90. Developing Synthetic Biology Tools to Improve Nutrient Acquisition of Energy Crops

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http://www.jbei.org/research/divisions/feedstock/cell-wall-engineering/

Project Goals: The main goals of this research are the generation of "universal" expression tools for plant root engineering and to utilize them to improve crop nutrient acquisition.

Plant growth is highly dependent on it root system since it anchors plants to the ground; it is responsible to acquire all essential mineral nutrients and water; and it has an important role in plant-rhizosphere interactions. The first green revolution has been mainly driven by the use of fertilizers since deficiency of any essential mineral elements (e.g. N, P, K) negatively impacts photosynthesis and plant growth. Unfortunately the excessive use of N-fertilizers has come at high environmental and economic costs; and its production utilizes a substantial proportion of worldwide energy consumption. The current development of dedicated crops for energy production that can be grown on marginal lands will reduce competition with food products and the pressure on high-quality arable lands utilization. Even if energy crops are selected for their ability to grow on marginal lands, it is important to note that these lands are not suitable for food crop production because the poor quality of the soil (e.g., poor nutrient availability, low water content, vulnerability to erosion, and, heavy-metal pollution) abates their yield potential. Therefore, even if bioenergy crops are better adapted than food crops to grow on marginal lands, they will most likely not reach their full yield potential without fertilizer application unless they are further optimized for growth with low nutrient availability.

Our current focus is to design "universal" expression tools that are functional across widely diverse plant species, and to utilize them to engineer metabolic pathways, which will be designed to optimize nutrient acquisition by energy crops. We expect that the results of this research will generate a diversity of building blocks for plant engineering and will directly contribute to advance the DOE's mission for the sustainable production of bioenergy.

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