Fishing for New Crop-Benefiting Soil Bacteria through Plant-Microbe Interactions

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The world is facing a serious food crisis due to increasing population, intensive farming, and environmental stressors such as drought. More effective and environment-friendly farming technologies are urgently needed. Crop-beneficial soil microbes are a promising alternative to chemical fertilizers and pesticides that have adverse effects on the environment and human health. This project aims to discover new crop-benefiting microbes that increase plant growth and its tolerance to drought using wheat as a fishing tool. I hypothesized that plant-microbe interactions allow the plants to select microbes beneficial to them. Soils were selected from an agricultural plot (Agr-M), an organic farm (Org-M), and a non-agricultural forest (TWDEF) in northern Utah. Cultivable microbes from these soils were applied to wheat. The Org-M or Agr-M microbes showed better effects on CO2 assimilation in wheat than the TWDEF microbes or sterile water (control). Nine root-colonizing bacteria, GZR1-R9, were isolated and identified using 16S rRNA sequences. For wheat grown with normal hydration, GZR4-R5 (Org-M isolates) and GZR7-R9 (Agr-M isolates) increased the CO2 assimilation rate by 18%-65%. After a drought stress, the wheat colonized by GZR8 and GZR4 had higher CO2 assimilation rates (107% and 252% than the control). The water transpiration rates with GZR4, GZR5, GZR7 or GZR9 were about 200% greater than the control. GZR4, a Pseudomonas species, was the most promising strain in enhancing both the CO2 assimilation and drought tolerance in wheat, and thus has great potential for agricultural applications. This finding demonstrates the success of the fishing method to isolate new crop-beneficial strains.

Awards Won:
University of Arizona: Renewal Tuition Scholarship