Plant-Soil Microbe interactions

Innovative techniques and new leads for improved plant defence and nutrition.

The Technology
The plant root-soil microbe interaction is critical to plant health and economic yield, however, due to its nature has been very difficult to study. Recent breakthroughs in next generation sequencing and metabolomics, together with the recent development of the first cDNA microarray for soil microbial communities by Professor Schenk’s group, have provided a great opportunity to understand this interaction at both the genetic and biochemical level.

Professor Schenk and his team are using a holistic approach to identify targets and develop bioactives for controlling/stimulating plant-soil microbe interactions. The group simultaneously analyses plant gene expression, plant-microbe chemical interactions, and microbial community gene expression (metatranscriptomics). The innovative methods being deployed by Professor Schenk and his team have opened new doors into understanding the soil microbe communities, their interactions with plants, and how to leverage this knowledge to improve crop production. Important novel genes and compounds are being identified and evaluated for their ability to improve soil health and increase resistance to soil pathogens and disease through plant-soil microbe interactions.

Competitive Advantages
99% of the soil microbial community is unable to be cultured, therefore the key interactions that contribute to plant defence and nutrition remain largely unknown.

The first to understand these complex systems will be positioned to capitalise on a raft of potential new technologies and applications.

Applications

Exogenous treatment of plants to manipulate soil microbial communities
Research in Prof Schenk’s lab has shown that bacterial composition in the soil is affected by activation of the plant’s naturally induced systemic resistance system. From this the team is aiming to develop plant defence elicitor products against a broad range of pathogens and pests; Alleviation of abiotic stress; and Improvement of plant nutrition by enriching plant growth promoting microbes.

Isolation and testing of new beneficial microbes
novel biocontrol agents; novel plant growth promoting microbes (PGPR).

Identification of new antimicrobial and insecticidal compounds
Novel antimicrobial compounds; novel insecticidal compounds; novel biocontrol peptides; novel transient RNAi technologies.

Discovery of new resistance genes
Novel antimicrobial genes; novel insecticidal genes

Direct soil treatment to manipulate soil microbial communities
Direct application of plant defence elicitors have been shown to have effects on soil bacteria. Prof Schenk and his team are evaluating opportunities to treat soils with bioactives to improve microbial communities for increased nutrition and disease resistance.

Use of root exudates to manipulate microbial communities
Research has shown that exudation of specific proteins by plants can confer resistance against bacterial pathogens and nematodes. Prof Schenk and his team are investigating opportunities to develop varieties that release specific exudates for: attraction of beneficial microbes for nutrition and disease resistance; and allelopathic compounds to control weeds.

Commercialisation opportunities
UniQuest Pty Limited, the main commercialisation company of The University of Queensland, is engaging with commercial partners to form research partnerships to realise and develop findings from this project.
Prof. Peer Schenk

DISEASE RESISTANT PLANTS:
Prof. Schenk and his team use a Functional Genomics and Biodiscovery approach to study beneficial and parasitic interactions of plants with microorganisms.

MICROBIAL COMMUNITIES ASSOCIATED WITH PLANTS:
Prof. Schenk and his team use are using molecular profiling tools, such as functional gene microarrays and next generation sequencing, to characterise highly diverse microbial communities that are associated with plants to identify novel compounds for agricultural applications. This environmental transcriptomics (metatranscriptomics) approach captures microbial activity profiles with direct implications for crop cultivation (e.g. soil-borne diseases, greenhouse gas emissions, yield increase or decline).

BIOFUEL PRODUCTION FROM ALGAE:
Prof. Schenk and his team use house a collection of Australian microalgae strains that are highly efficient producers of biodiesel and use a special non-GM breeding technique to further improve their performance. Cutting-edge molecular biology tools are used for metabolic engineering.

Relevant Publications


