ROTHAMSTED RESEARCH

BGRI black-grass farm network

10 years on: What lessons have we learned?

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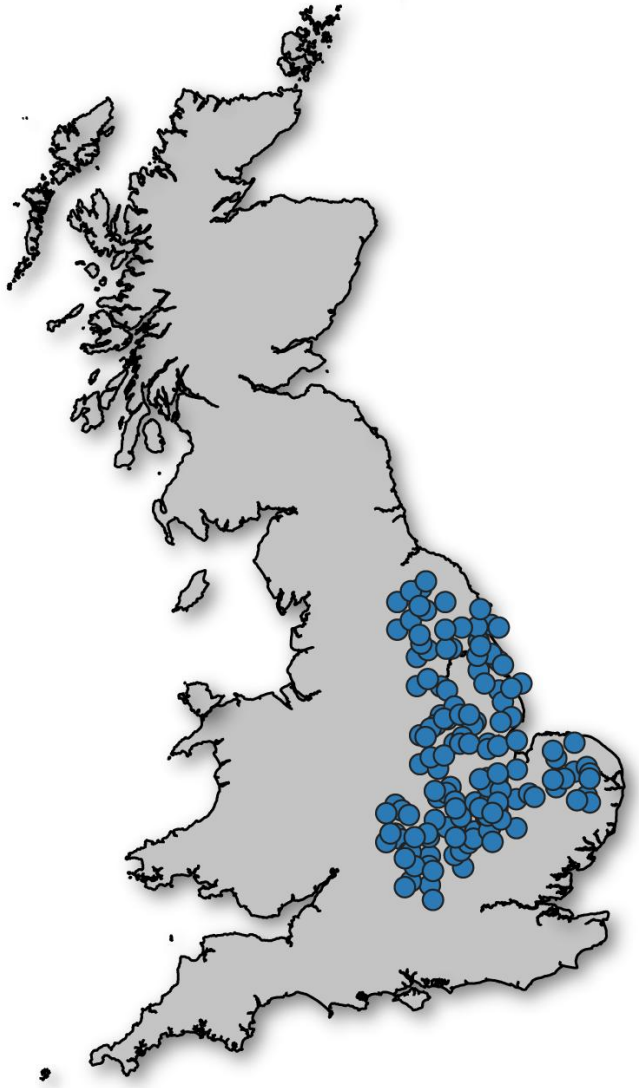
BBSRC bioscience for the future

Lawes Agricultural Trust

What is the BGRI Network?

- Established in 2014
- 60 farms; 180 fields
- 11 seasons of black-grass abundance mapping
- Seed samples collected



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What changes have occurred on the BGRI network so far?

Herbicide resistance is widespread

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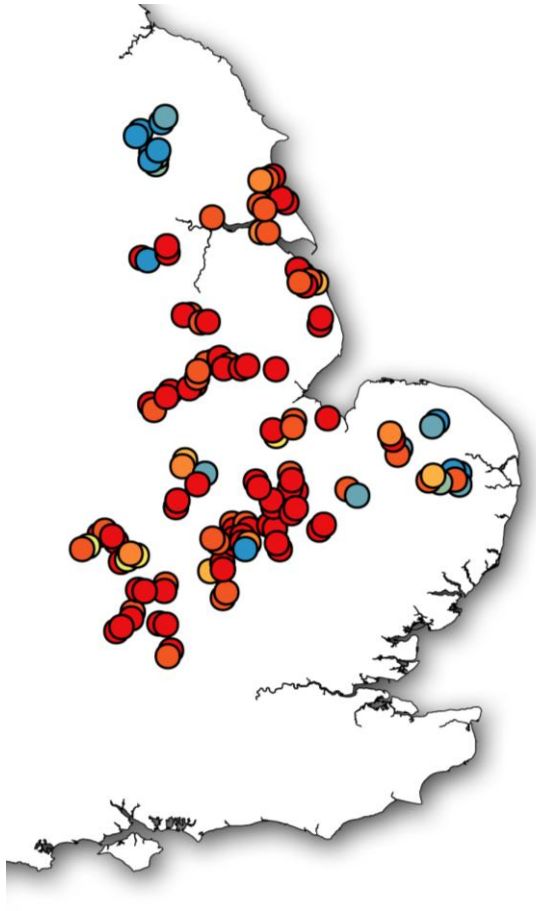
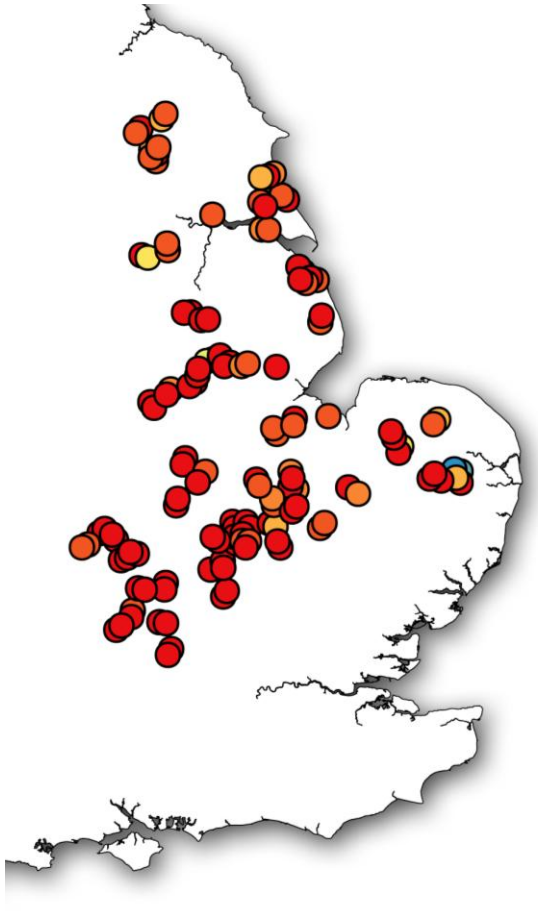
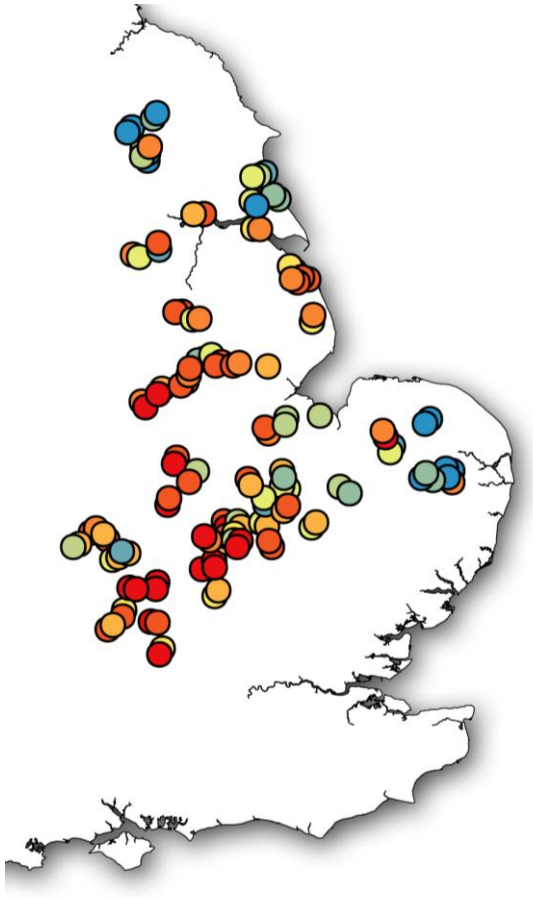
ALS
(Mesosulfuron)

