

Modelling the Effect of Glyphosate Loss

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Achieving Sustainable
Agricultural Systems



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Methods

- Rothamsted Landscape model
 - Crop/soil/weed community model
- Simulated two example min till farms in East of England with medium clay-content soils
 - Farm A: starting weed community with no herbicide resistance
 - Farm B: starting weed community dominated by herbicide-resistant black-grass
- Simulations for 10 years using continuous weather data from the region
 - start years between 1970-1998

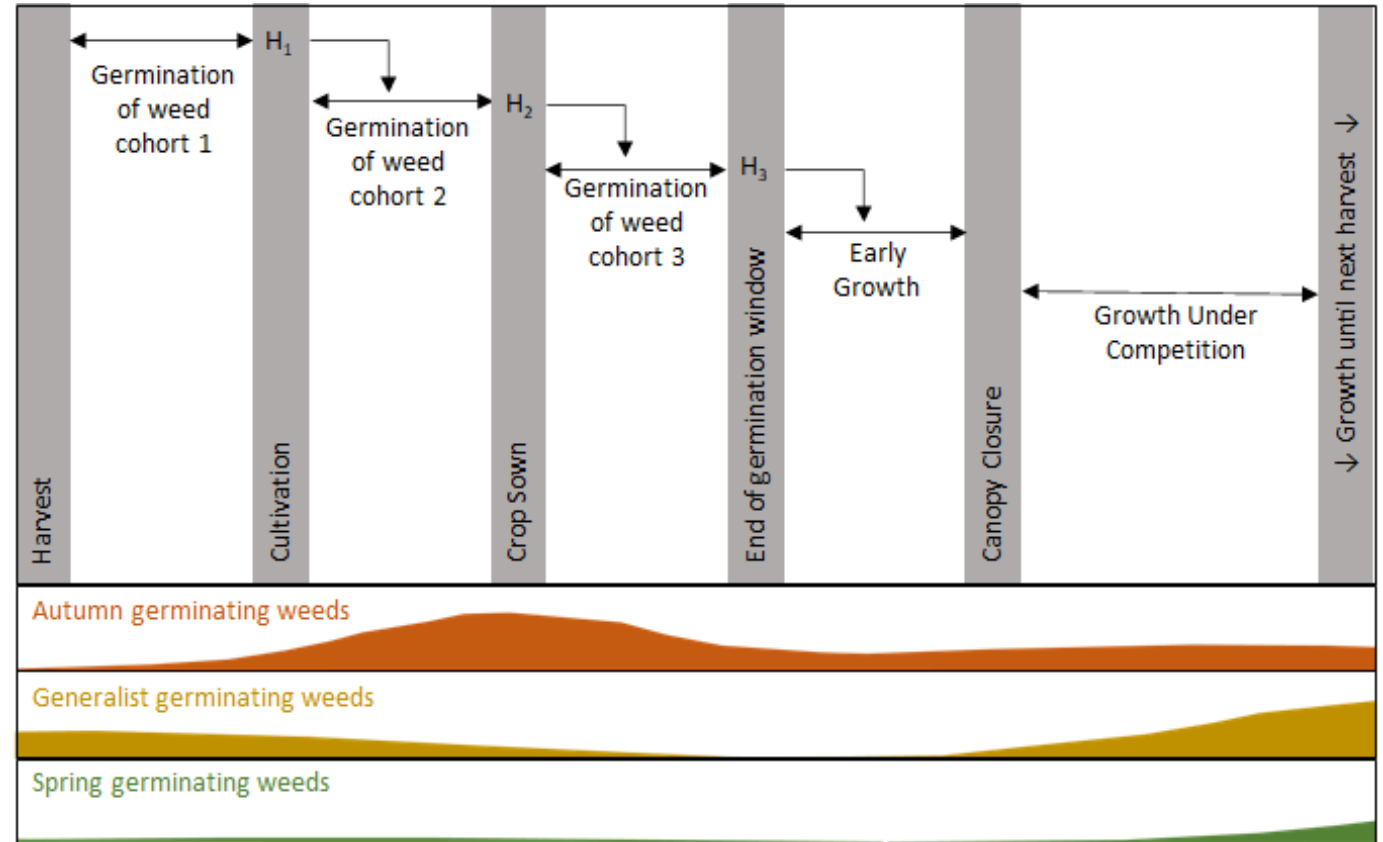
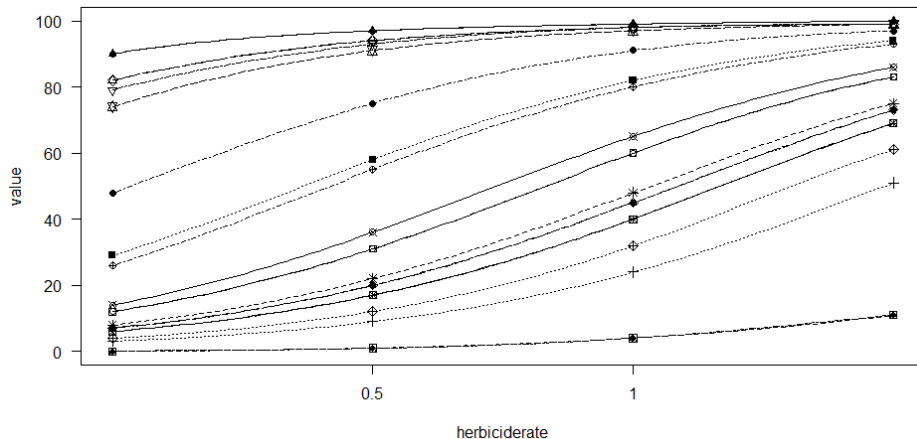
Methods

