The other pandemic: resistent ager-rævehale i England

Paul Neve

Plant & Environmental Sciences, University of Copenhagen

Who am I?

1999 – 2005 Australian Herbicide Resistance Initiative, University of Western Australia

2005 – 2013 University of Warwick, Weed ecology, evolution and management

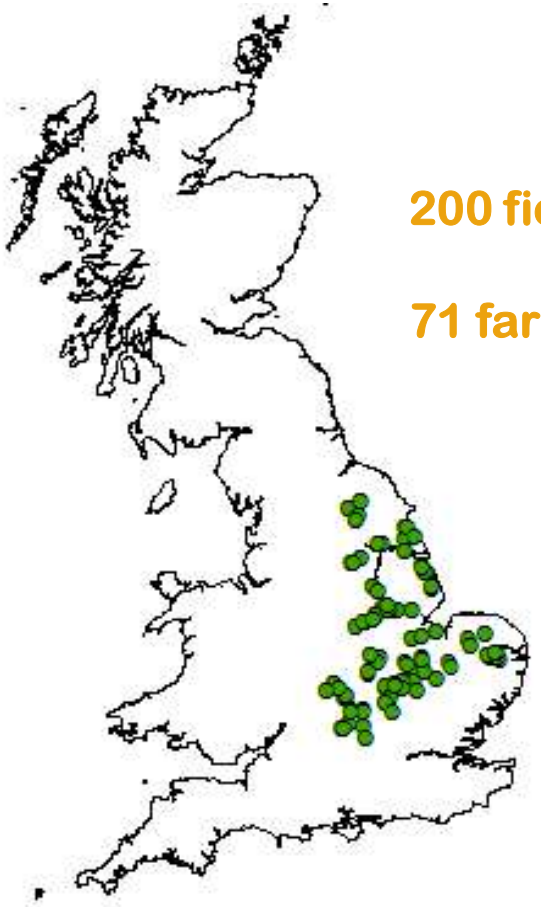
2021 – Professor, Plant & Environmental Sciences, University of Copenhagen

2014 – 2020 Rothamsted Research, Head of Smart Crop Protection Programme

Herbicide resistant blackgrass, 2014

A blackgrass farm network

Black-Grass Resistance Initiative



200 fields

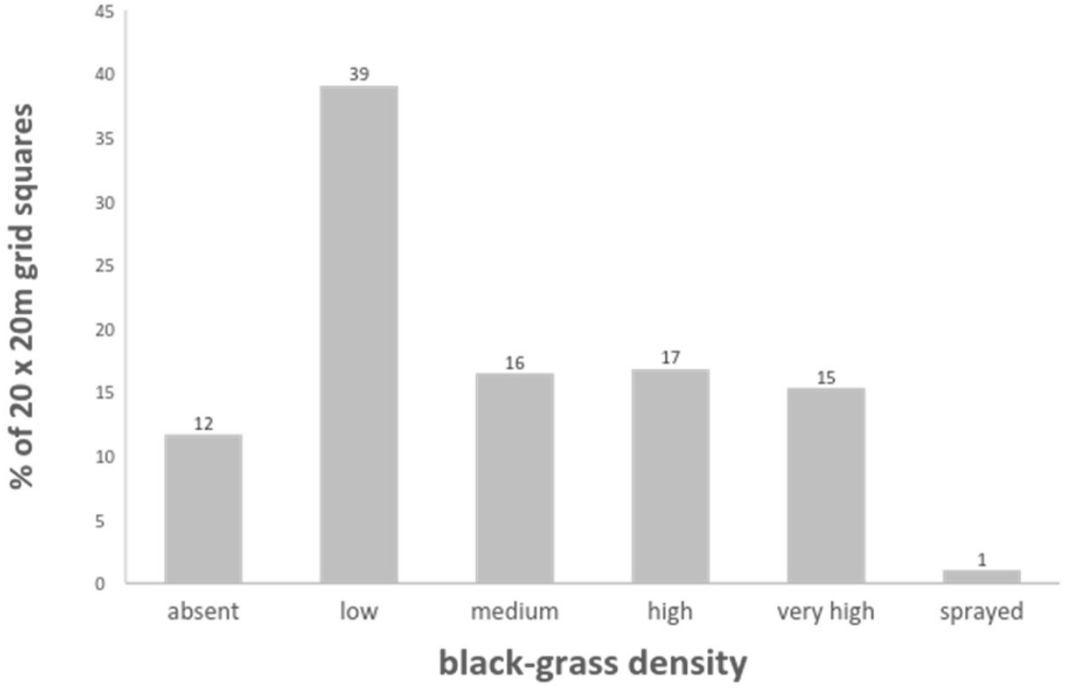
71 farms

- Field maps
- Resistance tests (glasshouse, molecular)
- Field management data
- Environmental data (soils, weather etc.)

