Creating Highly Efficient Auxin-Producing Soil Bacteria to Promote Crop Growth

Zhan, Gary (School: Logan High School)

Currently, more than 800 million are food insecure. While chemical growth promoters are widely used to enhance crop production, they have caused serious environmental pollution and adverse health effects to humans. Novel agricultural biotechnologies are urgently needed to promote crop production in a sustainable manner. Soil bacteria have potential to benefit crops in various ways, such as releasing indole-3-acetic acid (IAA), a plant auxin. However, soil bacteria naturally produce this compound at very low yields, limiting their impact on crops. This project aimed to create highly efficient IAA-producing soil bacteria to promote crop growth. The underlying hypothesis is that IAA biosynthetic genes can be discovered in the IAA-producing soil bacterium Pseudomonas chlororaphis O6 (PcO6) and overexpressed in a non-IAA-producing strain to efficiently produce the plant hormone. Through genome analysis, two putative IAA biosynthetic genes were identified from PcO6. These genes were functionally expressed in the model soil bacterium Pseudomonas putida KT2440 and confirmed to synthesize IAA from L-tryptophan. This result not only allowed for the identification of the IAA biosynthetic genes in PcO6, but also yielded a promising IAA-producing strain. Introduction of a novel tryptophan transporter into the system further increased the titer of IAA to 11.7 g/L (~1,100-fold higher than PcO6), representing an extremely efficient IAA-producing strain. Moreover, the engineered strains can produce IAA even without the use of an antibiotic. This study thus culminated in the creation of novel IAA-producing strains and provides an innovative approach to construct efficient auxin-producing soil bacteria for agricultural applications.

Awards Won:
Third Award of $1,000