- Typical herbicide programs for each crop

- e.g. Winter Wheat

Application window	a.i.	<i>f</i>
H ₁ : pre-sowing	glyphosate	1080
H ₂ : pre-emergence	diflufenican	60
H ₃ : post-emergence Autumn	mesosulfuron-methyl	12
	iodosulfuron-methyl-sodium	2.4
H ₃ : post-emergence Spring	florasulam	4.5
	fluroxypyr	180

- Dose response curves applied at each timepoint



Scenarios

G: Glyphosate (baseline scenario)

NG: No Glyphosate – remove glyphosate but keep all other management the same

Integrated Weed Management

Change crop rotations

R1: Increase frequency of grass leys

R2: Increase frequency of spring cereals

Stale Seedbed Management

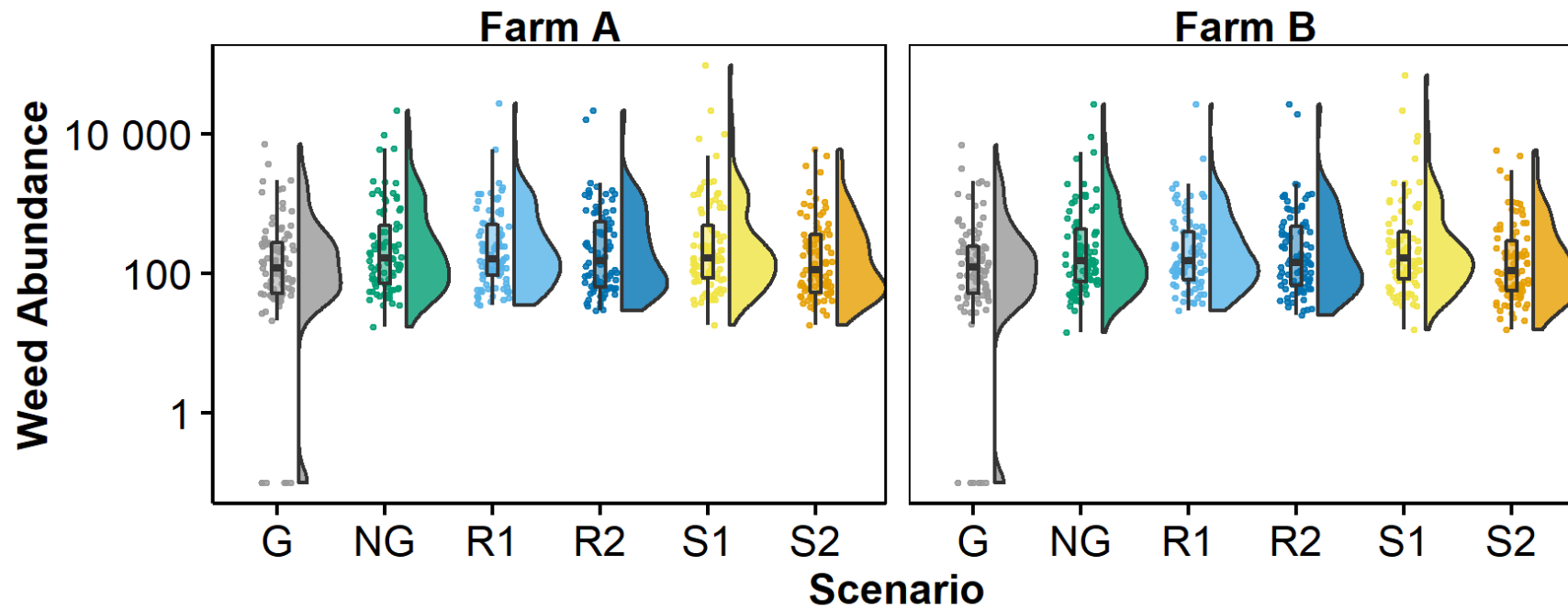
S1: Delay drilling of winter wheat crops by 3 weeks

