

Herbicide-resistant black-grass: managing risk with fewer options

Introduction

The threat posed by herbicide-resistant black-grass is likely to increase due to:

- loss of lower resistance risk herbicides, eg trifluralin and isoproturon
- lack of new modes of action
- increasing use of higher resistance risk herbicides (ALS and ACCase inhibitors)
- trend to more minimum tillage and early drilling, which favours black-grass
- increased sowing of winter cereals and oilseed rape
- loss of some cultural options, eg set-aside.

Consequently, herbicide resistance needs to be taken even more seriously.

This leaflet updates, and should be read in conjunction with the WRAG guidelines: *Managing and preventing herbicide resistance in weeds*, WRAG/HGCA (2003).

Occurrence of herbicide-resistant black-grass

Herbicide-resistant black-grass has been confirmed on over 2,000 farms in 32 English counties; its occurrence is widespread where serious infestations of black-grass exist. Resistance has recently been detected in Scottish black-grass populations for the first time.

The most widespread types of resistance are Enhanced Metabolism and Target Site to ACCase herbicides. Recent testing has also confirmed over 132 cases of resistance to ALS herbicides in 21 counties, mainly in eastern and central England. Eight out of nine populations tested to date were ALS target site resistant.



Three key challenges:

- Black-grass is increasing.
- Resistance is increasing.
- Herbicide choice is reducing.

Is your black-grass control strategy up to the challenge?

Always consider your local conditions and consult a BASIS-qualified adviser if necessary.

Types of resistance

Herbicide resistance is inherited and occurs through selection of plants that survive herbicide treatment. With repeated selection, resistant plants multiply until they dominate the population. Three main types of resistance are present in UK black-grass:

Enhanced metabolism resistance (EMR) results in herbicide detoxification and is the commonest resistance mechanism in grass weeds in the UK. It affects most herbicides to varying degrees, but only in very severe cases results in complete loss of control.

ACCase target site resistance (ACCcase TSR) blocks the site of activity specific to 'fop' (eg Topik, Cheetah, Falcon), 'dim' (eg Grasp, Laser) and 'den' (eg Axial) herbicides. It only affects these groups of herbicides, but often results in very poor control. It is now very common – recent surveys indicate that it occurs on over 60% of farms with black-grass.

ALS target site resistance (ALS TSR) blocks the site of activity of sulfonylurea and related herbicides (eg Atlantis, Lexus). It only affects this group of herbicides and can result in poor control. Currently, it occurs much less commonly than ACCcase TSR, but is increasing.

