Uncovering the impact of multiple anthropogenic stress factors on rhizosphere plant-microbe interactions

Project ID: 3701

Supervisory team

Lead supervisors: Prof Iain Hartley (University of Exeter) & Dr Harry Child (University of Plymouth)
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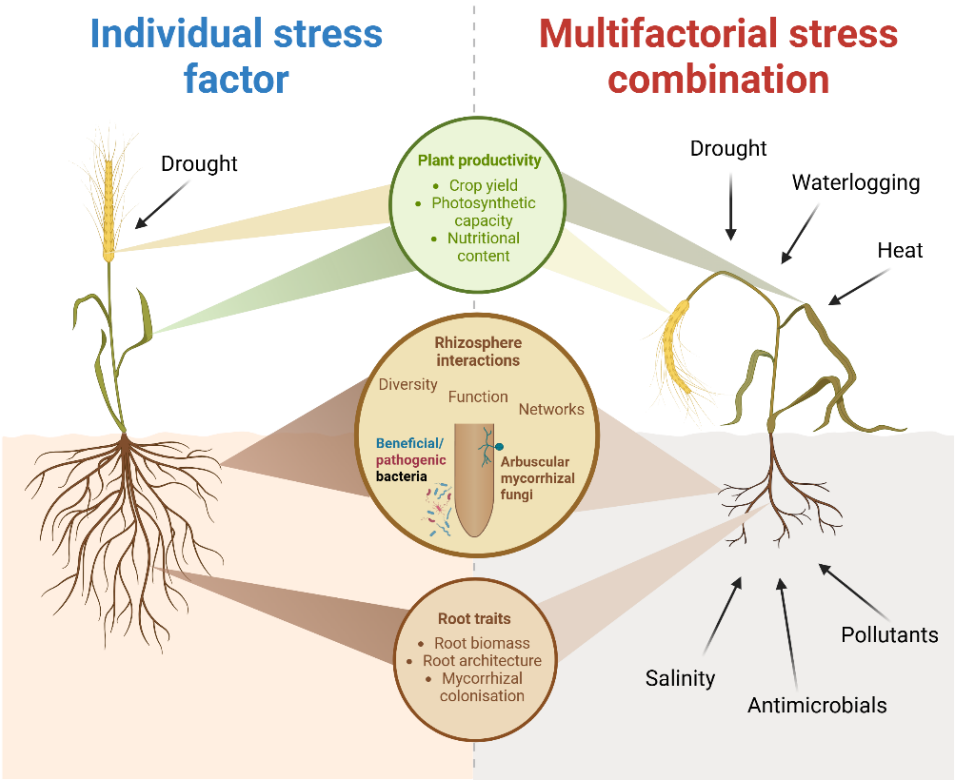
Registered institution: University of Plymouth
Host institutions: University of Exeter/University of Plymouth

Project description: Climate change and anthropogenic land use are known to impose stress factors (known as global change factors) on plants and soil microbial communities. These global change factors threaten the function, resilience and productivity of natural and agricultural ecosystems. Combined with increasing demand for agricultural productivity and declining soil health, improving the resilience of agricultural systems to these stress factors is vitally important. Simultaneous exposure to stress factors can have synergistic negative effects on plants and soil microbial communities, leading to the "multifactorial stress combination" (MFSC) principle that plant health and soil functions can decline sharply as stressors accumulate. However, multifactorial stress experiments have so far focused on soil microbial communities and plants separately.This project would bridge these fields by investigating combinations of stressors (e.g. warming, drought, soil contaminants and pesticides) at the plant-soil interface. This will address whether the intimate interactions between microbes and plant roots in the rhizosphere can buffer-against or exacerbate the response of microbial community diversity and function to combined stressors. This project will also reveal the influence of multifactorial stress on root traits and rhizosphere interactions to reveal how crops respond to stress combinations belowground, uncovering the consequences for crop health.The project: you will combine interdisciplinary methods from microbial ecology, environmental genomics, soil biogeochemistry and plant science to investigate the impacts of multifactorial stress on rhizosphere plant-microbe interactions, root trait responses and soil health. You will carry out controlled plant growth experiments, using wheat as a study system, to understand the effect of combined stress factors on crop yield and physiology. You will investigate the outcomes for rhizosphere soil microbial communities using cutting-edge sequencing and bioinformatics methods. You will monitor soil function using soil biogeochemical methods to measure soil greenhouse gas emissions and nutrient cycling. Through this work, you will learn how to use molecular biology, DNA sequencing and bioinformatics to understand complex microbial communities, while also gaining fundamental skills in experimental biology, soil science and plant science. As the project progresses, there is scope for you to direct the research questions depending on your interests, gaining experience of independent research design.This project will improve our fundamental understanding how plant-soil interactions respond to multifactorial stress, with potential implications for how agricultural management can maintain productivity and improve resilience under the pressures of global change. Continued on next page…….



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.