



Bayer CropScience

Establishing the extent of ACCase and ALS herbicide resistance mechanisms in UK populations of black-grass



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BACKGROUND

- Black-grass (*Alopecurus myosuroides*) is an economically important weed of UK winter wheat crops
- Herbicides with ALS & ACCase modes of action (MOA) are widely used for post-emergent black-grass control
- Resistance endowed by target-site mutations and enhanced metabolism is now a major agronomic concern in the UK

AIM: To determine the frequency of ALS & ACCase resistance and resistance mechanisms within a core arable region of the UK

2011 Seed Collection

46 farms experiencing black-grass control problems from counties with confirmed ALS resistance, had seed sampled from 2 fields: One **treated** with Atlantis in 2011; one **untreated** with Atlantis in 2011

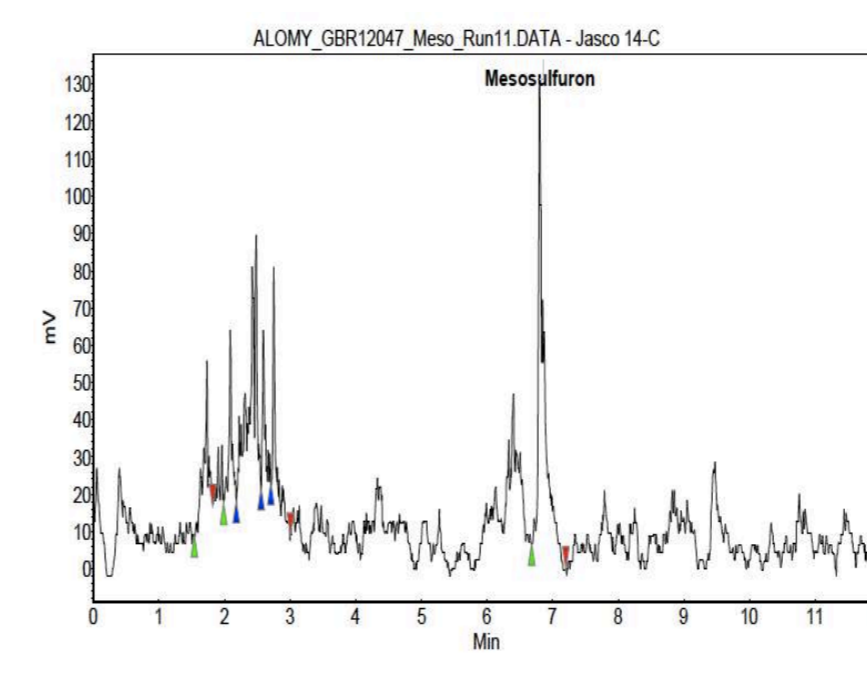


Phenotyping

ACCcase resistance identified using a field dose of clodinoxop-propargyl;
ALS resistance identified using a field dose of mesosulfuron + iodosulfuron

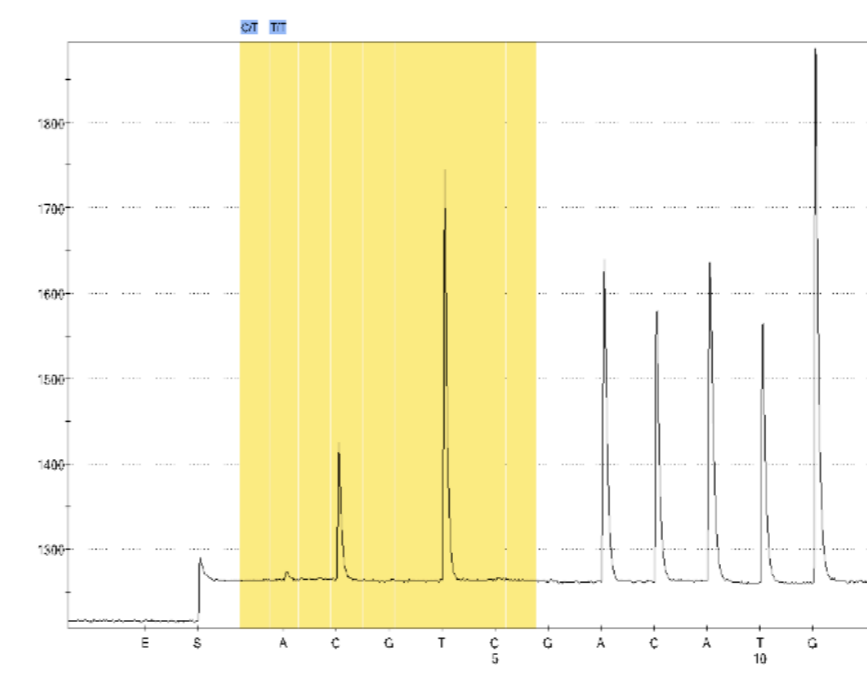


METHODS



Enhanced Metabolism (EMR) Analysis

Samples incubated in C₁₄ labeled mesosulfuron and fenoxaprop used to identify ALS and ACCase enhanced metabolism respectively with HPLC



