Tropical Wastelands to Croplands with Biotech

By Dennis T. and Alex Avery, Hudson Institute

Imagine Africa feeding itself comfortably, instead of being overwhelmed by its own expanding population. Imagine millions of tropical consumers being fed without clearing more forests, thus protecting the wildlife in the very regions where most of the species of the world live and are critically threatened by population pressure. Suddenly, high-yield conservation for the tropics may not be a pipedream.

Half of the world's tropic croplands suffer from aluminum toxicity that forces crop plants to shut down their growth. Grains and oilseeds produce meager yields—and scientists haven't even known why. The resulting low yields and food scarcity have stifled the tropics' efforts in health care, technology, and economic growth. At the same time, tropical farmers have been forced to clear more forest to grow enough food for their families displacing the wild species that make the forests their home.

Now genetic engineering—and only genetic engineering—has found a potentially massive food production breakthrough: crop plants that can ignore the aluminum toxicity and produce ample yields on huge tracts of tropic land that now produce little except stunted shrubs.

University of California/Riverside's Dr. Paul Larsen, while screening mustard plants for their ability to grow despite toxic aluminum, discovered a simple mutation to a single gene that lets plants thrive in spite of the aluminum. He was able to shut down a gene called AtATR and the plants ignored the toxic aluminum warnings from their roots.

"We have all these crop plants—wheat and corn and barley and so on—that didn't evolve or get developed on aluminum-toxic soils," says Larsen. Plant breeders have tried to cross-breed varieties that cope better with the aluminum, but there has been little progress. Larsen's work dangles the potential of a vast improvement, quickly. "It theoretically will eliminate the big acid-soil yield penalties in any plant species," he says.

Larsen says the plants "are really worried about the long-term damage aluminum toxicity could cause to their DNA over many generations." But that thousand-year problem doesn't mean much when modern seeds can be bred—and even grown out—on non-toxic soils and delivered to farms in the acid soil regions. Larsen says even after growing five generations of his mutant plants on aluminum-toxic soils, there are "no obvious deleterious effects on growth, viability, [or] seed production."

The transformation itself is one of the simplest in biotechnology. The scientists just block the gene that codes for aluminum sensitivity. No foreign genes are added.

“It’s a potential magic bullet, depending on how society decides to use it,” says Larsen. “My dream is to see in my lifetime highly productive food crops growing on soils that didn’t use to be able to support them, so more poor people can eat well. For that, it has massive potential. If we use (this technology) instead to produce a bit more biofuel on cleared forest land—for a huge fuel demand cropland can’t meet—it could be terribly negative.”

Larsen did his original experiments with Arabadopsis, an easily-manipulated member of the mustard family. He’s now seeking the funding to transform tomatoes, and ultimately a whole range of food crops.

He also notes that other researchers have engineered plants that prevent aluminum invasion by secreting citric acid from their roots. The negatively-charged acid binds with the positively-charged aluminum so the aluminum can’t get into the roots. “We might combine my strategy of by-passing the aluminum toxicity with the aluminum-blocking strategy to create a family of tropical super-crops,” he says.

Will this new breakthrough finally force the Green movement to recognize the vital potential of biotechnology to both feed poor people and save wildlife habitat?

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