Background

Resistant weeds have developed an ability to survive herbicides that should kill them. Herbicide resistance has been detected in the UK in black-grass (Alopecurus myosuroides), wild-oats (Avena spp.) and Italian rye-grass (Lolium multiflorum). HGCA, MAFF and agro-chemical company funding has increased our understanding and provided guidelines for farmers to maximise useful product life.

Distribution of resistance

Most cases of resistance have been selected through intensive herbicide use on individual farms. Some weed seeds may be spread in crop seeds, straw and manure or on combines or cultivation equipment. Pollen transfer is relatively unimportant in grass weeds.

The extent of resistance has increased each year since resistant black-grass was first confirmed in 1982. Relatively few resistance tests have been carried out, especially for wild-oats and Italian rye-grass. Less than 10% of cereal farmers in England have had black-grass seeds tested.

Resistant black-grass, wild-oats and Italian rye-grass are now widely distributed throughout England, but not elsewhere in the UK (Table 1).

Preventing resistance

There is greater scope to prevent development of resistance to herbicides than to insecticides and fungicides. Insects and diseases can move to a particular farm from elsewhere, whilst grass weeds rarely do.

Preventing resistance makes economic sense, whilst preserving useful product life. It has been estimated that a strategy to prevent black-grass resistance costs half that of dealing with resistant populations.

Action points listed in the panel according to season apply whether grass-weeds are resistant or not. In order to prevent resistance developing follow these important guidelines:

- **Keep good records of cropping, herbicide use and cultivation.**
Maintain the correct balance of cultivation, herbicides and cultural control.

Select herbicide programmes (mixtures or sequences) to treat young weeds under optimum conditions for activity.

**June/July:** Map weed patches, particularly if persistent over several years. Collect seed samples for resistance testing. Rogue wild-oats.

**July/August:** Minimise weed seed movement between fields. Review records of herbicide use and control achieved. Plan cultural and herbicide control strategy for following crops.

**September – March:**
1. Destroy weeds before sowing. Apply pre-emergence herbicides at optimum timing.
2. Apply post-emergence herbicides when weeds are small (mainly 1-3 leaves). Do not use ‘fop’ and ‘dim’ herbicides as the only means of grass weed control in consecutive crops. Keep good field records and weed maps.

**April/May:** Monitor herbicide performance and identify causes of poor activity. If you suspect resistance, prepare to have a resistance test carried out.

Read the Revised Guidelines for Preventing and Managing Herbicide-Resistant Grass Weeds produced by the Weed Resistance Action Group (WRAG) and published by HGCA.

**Detecting resistance**

Herbicides may fail to kill weeds because of adverse weather conditions at application, weed size, inappropriate dose or faulty application. If such factors have been eliminated, resistance may be the cause.

Resistance is often associated with intensive winter cereal growing, intensive use of ‘fop’ and ‘dim’ herbicides and frequent non-inversion tillage (Table 2).

**Resistance tests**

The standard method used was developed at IACR-Rothamsted and is available commercially through ADAS Boxworth and Oxford Plant Sciences. Seeds are germinated in pots in a glasshouse. Plants are sprayed at the 2-3 leaf stage. Foliage is weighed about three weeks later as a measure of herbicide activity. The faster ‘Rothamsted Rapid Resistance Test’, in which seeds are germinated in the presence of herbicides, will be available from summer 1999. Harper Adams University College is also developing a test for resistance based on enhanced metabolism.

**Resistance mechanisms**

- **Enhanced metabolism** results in the detoxification of herbicides. Resistance tends to be partial but plants may be cross-resistant to many different herbicides.

- **Target site** resistance blocks the site of herbicide activity. This affects only ‘fop’ and ‘dim’ herbicides but usually gives complete resistance.

Plants may have one or both types of resistance and may show complex patterns of cross-resistance to different herbicides.

**Table 2. Herbicide resistance risk factors**

<table>
<thead>
<tr>
<th>Agronomic factor</th>
<th>Least risk</th>
<th>Most risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cropping system</td>
<td>Good rotation</td>
<td>Continuous winter cereals</td>
</tr>
<tr>
<td>Cultivation system</td>
<td>Annual ploughing</td>
<td>Continuous non-ploughing</td>
</tr>
<tr>
<td>Control method</td>
<td>Cultural only</td>
<td>Herbicides only</td>
</tr>
<tr>
<td>Grass-weed herbicide use throughout the rotation</td>
<td>Different modes of action</td>
<td>Single mode of action</td>
</tr>
<tr>
<td>Weed infestation</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Resistance in vicinity</td>
<td>None</td>
<td>Common</td>
</tr>
</tbody>
</table>

**Further information:**

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