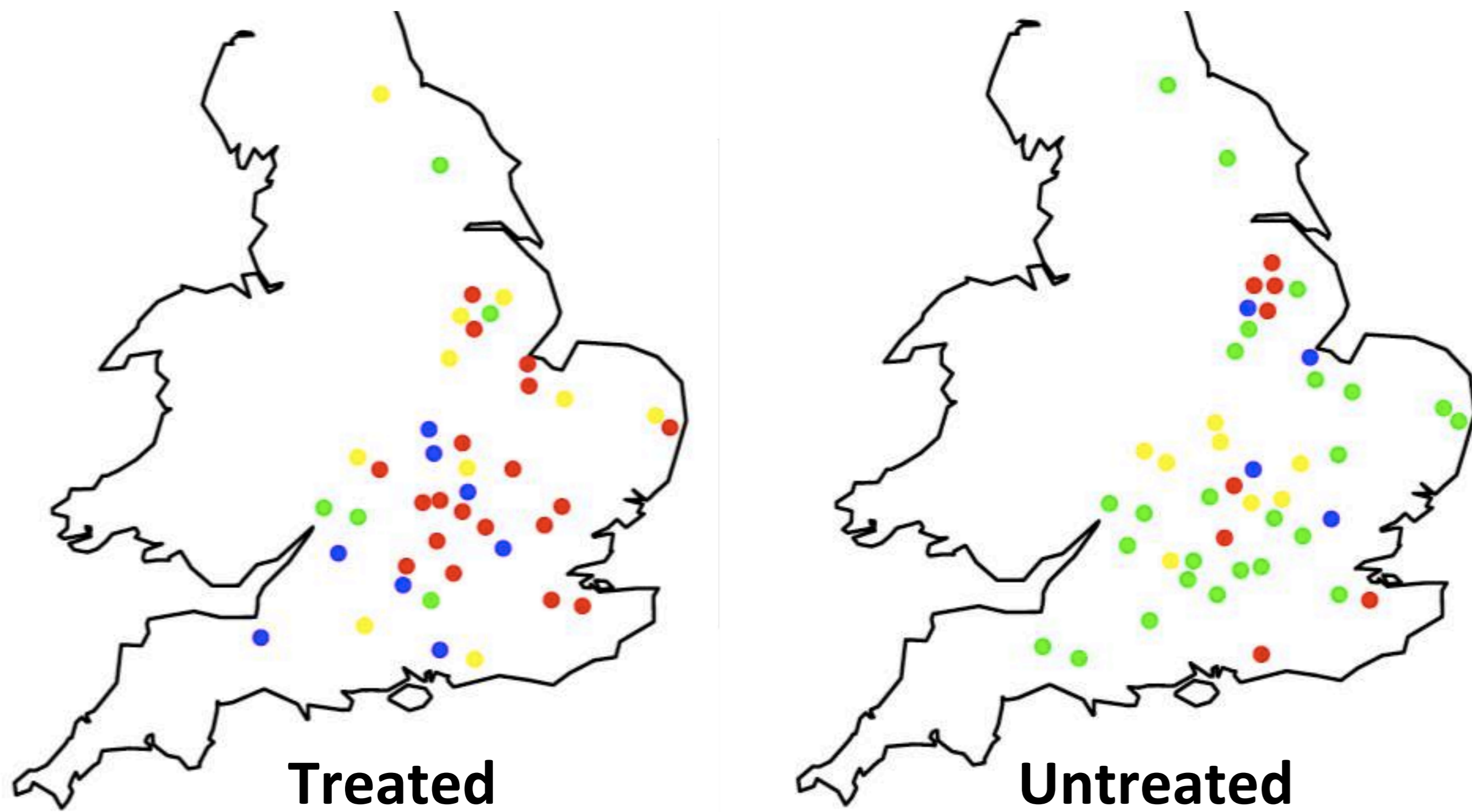
Target-site (TSR) Analysis

PCR/pyrosequencing was used to identify ALS (Pro-197, Trp-574) and ACCase (Ile-1781, Trp-2041, Ile-2027, Gly-2096, Asp-2078) mutations

