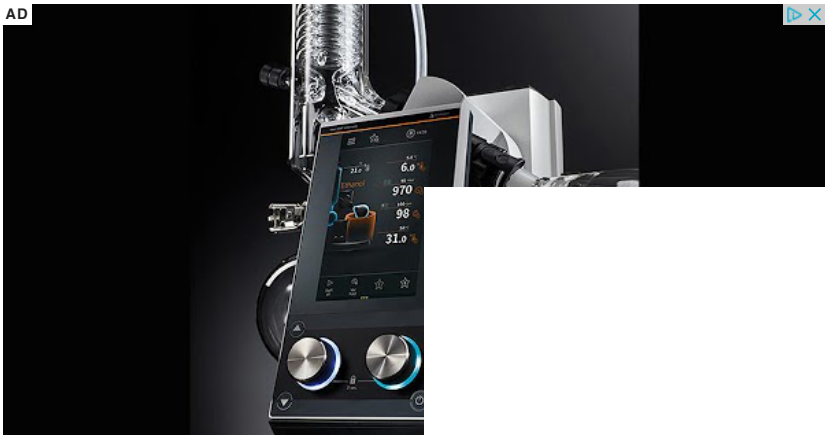
BIOLOGY

Engineering plants for better root microbiomes would unlock land for staple crops

David Szondy (https://newatlas.com/author/david-szondy/) | July 10th, 2019

Engineering plants that can better absorb iron from alkaline soils could open up large swathes of currently unsuitable land for staple crops like corn (Credit: Smileus/Depositphotos (https://depositphotos.com/20087015/stock-photo-sunlit-young-corn-plants.html))

A Stanford University team led by associate professor of chemical engineering Elizabeth Sattely is developing genetically engineered plants that can better absorb iron from the soil. By making it easier to ingest the trace mineral, it may be possible to open up the roughly one-third of the world's arable land that is unsuitable for growing staples like maize and soybeans.



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Growing crops is much more than water, sunshine, and the right climate. It also requires the plants getting the right soil nutrients in order to sprout, grow, and mature. The problem is that not only do the nutrients need to be present in the soil, they need to be in a form that the plants can use.

For example, there may be plenty of iron in the soils in arid regions like the western United States, but these soils are often highly alkaline, sealing the iron in what the Stanford team calls a "chemical lock." However, some plants, like *Arabidopsis thaliana*, a relative of cabbage and mustard, can absorb iron from the soil thanks to the ability of its roots to secrete coumarin – a simple aromatic organic molecule that picks the chemical lock and frees the iron.

The key to this is colonies of bacteria called microbiomes that live around the roots and produce the coumarin in a way analogous to how colonies of bacteria in the human gut aid digestion. The team also found the secretion of coumarin molecules could also benefit the plants by driving off certain bacteria, leaving the iron they would otherwise consume available for the plant.

In order to better understand this mechanism, the Stanford team hydroponically grew *Arabidopsis* plants in water with a chemical and mineral content similar to that of alkaline soils. To this, various strains of bacteria were added and how well the plants grew was measured.

The hope is that the hydroponic technique will help the researchers gain a full understanding of the coumarin adaptation so that plants such as wheat, maize, soybeans, and other crops can be engineered to grow in alkaline soils. This would be done by either direct bioengineering or by splicing natural genetic traits from one organism to another.

"We may be able to take traits developed through natural selection and move them where we need them," says Sattely, who added, "what we

envision is a new type of ecologically savvy crop science."

In the future, the team could also look to subject plants to different hydroponic pseudo-soil environments to see if they can adjust their microbiomes to deal with other deficiencies, such as soils that lack nitrogen.

The research was published in *PNAS*. (https://www.pnas.org/content/116/25/12558.abstract)

Source: Stanford University (https://engineering.stanford.edu/magazine/article/new-way-grow-crops-marginal-soils-could-help-feed-world)

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