ROTHAMSTED RESEARCH

Multiple herbicide resistance in populations of *Alopecurus myosuroides*

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BBSRC bioscience for the future

Black-grass Resistance Initiative (BGRI)

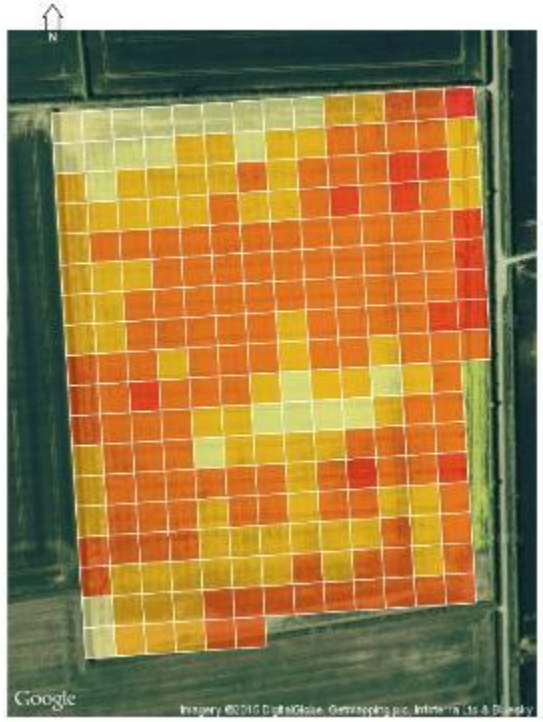
ROTHAMSTED RESEARCH

Newcastle University

The University Of Sheffield.

ZSL LIVING CONSERVATION

From gene to field



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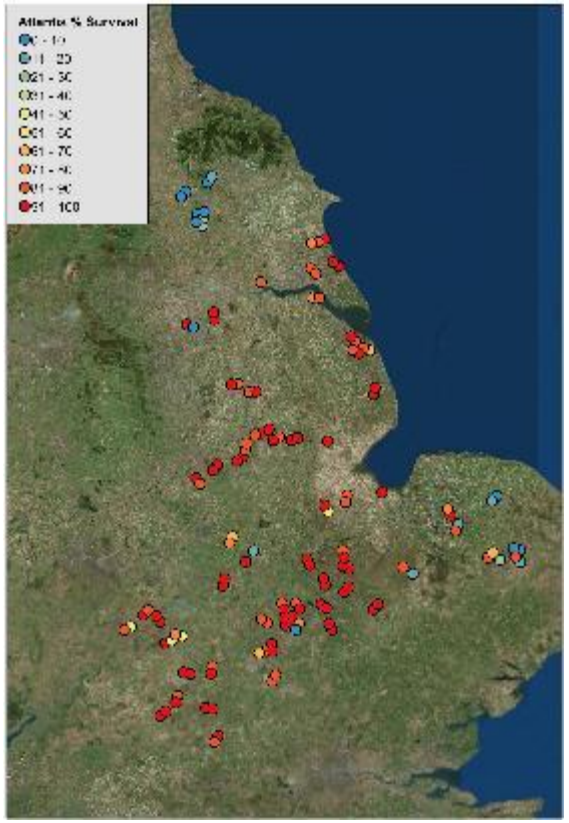
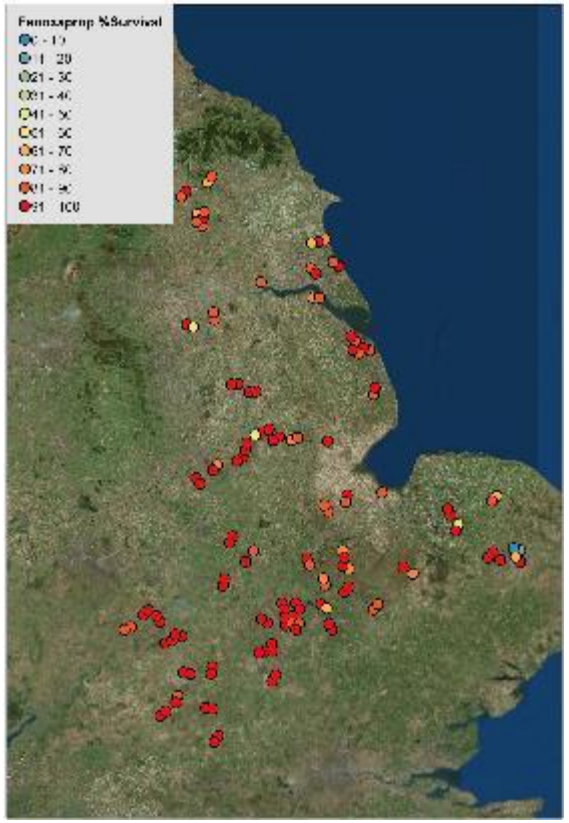
Large scale phenotyping experiments