2014: Black-grass abundance

Black-Grass Resistance Initiative

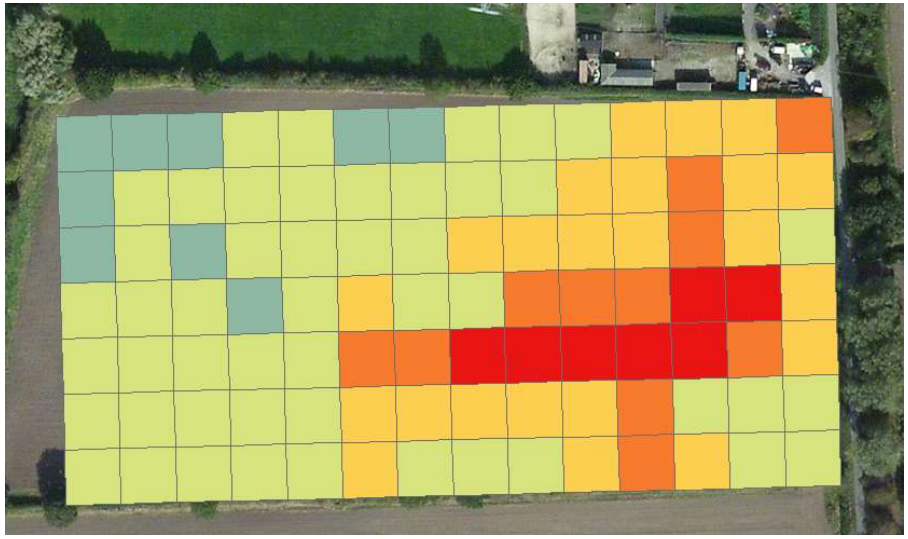
0 = absent
1 = 1-160 plants
2 = 16-450 plants
3 = 451-1450 plants
4 = 1450+ plants

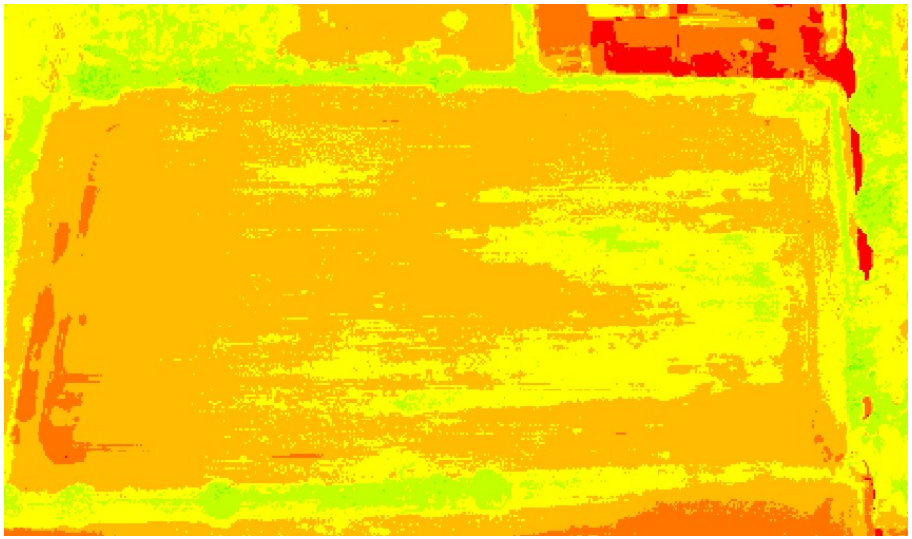


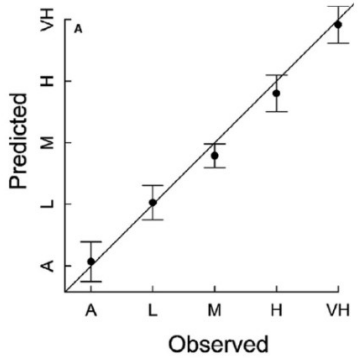
- Black-grass present in 88% of 25,000 sampled quadrats
- High or very high in 32%
- South to north gradient (more in south)

