

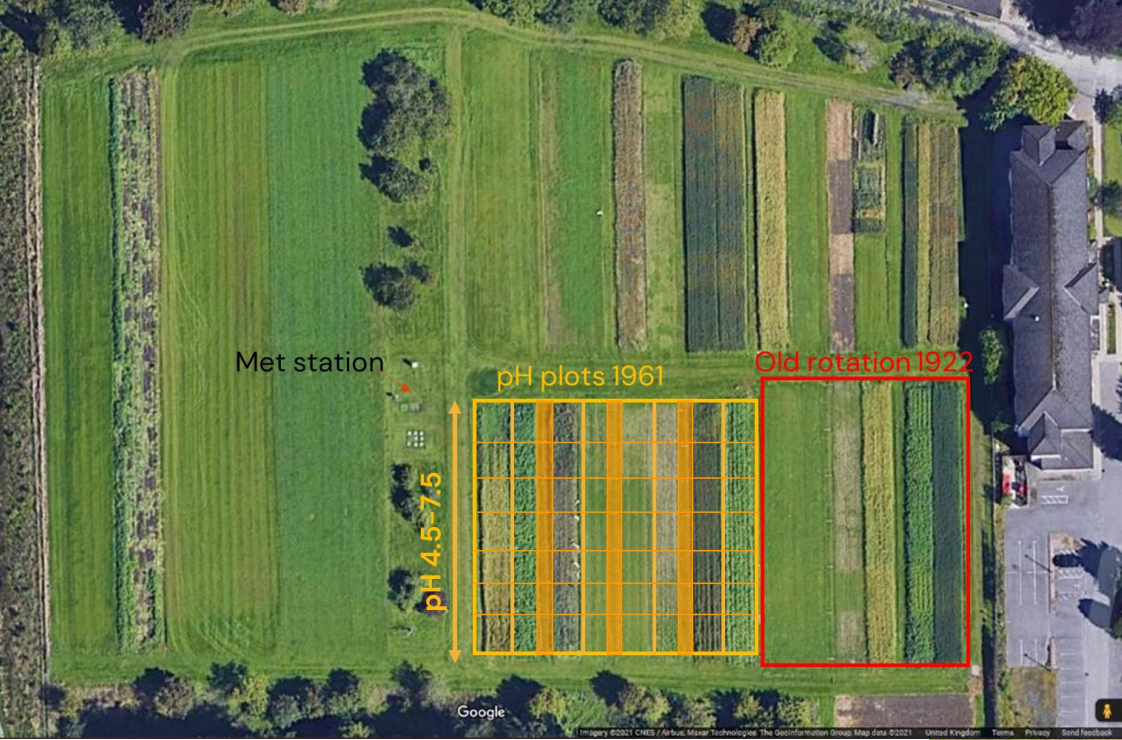
The impact of pH and climate on the yield of cereals

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Institution: SRUC, Rothamsted



pH Demonstration LTE



Woodlands Field
SRUC Aberdeen,
Scotland, UK



pH plots
Phase 1 >1961-2021

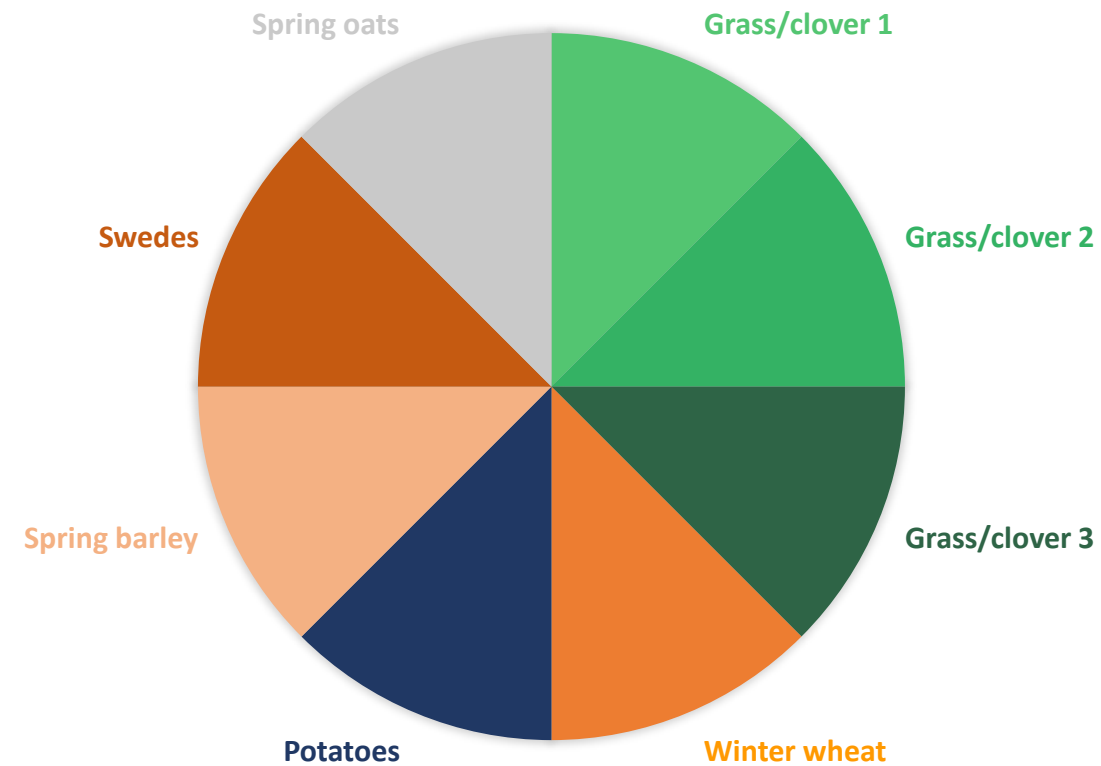
pHoenix experiment 2022 ->

Woodlands pH Plots - 2020 Plan



S Barley 56	S Barley 55	S Barley 54	S Barley 53	S Barley 52	S Barley 51	S Barley 50
Potatoes 49	Potatoes 48	Potatoes 47	Potatoes 46	Potatoes 45	Potatoes 44	Potatoes 43
W Wheat 42	W Wheat 41	W Wheat 40	W Wheat 39	W Wheat 38	W Wheat 37	W Wheat 36
Grass 3 35	Grass 3 34	Grass 3 33	Grass 3 32	Grass 3 31	Grass 3 30	Grass 3 29
Grass 2 28	Grass 2 27	Grass 2 26	Grass 2 25	Grass 2 24	Grass 2 23	Grass 2 22
Grass 1 21	Grass 1 20	Grass 1 19	Grass 1 18	Grass 1 17	Grass 1 16	Grass 1 15
S Oats 14	S Oats 13	S Oats 12	S Oats 11	S Oats 10	S Oats 9	S Oats 8
Swede 7	Swede 6	Swede 5	Swede 4	Swede 3	Swede 2	Swede 1

