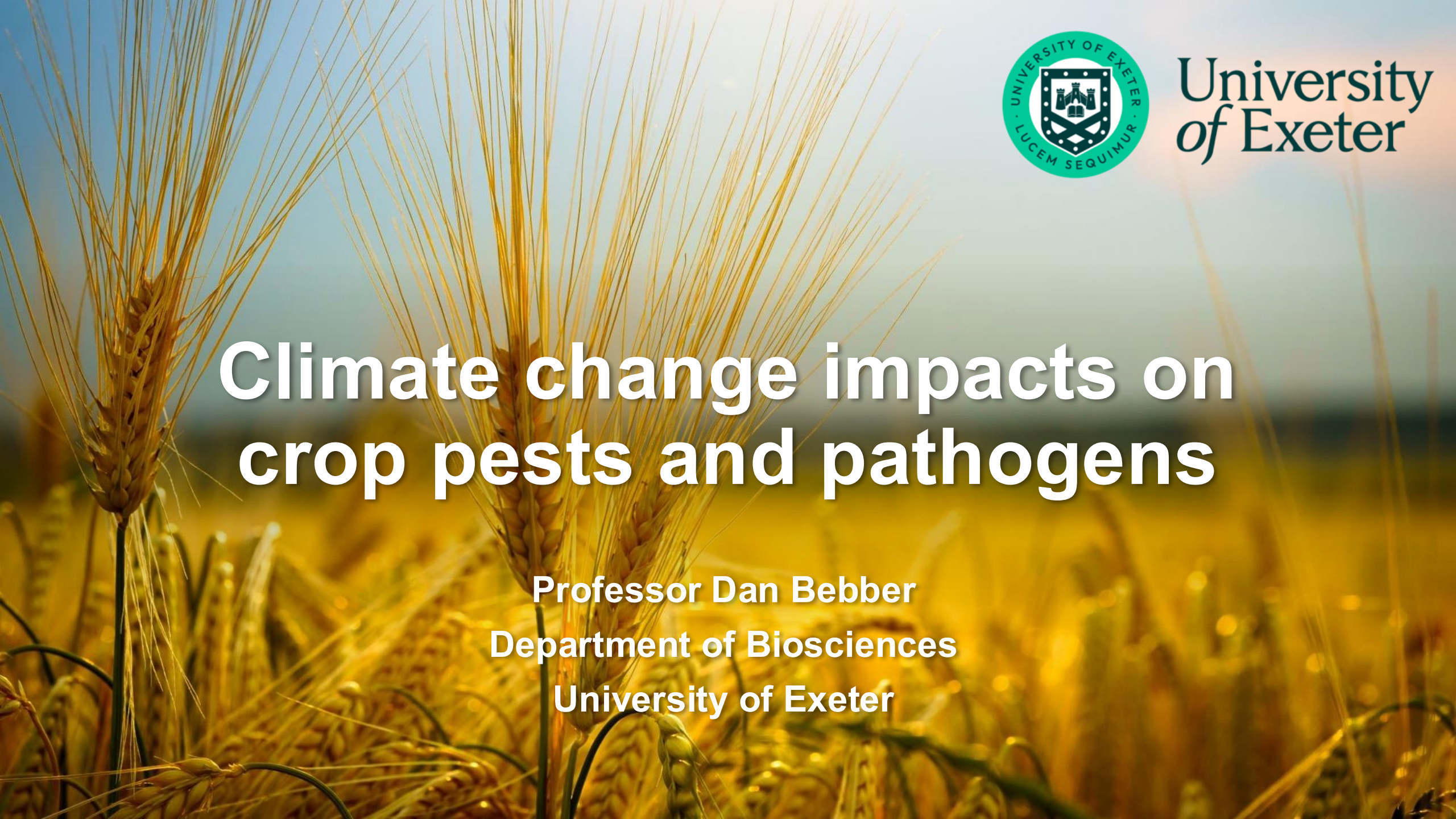
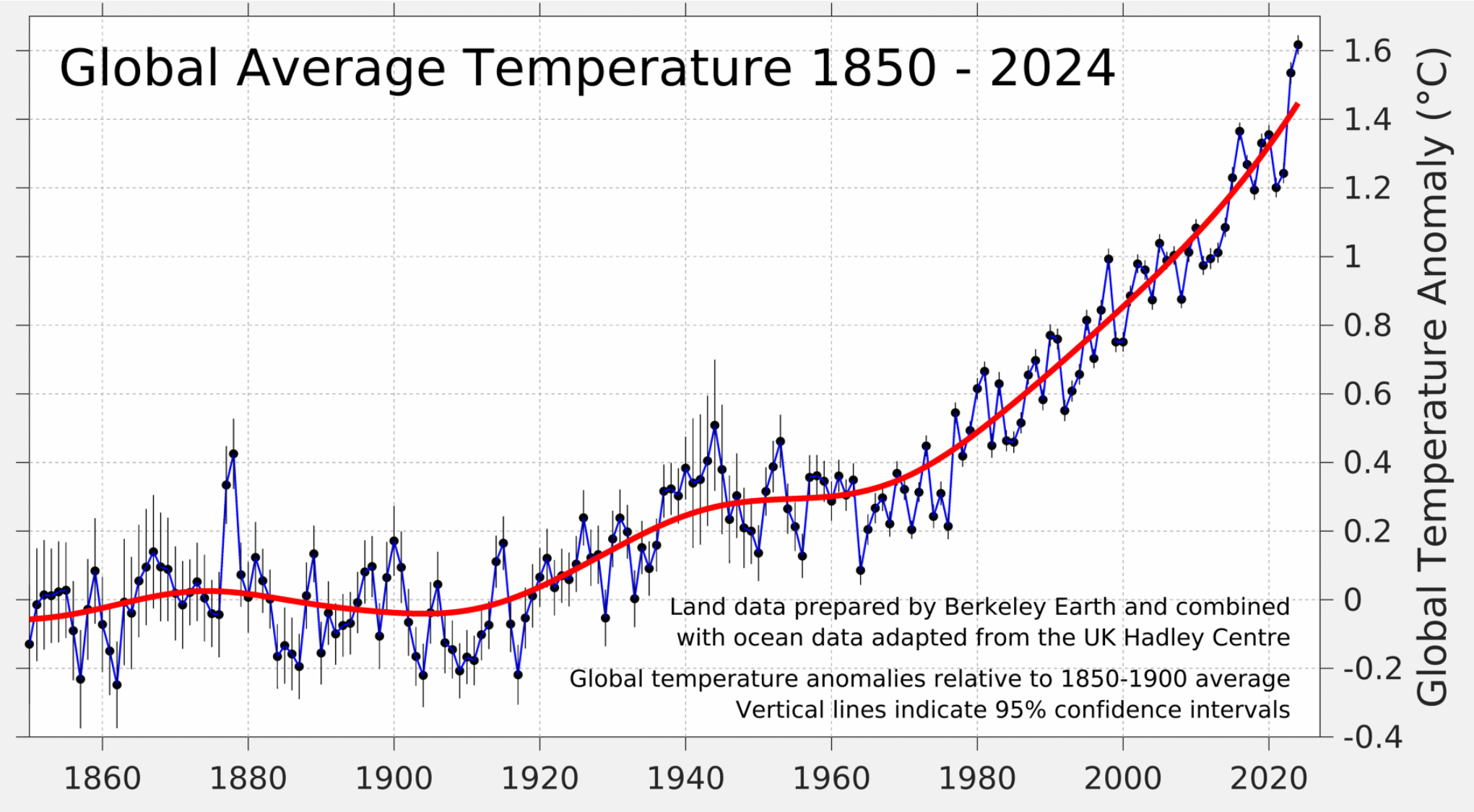