Automating weed mapping with UAVs

Black-Grass Resistance Initiative



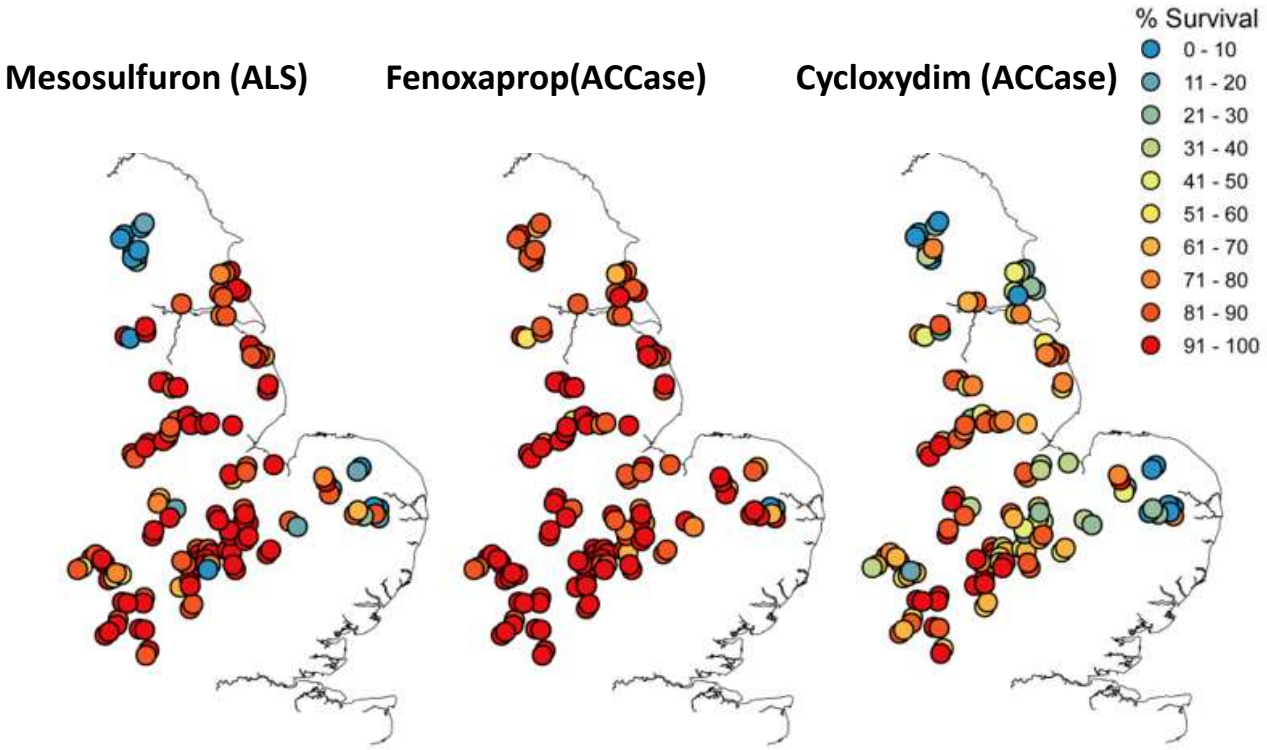




Lambert et al. *Weed Research* 2017.

