Black-grass: the potential of non-chemical control

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Very high levels of control are needed to prevent black-grass increasing – 97% in winter wheat grown in non-inversion tillage systems. Achieving such high levels of control is a challenge with herbicides alone. Farmers will have to use more non-chemical weed control methods in future because:

Herbicide-resistant black-grass. > £100/ha was spent on herbicides which gave <20% control. Non-chemical control methods are essential in fields like this.

- **Resistance is widespread and increasing, leading to unreliable control, especially from post-emergence herbicides**
- **No new herbicides are likely to become available in the immediate future, and some existing herbicides may be withdrawn for regulatory reasons**
- **The EU Sustainable use of Pesticides Directive (2009/128/EC) requires farmers to give priority to non-chemical methods of plant protection**

What level of control can be achieved from these methods?

The following table summarises the major methods available in winter cereals and the levels of control that can be achieved, based on a recent comprehensive review of over 50 field experiments (see further reading list). The range in the level of control recorded in the experiments is also presented for each method.

	% control of black grass achieved		
Method	**Mean**	**Range**	**Comments**
Ploughing	69%	-82% to 96%	Rotational ploughing has considerable benefits
Delayed autumn drilling (by ≈3 weeks from mid September)	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
More competitive cultivars	22%	+8% to 45%	Useful, but marginal effects
Spring cropping	88%	+78% to 96%	Effective, but challenging on heavy soil and limited herbicides
Fallowing/grass leys	70–80 % per year (of seedbank)	-	Absence of new seeding critical

Note:

- The wide range for each method shows how variable non-chemical control can be. Crucially, the objective must be to aim for levels of control at the ***upper*** end of the range, and this is more likely to be achieved by an understanding of the principles behind each of these methods, so that the potential benefits can be maximised at the individual field level.

What are the agronomic principles determining the efficacy of non-chemical control methods?

Diverse crop rotations, including autumn and spring-grown crops, can reduce the dominance of most annual grass-weeds.

Rotations – The prevalence of autumn sown crops is the main reason why black-grass is an increasing problem in the UK. More balanced rotations are needed on many farms, not just to help control grass-weeds, but also to reduce the impact of pest and diseases on crops such as oil-seed rape and to improve soil fertility. It is difficult to quantify the direct benefits of different rotations on black-grass control, although the inclusion of spring sown crops is likely to be the most beneficial single element (see below). There is no simple 'blueprint' for a perfect rotation – this must be developed at the individual farm level.

Re-evaluate your crop rotation for long term sustainability

Ploughing – Reduces the risk from grass-weeds by burying freshly shed seeds to a depth from which seedlings are unlikely to emerge (> 5 cm). Black-grass seeds are relatively non-persistent in the seed bank (70 – 80% decline per year) so usually fewer, old, buried seeds are brought back up to the surface, especially if ploughing is done on a rotational basis, once every 3 – 6 years. Another potential benefit of rotational ploughing is that older, less selected seeds may be brought back to the soil surface thus increasing the proportion of susceptible plants in the weed population. ***The benefits of rotational ploughing are totally dependent on achieving a good level of soil inversion.***

Good ploughing is dependent on correct set-up, effective use of skimmers and favourable soil conditions.

Shallow cultivation systems favour black-grass by retaining seeds close to the soil surface.

Shallow non-inversion tillage – This tends to favour black-grass, as freshly shed seeds are retained in the surface soil layer from where plants can readily emerge. However, shallow rooting black-grass plants following minimum tillage may be more easily controlled by residual herbicides (e.g. propyzamide in oil-seed rape). Non-inversion tillage avoids bringing large numbers of buried weed seeds back to the soil surface, so is preferable where little or no seed has been shed in the crop just harvested. Failure to control black-grass effectively in shallow non-inversion tillage systems can result in a much more rapid increase in infestation (> 10 fold/year) than occurs in systems based on annual ploughing.

Plan your cultivation strategy at an individual field level to maximise control of black-grass

Delayed autumn drilling – Delayed autumn sowing of cereals has two benefits:

1. It allows more weed seedlings to emerge and be controlled (e.g. with cultivations or glyphosate) before sowing.
2. Residual pre-emergence herbicides can be more effective when applied in later drilled crops, because soil conditions are more favourable for good activity.

Adequate soil moisture is vital to maximize the value of both benefits which can be achieved by drilling in mid-October (or later if feasible), rather than September. Delaying drilling carries obvious risks – these can be minimised by having adequate drilling capacity or by using drills that are capable of working in sub-optimal soil conditions.

Delayed autumn drilling reduces black-grass infestations, but carries risks.

Delaying autumn drilling can be very effective - but the benefit will vary from year to year.

High seed rates of winter wheat can produce very competitive crops.

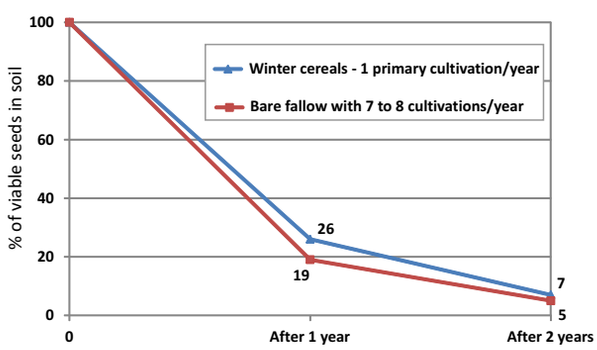
Competitive crops – Higher seed rates of winter cereals, more competitive crops or varieties, narrow row spacings, improved drainage and good seedbeds favour competitive crops that are better able to suppress weeds. Higher winter wheat populations (e.g. >300 plant/m^2) are much more competitive than low populations (e.g. 100 plants/m^2), but excessively high seed rates increase the risk of lodging. Narrow rows improve competition, but may be impractical where substantial amounts of crop residues are present. Widely spaced banded sowing systems can result in poor crop competition if crop seeds are not well spread out over the full band width.