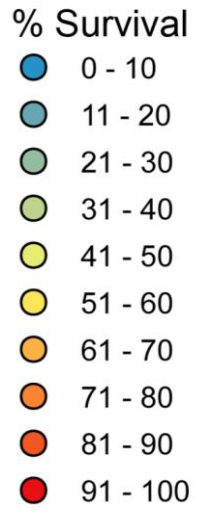


ACCase
(Fenoxaprop)



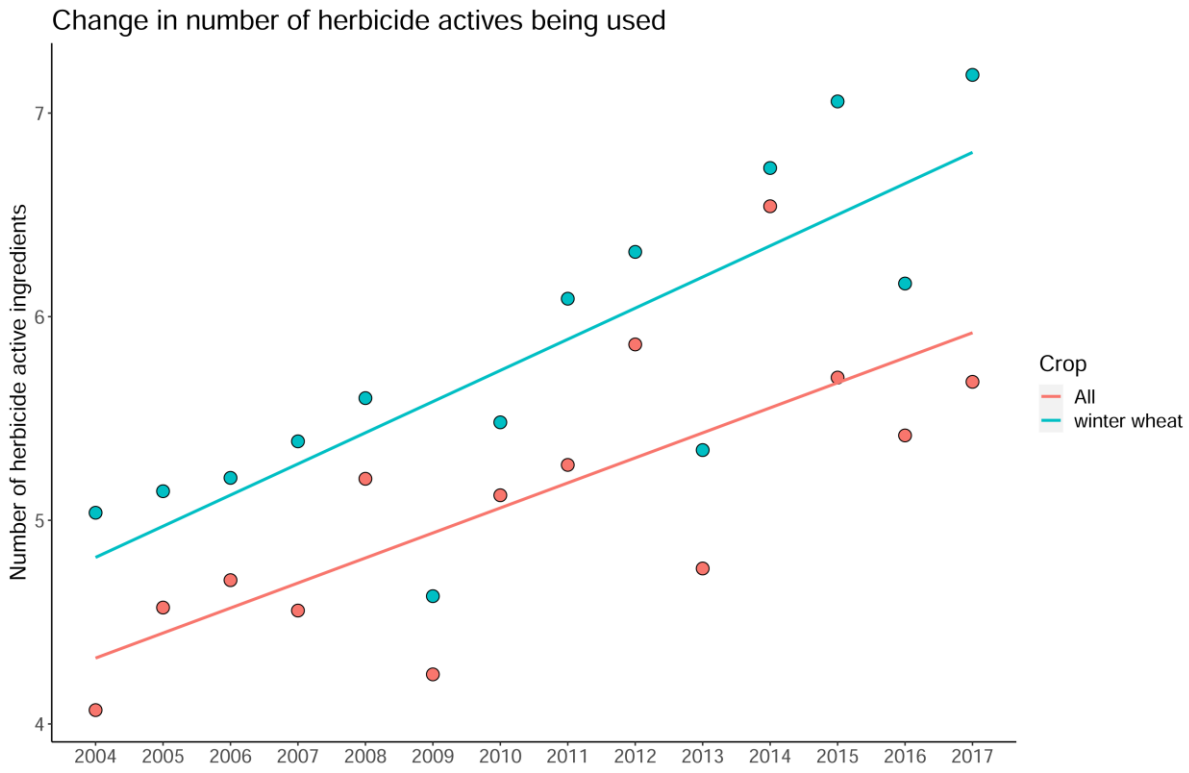
ACCase
(Cycloxydim)