Herbicide resistance at a national scale

Black-Grass Resistance Initiative

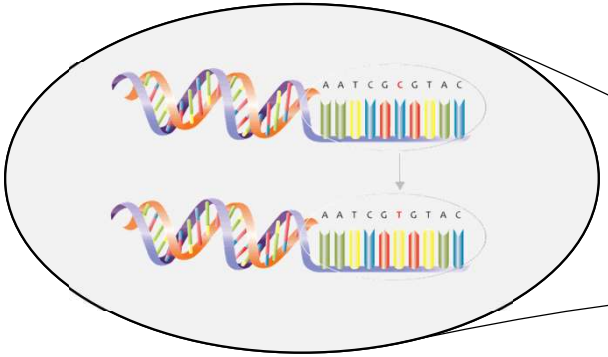


75% resistance **90% resistance** **56% resistance**

Types of resistance in blackgrass

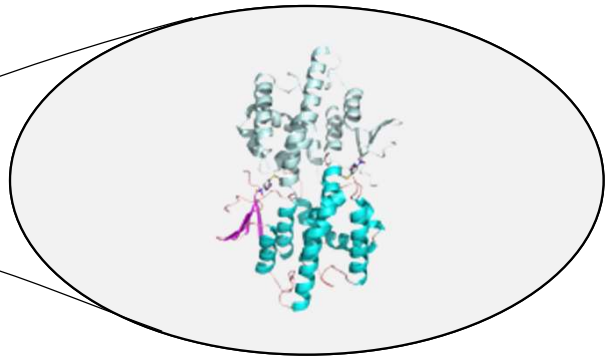
Black-Grass Resistance Initiative

Target-site resistance (TSR)



- Based on modification of target enzyme
- Resistance to one mode-of-action
- One gene

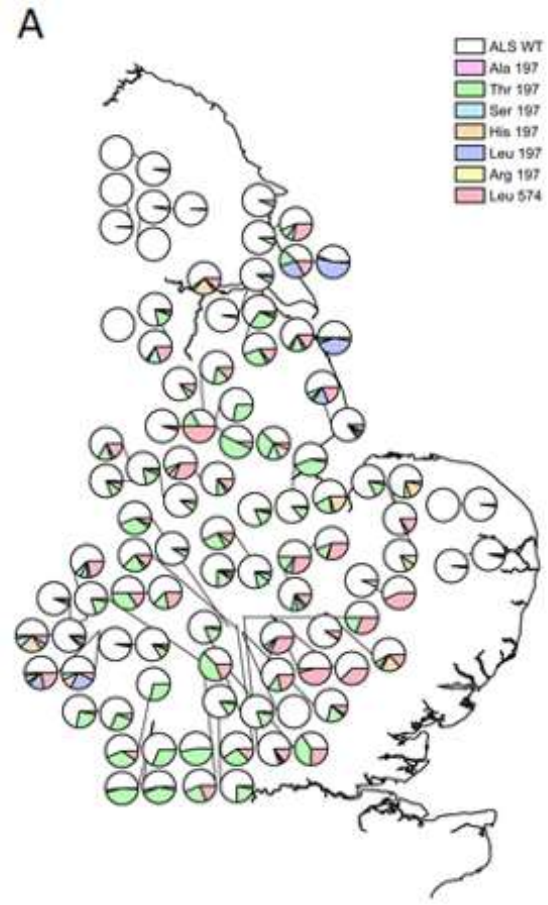
Metabolic resistance (NTSR)



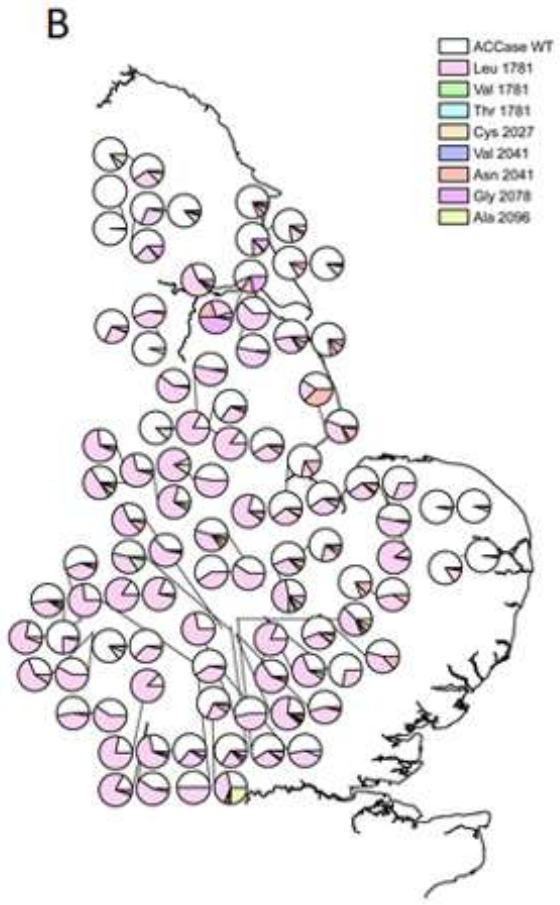
- Based on proteins that metabolise herbicides
- Resistance to multiple modes of action
- Many genes

Target site resistance in blackgrass

Black-Grass Resistance Initiative



ALS



ACCase

TSR is frequent and widespread, but it does not account for all resistance we see.