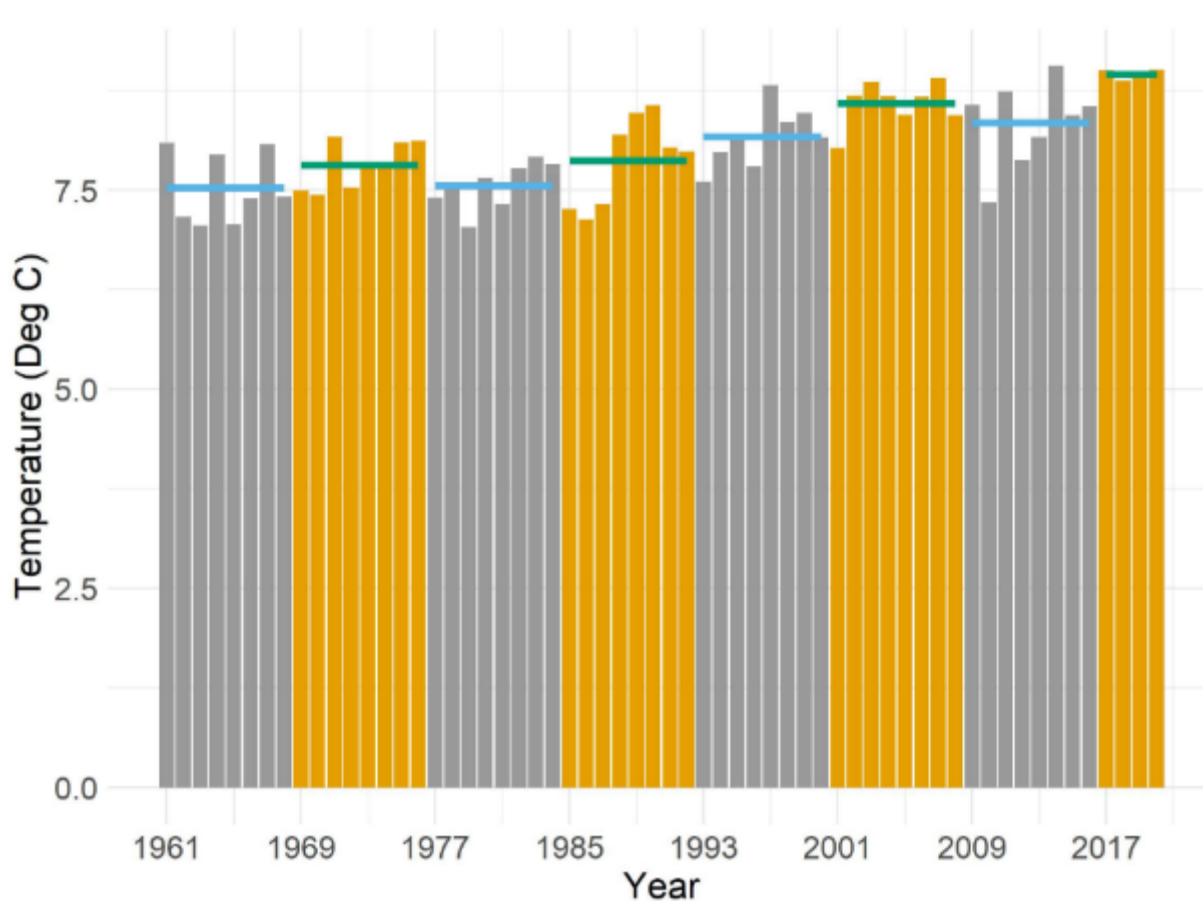
pH plots Phase 1



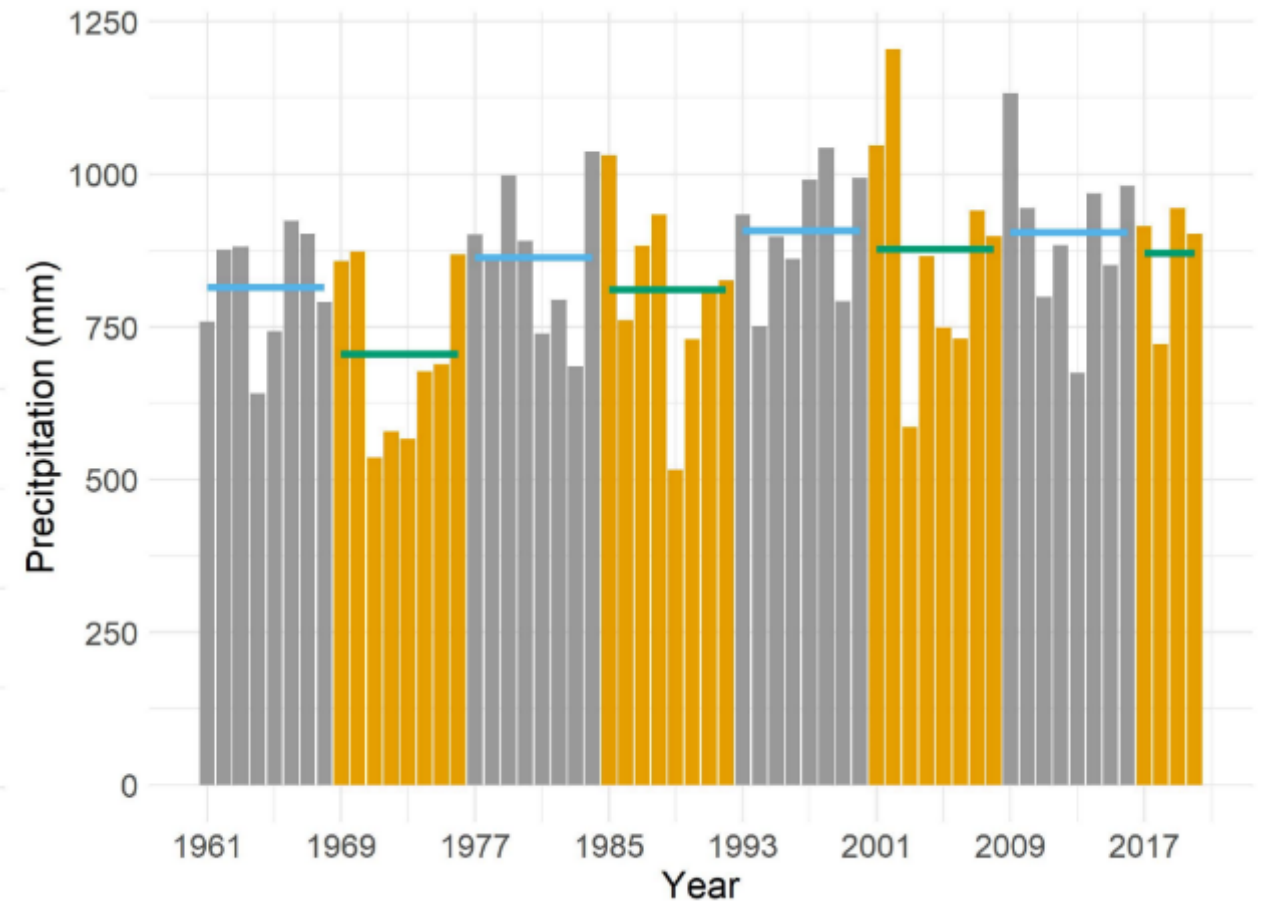
pH 7.5 7.0 6.5 6.0 5.5 5.0 4.5

Grass 1 = hay; Grass 2 & 3 are "grazed"

How has weather changed over 60 years?