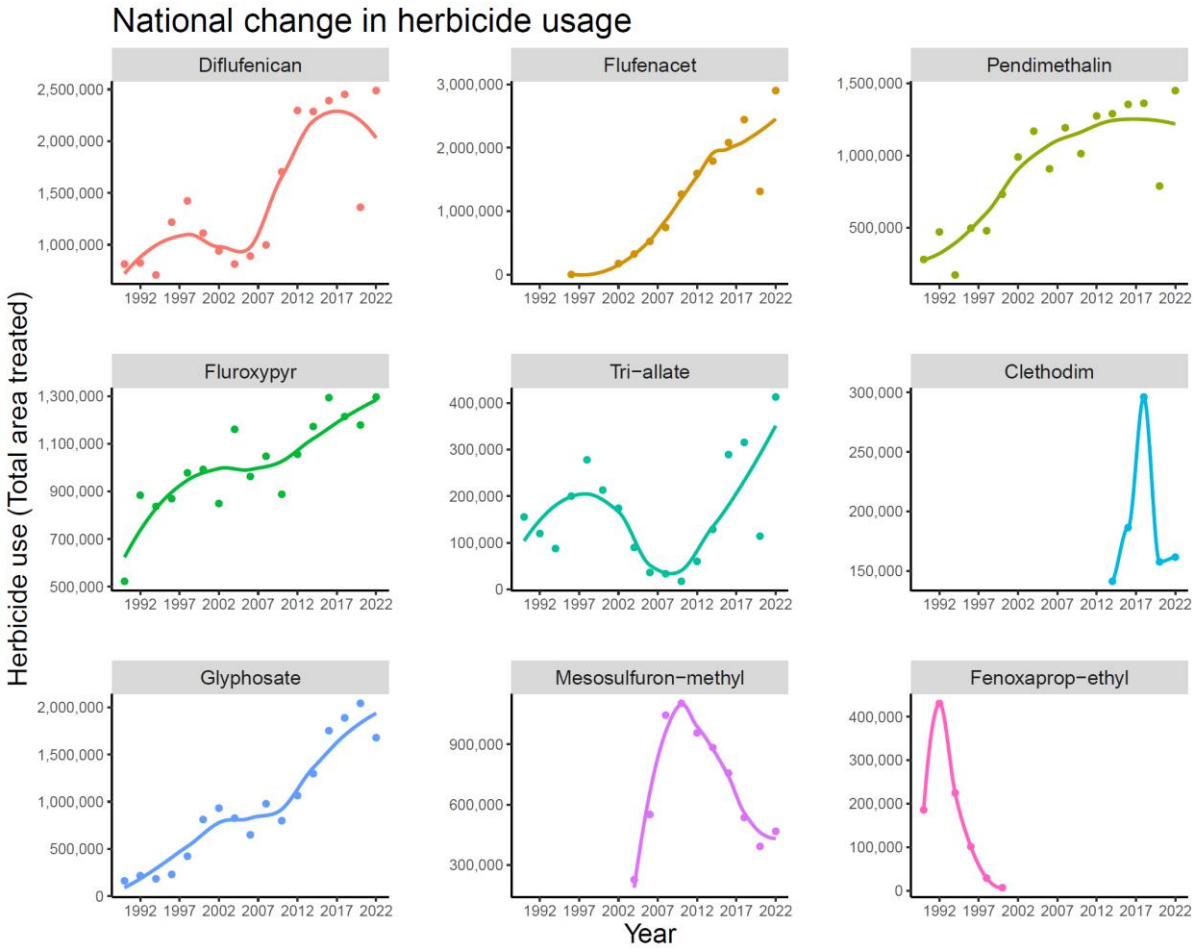




Herbicide usage has increased

- Herbicide usage remains high, and several actives are increasing
- Reliance on stacks of multiple pre-ems, and repeated glyphosate applications





Emerging issues: Flufenacet resistance

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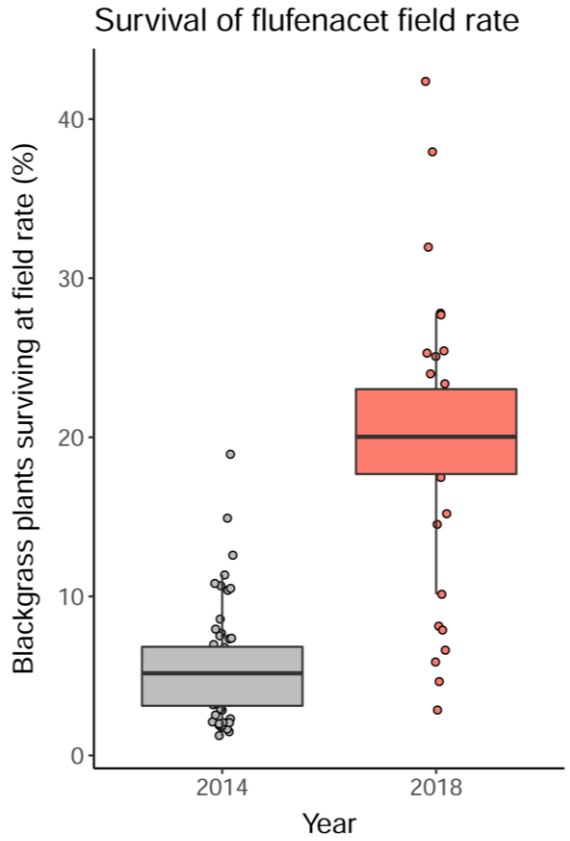
- Black-grass collected in 2014 and 2018 **from the same fields** and screened for flufenacet resistance
- Black-grass is clearly evolving lower sensitivity to flufenacet