NTSR is also important.

A field test for non-target site resistance

Newcastle University

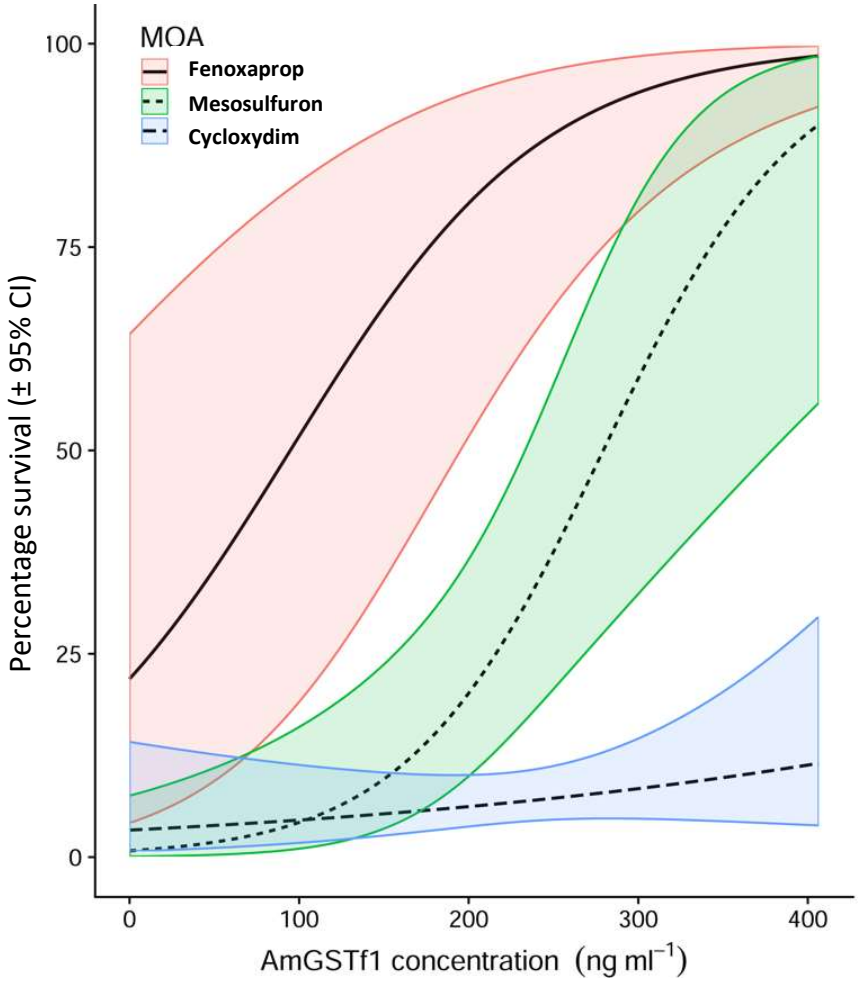
Black-Grass Resistance Initiative

NTSR?