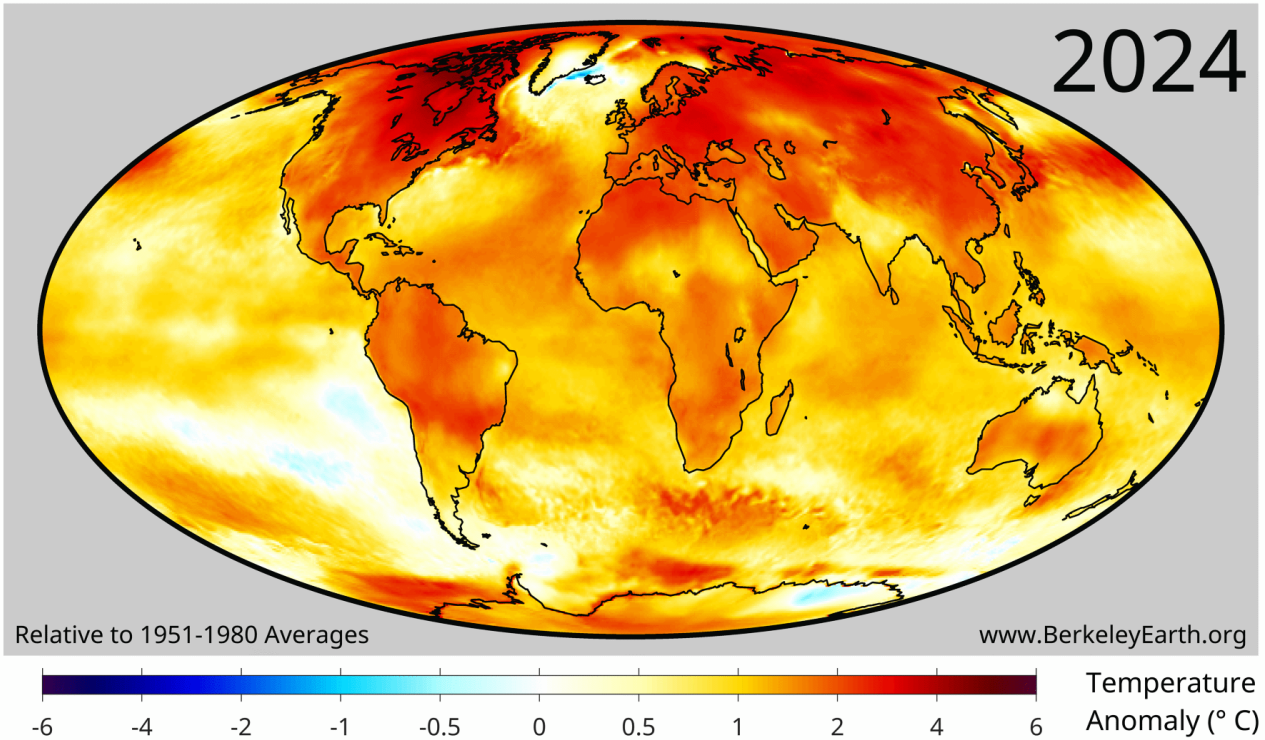
# Climate change impacts on crop pests and pathogens

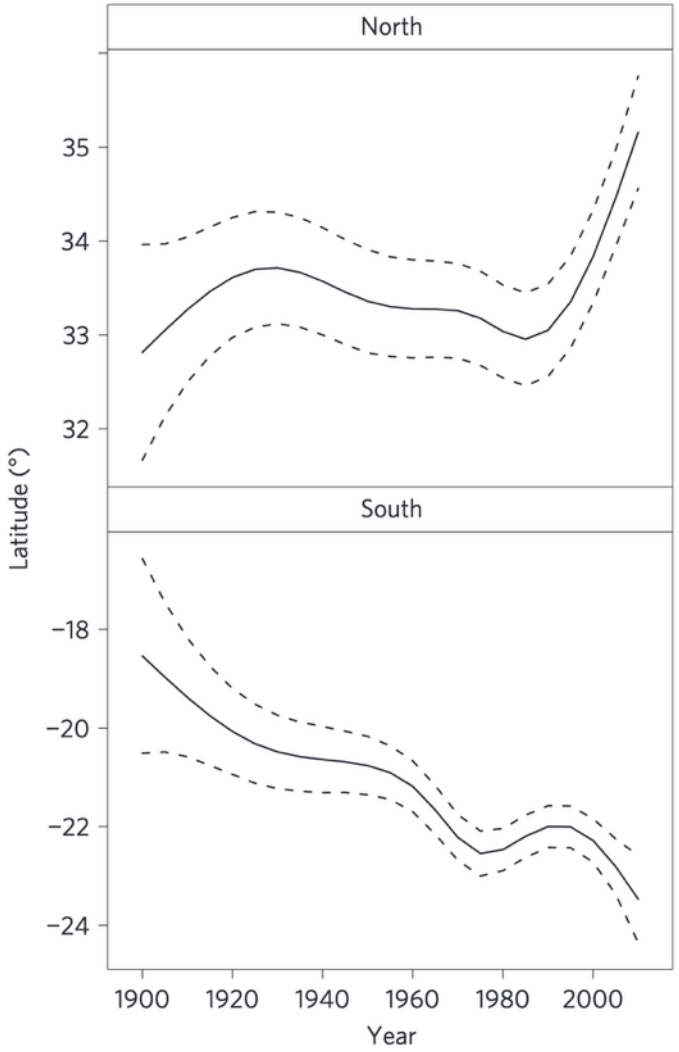
Professor Dan Bebber
Department of Biosciences
University of Exeter

# Climate change is accelerating



# Crop pests and pathogens seem to be moving polewards

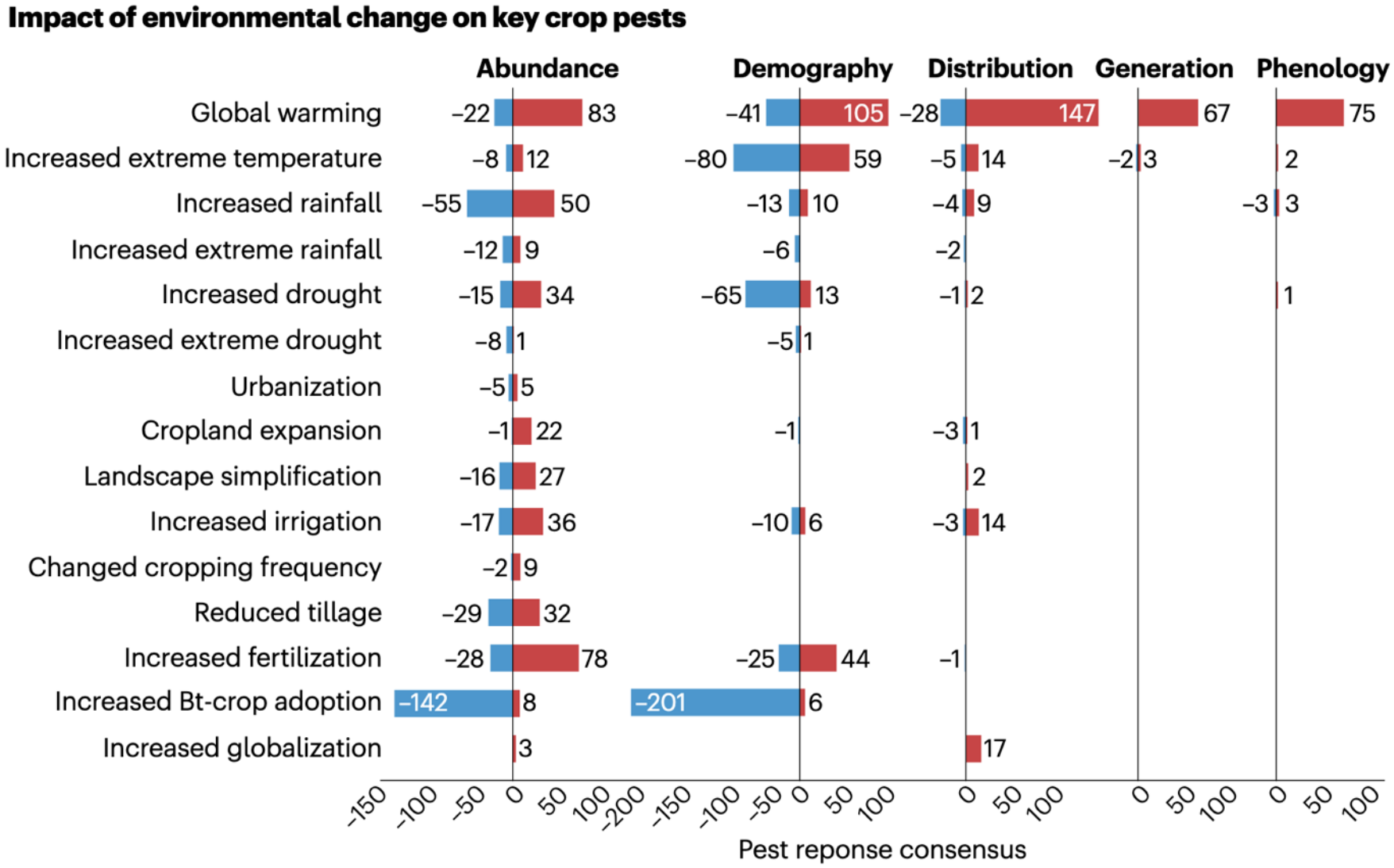



Bebber, D. P., et al. (2013). Crop pests and pathogens move polewards in a warming world. Nature Climate Change, 3(11), 985–988.