Competitive crops will help greatly in suppressing black-grass

Spring cropping – About 80% of black-grass emergence occurs in autumn, so spring sown crops tend to be much less affected and have given a consistently good reduction in weed infestation in field trials. However, establishing crops in spring can be difficult, especially on heavy soils, and herbicide choice is more limited. Spring barley is more competitive than spring wheat, but there is a lack of information on the effectiveness of other spring sown crops and the impact of different spring sowing dates.

Choose the most appropriate spring crops for your own individual farm

Spring barley is about twice as competitive as spring wheat in terms of reducing black-grass seed return.



Fallowing/Grass ley breaks – Fallowing is being considered increasingly as a means of reducing severe black-grass infestations. A grass ley break of 2 – 3 years is also a very good option. Failure to prevent seed return will greatly undermine the value of a fallow or grass ley break. Seed persistence data (see graph), and farm experience, both support the view that a ***1 year fallow or grass ley is not long enough*** to reduce high black-grass infestations to acceptable levels. After two years, less than 10% of seeds are likely to remain – a much more significant reduction.

The cultivation strategy at the end of any fallow or grass ley break is important. Sufficient time should elapse between cultivating and sowing the next crop to allow the destruction of black-grass seedlings emerging from residual seeds.

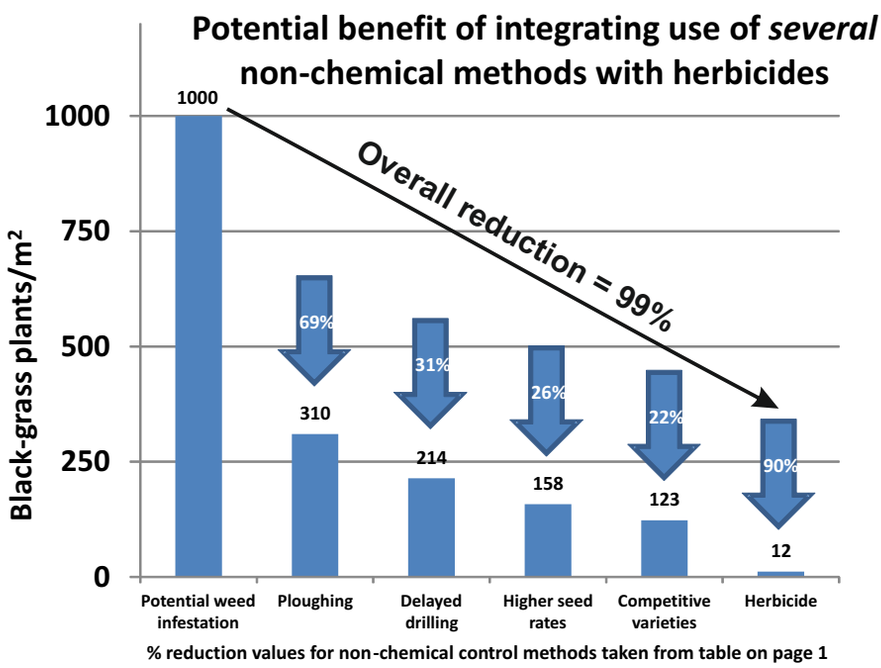
Fallowing and grass ley breaks have a valuable role to play in weed control in modern arable systems

Preventing seed return and spread of resistant seeds – spraying off patches of black-grass in winter wheat with glyphosate in the first week of June will prevent viable seed return. Consider spraying the same areas for 2 – 3 years to maximise reductions. Cutting, or spraying in May or later in June, is likely to be less effective. Minimise spread of seeds and plants in combine harvesters, balers, cultivation equipment, straw or manure. Hand roguing is feasible at low weed populations and is particularly recommended in fields where black-grass is only just starting to appear – it may already be resistant if it has been introduced (e.g. in contaminated straw) from the main arable areas of England.

Dense patches of black-grass like this are best sprayed off with glyphosate in the first week of June.

Integrated Weed Management (IWM) - key messages:

- **Relying solely on herbicides for control of black-grass is not sustainable in the long-term, due to increasing resistance**
- **Non-chemical methods have considerable potential, although each individual method tends to give mediocre control.**
- **Lack of 'resistance' to non-chemical methods means they should provide more durable control than herbicides.**
- **Integrating the use of *several* non-chemical methods, in combination with herbicides, should improve overall control**



% reduction values for non-chemical control methods taken from table on page 1

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A combined total of 80 years research experience in weed biology and control!

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Further reading

A review of the effects of crop agronomy on the management of *Alopecurus myosuroides* by P J W Lutman, S R Moss, S Cook & S J Welham. (2013). *Weed Research,* (in press).

Black-grass (*Alopecurus myosuroides*): Everything you really wanted to know about black-grass but didn't know who to ask. by S R Moss (2013 – revised edition). *A Rothamsted Research technical publication.*

Managing weeds in arable rotations- a guide. (2010). *HGCA publication*.

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