Project title: Plant-microbe interactions in the phyllosphere: response to hydrological change in a calcareous grassland

Project code: OU6

Host institution: The Open University

Theme: Anthropogenic Impact

Key words: climate change experiment, drought, ecosystem function

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Project Highlights:
- Frontier research in plant-microbe interactions and environmental change
- New, large-scale field-based climate change experimental platform
- Strongly interdisciplinary research linking plant ecophysiology and microbial ecology

Overview:
Modifications to the hydrological cycle are expected as part of the on-going changes to the climate-system. Climate simulations indicate both an increased frequency of extreme events, such as droughts and flooding, as well as changes to mean rainfall amount. These new climate regimes will have uncertain impacts on terrestrial ecosystems, but knowledge of how they will affect plant function and ecosystem processes remain uncertain. This project will investigate how plant-microbe interactions mediate response to both decreased and increased precipitation in a calcareous grassland ecosystem, using a new field-based climate change experimental platform (Fig. 1).

A shift to wetter or drier conditions will affect ecosystem processes, such as carbon exchange and nutrient cycling, through altering the function and properties of plants and microorganisms in the system. These changes are manifest at the physiological, organism and community scale. Understanding the links and interactions between these different scales and components is essential for predicting environmental change impacts.

Plant surfaces – the phyllosphere – are habitat for a range of microorganisms. Phyllopsphere microbial communities (PMCs) can be beneficial to plants through facilitating adaptation to changing environmental conditions, but they can also impair function or act as pathogens. Through altering plant function, the impact of phyllosphere communities may extend through to ecosystem processes such as carbon, water and nutrient cycling.

However, the response of phyllosphere communities to climate change conditions, and how these responses are affected by and feedback on plant host responses, has received little attention to date. Available evidence does indicate that water availability and drought do alter phyllosphere community structure, but overall we have a very poor understanding of how plant-microbe interactions in the phyllosphere influence the overall response to environmental change. The aim of this project is to take an integrated look at ecosystem response to environmental change to determine what role these interactions have in mediating plant and ecosystem resilience to hydrological change. Research will be conducted at a new climate-change experimental platform on a calcareous grassland, where rainfall...
manipulation both decreases and increases incident precipitation by 50% relative to ambient conditions.

Methodology:
The study site is a lowland calcareous grassland at the Wytham Upper Seeds Experimental site, near Oxford. Rainfall manipulation is performed using 5 m x 5 m rain-shelters and coupled irrigation systems to impose long-term drought and wetting treatments on replicated blocks. Phyllosphere community structure will be investigated using high throughput sequencing of PCR amplified ribosomal RNA genes obtained from phyllosphere DNA. Amplicon data will be analysed using bioinformatics pipelines and multivariate statistical approaches to assess how experimental/environmental parameters affect microbial community composition in the phyllosphere. Key functions provided by phyllosphere microbial communities will be assessed using targeted functional marker approaches and/or metagenomic/metatranscriptomic methodologies. Field campaigns will be conducted over the growing season to collect samples and measure leaf functional traits (e.g. photosynthetic rate, water status, leaf chemistry). Continuous measurements of meteorological variables and soil-water status are available on site.

Training and skills:
The student will receive full training in all necessary field, laboratory and molecular biology techniques and instrument use. The student will acquire specific skills in conducting field-based research and maintaining long-term experimental infrastructure; microbial ecology and molecular biology; plant ecophysiology; and scientific communication and networking. They will also be encouraged to undertake training in ecological statistics or modelling relevant to the data analysis that will be required.

CENTA students are required to complete 45 days training throughout their PhD including a 10 day placement. In the first year, students will be trained as a single cohort on environmental science, research methods and core skills. Throughout the PhD, training will progress from core skills sets to master classes specific to CENTA research themes.

Partners and collaboration (including CASE):
There will be the opportunity for collaboration with other students involved in this long-term climate-change experimental platform, including from the OU and Oxford University. The project will also link with the Drought-Net international network, providing the opportunity to join a network assessing responses of multiple types of ecosystems within an explicitly comparative experimental context.

Possible timeline:
Year 1: Literature review, instrument and technique training, first season fieldwork and analyses.
Year 2: Second season fieldwork, preparation of manuscript on microbial community composition and controlled experiment.
Year 3: Final season fieldwork, write up thesis, presentation of results at international conference and second manuscript on controlled experiment.

Further reading:

Further details:
We invite applications from students with a strong background in plant, soil or microbial ecology or physiology, an interest in global change processes and an enthusiasm for field work and independent research. Experience in experimental design and data analysis desirable. Clean driving licence preferred. The student will join a well-established team researching ecosystem processes at the Open University.

Please contact Kadmiel Maseyk for further information kadmiel.maseyk@open.ac.uk

Applications should include:
- a cover letter outlining why the project is of interest and how their skills match those required,
- an academic CV containing contact details of three academic references
- a CENTA application form, downloadable from www.centa.org.uk/media/1202/centa-studentship-application-form.docx
- and an Open University application form, downloadable from: http://www.open.ac.uk/students/research/sites/www.open.ac.uk.students.research/files/documents/Application%20form.docx

Apologies that some bits of information are requested multiple times on different forms. Please fill in everything requested.

Applications should be sent to STEM-EEES-PhD-Student-Recruitment@open.ac.uk by 5 pm on 25th January 2017