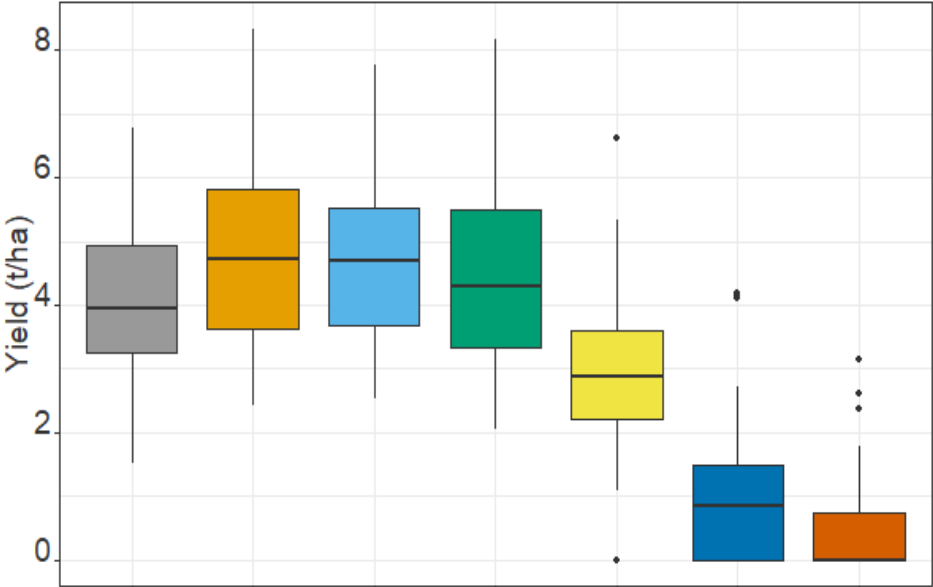


Annual temperature

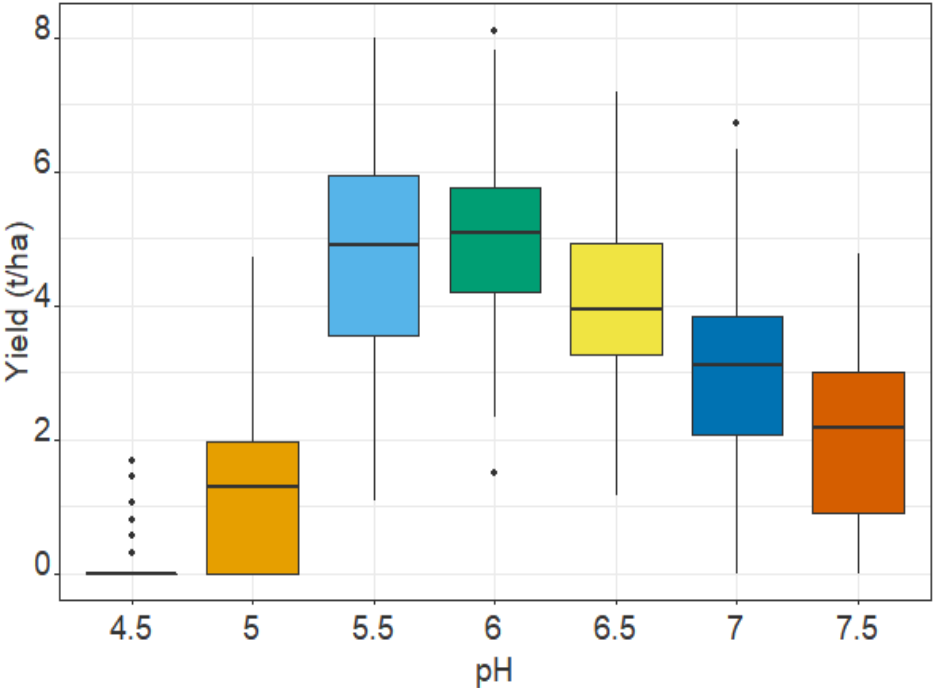
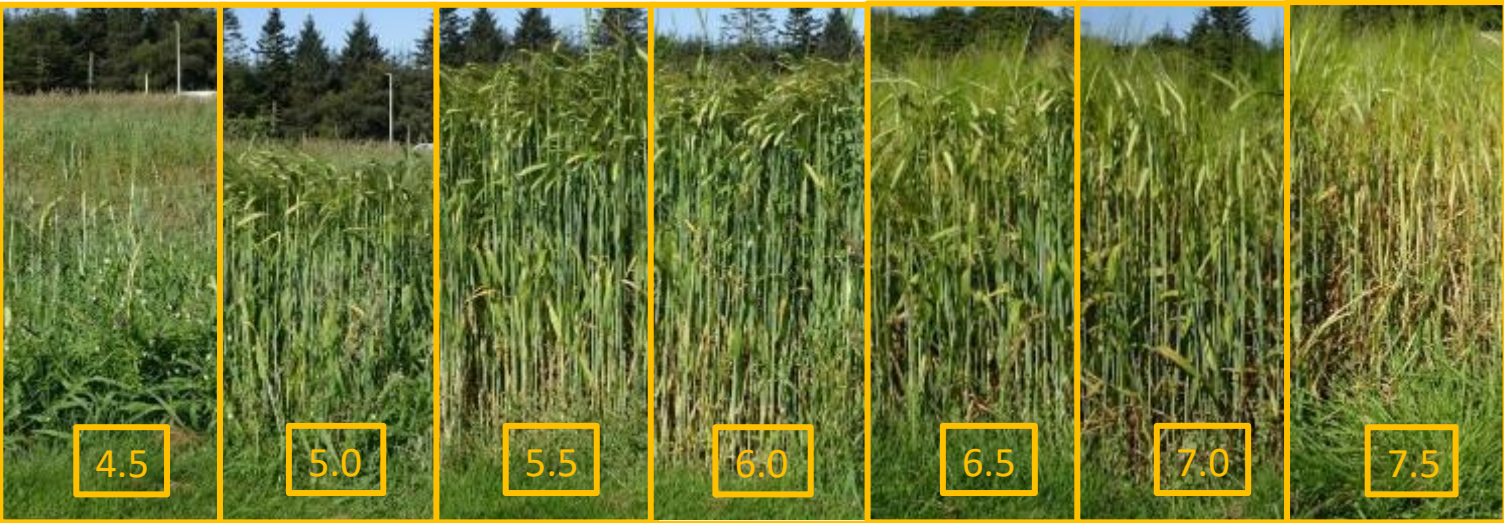


Rainfall (note the DRY years!)

