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Fungi could help boost crops and slow global warming

By John Upton



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Mmmm, fungi.

If not for an underground love affair between the fungal and plant kingdoms, today's planet would be a far less hospitable place.

Mycorrhizal fungi are critical for more varieties of crops than are bees — nine out of 10 crops have roots that are encrusted with these fungal tentacles. The fungi rummage through soil, fetching water and nutrients and delivering them to the roots of crops and other plants, receiving carbon-rich sugars produced through photosynthesis in return. The fungi protect the plants, which they are basically farming for sugar, from diseases and drought. The myco relationship was formed some 460 million years ago, allowing plants to migrate from the sea onto land, where they started helpfully drawing carbon dioxide out of the atmosphere, stowing carbon in the soil, and releasing oxygen into the air.

As scientists search for new ways to boost crop yields, they are turning their attention to this ancient and oft-ignored union between plants and fungus. Along the way, their research could have the additional benefit of slowing down climate change. From a magazine piece that I wrote recently for *The Ascender*:

The power of myco fungus lies in its partnership with plants. The relationship is known as mutualism — each species benefits. But what if we could make a fungus more generous — turn it into a selfless worker that fetches nitrogen, phosphorous and water for plants while asking for a pittance in return?

Vrije Universiteit Amsterdam researcher Toby Kiers thinks cheap-date-tolerating fungi hold promise for the ecosystems of the future — a world in which land recovers more quickly and produces more bountiful crops than ever before.

Kiers is preparing to conduct a series of experiments using different strains of myco fungi.

She has secured funding to watch mycelia squeeze through tiny mazes, peering at them through microscopes as they trade nutrients with plants for sugars under different conditions. The goal, she says, is to “study their decision-making skills.”

And here's *Modern Farmer* describing research by Monsanto, which is studying how fine-tuning myco fungi and other naturally occurring microorganisms could boost farm productivity:

Monsanto's partner in the new BioAg Alliance is Novozymes, a Danish company which knows a thing or two about putting microbes to work. They already offer farmers products like JumpStart, a strain of bacteria that grows along crop roots to help the plants take full advantage of phosphorus in the soil. Other agricultural biologicals – the umbrella terms for all living things that could protect plant health and productivity — include fungi that parasitically kills pests and bacteria that promotes root growth. ...

Such living pesticides and crop enhancers hold enormous promise for worldwide agriculture. A report from the American Academy of Microbiologists (A.A.M.) estimates that engaging the living world in and around plants could increase yields 20 percent in the next 20 years while at the same time reducing pesticide use by 20 percent. Right now, biopesticides only make up a 2.3 billion dollar industry — only 5 percent of the 44 billion dollars supporting chemical pesticides.

Of course, whenever Monsanto gets involved, things can get scary. Some fear that the company could start patenting microbes that grow naturally beneath our feet, and then sue the rest of us if we benefit from those microbes without forking over royalty payments. Kiers has researched this subject, and she tells me that “the patenting of microbes from farmers' fields is a huge, unresolved issue that deserves more attention.”

This growing spike in myco research is coming as farmers and other land managers discover that commercial fungal spores can help with the growth of crops and plants — even on marginal, salty, and polluted lands. The sale of such spores is rising in the U.S. and around the world. “We've had 17 straight years of growth,” said Mike Amaranthus, founder of Oregon-based company Mycorrhizal Applications. “It's a growing industry.”

Such research could also help tackle climate change. That's because these fungi take carbon captured by their plant partners and deposit it into the soil in the form of glomalin — a carbon-rich substance that fungi use to line the soil around themselves. The U.S. Department of Agriculture discovered the substance in the 1990s, and its scientists now estimate that 27 percent of the carbon in the world's soil is in the form of glomalin.

“Soil contains more carbon than the atmosphere and vegetation combined,” a team of scientists wrote in a letter published recently in the journal *Nature*. As Grist's Holly Richmond noted last week, the scientists concluded that EEM fungi, the variety of myco fungus that produces mushrooms, are better than the more common non-mushrooming variety when it comes to storing carbon in the soil. Here's more from a press release from the Smithsonian Institution:

Previous studies considered soil degradation, climate and plant productivity to be the most important regulators of soil carbon content. However, findings published this week in *Nature* ... suggest that soil biology plays a greater role. Some types of symbiotic fungi can lead to 70 percent more carbon in the soil. The role of these fungi is currently not considered in global climate models.

We're going to need to think all this good news over with a big slice of mushroom pizza.

Source

- The Macro of Myco, The Ascender
- Is Fungus the Next Frontier for Monsanto?, Modern Farmer
- Mycorrhiza-mediated competition between plants and decomposers drives soil carbon storage, Nature
- Fungi May Determine the Future of Soil Carbon, Smithsonian Institute

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