Testing black-grass for Glyphosate resistance

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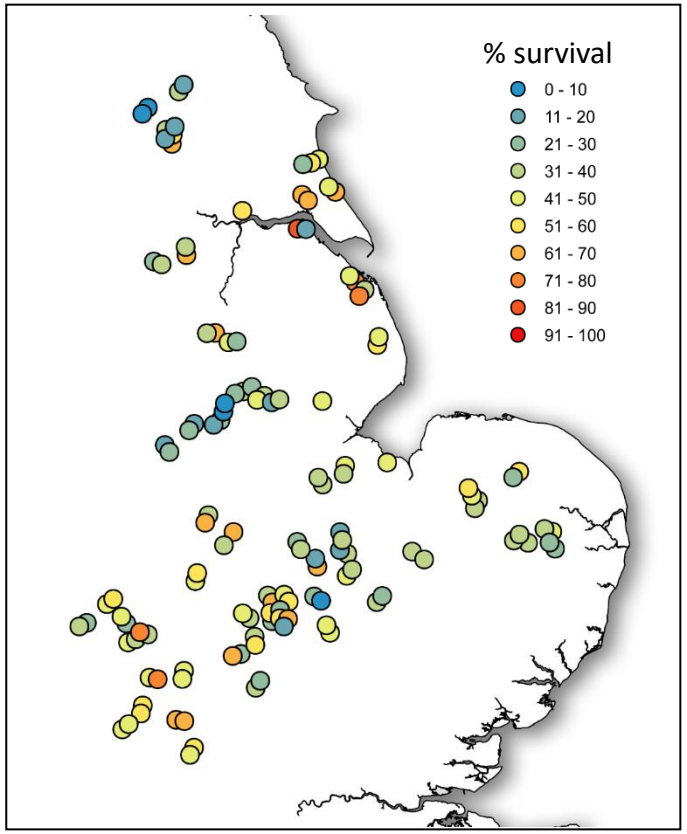
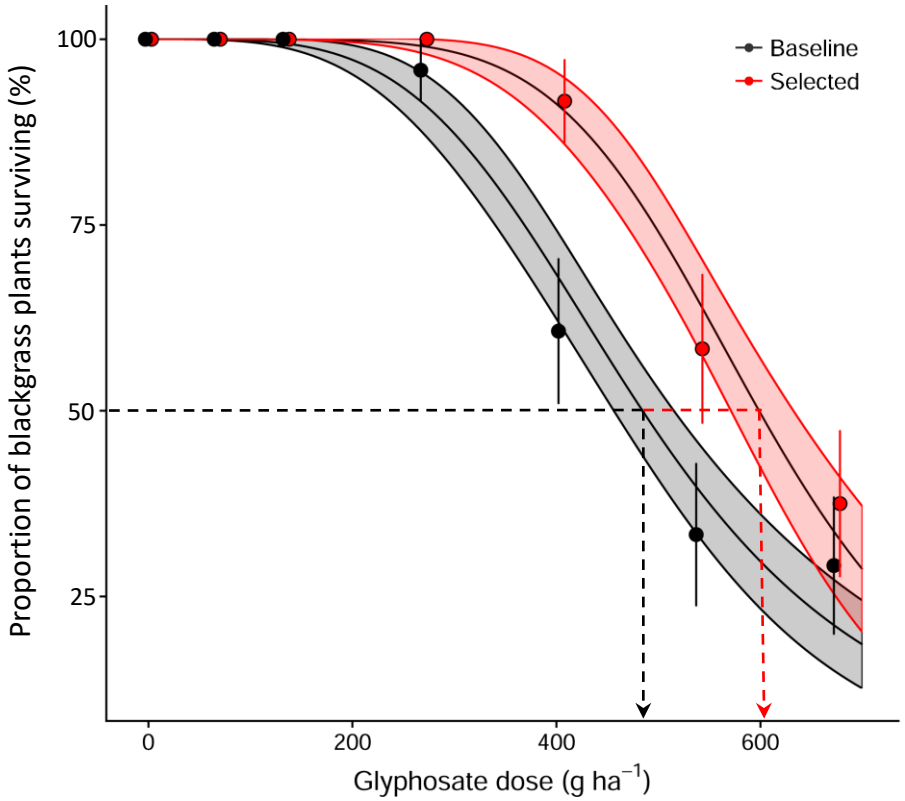
- No evidence for glyphosate resistance currently
- But populations vary in sensitivity, and repeated glyphosate use does select for black-grass populations which are ‘tougher’ to control with glyphosate