Spring oats - Woodlands Field (1961-2020)

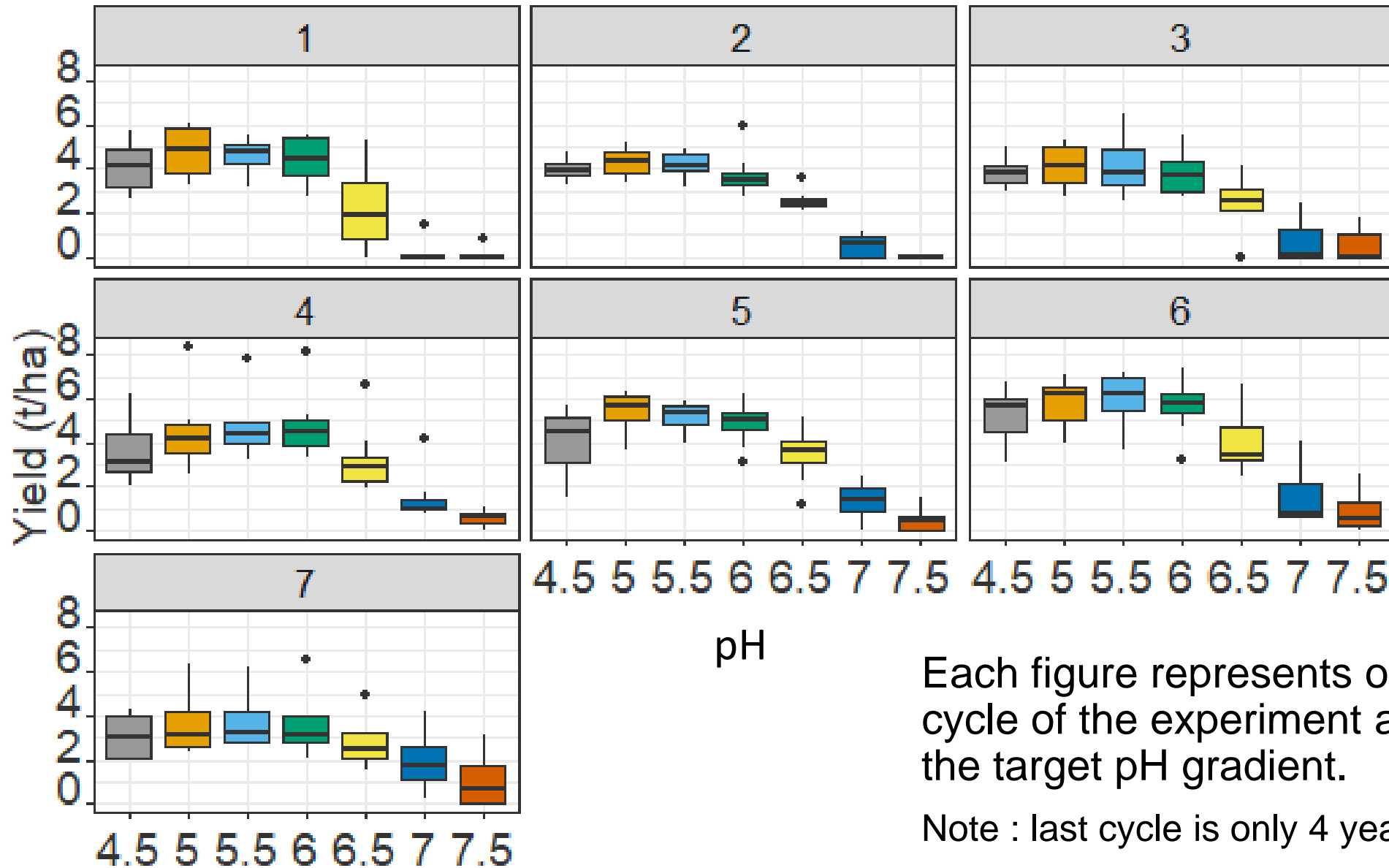


Spring barley Woodlands Field (1961-2020)



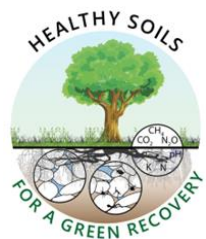
Box and whisker plots show median, min, max and interquartile range

Spring oat yield analysed by 8 year rotational cycle

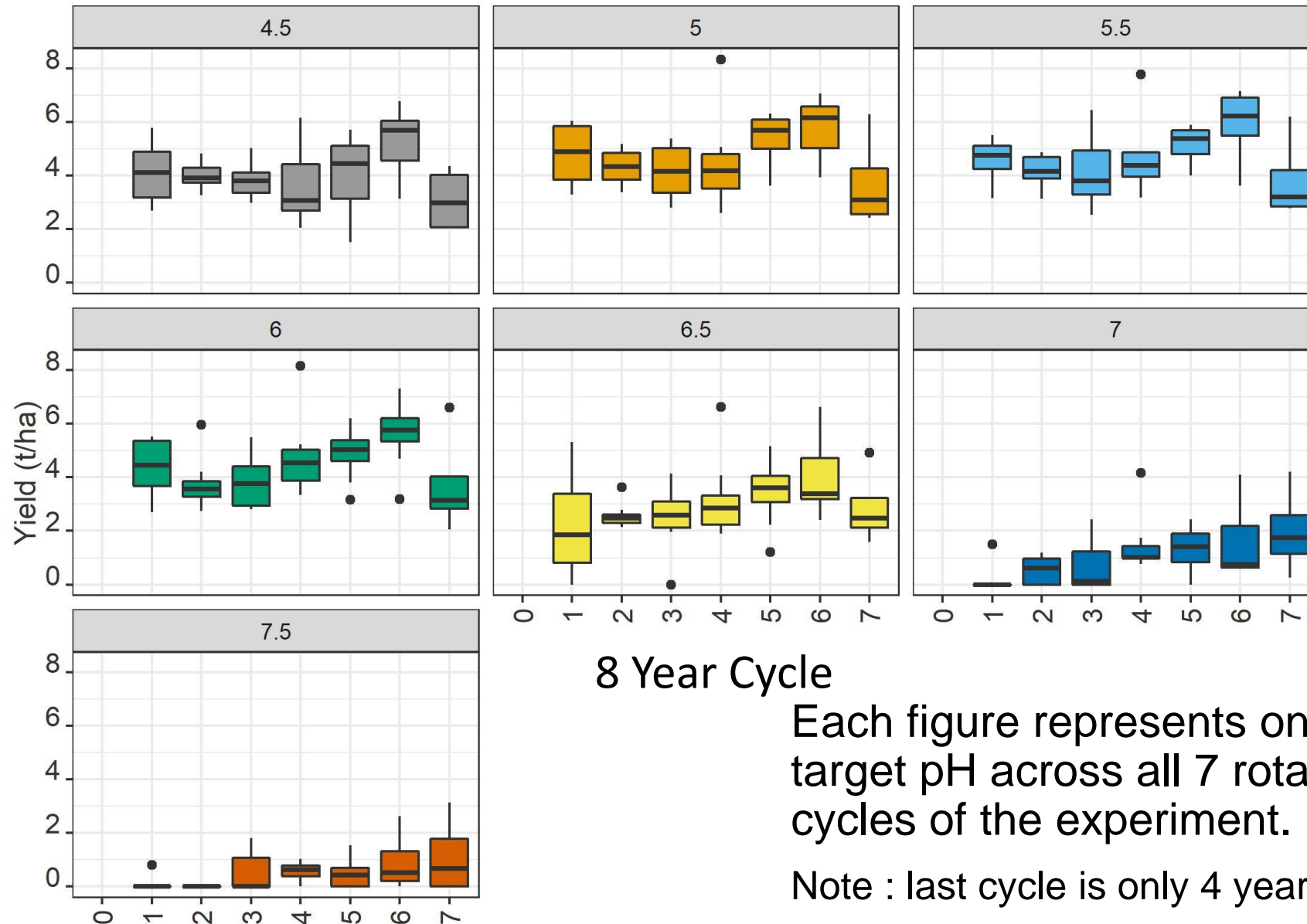


Each figure represents one cycle of the experiment across the target pH gradient.