Commercial production

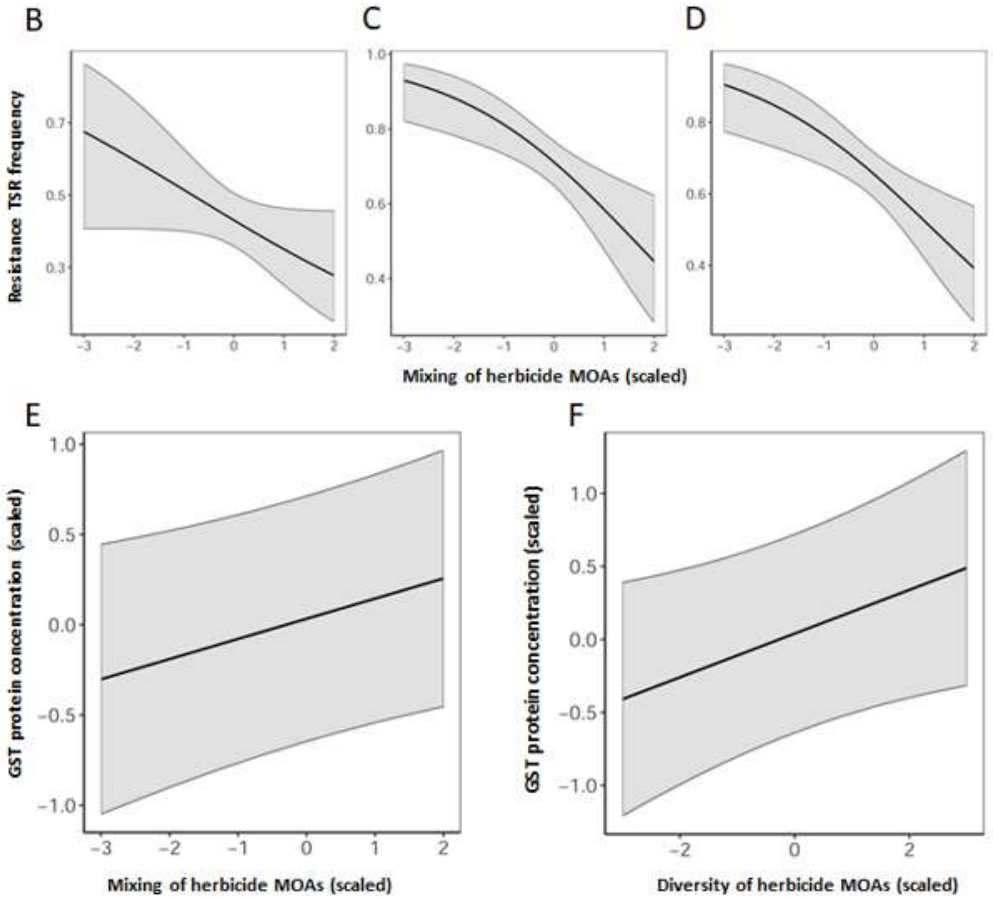
Non-target site resistance in blackgrass