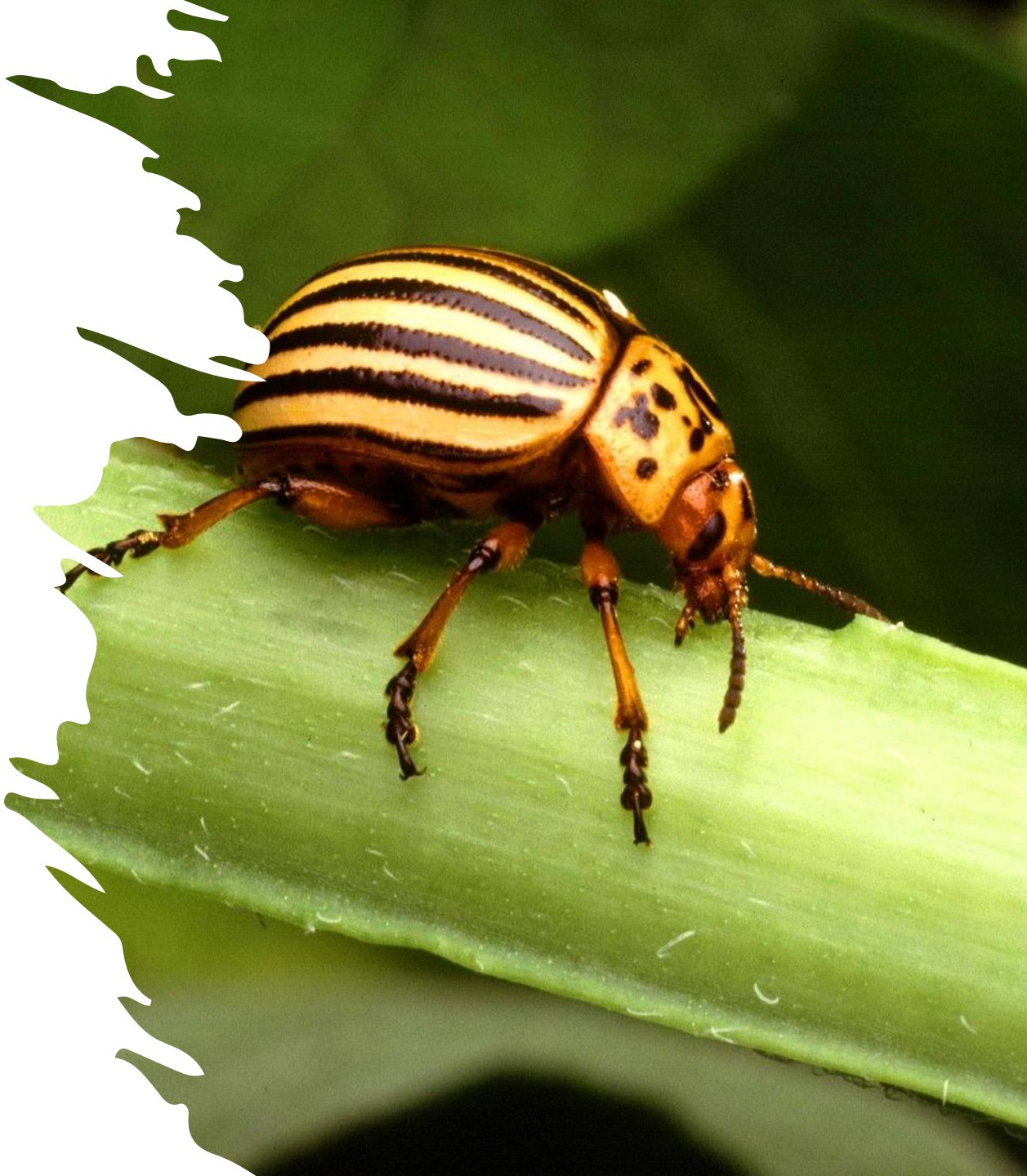
# Global warming increases pest abundance and impact

Bayer Crop Science




Ma, C.-S., et al. (2025). Crop pest responses to global changes in climate and land management. *Nature Reviews Earth & Environment*, *6*(4), 264–283.

# Warming makes establishment of Colorado Potato Beetle more likely



BBC For you Home News Sport Weather

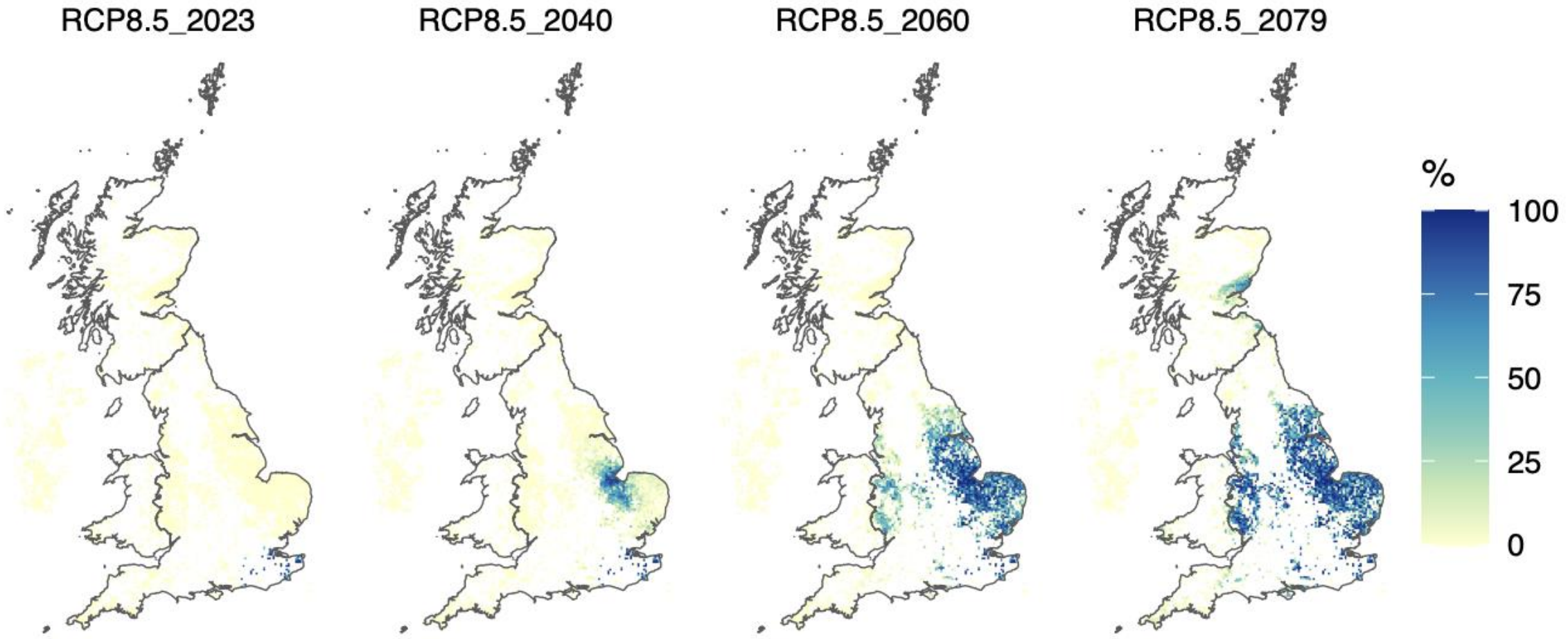
NEWS

Home | InDepth | Israel-Gaza war | War in Ukraine | Climate | UK | World | Business | Politic

England | Local News | Kent

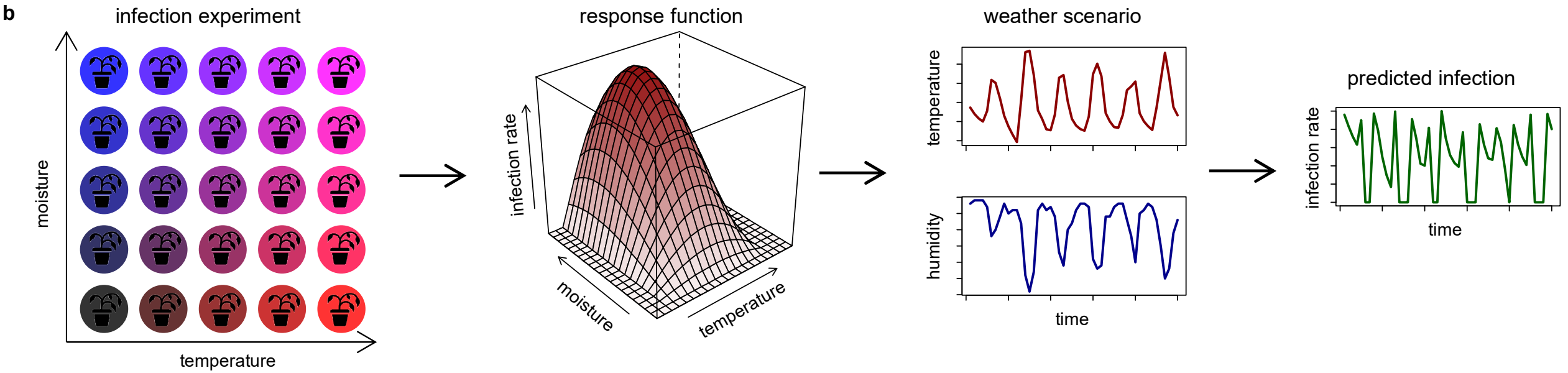
## Look for 'savage' beetle species, Titchmarsh warns