Note : last cycle is only 4 years



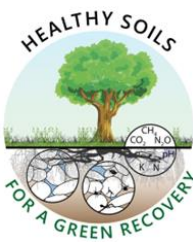
Spring oat yield analysed by 8 year rotational cycle



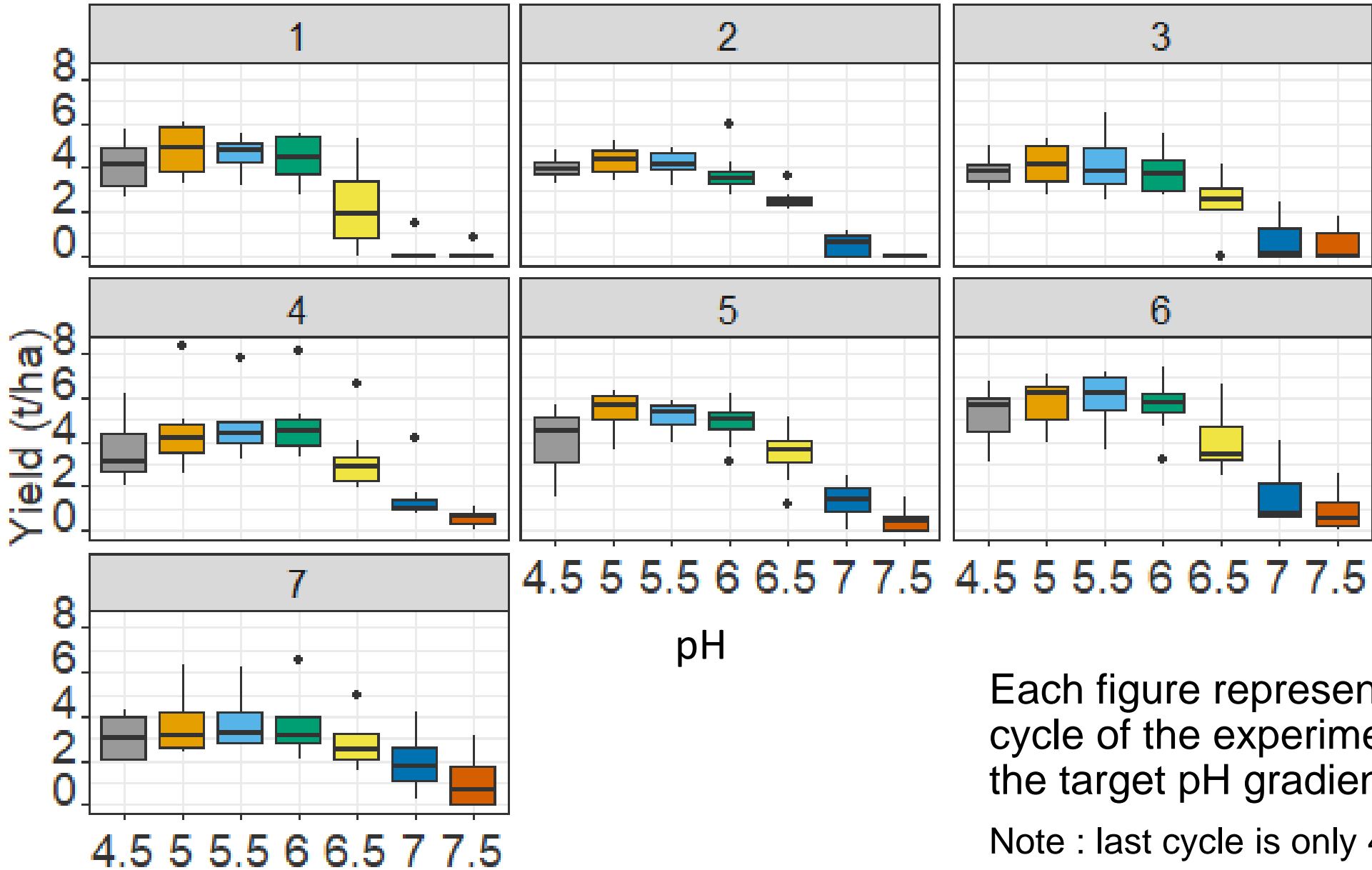
8 Year Cycle

Each figure represents one target pH across all 7 rotational cycles of the experiment.

Note : last cycle is only 4 years

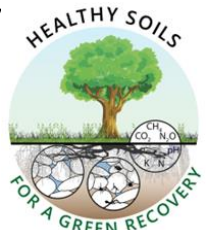


Spring barley yield analysed by 8 year rotational cycle



Each figure represents one cycle of the experiment across the target pH gradient.