Black-Grass Resistance Initiative



	TSR	NTSR
Fenoxaprop	✓	✓
Cycloxydim	✓	✗
Mesosulfuron	✓	✓

You cannot manage herbicide resistance with herbicides alone



TSR is reduced by using diverse herbicides

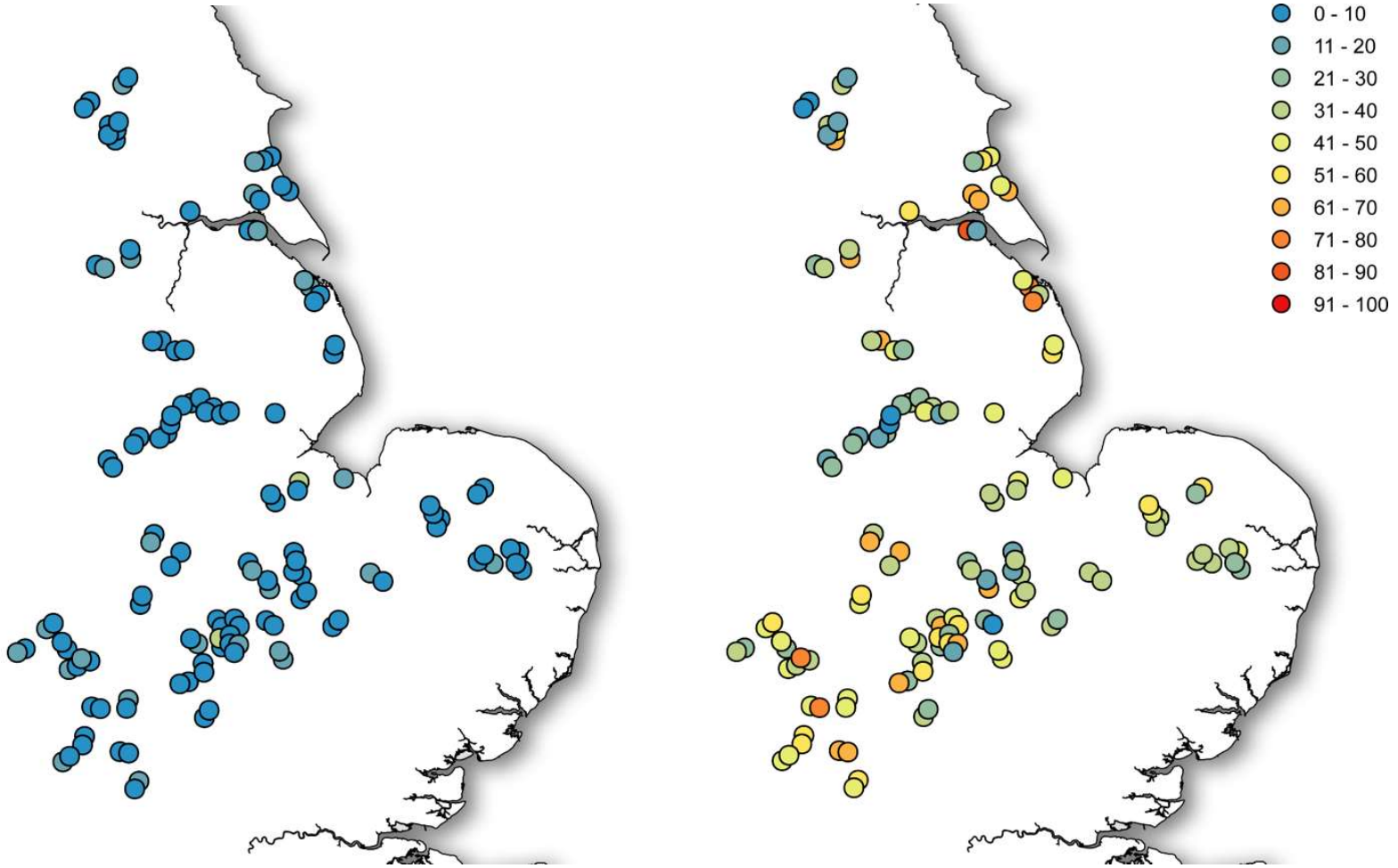
NTSR is increased when using diverse herbicides

Comont et al. (2021). Evolution of generalist resistance to herbicide mixtures reveals a trade-off in resistance management. *Nature Communications.*

Glyphosate is working …… but for how long?

UK Field rate (540 g ha^{-1})

¾ UK rate (405 g ha^{-1})



Collecting data on blackgrass density, resistance status, management costs and yields enabled us to ***count the cost*** of blackgrass resistance.

Integrated management of blackgrass

Ploughing

69%

-82 to 96%

Delayed autumn sowing

31%

-64 to 97%

Competitive cultivars

22%

8 to 45%

Spring crops

88%

78 to 96%

Sowing rate

26%

7 to 63%

Grass ley / fallow break

70%

Lutman et al., 2013

Every field with blackgrass is a blackgrass experiment!

A weed resistance farm network for Denmark?

With Aarhus University (Per Kudsk) and UK partners .....

National-scale monitoring and epidemiological modelling for sustainable weed management in agroecosystems.

Professor Paul Neve

Research idea. This project harnesses the latest technological advances at the interface of agriculture, ecology and modelling to reduce reliance on herbicides in Danish agriculture. The significant novelty in our approach is to consider "every farmer's field as an experiment", and we will work with farm and farmer data to develop real-world, data-driven models to optimise agroecological approaches to weed management, reducing reliance on synthetic herbicides. These epidemiological approaches have been pioneered by the project applicant in the UK, leading to publication of several high impact papers and industry engagement to develop end-user applications.

Blackgrass: problems and solutions

- **Resistance is at epidemic levels in England**
  - Very little post-emergence activity in cereals
  - Pre-emergence options continue to work well (with some loss of efficacy)
  - Glyphosate is critical – but can we keep it?
  - Metabolic resistance widespread and problematic for management
- **No new "silver bullets" on the horizon**
- **Integration and diversity are key**
- **New and 'old' technology can help to tackle blackgrass**
  - Cultural control works, but there are trade-offs
  - Monitoring, 'big' data and decision support are important
  - New herbicides, new technologies (harvest weed seed control, robotics, genetic solutions)
  - Regulation will continue to present challenges

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Tak for at lytte.

Spørgsmål?


AFGRI
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Chaff tram-lining in the UK

Photo credit; Paul Fogg, Frontier Agriculture