S2: Switch from minimum tillage to ploughing



Results

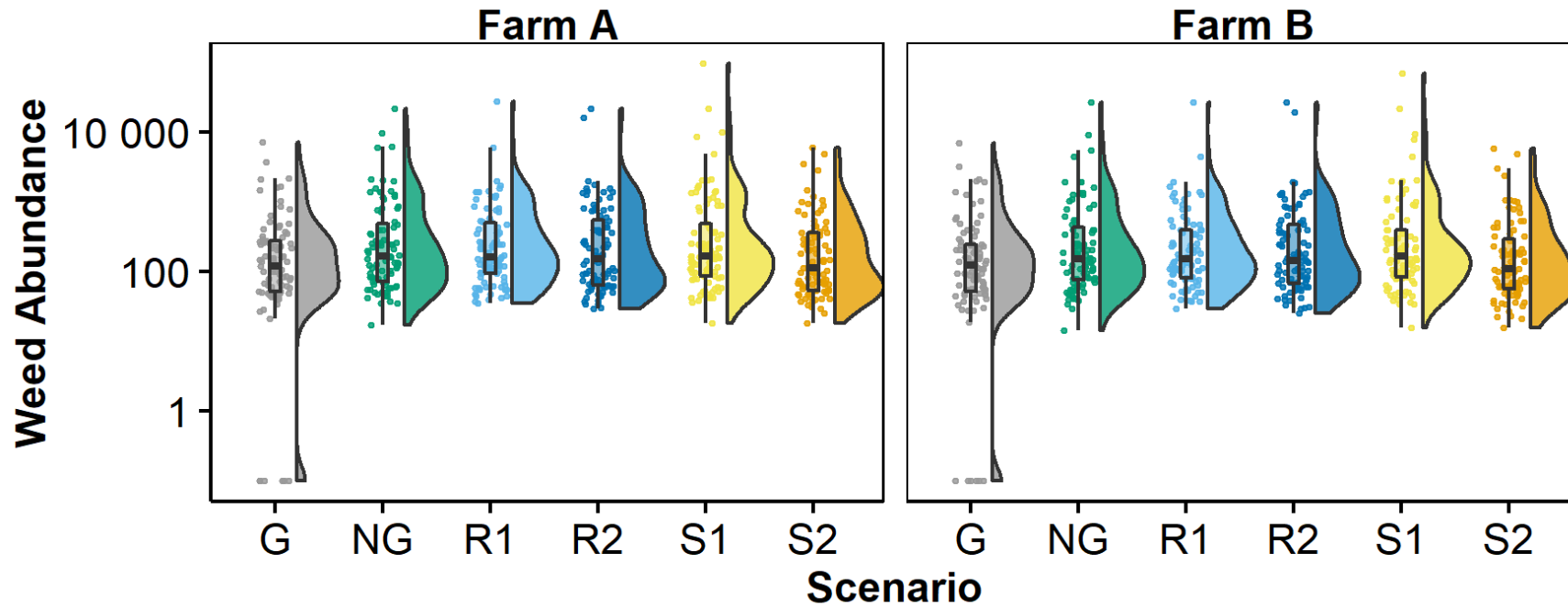
- Weed Abundance



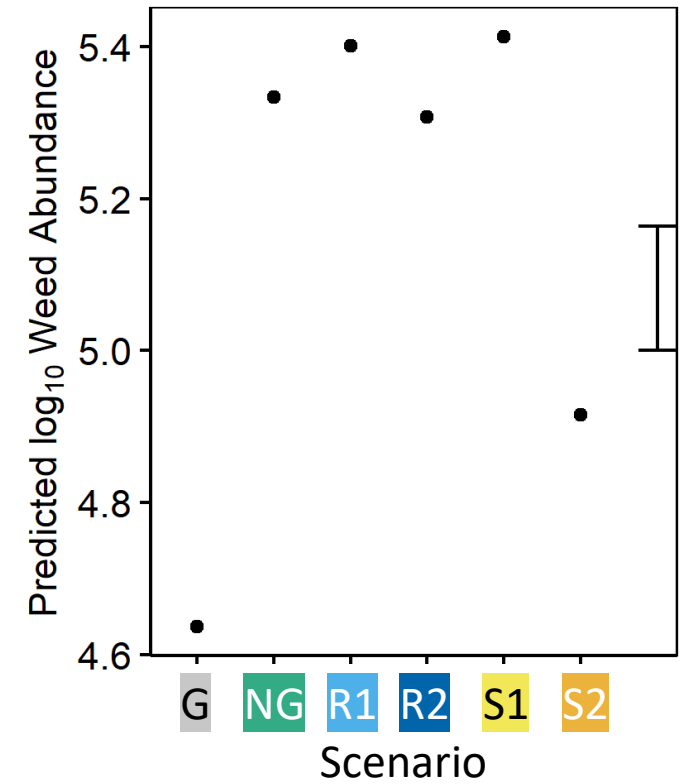
G: Glyphosate NG: No Glyphosate R1: Grass leys R2: Spring cereals S1: Delay drilling S2: Plough

Results

- Weed Abundance



- Significant differences between Scenarios
 - no significant change over time or between farms