540 g ha^{-1}

405 g ha^{-1}



Response to glyphosate selection



Black-grass has declined across our network

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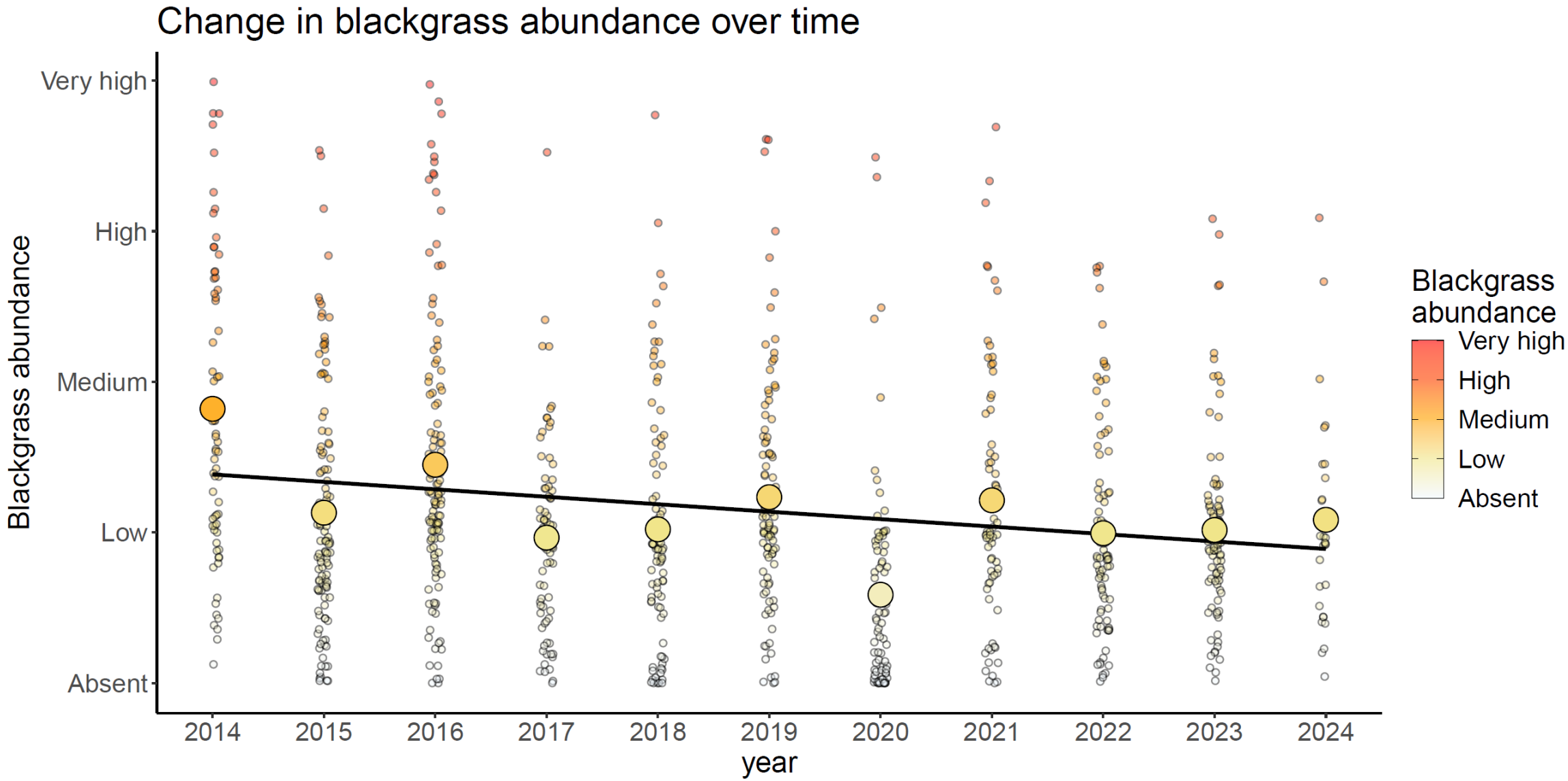

Examples on the network: effective black-grass control

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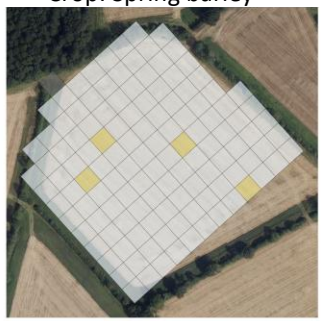
2014
Crop: Winter wheat

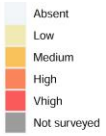
2015
Crop: Spring barley

2016
Crop: Spring barley

2018
Crop: Winter wheat

2020
Crop: Spring barley





2014

2018

Examples on the network: changes in abundance

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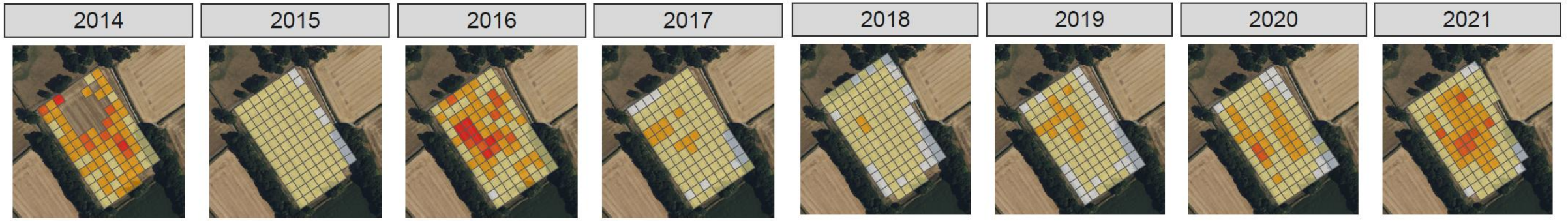
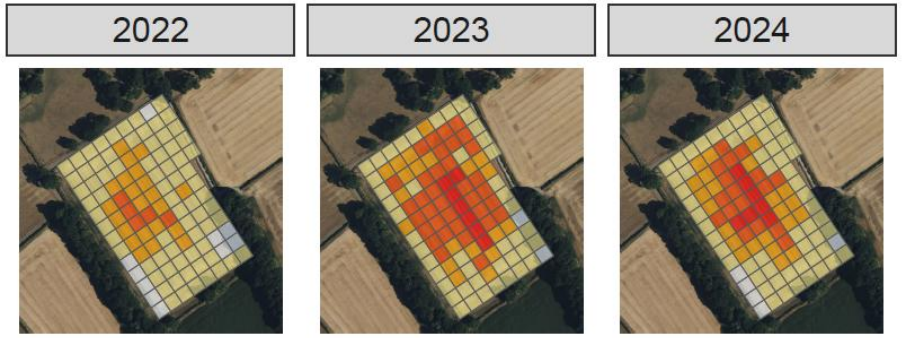
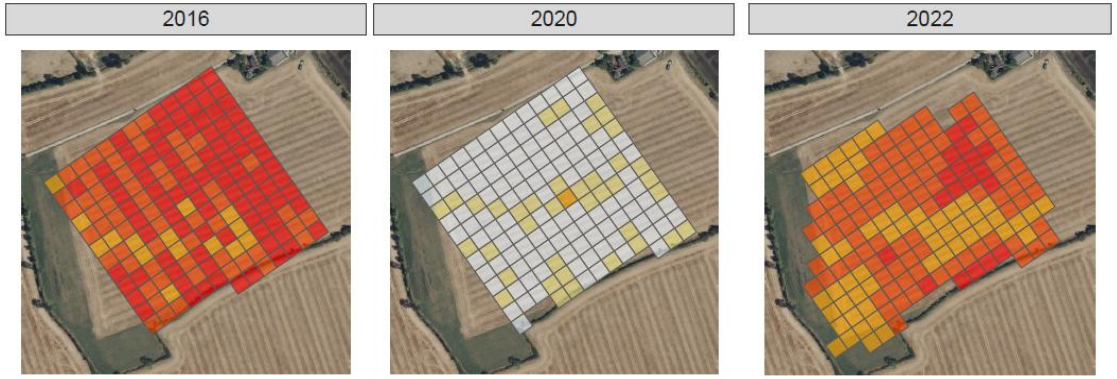