# CPB dispersal and establishment following initial invasion in Kent



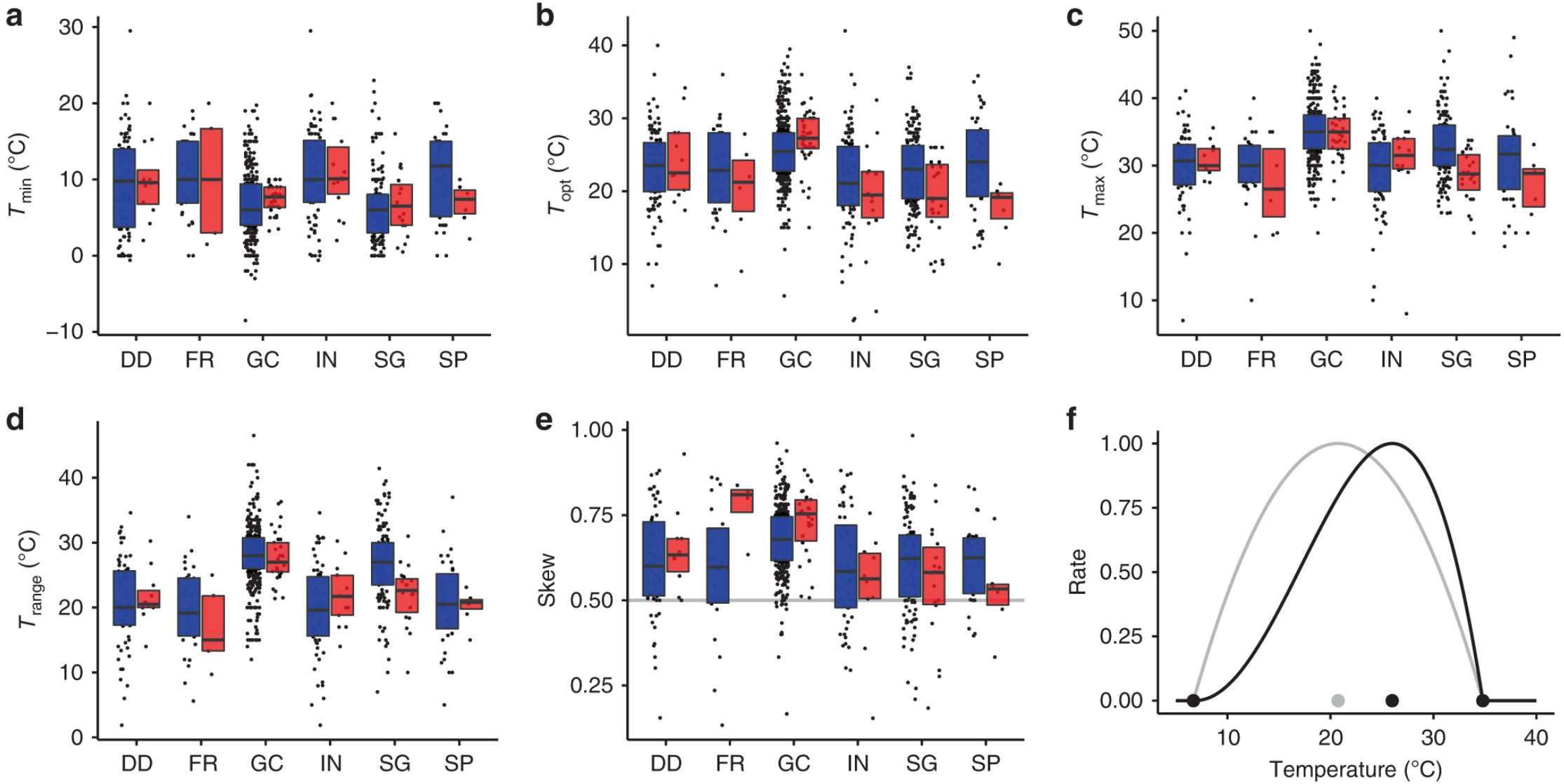

Bebber DP et al. (2024) *Interdisciplinary Analysis of Plant Health Threats to Scotland*. PHC2022/05. Scotland's Centre of Expertise for Plant Health (PHC).

# Epidemiological models
## Rates of biological processes




Raza MM & Bebber DP 2022. Climate Change and Plant Pathogens. *Current Opinion in Microbiology* 70:102233.

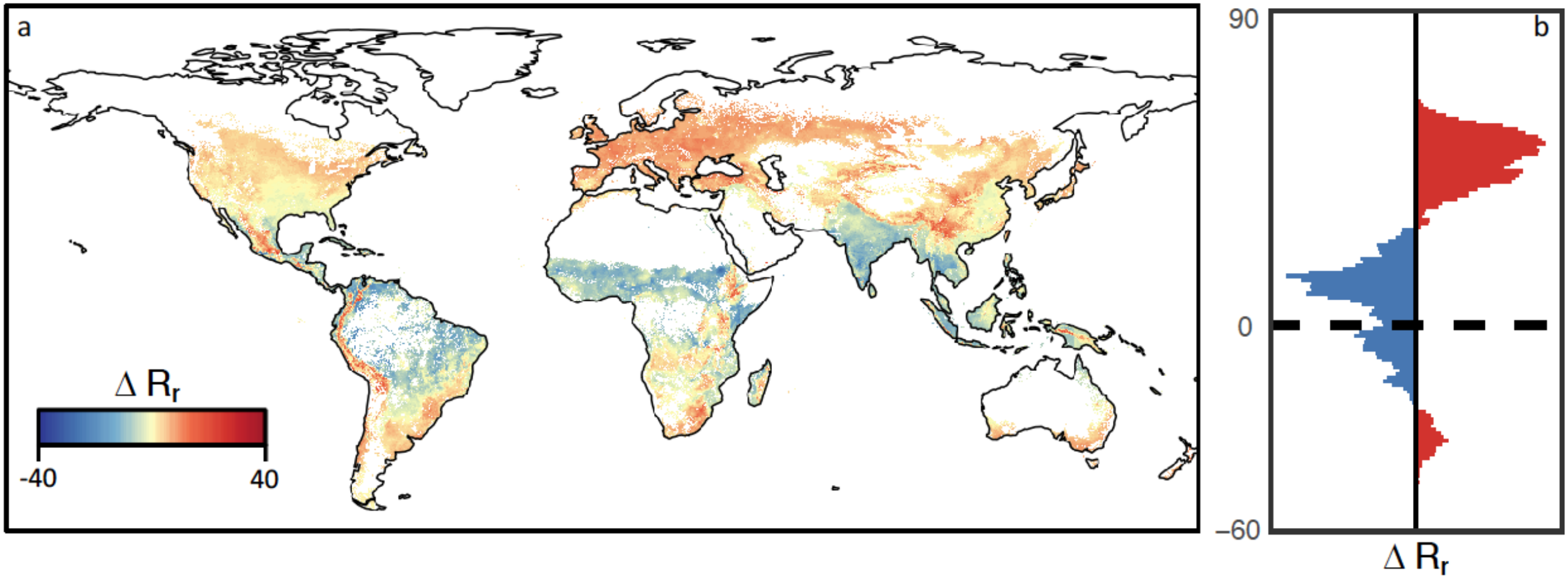
# Temperature responses of pathogen life-cycle processes




Chaloner TM et al. 2020. Geometry and evolution of the ecological niche in plant-associated microbes. *Nature Comms.* 11, 2955.

# Pathogen infection risk shifts poleward in future

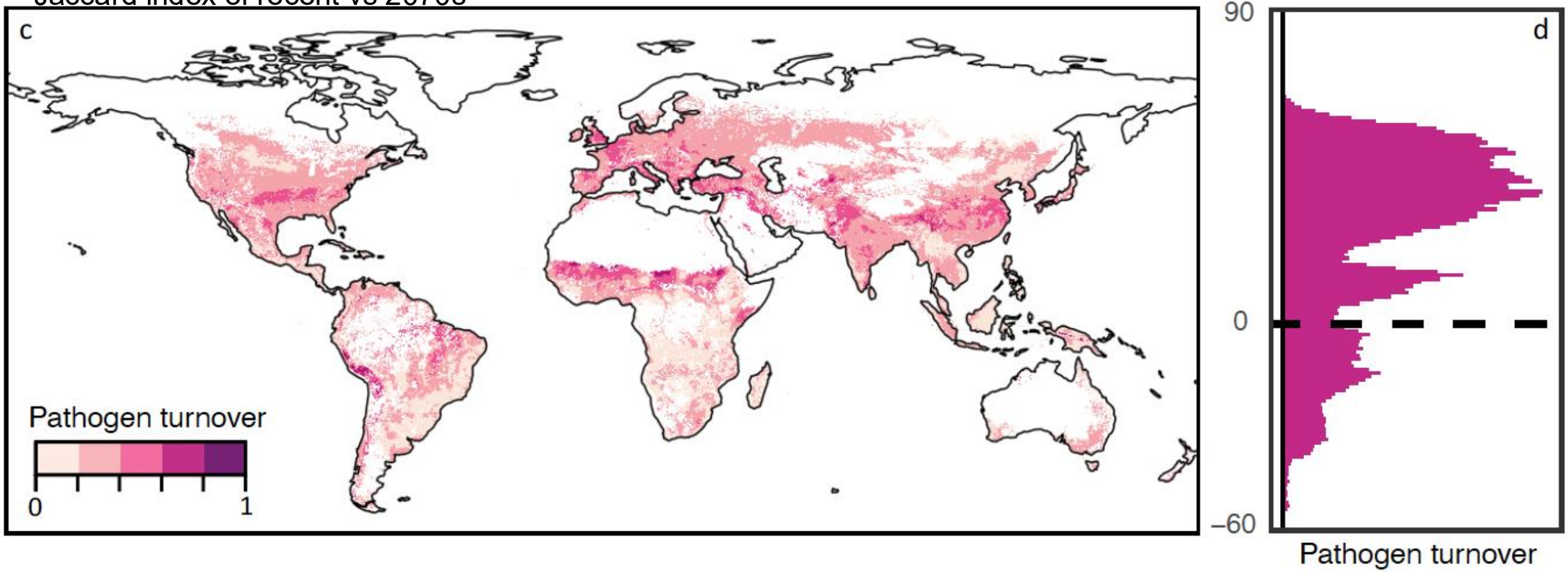
Average change in number of pathogens, restricted by current estimated host distribution, recent vs 2070s, RCP6.0