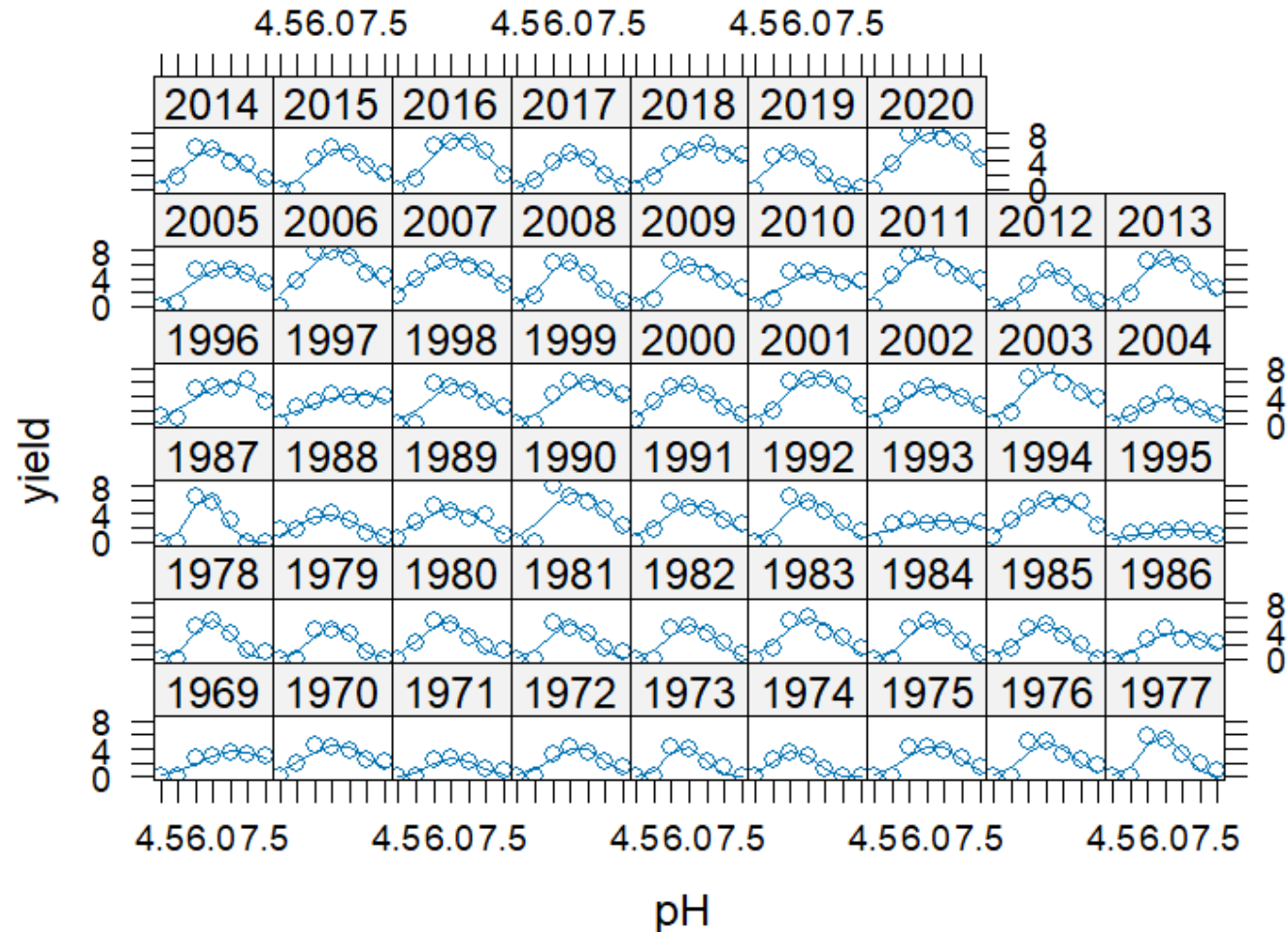
Note : last cycle is only 4 years





Model fitting

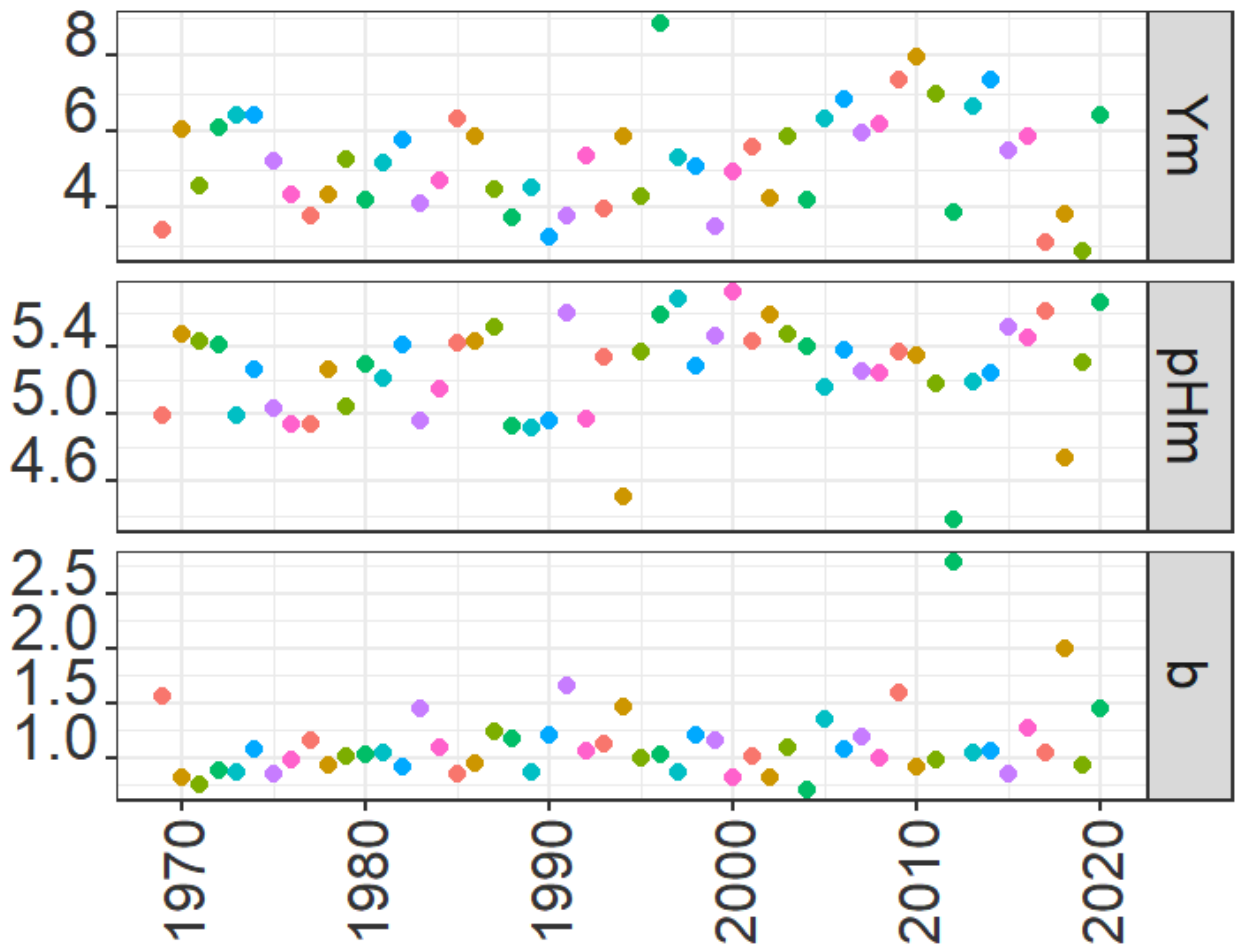
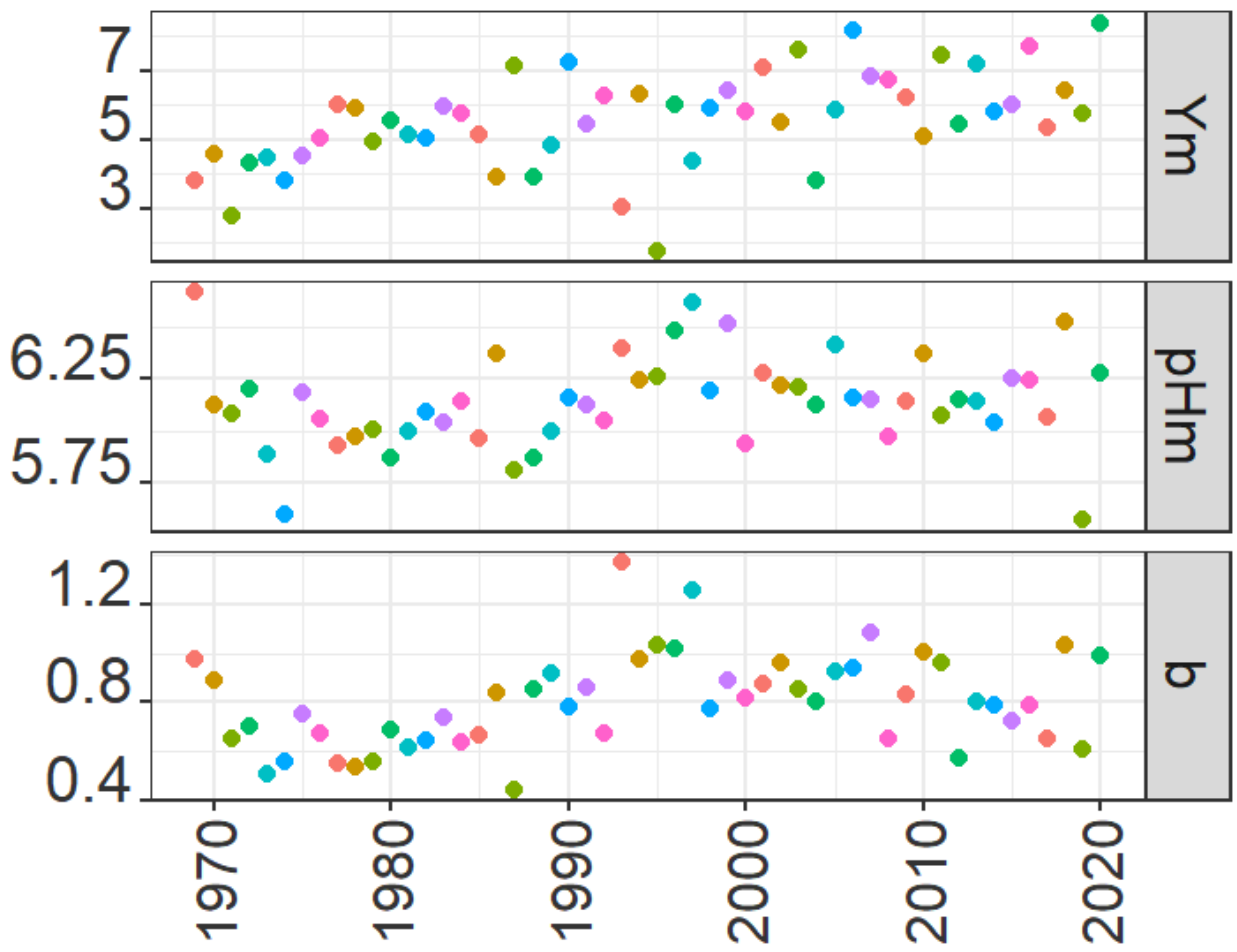
- Gaussian function
- $Y = Y_m * \exp\left(-0.5 \left(\frac{pH - pH_m}{b}\right)^2\right)$
- Y_m = asymptotic value of Y
- pH_m – centre of the peak
- b controls the width of the bell