Black-grass in patches

Significant changes in abundance

Due to management practice



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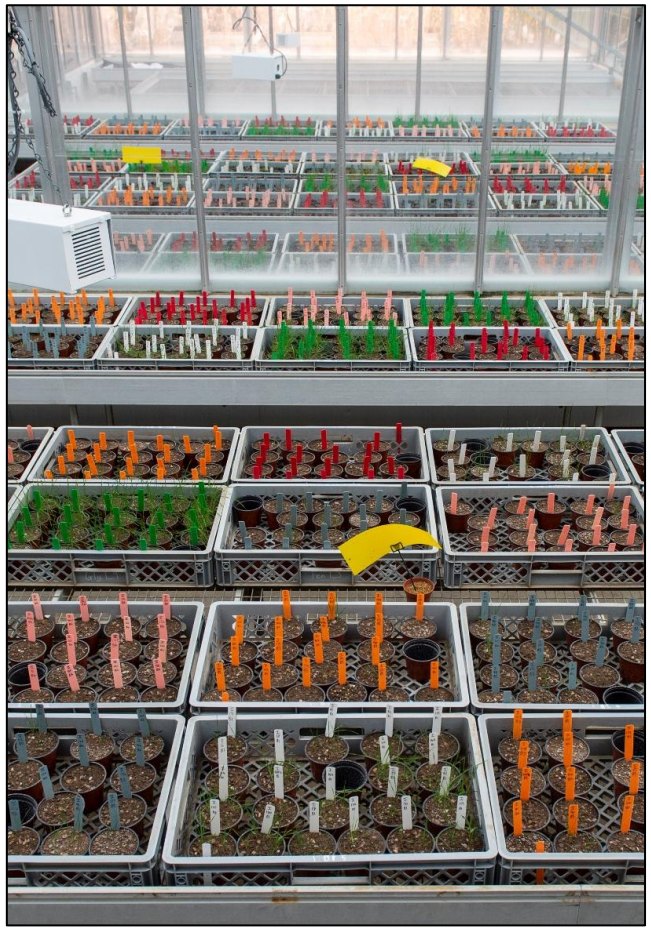
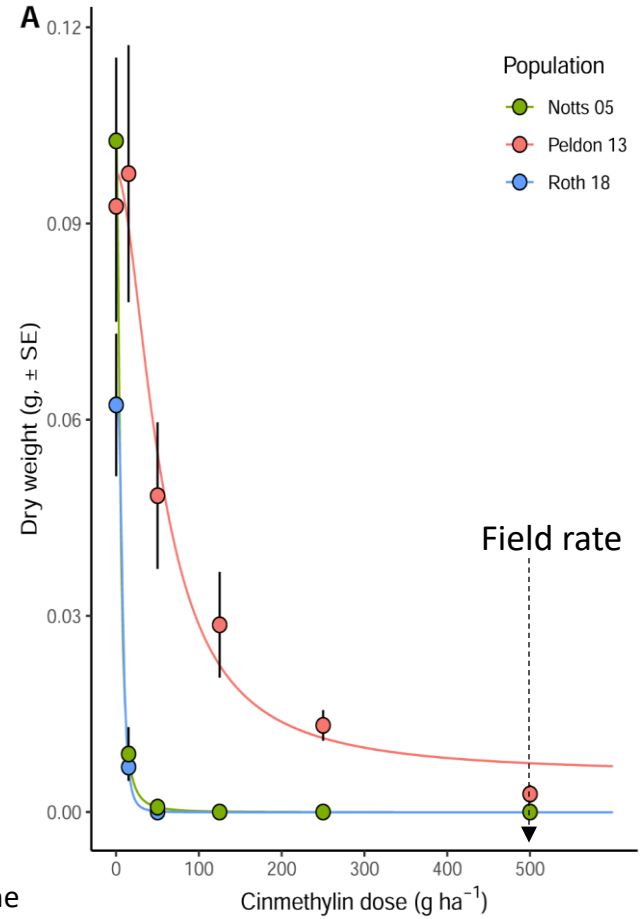
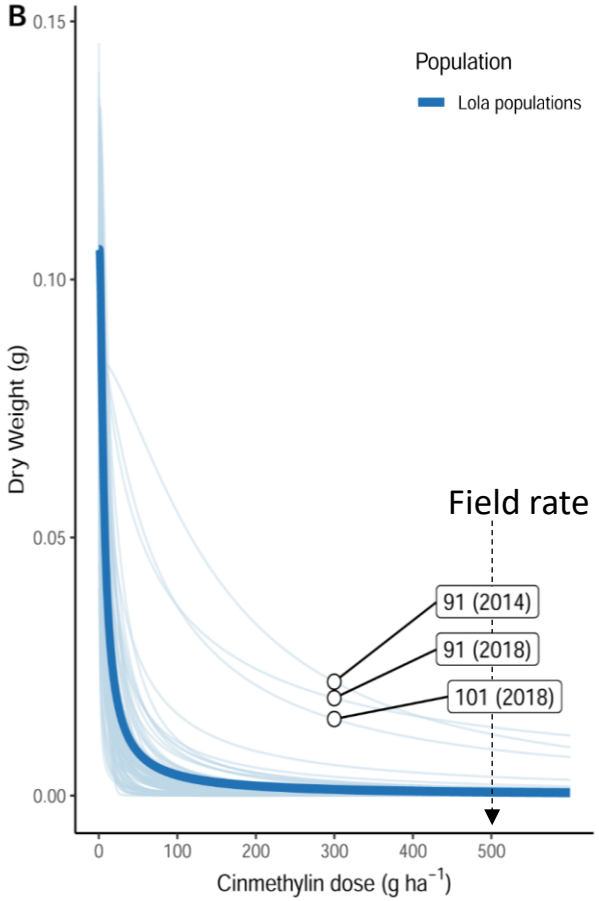
Using the BGRI network to be relevant to current black-grass issues

