

Tackling the threat of wheat disease in a changing climate

Project ID: 3579

Supervisory team

Main supervisor: Prof Dan Bebber (University of Exeter)

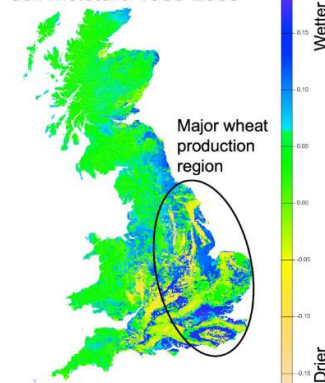
Second supervisor: Prof Kim Hammond-Kosack (Rothamsted Research)

Other supervisors: Dr Helen Eyles (nee Fones)(University of Exeter), Prof Jo Bowtell (University of Exeter)

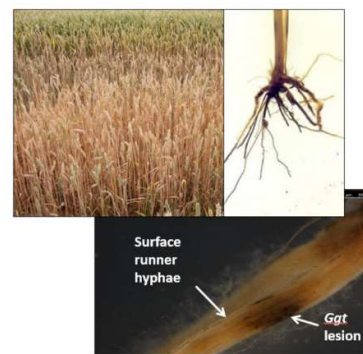
Host institution: University of Exeter

Project description: Background and SignificanceThe UK is seeing the impacts of climate change in wetter winters and hotter, drier summers. These extremes threaten food security through direct impacts on crops, and by altering crop disease risk.Take-all disease, caused by the soil-borne fungus *Gaeumannomyces tritici*, is the most serious root disease of wheat worldwide. Infection reduces nutrient and water uptake, leading to yield losses. With no resistant cultivars and

a) Projected change in winter soil moisture 1980-2080



b) Take-all disease of wheat



limited chemical control options, management is challenging. Weather extremes can exacerbate the impact of take-all.ObjectivesThis project will address take-all in wheat through four objectives:1. Map the distribution of take-all in the UK and quantify yield impacts.2. Develop a dynamic epidemiological model incorporating climate variables.3. Review global incidence in relation to climate and management.4. Investigate the role of the soil microbiome in disease suppression and explore microbiome manipulation strategies. Research PlanField surveys across the UK will quantify prevalence and severity of take-all using molecular diagnostics and field assessments, linked to yield data. The surveys will also examine cultivar differences in building up soil inoculum (take-all inoculum build-up, TAB), a key factor for disease severity in following crops.A predictive epidemiological model will then be developed to simulate disease dynamics under varying soil moisture and temperature conditions. The model will incorporate pathogen biology, including survival in crop debris and infection responses to environmental conditions. Validation against field data will allow the model to forecast disease risk under future climate scenarios.A global review will assess take-all distribution, severity, and yield impact across different climatic zones and farming systems. Special focus will be given to “dryland” and “wetland” forms of take-all, providing insights into climate-driven disease variability and the development of adaptive management practices.The final objective will explore the soil microbiome’s role in natural disease suppression. Certain beneficial fungi and bacteria are known to inhibit *G. tritici*. This work will characterise soil microbial communities across gradients of take-all severity, and test microbial inoculants and soil amendments in controlled experiments to enhance suppression. Expected OutcomesThe project will deliver a robust epidemiological model, new insights into global disease patterns, and practical microbiome-based management strategies. These outcomes will improve forecasting and mitigation of take-all, supporting sustainable wheat production under climate change. The research has direct relevance to UK agriculture and global food security, and will contribute to developing resilient cropping systems less reliant on chemical control.

Our aim as the SWBio DTP is to support students from a range of backgrounds and circumstances. Where needed, we will work with you to take into consideration reasonable project adaptations (for example to support caring responsibilities, disabilities, other significant personal circumstances) as well as flexible working and part-time study requests, to enable greater access to a PhD. All our supervisors support us with this aim, so please feel comfortable in discussing further with the listed PhD project supervisor to see what is feasible.