Chaloner TM et al. 2021. Plant pathogen infection risk tracks global crop yields under climate change. *Nature Clim. Change*, *11*, 710

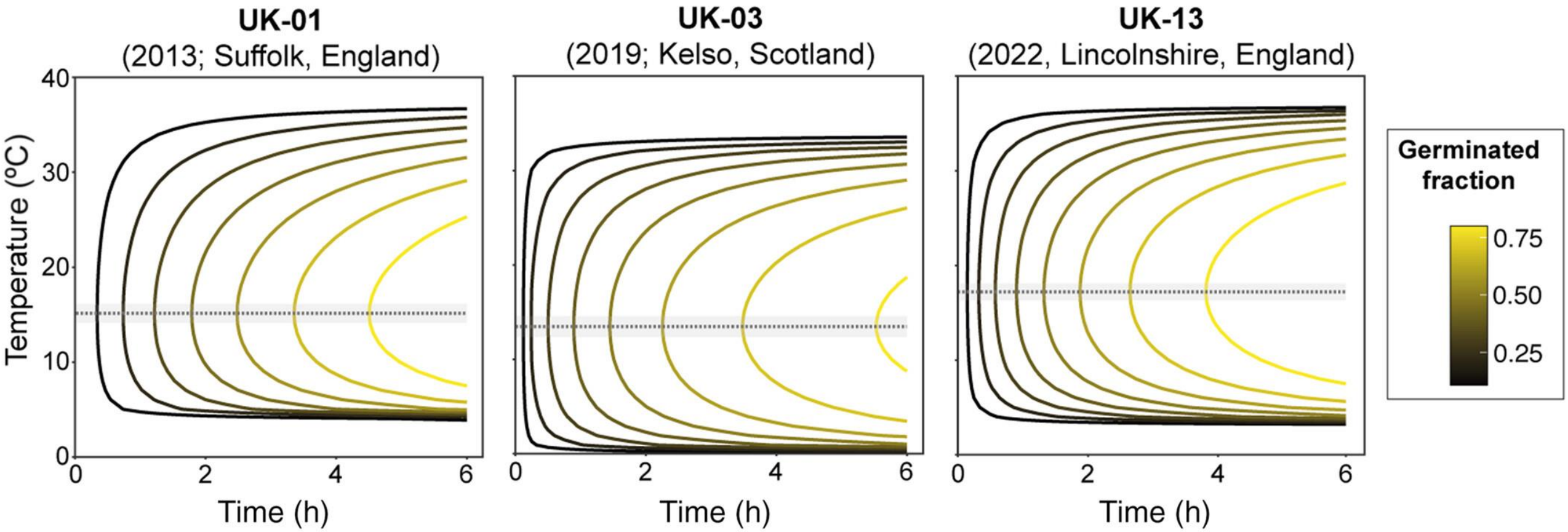
# The suite of pathogens attacking crops will change

Jaccard index of recent vs 2070s



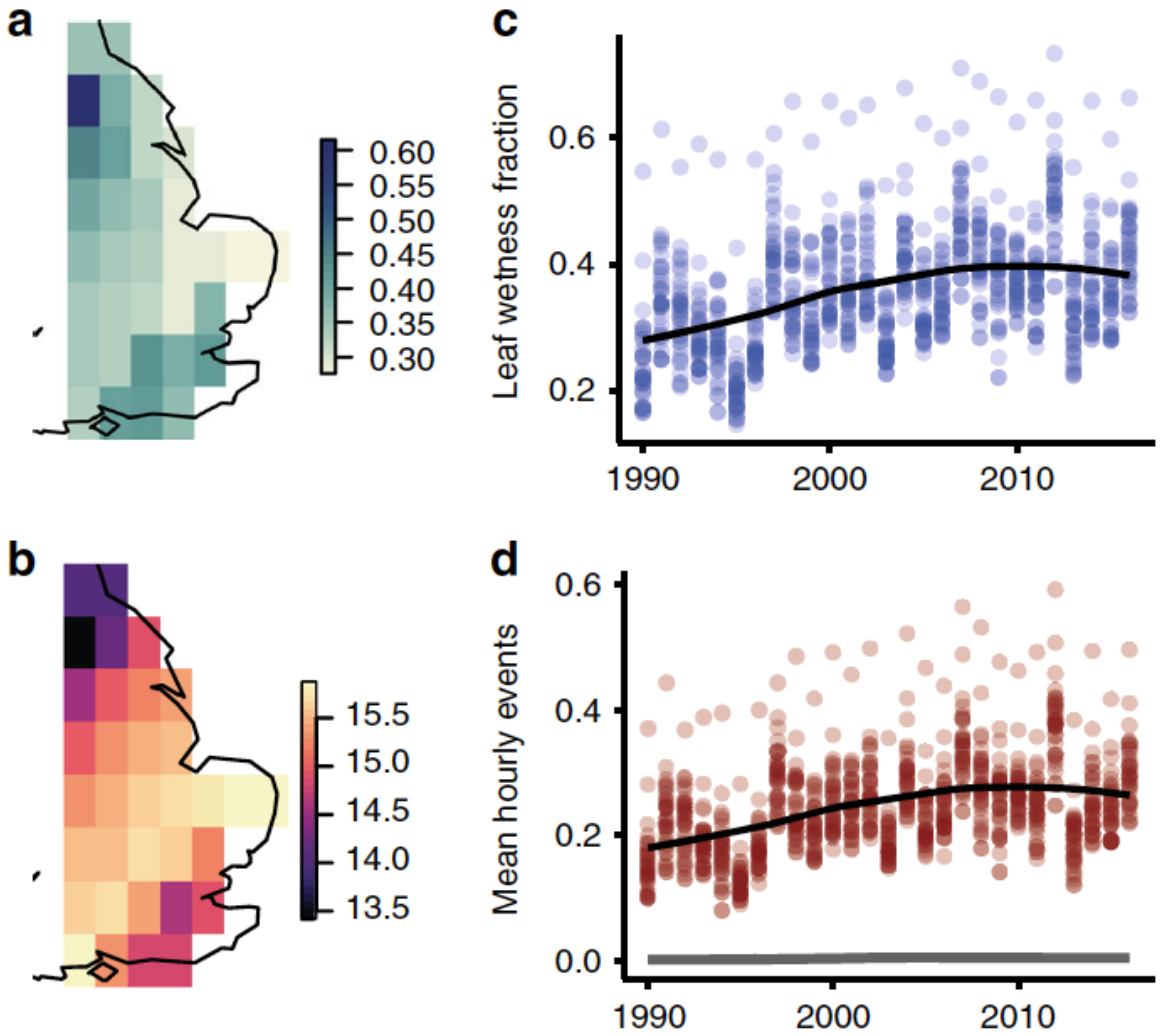

Chaloner TM et al. 2021. Plant pathogen infection risk tracks global crop yields under climate change. *Nature Clim. Change*, *11*, 710

# Wheat stem rust may be adapting to local climates




Lewis, C. M., et al. (2024). Resurgence of wheat stem rust infections in western Europe: Causes and how to curtail them. *New Phytologist*, *243*(2), 537–542

