Can engineering plant-compatible bacteria enhance nutrient availability to the plant?

More than half of global agricultural soils lack the macronutrients potassium, phosphorus, and nitrogen required for full plant productivity and health. Deficient plant nutrition increases plant susceptibility to climate instability, including drought and temperature extremes. Agriculture contributes over $70 billion annually to Georgia's economy, highlighting the importance of sustainable soil productivity.

Currently, fertilizers used to supply essential nutrients involve significant purchasing costs, investments in application equipment, and environmental risks due to misuse and nutrient runoff. However, many soil microbes naturally possess the ability to fix nitrogen from the atmosphere through the nif operon, while others can solubilize phosphate and potassium ions from soil minerals via characterized gene clusters. Nonpathogenic pseudomonad isolates exhibit some of these beneficial traits. We propose to determine whether a plant-associated bacterium, *Pseudomonas putida*, can be engineered to express a combination of these functions. Growth studies would assess whether such an engineered strain enhances plant development in nutrient-deficient soils.

The use of plant-beneficial microbes represents a sustainable and ecologically sound approach to improving plant nutrition in poor soils. Implementation of this synthetic biology strategy could reduce reliance on chemical fertilizers and contribute to improved food security worldwide.