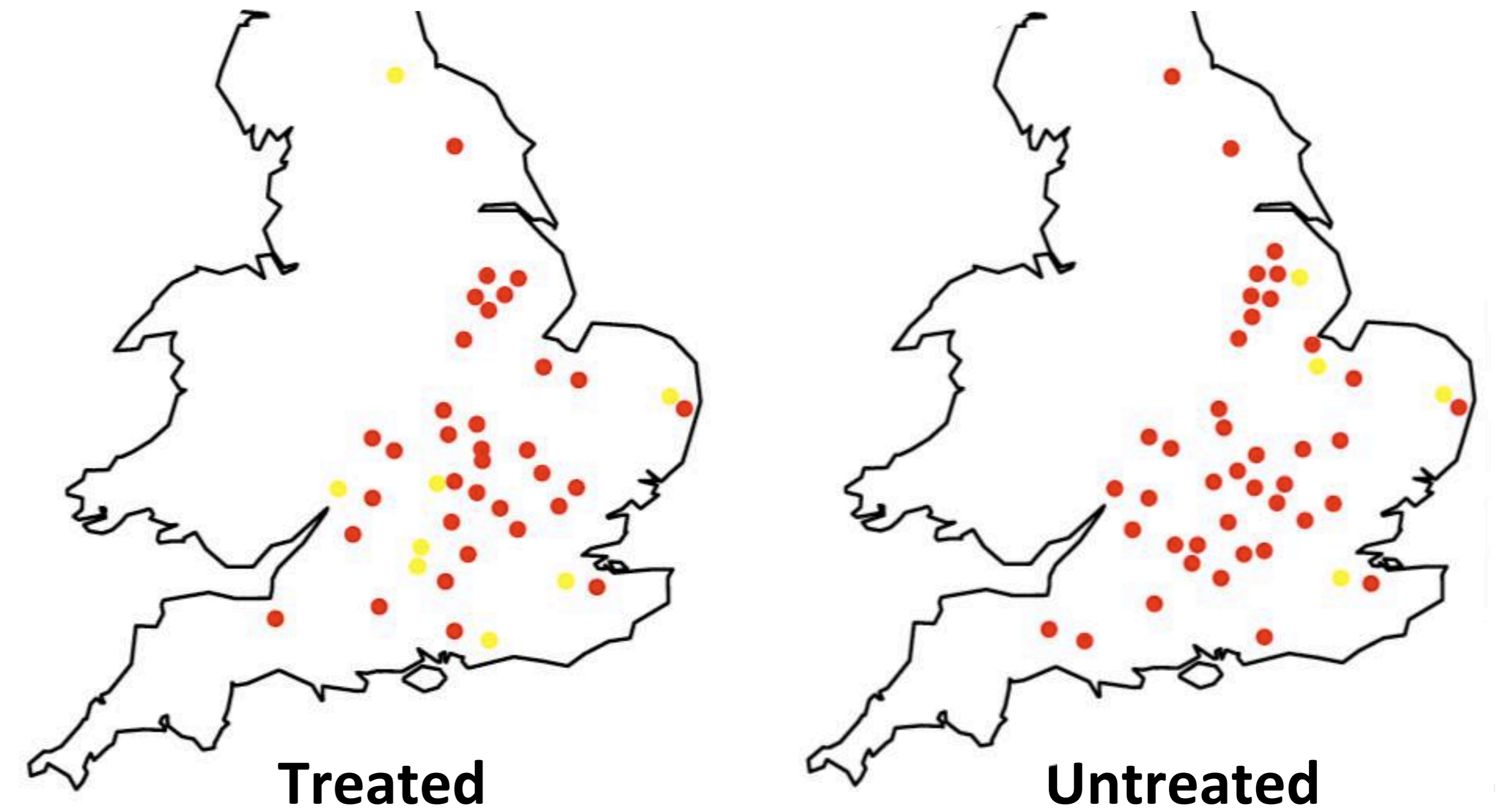
RESULTS

Populations with a susceptible phenotype are shown in **GREEN**; populations with a resistant phenotype are shown by the mechanisms identified that endow the resistance: TSR = **BLUE**, EMR = **YELLOW**, both TSR & EMR = **RED**

ALS Resistance



ACCcase Resistance



- 72% & 35% of treated and untreated populations exhibited some degree of enhanced metabolism respectively
- Pro-197-Thr ALS mutations accounted for 59% of all ALS mutations identified (Trp-574-Leu = 41%)
- Atlantis untreated populations had lower frequencies of mesosulfuron + iodosulfuron resistance, with 89% & 43% of treated and untreated populations resistant respectively

- All of the UK black-grass populations sampled were resistant to the clodinoxop-propargyl
- All populations contained black-grass individuals that were able to metabolize fenoxaprop-p-ethyl to some degree
- Of all of the ACCase TSR mutations identified, Ile-1781-Leu were most prevalent (81%), followed by Ile-2041 (7%), Asp-2078 (4%), Gly-2096 (3%) and Trp-2027 (2%) mutations.

CONCLUSIONS

- Herbicide resistance is widespread in the UK black-grass populations with control issues sampled. All sampled populations exhibited ACCase resistance; 43% and 89% of ALS untreated and treated populations respectively exhibited ALS resistance.
- Enhanced metabolism is prevalent in both MOA; a diverse range of previously identified TSR mutations were also found.
- The identification and prevalence of target-site and enhanced metabolic resistance together within a single population illustrates how both mechanisms may be important in the evolution of resistance at the population level.
- Resistance frequencies may be over-estimated in years where the mode of action of interest has been applied, accounting for the different proportion of ALS resistance in treated and untreated populations.