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# Black-grass (*Alopecurus myosuroides*) Revised 2013

*Everything you really wanted to know about black-grass but didn't know who to ask*

**Dr. Stephen Moss**

**Occurrence:** Black-grass occurs throughout much of Europe but is a particular problem in the more western countries of England, France, Germany and parts of Belgium and the Netherlands. It appears also to be increasing in the Scandinavian countries of Denmark and southern Sweden and in eastern European countries, such as Poland. The main reason for this is almost certainly changes in cropping systems, which are a major factor in the success of this weed, as detailed below. Black-grass is favoured by water retentive soils, so tends to be more of a problem on heavier clay or silt rather than on lighter sandy soils.

Black-grass plant in a wheat crop.

**In Europe, the distribution and severity of black-grass infestations are determined mainly by soil type and cropping system rather than by climate, although it prefers cool/damp conditions.**

**Biology:** Black-grass is an annual grass-weed propagated solely by seeds, so for long term control seed return must be minimised. The number of heads per plant varies considerably, depending mainly on crop competition, but 2 - 20 heads/plant is typical in competitive winter cereal crops. Each head contains about 100 seeds, and with populations of 500 heads/m$^2$ seed return can easily exceed 50,000/m$^2$. Black-grass is a cross-pollinating species and this may explain why viability of seeds tends to be variable, although typically about 40-60 % of seeds will be viable. Most seeds are shed between June and August with the majority shed before harvest of winter wheat. Seeds have a relatively short period of innate dormancy (several weeks) although this is reduced when seeds mature under hot/dry conditions. If uncontrolled, populations can increase very rapidly, by over 30 fold per annum. Survival of buried seeds in the soil is about 20% - 30% per year, so after 3 years burial, only about 1% - 3% of seeds will still be viable – although this may still represent a considerable number of seeds.

**The biology explains why black-grass populations can build up very rapidly given favourable conditions, and also why populations can also decline rapidly *if* seed return is prevented.**

**Emergence patterns:** Black-grass plants can only emerge successfully from seeds retained within the surface 5 cm of soil, which is why minimum tillage encourages black-grass. Provided there is sufficient moisture, about 80% of black-grass germination and emergence occurs in the autumn, from September to November, and consequently black-grass is mainly associated with autumn sown crops, especially cereals. Spring sown crops tend to be less vulnerable to black-grass, as the majority of weed plants will have emerged before sowing and can be destroyed by seedbed cultivations or use of a total herbicide, such as glyphosate. However, intensive cultivations and early sowing can result in serious infestations in spring crops.

**The emergence patterns explains why black-grass is an increasing problem – more autumn sown crops, earlier sowing and more minimum tillage are the critical factors.**

**Competition:** Black-grass can seriously reduce crop yields through competition for nutrients, especially nitrogen. The tillering capacity, and thus competitive ability of black-grass, depends greatly on the vigour of the crop. Consequently, there can be considerable variation in crop yield response to similar black-grass populations. Table 1 highlights the variability in yield responses of winter wheat to different black-grass populations in England. On average, yield losses of 0.4 – 0.8 t wheat/ha can be expected at black-grass populations of 12 – 25 plants/m$^2$, but much higher losses of over 2 t wheat/ha at densities of over 100 plants/m$^2$ (based on weed free crop yielding 8 t/ha).

**Table 1.** Variation in yield loss from black-grass in winter wheat in England, based on 16 trials conducted between 1995 and 1997.

| Black -grass plants/m$^2$ | % crop yield losses | Range of % crop yield losses |
|---|---|---|
| 12 | 5 | <5 - 15 |
| 25 | 10 | <5 - 25 |
| 50 | 15 | <5 - 35 |
| 100 | 20 | 5 - 50 |
| 250 | 35 | 10 - 65 |
| 500 | 50 | 20 - 70 |

**Based on: Blair, Cussans & Lutman, Proc. 1999 Brighton Conference – Weeds, 753 - 760**

This dark coloured patch in a wheat crop is due to a serious (over 500 heads /m$^2$ ) black-grass infestation - hence it's name. This infestation is likely to reduce crop yield by at least 25%, or 2-3 t/ha.

A weed density that causes a 5% yield loss is often used as a threshold value at which herbicidal control is justified to prevent unacceptable loss. For black-grass in winter wheat (in England) this is 12 plants/m$^2$. However, this is an average figure, so higher yield losses should be expected in 50% of fields. Because of the risk of higher yield losses, the potential for rapid population increase and the difficulty of assessing weed densities on a field scale, most farmers aim to apply herbicides to control black-grass at much lower densities. Control of black-grass densities of less than 1 plant/m$^2$ may be justified in high risk situations (minimally cultivated, early autumn sown crops on heavy soils).

**Black-grass is a deceptive weed - yield losses are hard to predict at an individual field level. High potential yield losses and population increases necessitate high levels of control (>90%).**

**Control measures:** Herbicides are often considered the primary method of control, but loss of existing herbicides through regulatory action, lack of new modes of action and increasing resistance means that non-chemical methods will become increasingly important.

**Herbicides:** Pre-emergence herbicides, such as flufenacet, pendimethalin, prosulfocarb and tri-allate, can give a good level of control of black-grass in cereals (50 – 80%), and efficacy is usually only partially reduced by resistance.

