Boosting Plant-microbiome Interactions to Increase Plant Productivity

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Overall Aim

- ✓ To better understand how beneficial microbes can be applied, maintained and recruited in order to improve plant nutrient uptake and disease resistance
- ✓ To use this knowledge to develop new agricultural practices for increased crop yields

Beneficial plant-associated microorganisms play an important role for nutrient acquisition, disease suppression and alleviation of abiotic stress symptoms for crops. These associations have been repeatedly proposed to offer solutions to improve crop yields, but their performance was often inconsistent under field applications. We have recently identified several of the microbial, environmental and plant-mediated factors that determine the variability in performance of microbial biofertilisers and biopesticides. We have shown that with microbial biofertilisers, up to four times more biomass can be produced in some genotypes, while plants grown under axenic conditions (without microbes) only had half the yield.

Our team specialises in the following emerging management strategies:

- ✓ **Biodiscovery of New Microbial Bio-fertilisers and Bio-Pesticides**
- ✓ **Identification of new bioactive natural compounds to control crop disease.**
  (Focus: Control of soil-borne *Phytophthora* and *Fusarium*; Control of leaf pathogens by phyllosphere microbes).
- ✓ **Customised use of beneficial microbes to best match local soil and environmental conditions.**
- ✓ **Development of plant-optimised mircobiomes by microbiome engineering, microbiome breeding and microbiome transplanting.**
- ✓ **Selection and Molecular breeding of microbe-optimised crop cultivars.**

Our applied research is directed to develop new management strategies that improve plant nutrition and/or suppress disease by altering the composition of root and leaf-associated microbial communities. This includes the use of new antimicrobial compounds and disease-suppressive microorganisms. We also breed optimised microbiomes and then transplant these to crops for immediate yield increases, treat plants with signalling chemicals to bioengineer their rhizosphere microbial community, and screen crop cultivars for optimal plant-microbe interactions that lead to increased crop yields and resilience.

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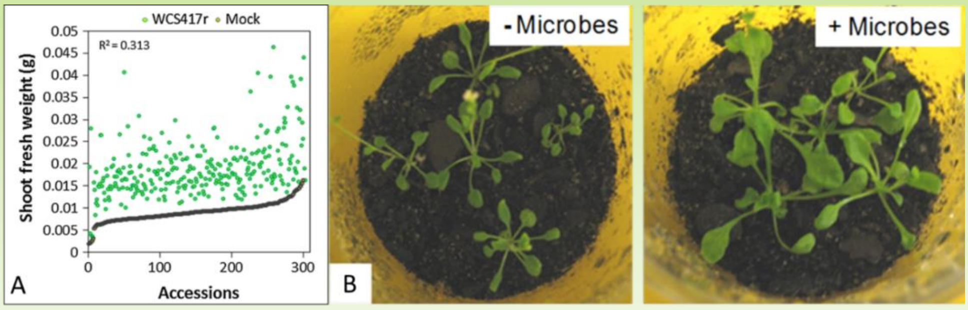
Examples:

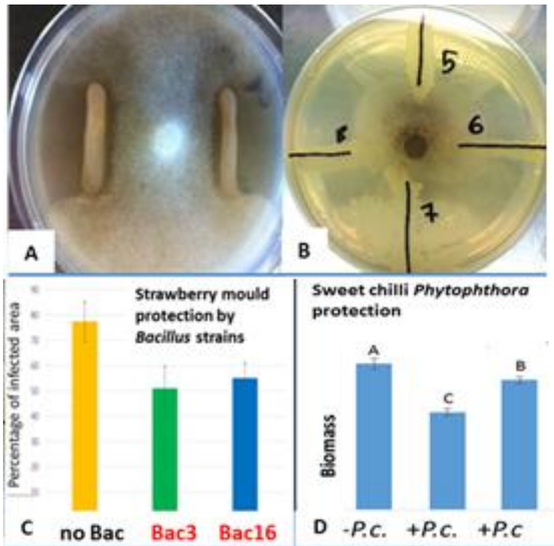
Biomass Increase in the Presence of Growth-Promoting Microbes



(A) Plants with bacterial biofertiliser Pseudomonas simiae WCS417r produced up to four times more biomass (green dots) in some genotypes compared uninoculated plants (black dots).

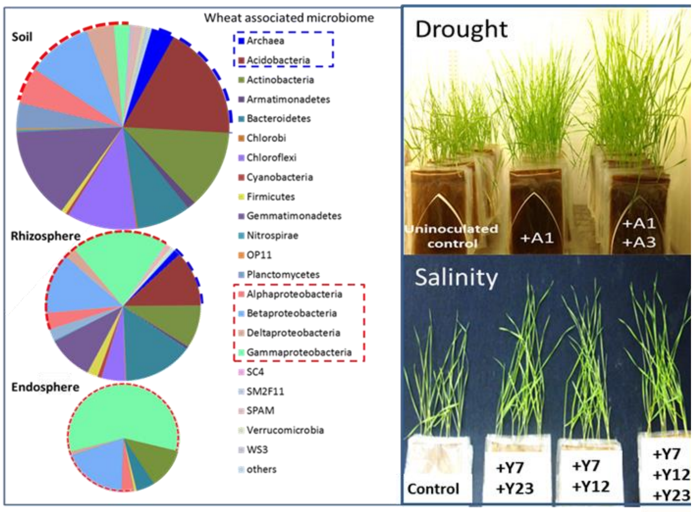
(B) Plants grown under axenic conditions (without any microbes) only had half the yield, demonstrating the potential to increase yields and the necessity to match beneficial microbes to cultivars.

Microbial Bio-Pesticide Discovery Platforms



A. Bioinoculum AX inhibiting Phytophthora; B. Bacillus amyloliquefaciens UQSF inhibiting Aspergillus; C. Dipping significantly increased the shelf life of strawberries; D. AX1, the bioactive compound identified in Bioinoculum AX protects sweet chilli plants against Phytophthora.

Microbiome Profiling and Bioinoculant Discovery Platform For Abiotic Stress Tolerance



Abiotic stress tolerance is often enhanced by synergistic bioinoculants

For recent references see: http://www.schenklab.com/publications/