Manipulation of the rhizosphere and modification of micronutrient uptake by parasitic plants

Supervisors: Jennifer Rowntree (FLS, The University of Manchester), Jon Lloyd (SEAES, The University of Manchester), Richard Pattrick (SEAES, The University of Manchester)

Contact: jennifer.rowntree@manchester.ac.uk

Turf cut from a grassland where *Rhinanthus minor* is growing

Introduction: Grasslands form one of the most extensive biomes covering the terrestrial surface of the planet. They are arguably one of the most human-utilised habitats on earth and are not only important as agricultural areas, but also as repositories for biodiversity. In the UK, the parasitic plant *Rhinanthus minor* is a common component of many grassland habitats, where it is a keystone species and ecosystem engineer. Presence of *R. minor* is known to change above ground plant species diversity and influence the below ground environment.

Rhinanthus minor is a root parasite and forms specialised structures called haustoria on the roots of its hosts. Infection with the parasite reduces host root biomass but also has the potential to change the exudate patterns in the rhizosphere. Root exudates are an important source of food for the soil microbial community and are thought to influence the exchange and availability of key macro and micronutrients in the soil. Micronutrients include many metallic compounds from elements such as Iron, Copper, Manganese, Molybdenum and Zinc, and are essential for successful growth and survival of plants.

Project Summary: The aim of this project is to determine how infection with the parasitic plant *R. minor* changes the pattern and composition of root exudates of a number of common host plants, and how this in turn might affect the rhizosphere microbial community and the speciation and uptake of metals in grasslands. In addition to increasing the understanding of the role of micronutrients in key ecosystems, this project has applications for the restoration of contaminated land.

Rhinanthus minor haustoria attached to a potential host root.

We will sample *in situ* in natural grasslands and use complementary manipulative experiments to determine the effect of specific host-parasite combinations on the rhizosphere microbial community, below ground biomass production and the uptake, concentration and speciation of specific metals. We will use a combination of genetic and genomic technologies (including next generation sequencing) to characterise the microbial (bacterial, archaeal and fungal) communities, metabolomics analyses to determine root exudate composition, functional gene analysis and synchrotron techniques to determine metal concentration, speciation and uptake in the plant-soil environment.

Dr Rowntree will provide training in the design, establishment and maintenance of glasshouse and field based experiments, and in the statistical analysis and interpretation of resulting data. Training will also be provided in state of the art techniques to determine root exudate composition. In collaboration with Professor Lloyd, Dr Rowntree will provide training in genetic and genomic techniques for assessing the rhizosphere microbial communities and functional gene analysis. This includes the subsequent processing and interpretation of the data produced. Professors Lloyd and Pattrick will provide training in synchrotron techniques for measuring speciation and uptake of metals in the plant-soil system.

References:

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