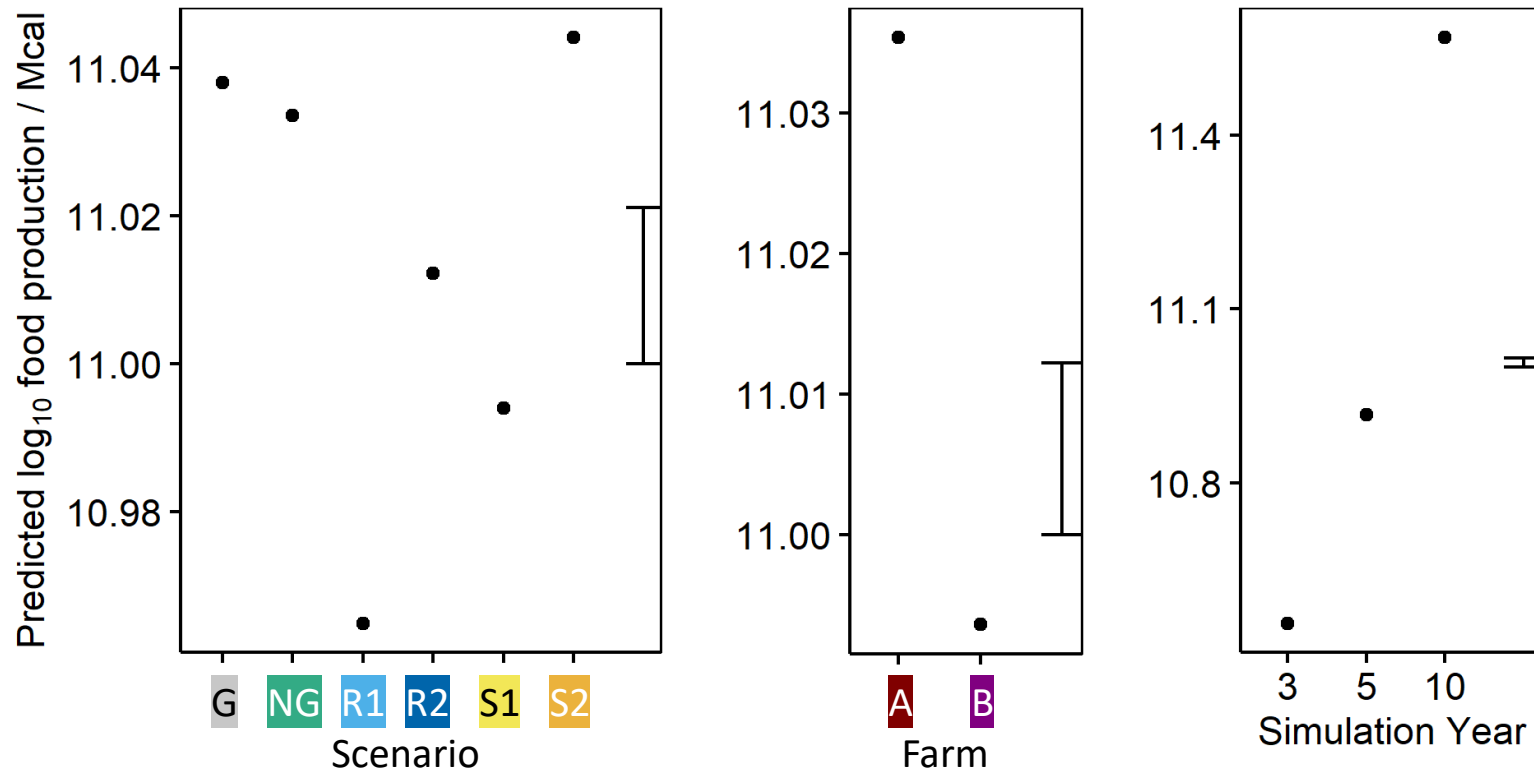


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Results

- Food Production

- significant differences between scenarios, farms, timescales (but note no interactions)