Spring Oats

Spring Barley



Weather variables

- T – Ave GS temperature
- TDD – mean max temperature
- mGDD – growing day degrees (base – 5 deg C)
- WT – Ave winter temperature

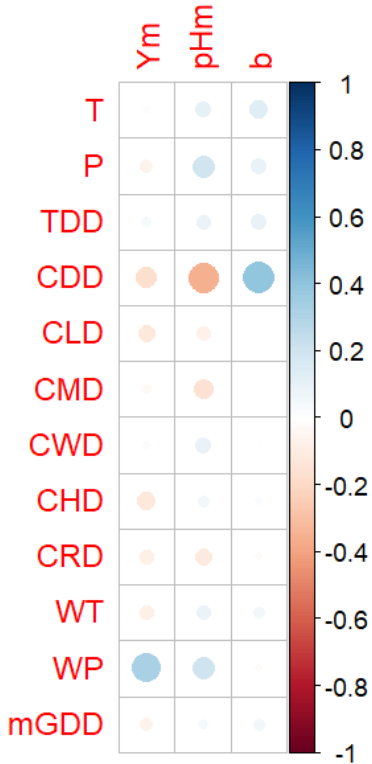
Weather variables

- Drought – rain ≤ 0.2 mm
- Low - $0.2 < \text{rain} \leq 1$
- Medium – $1 < \text{rain} \leq 10$
- Wet > 10 mm

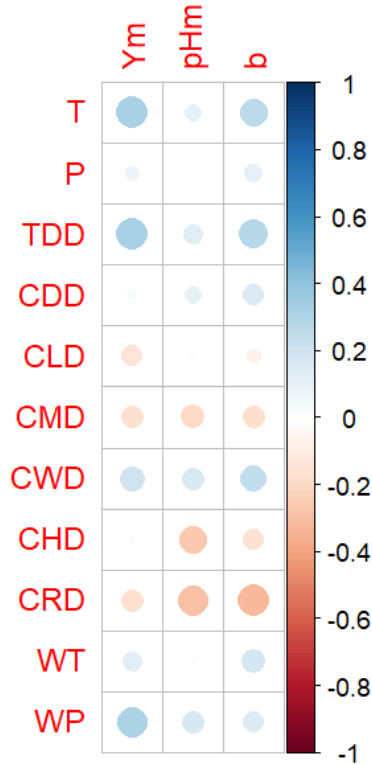
- P – $\Sigma(\text{GS precipitation})$
- WP – $\Sigma(\text{winter precipitation})$

- **CDD** – Max no of consecutive drought days
- **CLD** - Max no of consecutive low days
- **CMD**- Max no of consecutive medium days
- **CWD** - Max no of consecutive medium days
- **CHD** – Max no of medium or wet days
- **CRD** - Max no days with rain $>$ drought

