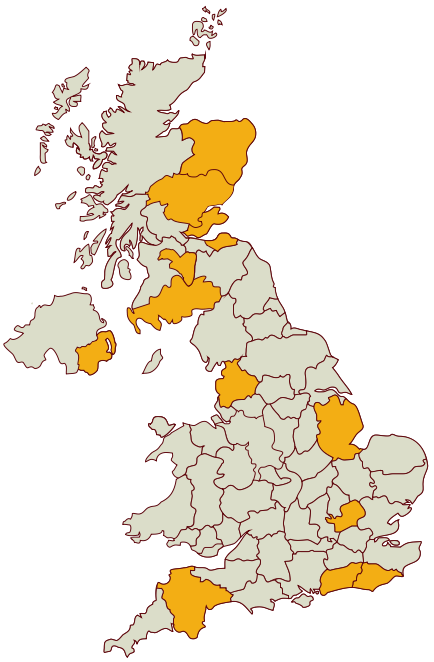
Chickweed

More than 50 ALS-resistant chickweed populations have been identified in 13 counties of England, Scotland and Northern Ireland. The frequency of resistant chickweed in Scotland and Northern Ireland may be linked to continuous spring barley cropping and greater dependence on sulfonylureas for broad-leaved weed control.

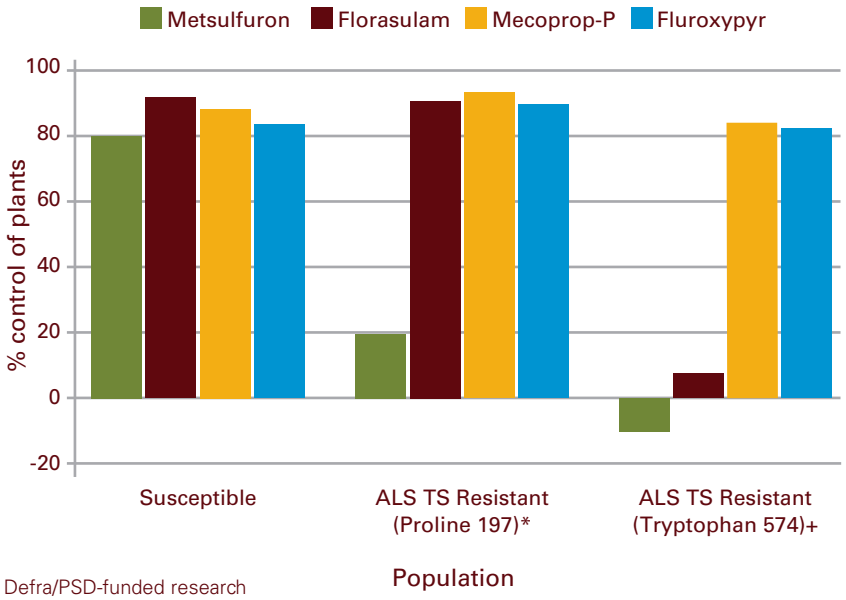
Two different ALS target site mutations have been identified in UK populations – Pro-197-Gln and Trp-574-Leu. The Pro-197-Gln mutation appears to be much more common and is associated with resistance to the sulfonylurea, metsulfuron-methyl, but not to the triazolopyrimidine, florasulam. In contrast, the Trp-574-Leu mutation is associated with resistance to both herbicide groups.

If resistance is confirmed, use alternative (non-ALS) herbicides, such as fluroxypyr in cereals, which remains highly effective.

Resistance to mecoprop has been found in chickweed in the UK in the past (1985) and inadequate control has been reported in Scotland and Ireland. However, all samples of ALS-resistant chickweed tested so far have been well controlled by mecoprop in screening assays by Rothamsted Research.



Effects of ALS target site mutations on cross-resistance patterns in chickweed



* The Proline 197 mutation conferred resistant to the sulfonylurea metsulfuron but not to the triazolopyrimidine florasulam, which was fully effective on this population from Perthshire.

\+ The Tryprophan 574 mutation conferred resistance to both metsulfuron and florasulam and both herbicides gave very poor control of resistant plants on this population from Aberdeenshire.

Limited evidence suggests that Proline 197 resistance is more common than Tryprophan 574 resistance. No resistance was found to the alternative herbicides tested. Mecoprop-P and fluroxypyr were fully effective on all populations.

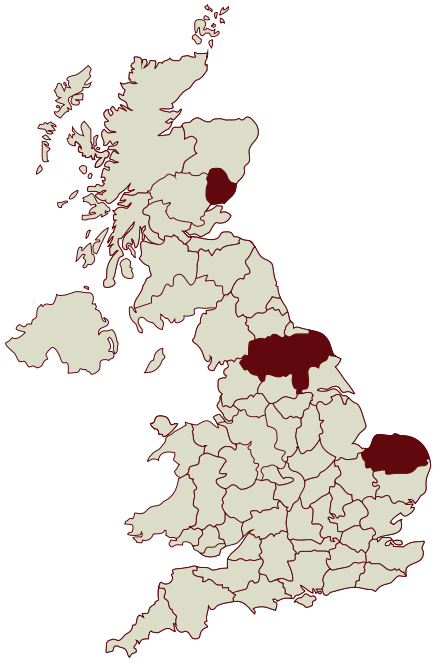
Defra/PSD-funded research project PS2709

Scentless mayweed

ALS-resistant populations of scentless mayweed have been identified in two counties in England and one in Scotland but the true number of cases is probably under recorded.