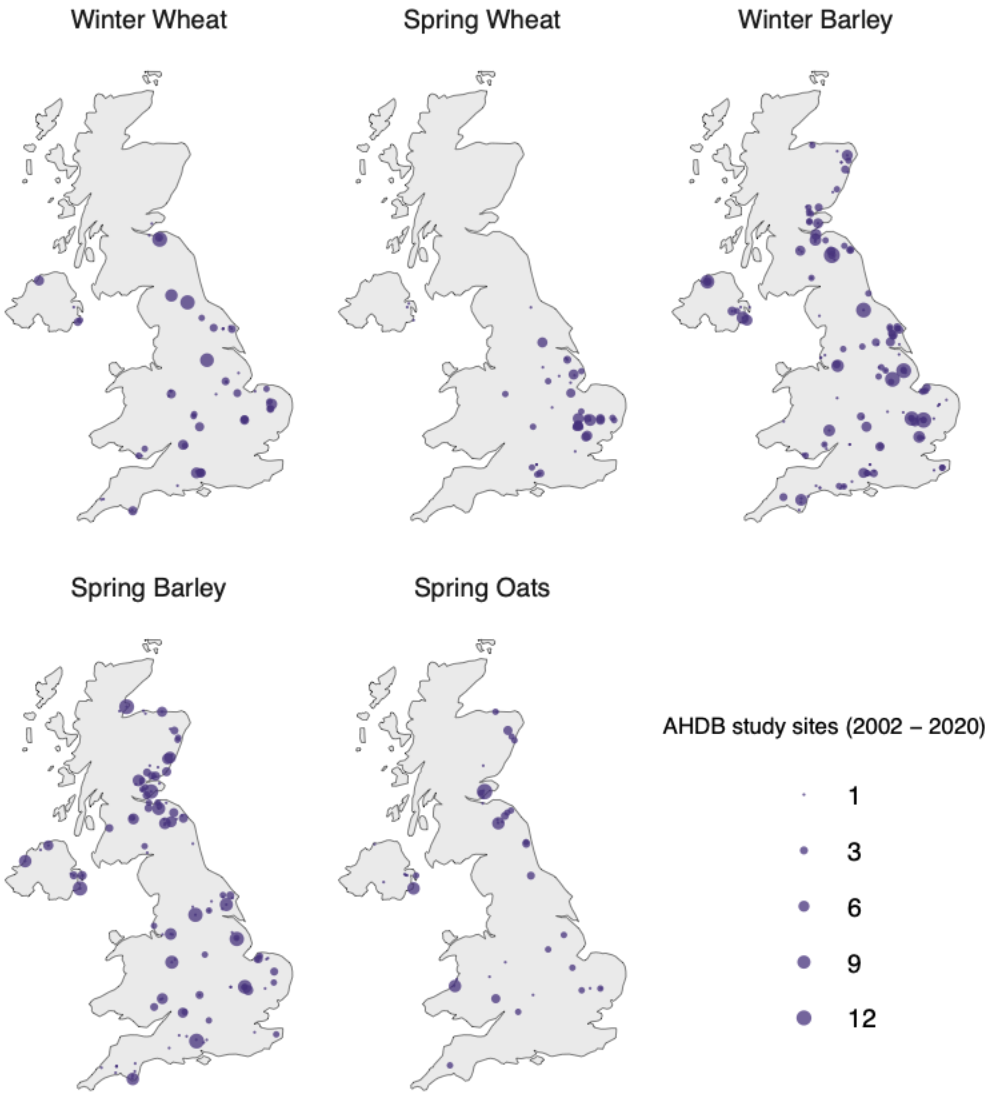
# Fungal lifecycles can be complex: not just weather

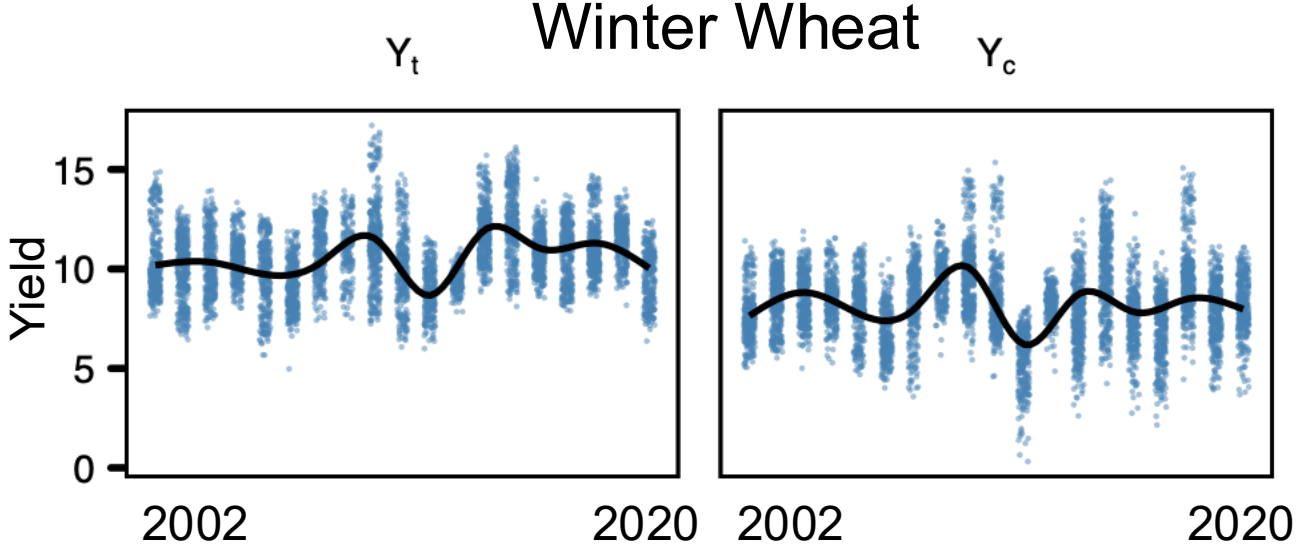



Barberry: alternative host for stem rust

Lewis, C.M. et al. (2018) Potential for re-emergence of wheat stem rust in the United Kingdom. *Communications Biology*, 1, 13.

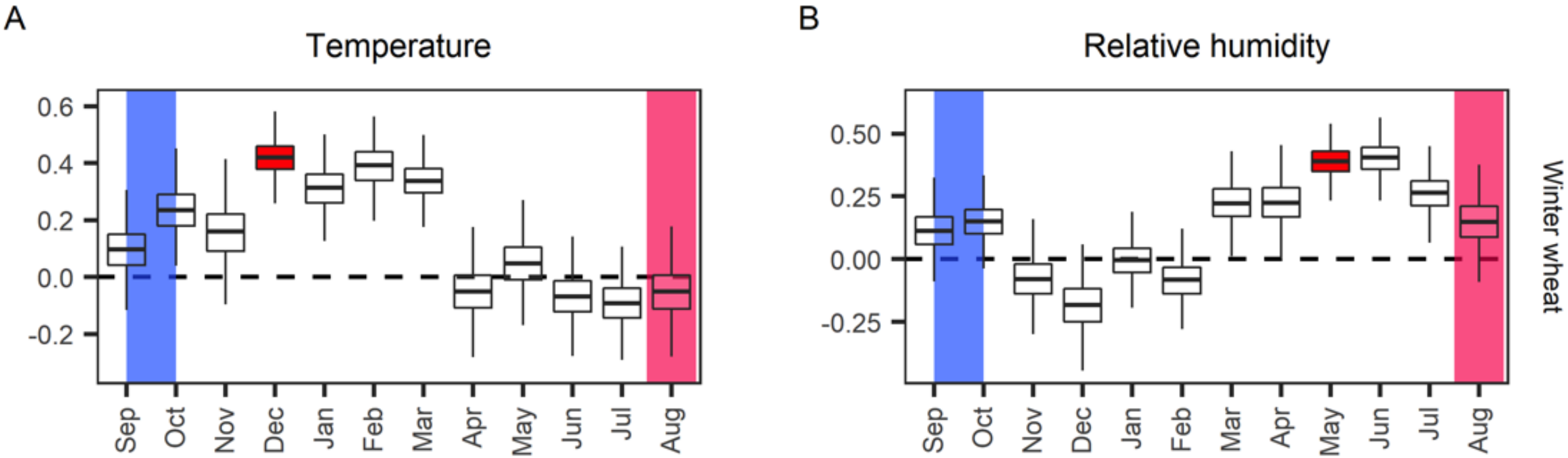
# Field trials of crop varieties under fungicide-treated and untreated conditions reveal potential losses