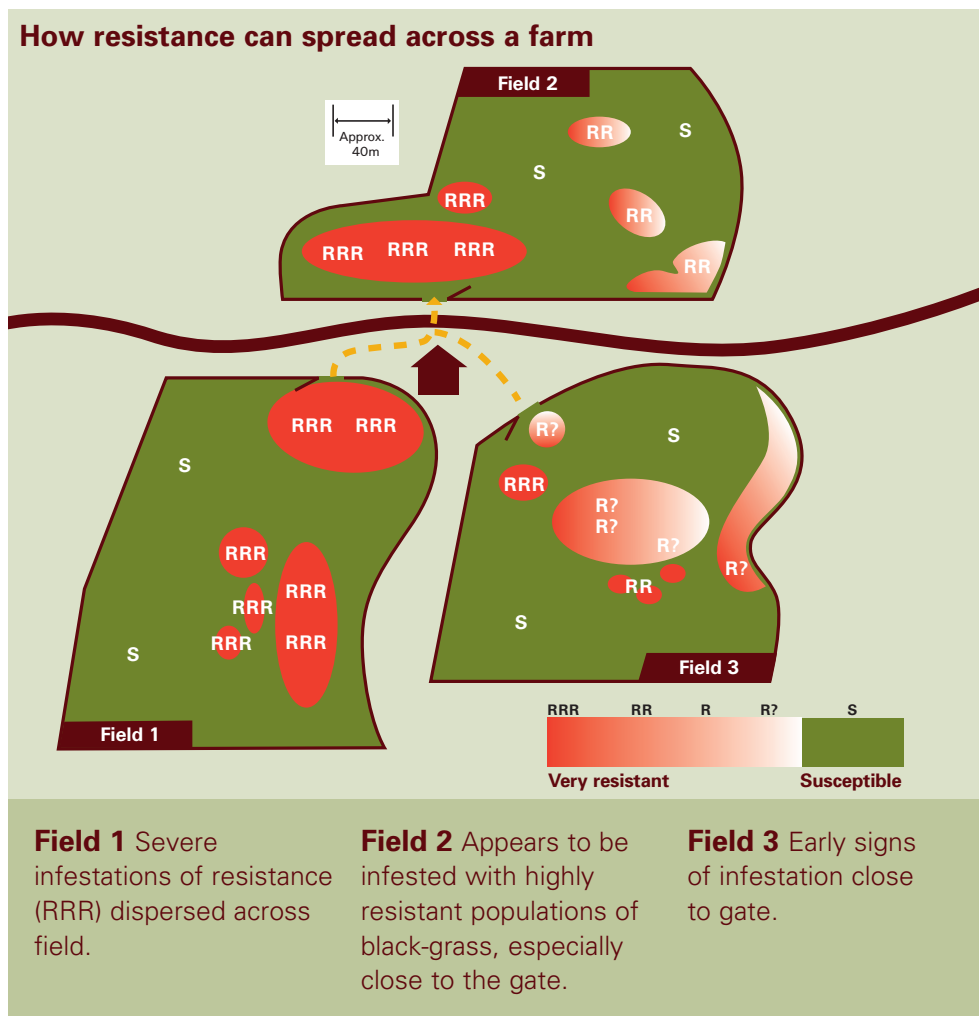
These three forms of resistance can occur independently, in different plants within a single field, or even within the same plant.

See WRAG website www.pesticides.gov.uk/rags.asp?id=714 for an up-to-date 'Grass weed herbicides: Mode of Action Table'.



Preventing spread of resistance on a farm

Weeds should be managed at a local or field level as resistance may develop in any field. Preventing spread between, and within, the farm is of great importance. Resistance may have been influenced by proximity to another affected field and farm gateways on the farm, as shown in the diagram.



To avoid spread between fields:

- cut weed patches or spray off with a non-selective herbicide
- hand rogue patches of low density/frequency
- prevent movement of contaminated seed on machinery (eg combines, balers or cultivation equipment) and combine the cleanest part of the field last
- avoid using contaminated straw and manure
- clean equipment and clothing between fields.

Making the most of cultural options

Rotation planning is at the heart of a successful strategy while cultivation options and herbicides are all vital to prevent, reduce and manage resistance.

Several non-chemical control methods reduce the need for herbicides and the risk of resistance developing. These include:

- **Crop rotation** – adopting as diverse a rotation as possible, including non-cereal and spring-sown crops, reduces the dominance of black-grass and other annual grass weeds. Overall herbicide use may be reduced and a wider choice of herbicide modes of action can be used.
- **Ploughing** – reduces weed numbers and lowers resistance risk. It buries freshly-shed seeds and brings older, less-selected seeds back to the soil surface. This increases the proportion of susceptible plants in the weed population. Consider rotational ploughing if annual ploughing is not feasible.
- **Delayed drilling of winter cereals** – allows a higher proportion of weed seedlings to emerge and be controlled before sowing, provided there is sufficient soil moisture for germination. This is particularly useful in years when black-grass seeds are relatively non-dormant (hot, dry conditions when black-grass seeds are maturing in June and July). Wherever possible, use a non-selective herbicide, eg glyphosate, before drilling. Avoid early sowing in the same fields every year.
- **Competitive crops** – weed suppression is enhanced by using higher seed rates, more competitive varieties and narrower rows.



Ensure combines are cleaned between fields to avoid spreading infestations.

Optimising herbicide strategy

Many of the most active herbicides (eg ALS and ACCase inhibiting herbicides) also pose a very high resistance risk. It is essential to utilise strategies to ensure that resistance does not develop to these herbicides, especially now that fewer lower risk herbicides are available. This means maximising benefit from pre-emergence herbicides and ensuring effective use and timing of post-emergence products.

