

Root Engineering:
A Strategy for Agriculture in Marginal Areas of Cultivation

Finding ways to improve productivity in marginal agricultural lands is the driving force of our research program. Enhanced root mass is expected to increase crop biomass and seed yields, making the root system an extremely attractive candidate for engineering crops to step up productivity.

Through the overexpression of a plant H⁺-PPase we have engineered plants (Arabidopsis, tomato, rice) that can grow in the presence of toxic levels of salts, develop very robust root systems and therefore resist extended drought and thrive in marginal soils. We have been able to demonstrate that the H⁺-PPase is not only involved in vacuolar pH homeostasis but that in addition controls auxin transport and consequently auxin-dependent development (i.e., root systems).

Projects in which SOLUR students could participate:

First, we are characterizing the effects of type I H⁺-PPases on root system development and define their mode of action at the molecular and cellular level using Arabidopsis and rice as models.

* We are testing if the localization (i.e., tonoplast, endosomes, plasma membrane) of plant H⁺-PPases is tissue dependent and if it varies with developmental and/or environmental cues.

* We are looking for H⁺-PPases interacting proteins (i.e., kinases, phosphatases, 14-3-3) that would regulate their activity and/or intracellular localization.

Second, we are characterizing the effects of H⁺-PPase over-expression on candidate crops for enhanced food and fuel production, i.e., rice, corn, sweet sorghum, medicago, alfalfa, and cotton. Third, we are using genetic engineering for gene pyramiding in order to introduce several quality characters that could result in a further improved genotype (i.e., co-expression of H⁺-PPases and vacuolar Cation/H⁺ exchangers, and/or H⁺-PPases and plasma membrane Cation/H⁺ exchangers).

Requirements:
Curiosity and willingness to learn.

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