Invisible Diversity: The effects of plant genetic diversity on soil functioning

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Introduction:

Biodiversity is central to the maintenance of ecosystem services, such as primary production, carbon storage, and nutrient cycling. Plant species diversity can be easily assessed with the naked eye and its importance for ecosystem functioning is well established. Genetic diversity within species can only be assessed with molecular tools, but evidence suggests that this invisible diversity may play an equally important role in enhancing productivity, litter decomposition and resistance to natural enemies (Schweitzer et al. 2005; Crutsinger et al. 2006; Tooker & Frank 2012). The mechanisms linking within-species diversity with ecosystem functioning are still poorly understood. This project will explore a novel mechanism by which within- species genetic diversity may affect ecosystem functioning: new evidence shows that plants can detect their neighbours via root exudates and respond by shifting resources between growth- and defence-related functions depending on the genetic diversity of their neighbourhood (Semchenko et al. 2014, 2017; Abakumova et al. 2016). Such changes in plant function are likely to cascade through the food web affecting soil microbial communities and nutrient cycling, which ultimately underpin important ecosystem services.

High (upper panel) and low diversity plots (lower panel) at Park Grass experiment

Project Summary:

The aim of this project is to investigate a) how plants respond to the presence of genetically identical *versus* diverse neighbours, and b) what are the consequences of these changes for soil microbial communities, litter quality and decomposition, and the feedback between plants and soil microbiota. The

student will be engaged in highly multidisciplinary research and will perform a series of lab and common garden experiments using clonally propagated genotypes of sweet vernal grass (*Anthoxanthum odoratum)* collected from the longest running fertilization experiment in the world, Park Grass at Rothamsted established in 1856. This unique collection of genotypes spans a wide range of heritable differences in plant function and will be used to test plant responses to exudates collected from the same, different or a mixture of genotypes and how nutrient cycling is affected by plant genetic diversity via differences in organic matter quality and root exudation. The student will have access to state-of-the-art facilities in the newly formed School of Earth and Environmental Sciences and will be trained in a wide range of techniques used to measure carbon and nitrogen cycling, plant functional traits, exudate profiles and microbial processes, as well as advanced statistical data analysis.

References

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