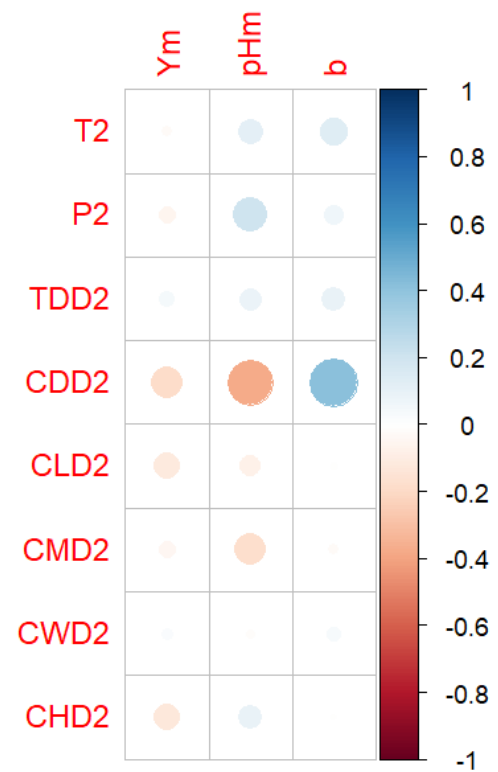
Spring Oats



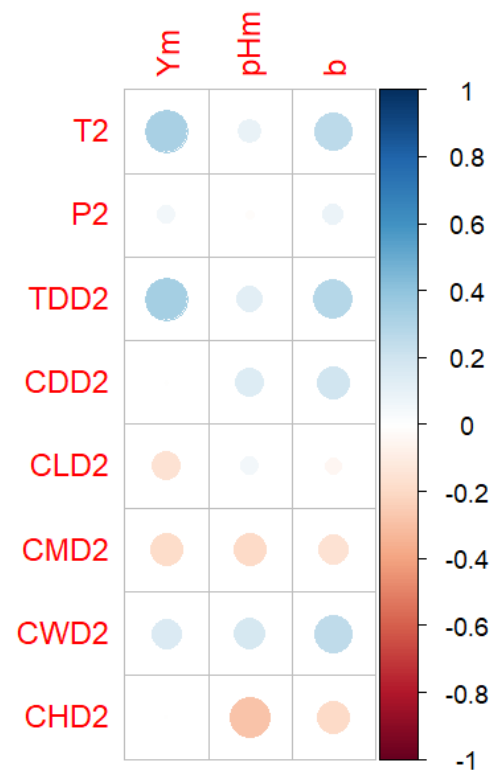
Spring Barley



Spring Oats



Spring Barley



Spring Oats – fitted Ym

	Estimate	Std Error
(Intercept)	-6.66	3.70
T	-3.74	1.05
TDD	3.69	9.56E-01
CDD	-9.94E-02	3.08E-02
WP	4.87E-03	1.32E-03
mGDD	-1.84E-03	1.03E-03

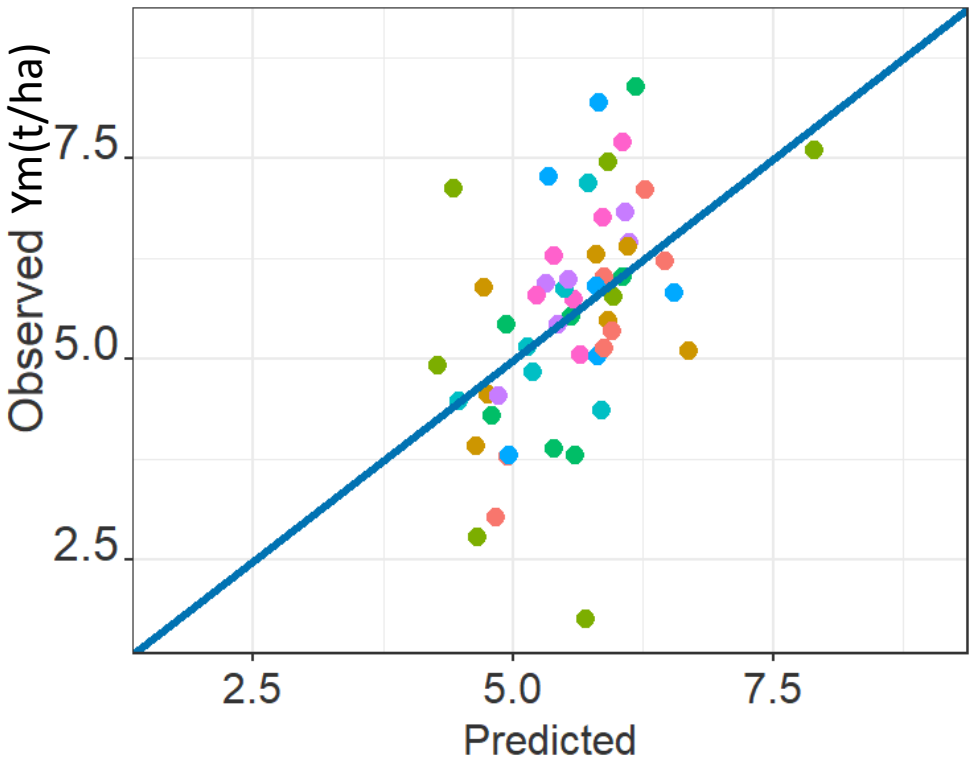
$R^2 = 30\%$

Spring Barley – fitted Ym

	Estimate	Std Error
(Intercept)	-5.83	3.42
WP	4.00E-03	1.42E-03
TDD	7.14E-01	2.44E-01

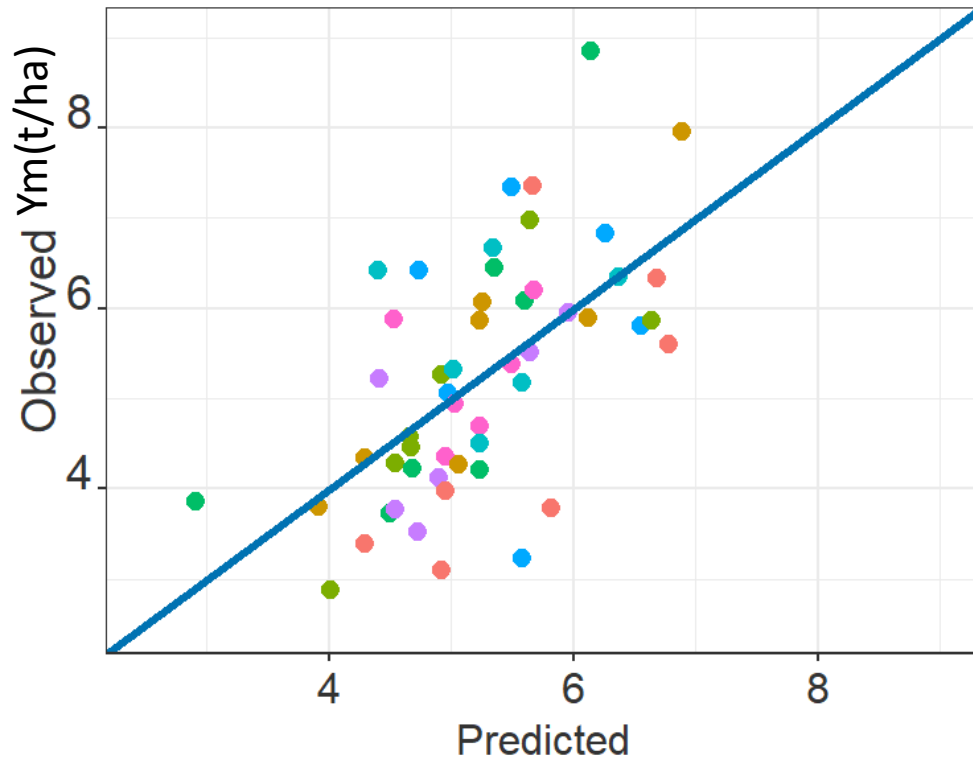
$R^2 = 20\%$

Spring Oats



$R^2 = 30\%$

Spring Barley



$R^2 = 20\%$

July 2021 – time to leave Woodlands Field behind for ACE!



21 July



26 July

Acknowledgements



Scottish Government
Riaghaltas na h-Alba
gov.scot