Luximo®: 100 populations dose-response





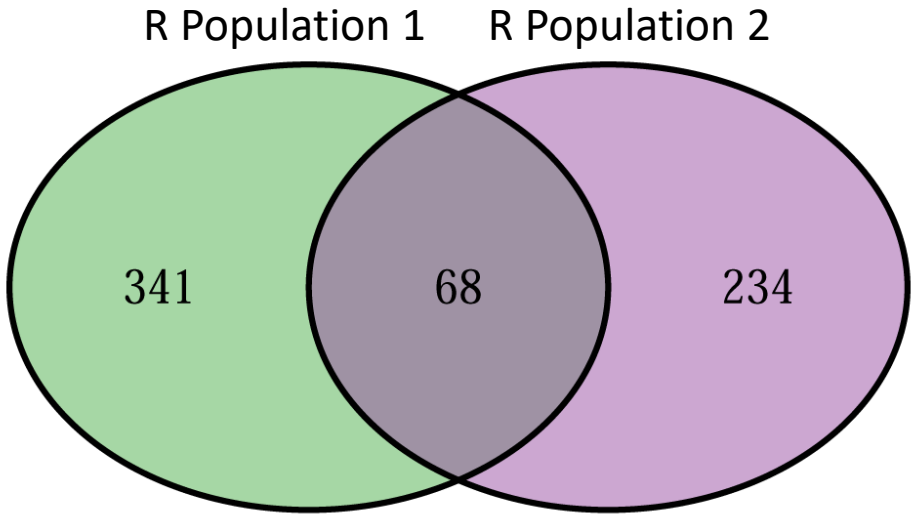


Comont, D., Crook, L., Hull, R. I., Sievernich, B., Kevis, S. and Neve, P. 2024. The role of interspecific variability and herbicide pre-adaptation in the cinmethylin response of Alopecurus myosuroides. *Pest Management Science.* https://doi.org/10.1002/ps.8021

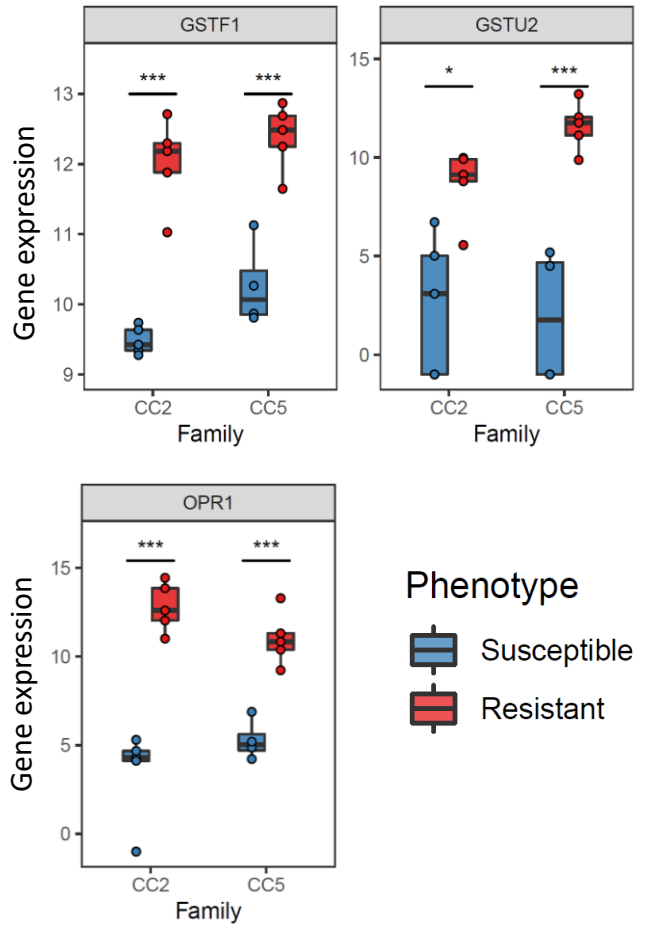
Sequencing black-grass genome

- Seed populations from network used to produce families used in sequencing genome
- Vital resource for further understanding metabolic resistance (NTSR)

