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Remote beneficials in soil; potential role of bacterial volatiles in suppression of soil-borne fungal pathogens

General disease suppression (GDS) in agricultural soils is attributed to nutrient competition within the microbial community. So far, the withdrawal of nutrients by non-pathogenic microbes from soil or even from pathogen survival structures (e.g. spores) has been considered as the main mechanism by which pathogens are restricted in their ability to infect roots. However, besides nutrient deprivation (substrate competition), also inhibitory compounds released by microbes (interference competition), are found to contribute. As a consequence, not only the total soil microbial metabolic activity but also microbial species that produce inhibitory compounds, are involved in GDS. The relative importance of interference competition in GDS, and thus the relative importance of microbial community composition, is not yet known.

Antimicrobial volatile organic compounds, emitted by soil bacteria, might be important candidates based on their ability to diffuse through the soil network. Antifungal volatile production has been shown for a broad range of bacterial phyla; 30-60% of the soil bacteria can produce inhibitory volatiles (Wheatley 2002; Zou 2007). Our experiments aim to test the effect of these volatiles on the growth of fungal plant pathogens and the ability to infect plant roots.

Results of these experiments show a strong reduction of mycelial density of fungal pathogens by volatiles emitted by soil bacteria in suppressive soils whereas in soils conducive to disease no growth reduction was observed. Bioassays were performed to link the observed reduction in pathogen growth to crop infection. These correlated with volatile growth reduction thus showing a potential role of volatiles in both pathogen suppression and reduction of disease incidence. GC/MS analysis and 454 sequencing and were performed to identify the inhibitory volatiles and potential volatile producing bacterial taxa.