Post-emergence herbicides, such as chlorotoluron, clodinafop[a], fenoxaprop[a], pinoxaden[c], flupyrsulfuron[d], mesosulfuron+iodosulfuron[d] and pyroxsulam[d] have the potential to give high levels of control in cereals (>95%), but resistance to all these herbicides is increasing. A range of other herbicides is available for black-grass control in non-cereal crops, such as oilseed rape (e.g. fluazifop-P[a], propaquizalofop[a], cycloxydim[b], quizalofop[a], tepraloxydim[b], propyzamide and carbetamide).

Each black-grass head contains about 100 seeds which are mainly shed prior to harvest.

(Note: for explanation of [a, b, c, d] see next table)

**Herbicide resistance**: Resistant populations of black-grass has been confirmed in many countries. Resistance is widespread in England and increasing in France and Germany. 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 Europe.

| Type | Mechanism |
|---|---|
| Enhanced metabolism resistance (EMR) | Results in herbicide detoxification and is the commonest resistance mechanism in black-grass. It affects most herbicides to varying degrees, but only in very severe cases results in complete loss of control. Tends to increase slowly. |
| ACCase target site resistance (ACCase TSR) | Blocks the site of activity specific to 'fop' ([a] in 'Herbicides' section on previous page), 'dim' ([b]) and 'den' ([c]) herbicides. It only affects these groups of herbicides, but often results in very poor control and can increase rapidly. |
| ALS target site resistance (ALS TSR) | Blocks the site of sulfonylurea and related herbicides ([d] in 'Herbicides' section above). It only affects this group of herbicides and can result in poor control. Currently it occurs less commonly than ACCase TSR, but it is increasing. |

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

**Resistance is increasing although complete loss of control is rare. However, achieving the levels of control needed to contain black-grass (>90%) will become increasingly difficult using herbicides alone.**

**Non-chemical weed control:** These can reduce the need for herbicides and the risk of resistance developing. These are summarised in the Table 2.

**Table 2. Non-chemical control of black-grass in winter wheat based rotations.**

| | % control achieved | | |
|---|---|---|---|
| **Method** | **Mean** | **Range** | **Comments** |
| Ploughing | **69%** | -82% to 96% | Rotational use has potential benefits |
| Delayed autumn drilling (by ≈3 weeks) | **31%** | -71% to 97% | The later the better – but increased risk |
| Higher seed rates | **26%** | +7% to 63% | The higher the better – but lodging issues |
| Competitive cultivars | **22%** | +8% to 45% | Useful, but marginal effects |
| Spring cropping | **88%** | +78% to 96% | Effective, but challenging on heavy soils and limited herbicide options |
| Fallowing/grass leys | **70-80%/year (of seed bank)** | – | Absence of new seeding critical |

Based on a review by Lutman, Moss, Cook & Welham (2013).

**Non-chemical methods tend to give only moderate, and unpredictable, levels of control at an individual field level. However, lack of 'resistance' to non-chemical methods means they should provide more durable control than herbicides.**

**Integrated Weed Management:** The use of a combination of weed control measures, each of which is only partially successful, should improve the overall control of black-grass. Herbicides or non-chemical methods alone will not offer sustainable long-term control. Their use needs to be fully integrated to increase the overall level of control, and so reduce the dependence on herbicides.

### Ten key factors to consider are:

- Aim to keep black-grass populations as low as possible – high populations of resistant black-grass may be impossible to control in intensive winter cropping systems.
- Rotational planning should be at the heart of any successful control strategy. The inclusion of non-cereal crops within the rotation may reduce black-grass infestations and allow the use of alternative herbicides.
- Use of *several* non-chemical methods will reduce the need for herbicides and the risk of resistance developing.
- Greater use of lower resistance risk pre-emergence herbicides will reduce dependence on the higher resistance risk post-emergence herbicides.
- Many of the most active post-emergence herbicides are ACCase ('fops'/'dims'/'dens') and ALS inhibitors (e.g. sulfonylureas) which pose a very high resistance risk. Do not rely on either class as the main means of black-grass control in successive crops.
- Where possible, use lower resistance risk post-emergence herbicides in the rotation e.g. propyzamide and carbetamide in oilseed rape. To date, no resistance to either herbicide has been found in black-grass.
- Herbicide sequences and mixtures will help improve overall control but will not prevent resistance developing.
- Pay attention to recommended rate, nozzle choice, water volumes and spray timings to maximise herbicide effectiveness.
- Monitor herbicide performance critically to detect any progressive loss in herbicide efficacy.
- Have a test carried out on black-grass plants or seeds 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.

**Dr. Stephen Moss** has been a weed scientist for over 37 years specialising in grass-weeds of arable crops. Black-grass has been his main speciality and his research studies include its agro-ecology, control by herbicides and non-chemical methods and, most recently, he has concentrated on the threat posed by herbicide resistance in this weed.

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Further reading:

Holm, L., Doll, J., Holm, E., Pancho, J. & Hererger, J. (1997). *Alopecurus myosuroides*. In: *World Weeds: Natural Histories and Distribution*. Chapter 5, pages 29 – 36. Publisher: John Wiley.

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See also the Weed Resistance Action Group (WRAG) website

A Rothamsted technical publication, 2013. 