Studies with the Scottish population showed that resistance was conferred by a Pro-197-Gln target site mutation.

If resistance is confirmed, use alternative (non-ALS) herbicides, such as clopyralid and bromoxynil, which remain highly effective.



Groundsel

Triazine resistance has been confirmed in UK populations of groundsel. Although triazine herbicides were banned in the EU in 2007, triazinone herbicides (such as metribuzin and metamitron) have the same mode of action as the triazines. Triazinone herbicides are still widely used for weed control in potatoes, sugar beet and other crops.

The first documented cases of triazinone resistance were identified in 2010 in four populations of groundsel from asparagus fields in Worcestershire and Warwickshire. These populations are highly resistant to triazines and have partial resistance to the triazinone herbicides, metribuzin and metamitron.

Wherever possible, try to avoid using the triazinone herbicides as the sole or main means of control of broad-leaved weeds. Preferably, use them in mixture, sequence or rotation with alternative modes of action. If alternative herbicides are unavailable, consider non-chemical methods, such as inter-row hoeing and hand-rogueing, to reduce dependence on herbicides.

Detecting resistance early can help greatly. If resistance is confined to a relatively localised area, it may be possible to destroy this area with glyphosate or cultivations and hence minimise further spread.

Future issues

- In the UK, herbicide-resistant broad-leaved weeds are currently less of a threat than resistant grass weeds, because resistance is confined to the ALS and triazinone herbicide classes, with alternative modes of action remaining effective; however, this situation could change
- Control of ALS-resistant broad-leaved weeds depends on the continued availability of effective alternative herbicides, which may be affected by further loss of active ingredients as a consequence of regulatory decisions during re-registration
- It should not be assumed that resistance cannot, or will not, evolve in other species or to other herbicides and continued vigilance is required; particular high-risk situations are those where control of a specific weed is dependent on a single or very limited range of herbicide modes of action
- No cases of herbicide-resistant charlock or wild radish have yet been detected in the UK but the UK Weed Resistance Action Group considers these to be some of the weeds most likely to evolve resistance here in future; resistance of fat-hen to triazinone herbicides is also a particular risk – cases already occur in several other European countries
- Resistance to glyphosate in both broad-leaved and grass-weeds is a threat and, while no cases have so far been confirmed in the UK, there are now 35 glyphosate-resistant species in 27 countries worldwide

Seed sampling

If herbicide resistance is suspected, collect seeds for testing. This is usually more difficult than with grass-weeds and the best technique and timing varies with species. If in doubt, seek advice – many cases of resistance go unreported due to lack of adequate seed samples for testing.

For seed collection you will need:
- Large container or paper sack
- Paper bag/envelope with the bottom taped up to prevent seed escape (do not use plastic bags for storage of freshly collected seeds, as this will prevent them drying out)
- Sharp knife or scissors

Once the seeds have been collected, place them in the paper envelope, leaving it open in a dry, airy place, away from sunlight. When the seeds are dry, send them for resistance testing. Do not send wet seeds.

Poppy seeds

Collect poppy seeds in July/August when the seedpods become a greyish-brown colour.

The brown seed heads will begin to open just under the 'lid' and a row of holes will be visible.

- Cut the seedpods from the stem
- Place the seedpods in the paper bag or envelope
- Leave the seeds in a well-ventilated area, keeping the bag open to the air to promote drying

Groundsel seeds

Collect groundsel seeds between May and October. When plants are mature, the petals will have disappeared and the seed heads will be white and fluffy.

- Pinch the white top of the seeds and pull them off the plant
- Place the seeds in a paper bag/envelope

Scentless mayweed and chickweed seeds

Collect mayweed in August when mature; the petals will have disappeared and the central dome will be yellow/brown in colour.

Collect chickweed in June, July and August. Check chickweed plants for flowers and seedpods. Seedpods will always be green.

For collecting seeds of both mayweed and chickweed:
- Pull up/cut at the plant base large quantities of mayweed/chickweed and place in a large paper sack – do not pack too tightly but allow enough room for air to circulate
- Place the open sack in a well-ventilated area where the plants can dry out; as they dry, seeds will fall from the heads to the bottom of the sack
- When dry, remove the mayweed/chickweed straw, shaking any loose seeds into the sack
- When the straw has been removed, tip the seeds into an envelope

Further information

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Managing weeds in arable rotations – a guide (AHDB, 2014)

Minimising the risk of glyphosate resistance (AHDB, 2015)

cereals.ahdb.org.uk/weeds

Publication orders
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Research organisations, major agrochemical manufacturers and some commercial companies may test seed for resistance on request. Speak to your local rep or one of the people named above.

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