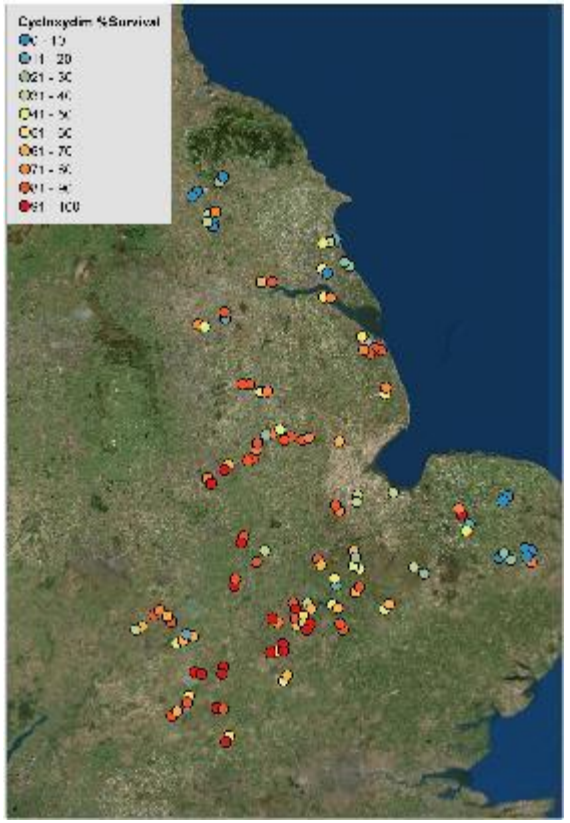
- 71 farms across main arable region of England
- 132 individual populations collected

- Phenotyping experiments in glasshouse conditions
- Tested with three post-emergence herbicides
  - Mesosulfuron + Iodosulfuron
  - Fenoxaprop
  - Cycloxydim

Widespread multiple herbicide resistance present







Of the ~2400 plants tested at approximate field rate:

- 77% resistant to mesosulfuron + iodosulfuron
- 90% resistant to fenoxaprop
- 60**%** resistant to cycloxydim

79% of the 132 populations were resistant to all three herbicides

Widespread multiple herbicide resistance in UK populations of *Alopecurus myosuroides*

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Example of dose response experiments in glasshouse facilities.

INTRODUCTION

Alopecurus myosuroides (black-grass) is the most prevalent weed species in the UK and has become a major limitation to crop production due to resistance to multiple herbicides, particularly in fields of winter wheat. Very high densities of *A. myosuroides* can lead to significant yield losses and requires farmers to adopt cultural control methods to bring populations under control. **Here, we report the findings of a UK herbicide resistance audit, conducted as part of the Black-grass Resistance Initiative, a large multi-disciplinary research project to unravel the mechanisms, genetics, evolution and management of black-grass.**

METHODS

Seed samples were collected from two winter wheat fields at each of 71 farms distributed throughout the main arable production area in England. Field collection sites were impacted by a range of *A. myosuroides* population densities to encompass heavily infested fields and those with an emerging control problem. In total, 132 individual populations were collected. The resistance phenotype of collected populations was determined by dose response. Three post-emergence herbicides were included in experiments; mesosulfuron + iodosulfuron (Atlantis), fenoxaprop and cycloxydim. Mortality and biomass estimates were made three weeks after herbicide application.

RESULTS

Resistance to all three herbicides was widespread with some regional variation in the frequency of resistance (Figure 1). On the basis of observed survival at the field rate:

- **77% of individuals (n = 2,376; 132 populations, 18 plants/population) were resistant to mesosulfuron + iodosulfuron.**
- **90% were resistant to fenoxaprop**
- **60% were resistant to cycloxydim**

Of the 132 populations of *A. myosuroides* tested, **79% of these were resistant to all three herbicides** (Figure 2).

Two populations remained susceptible to all three herbicides

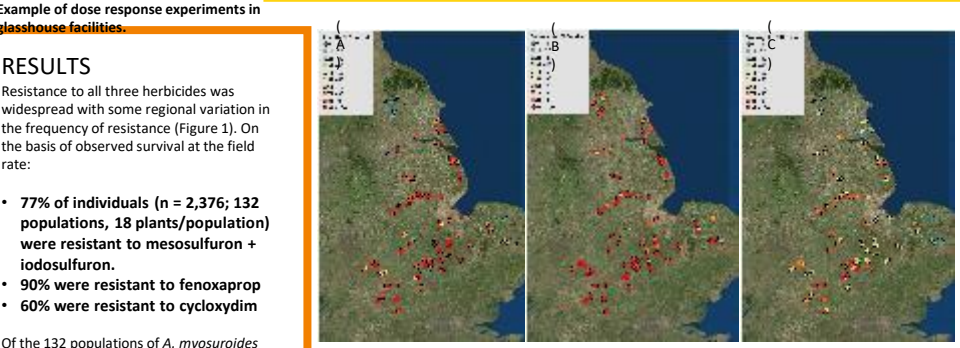

Figure 1. Maps showing locations of the 132 collected *A. myosuroides* populations. Coloured dots show the frequency of resistance for each population at the field rate of mesosulfuron + iodosulfuron (Atlantis) (A), fenoxaprop (B) and cycloxydim (C).

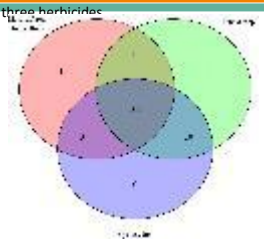

Figure 2. Venn diagram showing the cross resistance of populations of *A. myosuroides* to the three different herbicides tested at field rate. Populations were classified as resistant when population survival at field rate was >20%.

CONCLUSIONS

Control of *A. myosuroides* populations with post-emergence herbicides in wheat crops in the UK is severely compromised by widespread multiple herbicide resistance.

These characterised populations provide an important resource for further in depth studies into the mechanisms, genetics, evolution, epidemiology and management of herbicide resistance in the UK as part of the Black-grass Resistance Initiative (BGRI).

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http://bgri.info/

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