Application of herbicides is very important. Pay attention to recommended rate, nozzle choice, water volumes and spray timing to maximise product effectiveness. See *Nozzle Selection Chart*, HGCA (2007) for more information.

- Match nozzle and water volume to product choice.
- Ensure products are applied at their optimum rate and timing.

Pre-emergence herbicides – reduce the overall weed population and the need for higher risk post-emergence products.

- Pre-emergence herbicides, eg flufenacet, pendimethalin, prosulfocarb and tri-allate, are all affected by enhanced metabolism resistance, but generally only to a limited extent.
- Products or programmes based on combinations of these active ingredients will usually give useful levels of control. Current evidence is that resistance to these herbicides does not build up rapidly.
- Pre-emergence herbicides have a valuable role in any integrated resistance management strategy.

Monitor the success of resistance management strategies

- Keep accurate field records of cropping, cultivation and herbicide use, and control achieved.
- Monitor herbicide performance critically to detect any progressive loss in herbicide efficacy.
- Test specific fields regularly every three years – either those with a known degree of resistance or where there is a high risk of resistance developing.



Post-emergence herbicides – the ACCase ('fops', 'dims', 'dens') and ALS inhibitors (eg sulfonylureas) can provide very good levels of control of sensitive black-grass.

- ACCase and ALS inhibitors are prone to resistance. If target site resistance increases to a high frequency in any field, very poor control is likely.
- To avoid, or delay, resistance development, do not rely on either class as the sole means of black-grass control in successive crops.
- Use these herbicides, in mixture or sequence with lower risk modes of action, to help reduce weed populations. However, this will not prevent further selection for resistance.
- Remember, there are restrictions on the sequential use of both ACCase and ALS inhibitors – introduced to reduce herbicide resistance risk.
- Using mixtures and sequences is a sensible approach, but is best considered as a strategy to delay, rather than prevent, resistance.
- Where possible, use lower resistance risk post-emergence herbicides in the rotation, eg propyzamide and carbetamide, in oilseed rape.

It is important to make the most of pre-emergence herbicides.

An ongoing four-year Sustainable Arable LINK project (Integrated Management of Herbicide Resistance – SA-LINK LK0965, HGCA 3035), sponsored by Defra with funding from HGCA and industrial support from Bayer CropScience, BASF, Dow AgroSciences, DuPont and Syngenta Crop Protection UK, aims to help improve herbicide resistance management.

Testing for herbicide resistance

Early detection is very important. Rapid and effective tests are now available to help distinguish between the three forms of resistance. Resistance varies between fields and farms, so having seed samples tested can help you identify how extensive the problem is across your farm.



A serious case of ALS Target site resistant black-grass

- Have a test carried out if you suspect resistance might be developing – do not wait until a major problem exists, as by then your control options will be much more restricted.
- Collect samples representative of the problem field (see table below). Discuss testing requirements with your consultant or adviser – several organisations and companies provide a commercial testing service. The most appropriate test will depend on individual farm circumstances.

Sampling strategies to detect resistance

Getting representative samples for testing is an important part of any risk assessment. The current SA-LINK project has provided a greater understanding of the degree of variability of black-grass resistance within a patch, field or farm as summarised below.

Unit of assessment	Consistency	Implication for sampling
Patches	Good	One sample is likely to be representative of that patch.
Within fields	Good/variable	Collect seed from a number of patches across the field.
Between fields	Variable	Consider carefully how to approach sampling and be prepared to take samples from several fields on each farm.
Farms	Variable	Do not rely on the results at one farm to predict those of another.

Collect only dry ripe seeds (easily shed when shaken) in mid-July. It is important to look low down into the crop for any survivors of herbicide treatment. These could be early indicators of resistance developing. For full details of sample collection contact your testing organisation.

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Further information

Managing and preventing herbicide resistance in weeds, WRAG/HGCA (2003)

Nozzle Selection Chart, HGCA (2007)

The above publications are available at www.hgca.com

WRAG website
<http://www.pesticides.gov.uk/rags.asp?id=714>



The Weed Resistance Action Group (WRAG) website contains many useful documents and references. This includes the WRAG guidelines and an up-to-date list of herbicide modes of action.

Always discuss herbicide resistance management strategies with your agronomist or adviser.

Disclaimer

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