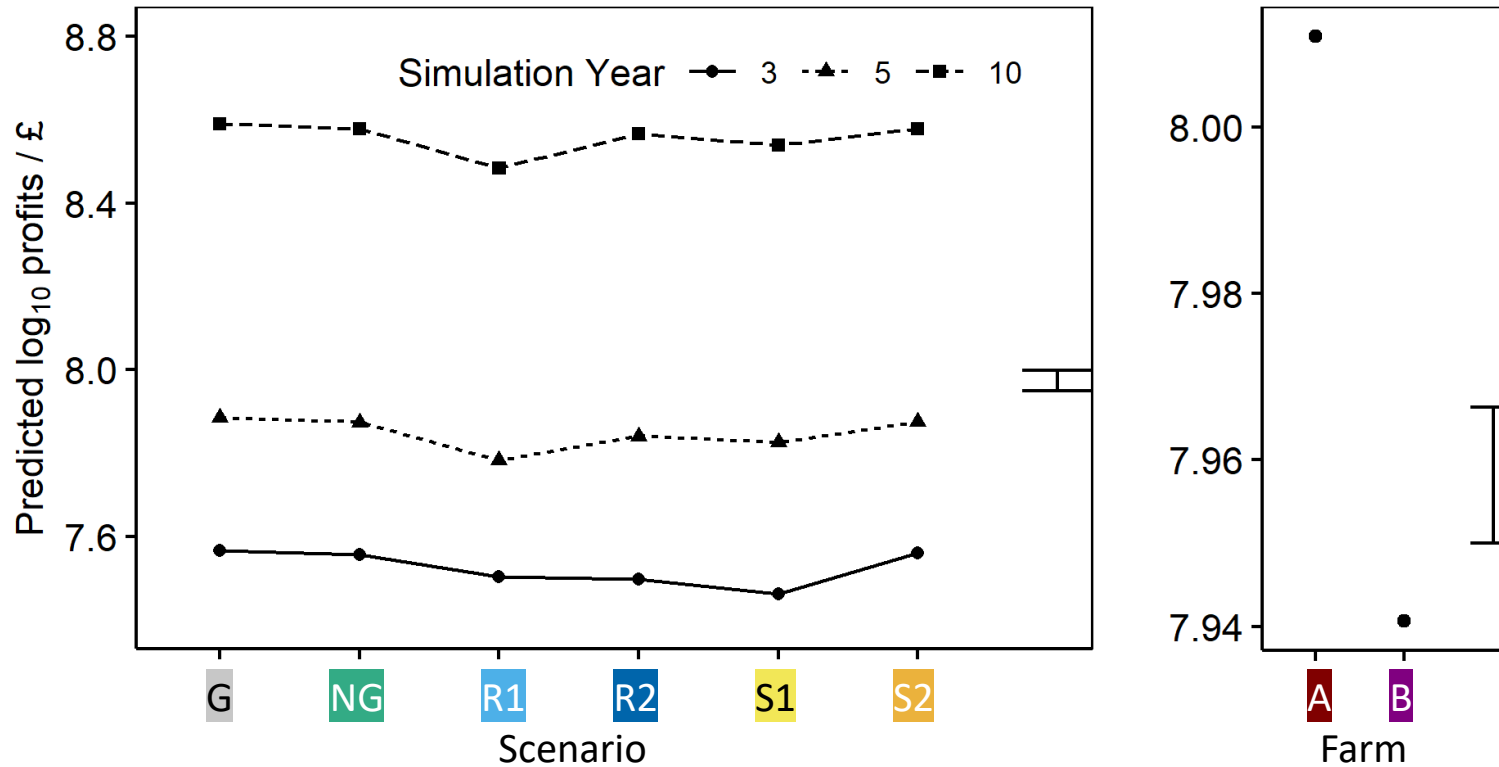


G: Glyphosate NG: No Glyphosate R1: Grass leys R2: Spring cereals S1: Delay drilling S2: Plough
Farm A: no herbicide resistance Farm B: herbicide-resistant black-grass

Results

- Profits

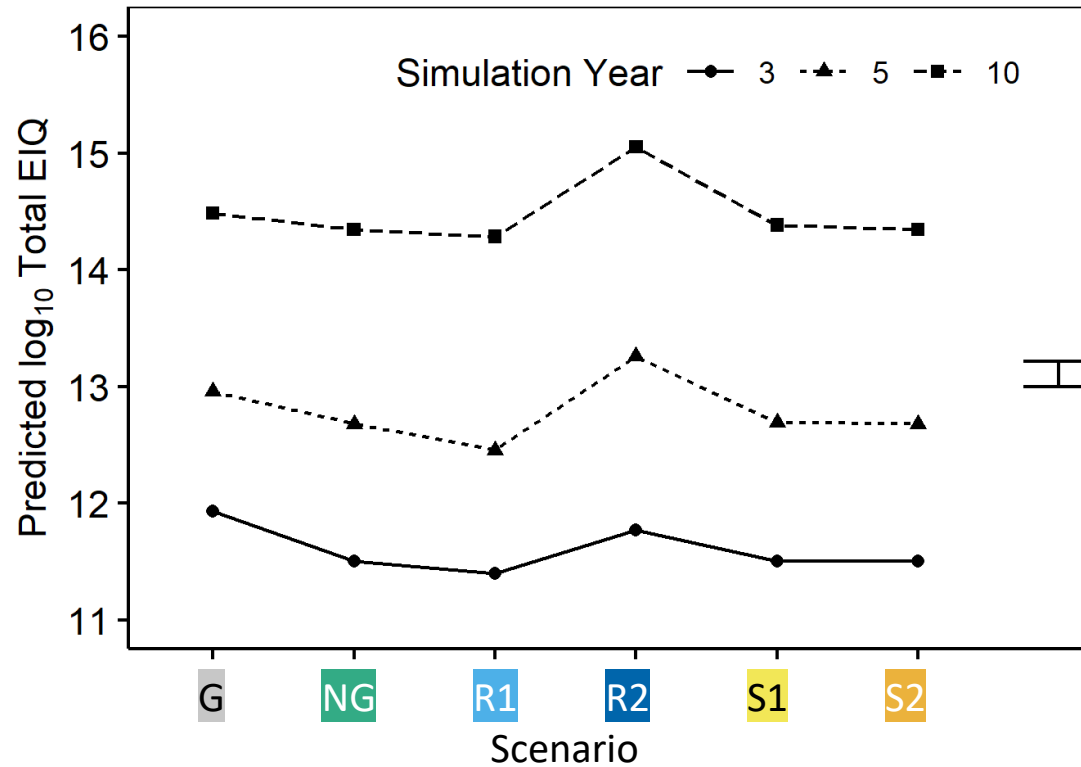
- significant differences between scenarios, farms, timescales
- interaction between scenario and timescale



G: Glyphosate NG: No Glyphosate R1: Grass leys R2: Spring cereals S1: Delay drilling S2: Plough
Farm A: no herbicide resistance Farm B: herbicide-resistant black-grass

Results

- Environmental Impact of Herbicides
 - significant differences between scenarios, timescales
 - Interaction between scenario and timescale



Discussion

- Lots of variation in results
 - difficult to draw conclusions from isolated studies
 - paired simulations allow us to tease out the effects of management (independent from weather and stochastic elements)
- Glyphosate use significantly improves weed control compared to IWM options
 - however downstream effects including food production and profit can be mitigated through IWM
 - note: we did not explore the use of introducing alternative chemicals
- The relative benefits of different strategies change over time
- Herbicide resistance status reduces both food production and profits
 - but does not impact the relative efficacy of different IWM management options
- The “best” option depends on the metric and timescale