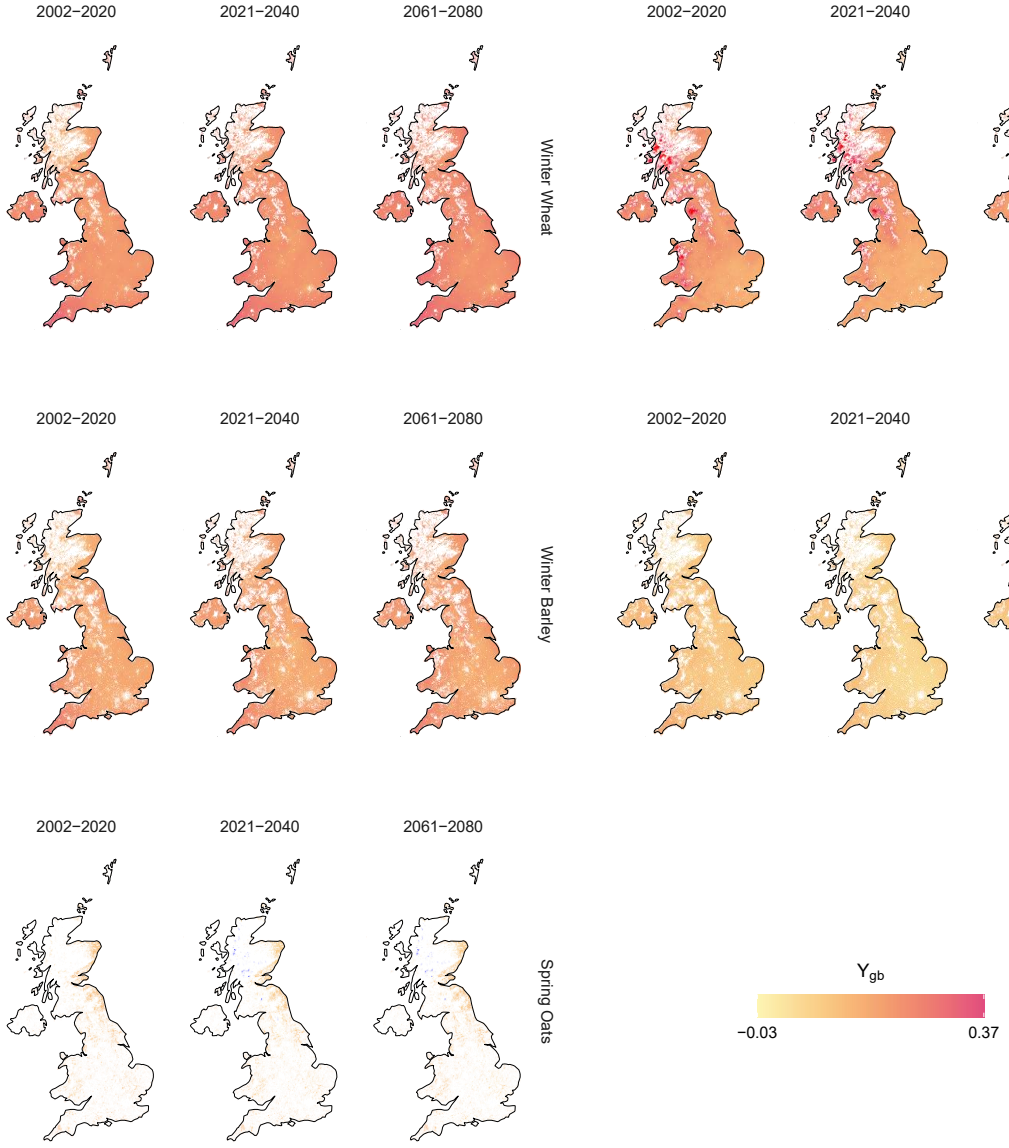

AHDB trial data

# Correlate yield gap with temperature and humidity through the growing season




Raza MM & Bebber DP, in prep.

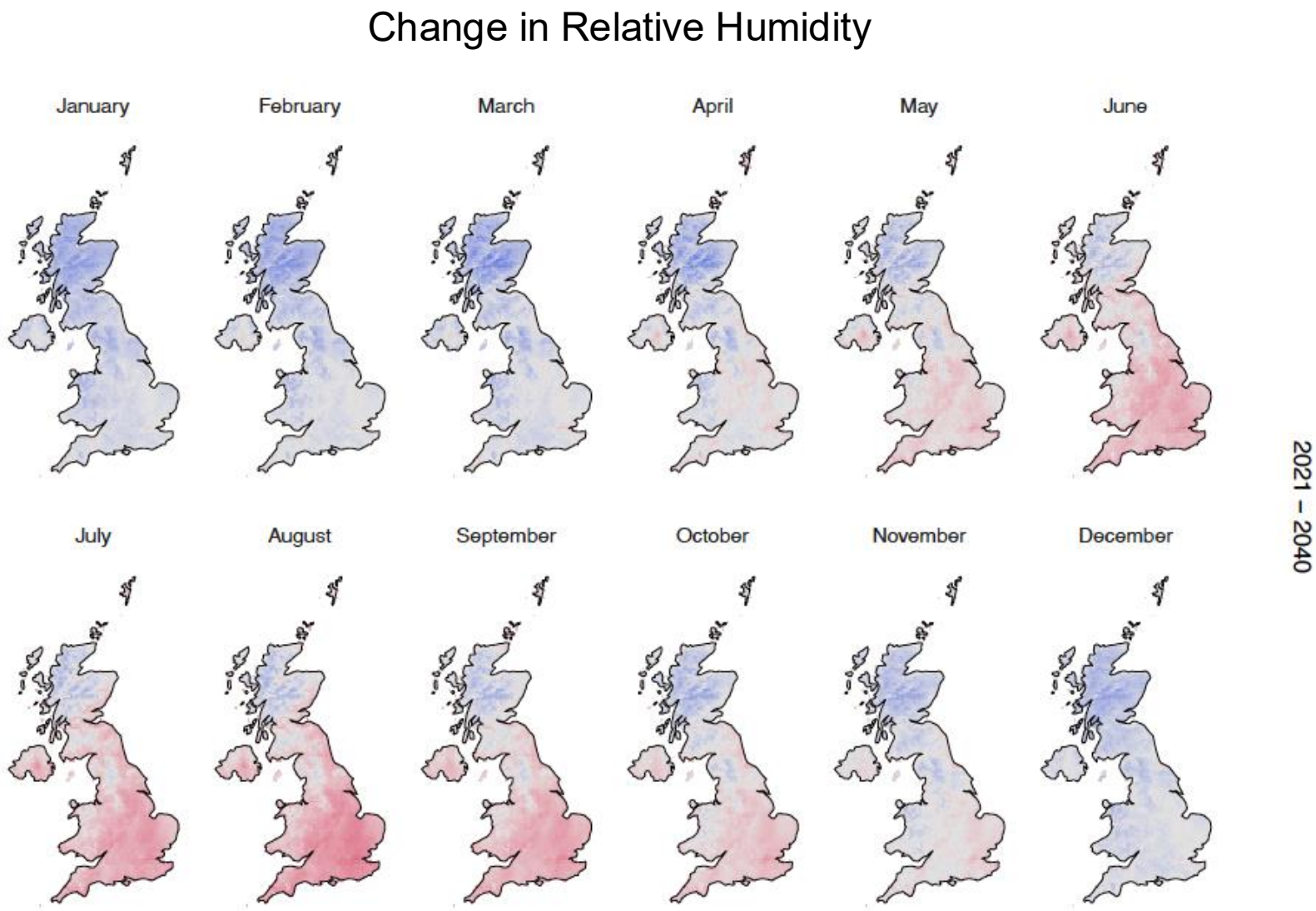
# Historical and projected yield gaps




| Crop | 2002 - 2020 | 2021 - 2040 | 2061 - 2080 |
|---|---|---|---|
| **Winter Wheat** | 21.4 | 22.8 | 24.3 |
| **Spring Wheat** | 22.0 | 20.4 | 17.9 |
| **Winter Barley** | 18.1 | 18.7 | 19.3 |
| **Spring Barley** | 10.3 | 7.5 | 6.9 |
| **Spring Oats** | 12.0 | 9.7 | 10.1 |

Raza MM & Bebber DP, in prep.

# Difference due to warmer, wetter winters and hotter, drier summers




Raza MM & Bebber DP, in prep.

# NEM EMERGE

AN INTEGRATED SET OF NOVEL APPROACHES TO COUNTER THE EMERGENCE AND PROLIFERATION OF INVASIVE AND VIRULENT SOIL-BORNE NEMATODES

https://nem-emerge.eu/

European Commission

Horizon Europe
2021-2027

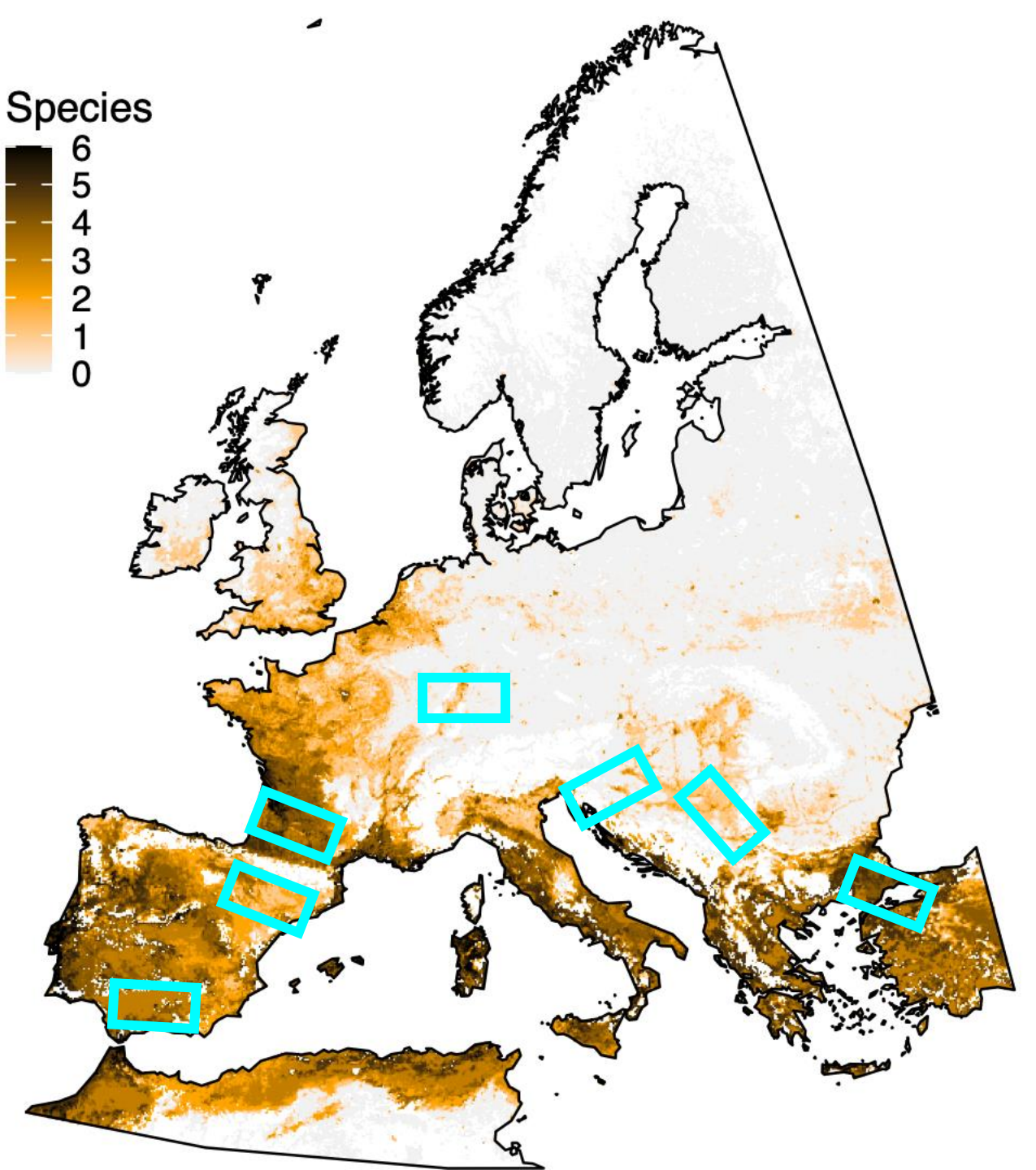
# “Tropical” root knot nematodes (RKN) are invading Europe

