Black-grass Bulletin Issue 5

How black-grass evolves resistance

BLACK-GRASS RESISTANCE INITIATIVE

Evolution of herbicide resistance

The Black-Grass Resistance Initiative (BGRI) has been underway for three years now. As it comes to an end, we reflect on what has been learnt about the evolution of resistance to herbicides.

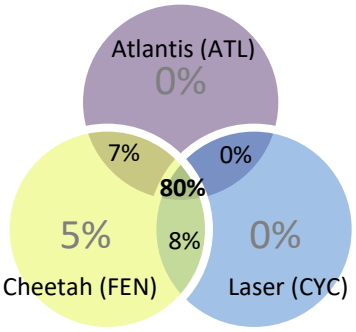
Drivers of resistance

Over the last few years, researchers from the University of Sheffield and Rothamsted Research have been travelling up and down the country mapping black-grass densities in over 140 fields and collecting seeds to test for herbicide resistance. The data collected was used alongside records of historical weed management strategies to tease apart the factors involved in evolution of herbicide resistance in black-grass.

Previous literature and industry recommendations suggest that varying the type of herbicide used will prevent evolution of resistance. Our research suggests that this is not the case. Resistance is correlated with the frequency of historical herbicide use and is in fact driven by the intensity of herbicide use, not lack of variety. Reducing the number of applications of herbicide in a year is the most important factor in preventing resistant black-grass.

MODES OF ACTION (MOA)

Chemical families which kill pests by targeting different cellular machinery or metabolic processes



Venn Diagram indicating the percentage of populations resistant to multiple herbicides

FAST FACTS

30	Years since a new herbicide mode of action was developed
88%	Of quadrats surveyed had at least one black-grass plant
80%	Of black-grass populations were resistant to all 3 herbicides

Multiple Herbicide Resistance

Seeds collected during the field surveys were grown in our glasshouses and the resulting plants were tested for resistance to 3 different herbicides commonly used for grass weed control in arable fields. Populations were considered resistant if over 80% of the weeds survived herbicide applications. Results revealed that 80% of fields had populations of black-grass which were resistant to all three herbicides. This could mean one of two things:

1. The populations have evolved resistance to each herbicide independently
2. Resistance to one type of herbicide confers cross-resistance to others

It looks like much of the resistance found in the tested populations is not target-site specific, meaning that plants have developed resistance to multiple herbicides at once - including those they haven't ever been exposed to! This is a major cause for concern as it means that new herbicides could be ineffective despite never having been sprayed on crops before.

The cost of resistance

Herbicide resistant weeds are one of the biggest agronomic issues in the UK and weeds are the biggest cause of yield loss globally. Insensitivity to herbicides will reduce crop yields, threaten food security and be economically damaging. The combined cost of herbicides + yield loss ranges from £115/ha to £320/ha, accounting for profit losses between 4% and 12%.

% QUADRATS WITH HIGH & VERY-HIGH DENSITY BLACK-GRASS	
75%	Buckinghamshire (South)
20%	Yorkshire (North)

Currently black-grass is a much bigger issue towards the south of the main arable region in the UK. Densities recorded in this area are much higher than in East Anglia and Yorkshire. But the geographic range is increasing each year and if practices don't change we will see very high densities of black-grass up and down the UK.

Controlling resistance

To prevent resistance spreading, reproduction and survival of resistant individuals needs to be minimised; integrated weed management strategies are the best way to do this. Limiting the use of herbicides and reducing population sizes of black-grass using non-chemical alternatives has the potential to prevent the evolution of resistance and preserve the efficacy of current and new chemicals in the future. If current strategies don't change, any new herbicides on the market could rapidly be rendered useless.

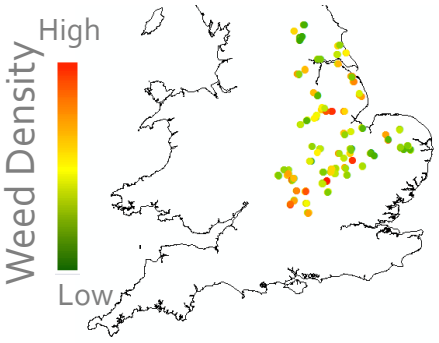
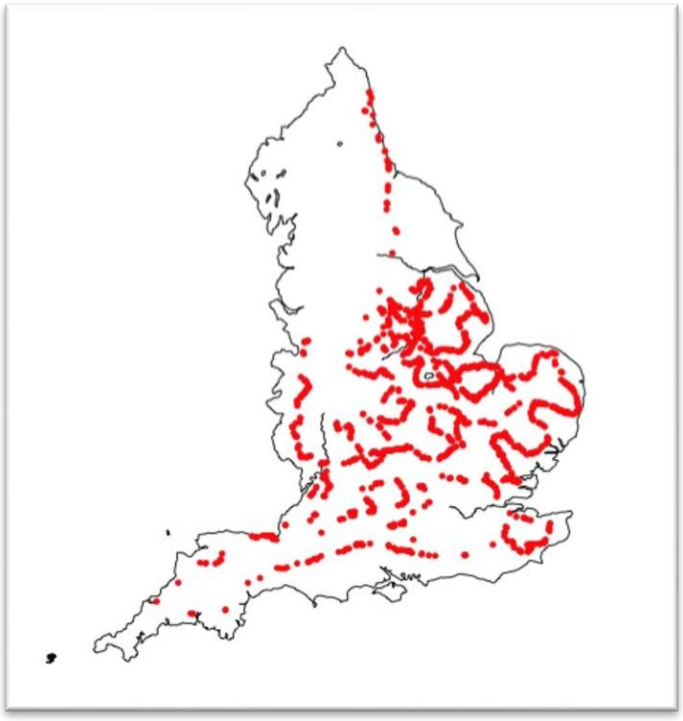


Diagram showing how weed density varies across the UK

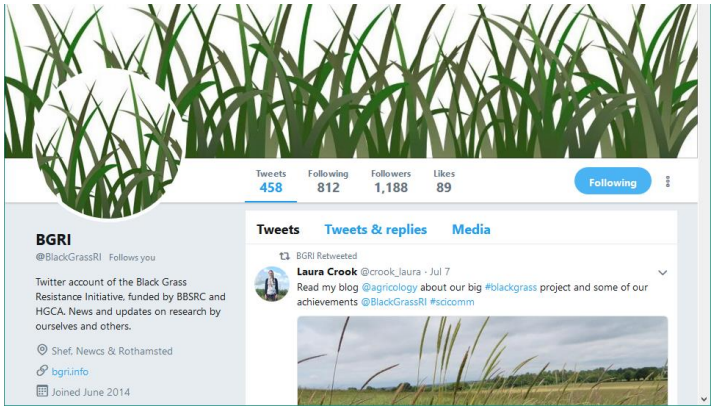
Rapid assessment surveys

Earlier in the summer, our team of researchers traversed the country rapidly assessing the density of black-grass in winter wheat fields. They drove 4,500 miles and surveyed 2,282 fields. Results available soon…



Black-grass on the Twitter-sphere

Follow the BGRI on twitter - we tweet about the latest news from ourselves, as well as retweeting news and views about the latest on black-grass research and management from across the UK. This month a lot of people are sharing experiences of post-harvest management: *alternative crops*, *stale seed-beds*, *ploughing* and *flushing*. See what everyone else is up to and tell us how you are getting on **@BlackGrassRI**



FOR MORE INFORMATION

For more information on any aspect of the project please see our website at bgri.info or contact us by email at bgri@rothamsted.ac.uk