Differentially expressed genes associated with NTSR:



Candidate NTSR genes
(Gene expression)



Cai, L., Comont, D., Macgregor, D., Lowe, C., Beffa, R., Saski, C. A. and Neve, P. 2022. The blackgrass genome reveals patterns of non-parallel evolution of polygenic herbicide resistance. *New Phytologist.* https://doi.org/10.1111/nph.18655

10 years: landscape approach

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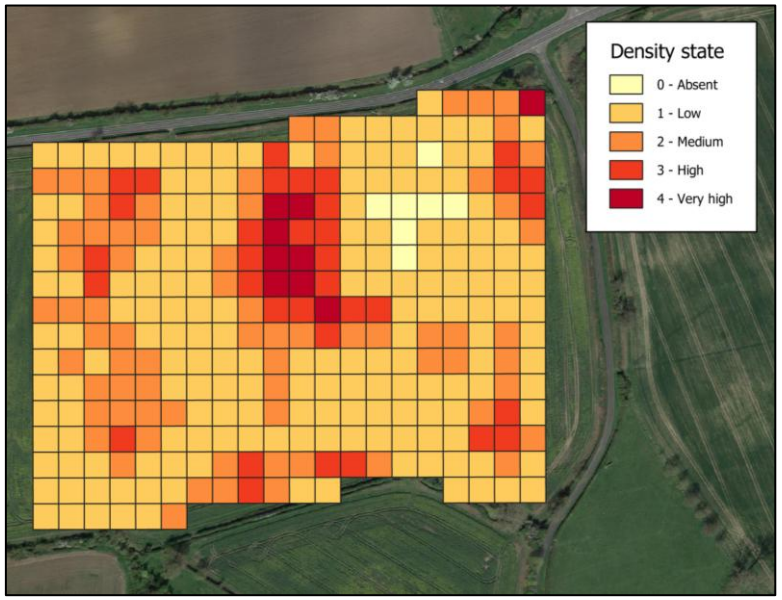
- Now have over 10 years of density mapping data
- Opportunity to link black-grass abundance + management data + soil properties
- Also investigate patch stability of black-grass in fields



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What does the future hold for the BGRI network?

Future: herbicide screening

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- Testing seed 2014 vs 2024 – opportunity to investigate changes in resistance over time
- Testing efficacy pre-ems – glasshouse experiments but also developing agar assay for high throughput

Future: One Crop Health Project

- Six year project in partnership with Rothamsted Research, University of Copenhagen and Aarhus University
- Using BGRI network to explore wider issues and reduce reliance on pesticides
- Continue researching black-grass but also other weeds as well as pests, diseases and soil health
- Next 5 years network integrated into OCH – exploring regenerative ideas

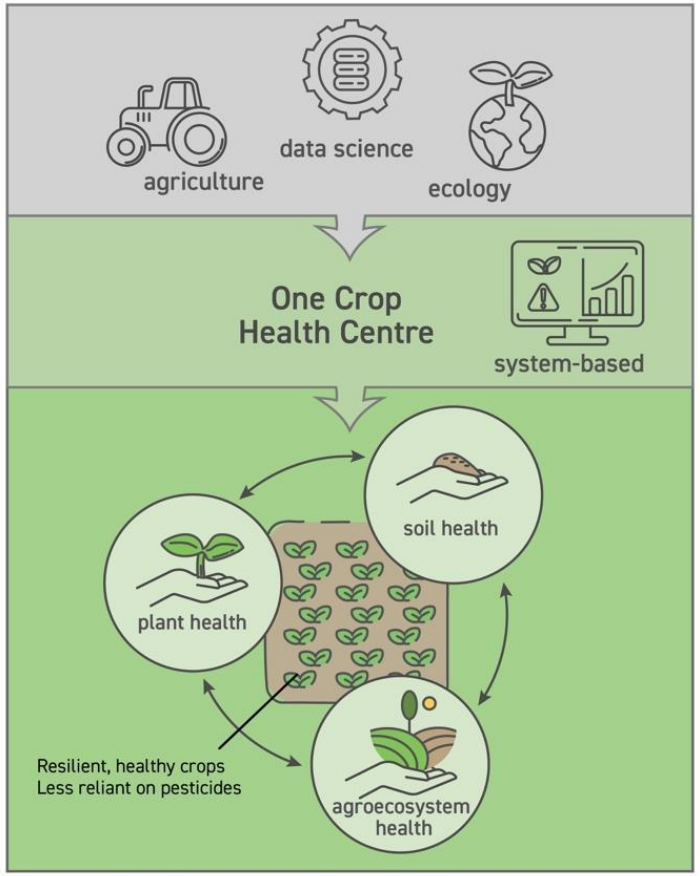

Figure 1. The One Crop Health Centre integrates agricultural, ecological and data sciences to develop innovative, systems-based approaches to crop protection that recognise the interdependencies between plant health, soil health and agroecosystem health.

Conclusions

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- BGRI network has been running for over 10 years and has provided opportunity to map black-grass abundance over time and establish a significant archive of wild-type seed populations
- Used this resource to establish a baseline of resistance levels and test important actives such as glyphosate
- Maps produced have been useful to see trends over time in black-grass abundance and usage of herbicides to tackle the issue
- The network has contributed to current issues such as testing new chemistry and developing black-grass genome
- There is still more to gain from BGRI network through collecting management data to link with abundance and soil properties as well as testing resistance over time and future efficacy of actives
- The BGRI network is a unique resource and by including it in new projects such as OCH, this ensures its longevity and relevance for the next 10 years

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Thanks for listening

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