- *M. luci* present in Türkiye, Serbia, Slovenia, Greece, Portugal and Italy
- *M. enterolobii* also recently invasive
- *M. incognita*, *M. javanica, M. arenaria* present in Europe and expanding range
- Very wide host range
- Very difficult to control

S. Širca, KIS (Slovenia)

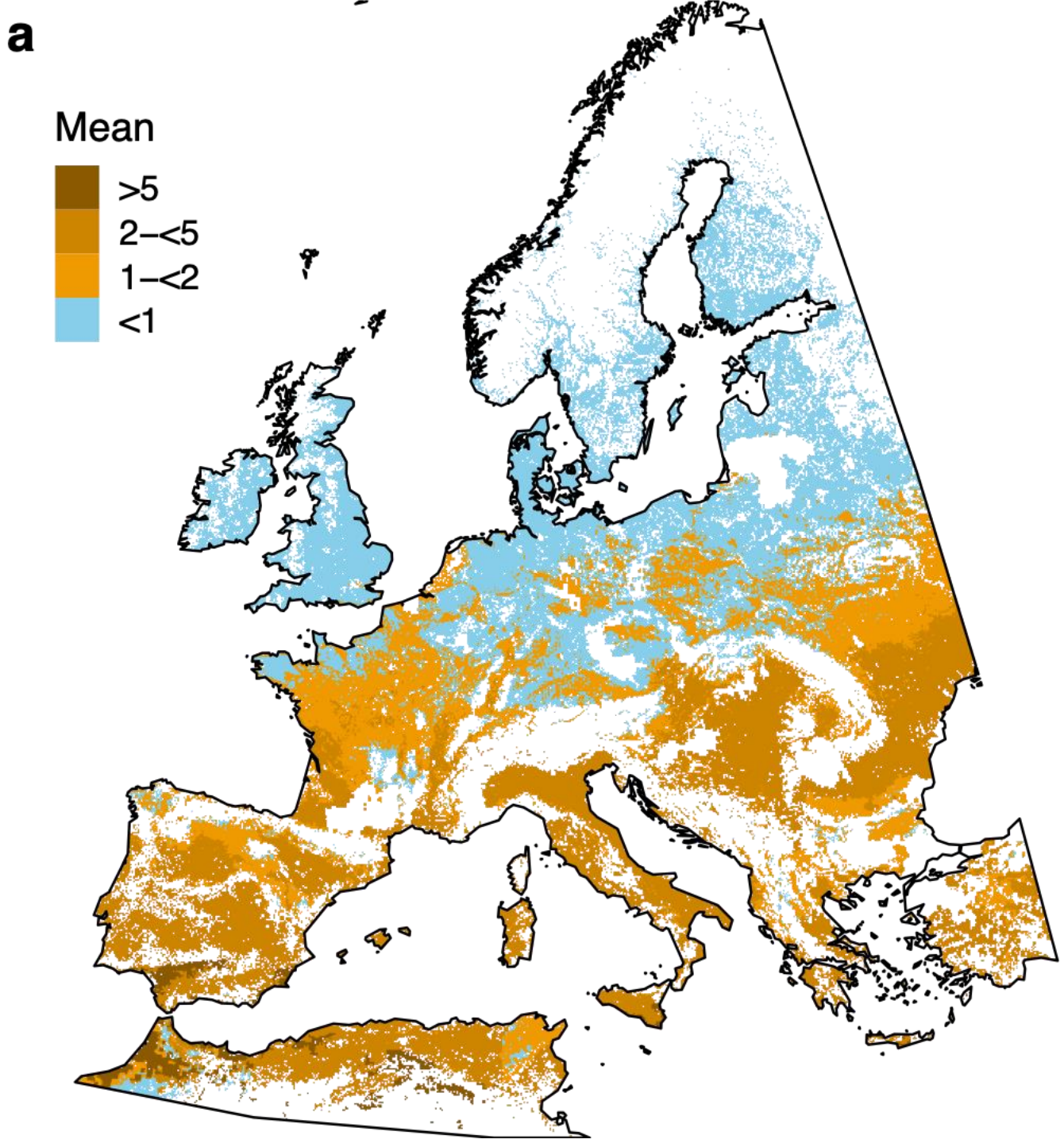
# Species Distribution Models

- Estimate suitability based on known distributions
- Focus sampling efforts on key regions
- Improve understanding of environmental and biological controls on distributions



# RKN proliferation in Europe

- Thermal time models of RKN development
- Generation completion during potato growing season
- Warming will increase risk into Northern Europe

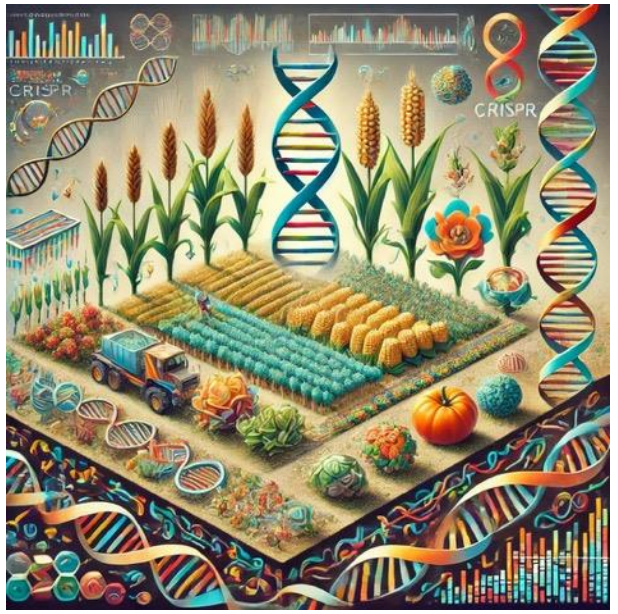


# How do we respond?

## AI

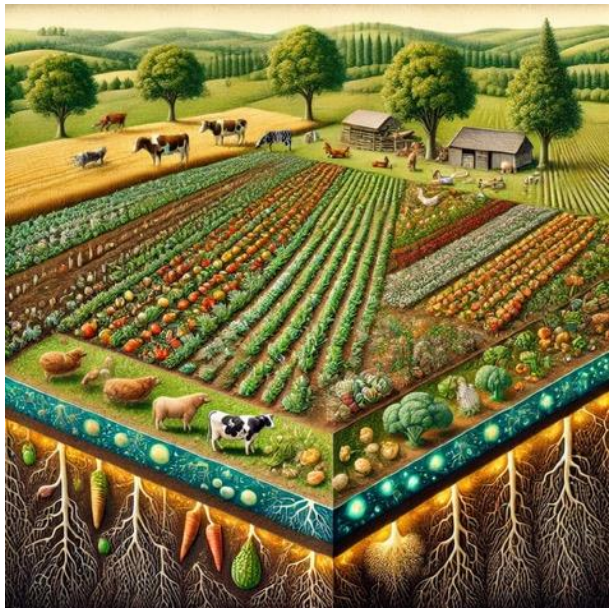

AI agents can integrate and ‘discuss’ vast data sources to identify possible solutions

## Genomics




Genetic modification and editing to protect crops without environmental harm

## Diversity



Diversification across scales provides resilience to known and unknown shocks

University of Exeter

UK Research and Innovation

RESILIENCE OF THE UK FOOD SYSTEM IN A GLOBAL CONTEXT
A Global Food Security Programme

Horizon2020
European Union Funding
for Research & Innovation

BILL & MELINDA GATES foundation

CABI

The Alan Turing Institute


- Dr. Muhammad Mohsin Raza
- Dr. Thomas Chaloner
- Dr. Eliana Torres Bedoya
- Dr. Helen Fones
- Prof. Sarah Gurr
- Prof. David Studholme
- Dr. Mohammed Dakhil
- Dr. Neil Brown (University of Bath)
- Prof. Diane Saunders (John Innes Centre)
- Prof. Hans Helder & Prof. Aska Goverse, (Wageningen University) and the NEM-EMERGE team

d.bebber@exeter.ac.uk