Can a Fungus Save Plants from Global Warming?

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Animated Short Transcript

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Ed Yong: This is Rusty Rodriguez. He is a microbiologist who studies the microbiome of plants.

Rusty Rodriguez: Hi, Ed, hello. It's very nice to meet you.

Ed Yong: Yes, plants have their own microbes too-

Rusty Rodriguez: Absolutely and it's not that dissimilar from humans. Animals are really nothing more than meat bags full of bacteria. Plants are veg bags full of bacteria and fungi.

Ed Yong: Rusty specializes in a particular part of the plant microbiome. Fungi. But not the kind of fungi you would find in a salad or on a pizza, but this kind. Microscopic fungi are vital to the wellbeing of many species of plants, and in some cases they provide their hosts with superpowers, as Rusty and his colleague Regina Redman discovered when they went to the hot springs and geysers of Yellowstone.

Ed Yong: They weren't surprised to find the soils around the geysers saturated with thermophiles—microbes that can thrive in extreme heat. But they were surprised to find grasses, with a catchy name of tropical panic grass, living on the edge of the geysers and hot springs.

Most plants can't survive in soil above a hundred degrees Fahrenheit, but the panic grass was happily making its home in soil temperatures up to a hundred and fifty degrees.

Rusty Rodriguez: Yeah, yeah you could cook a turkey in there if you wanted to.

Ed Yong: So they collected panic grass samples from the heated soils of Yellowstone and took them back their lab at Washington State, and to figure out how these grasses had evolved to withstand such heat and Rusty being a fungi-gi…, a fung… a guy who studies fungus looked at the microbes living inside the plants.

Rusty Rodriguez: Well, it's really interesting. These fungi live in what are called the interstitial spaces. They live in between cells.

Ed Yong: And what did you find when you looked at the fungi in the panic grass?

Rusty Rodriguez: We probably collected two hundred plants across, uh, maybe a forty mile range in Yellowstone. But the peculiar part of it was all of the plants had the same fungus.

Ed Yong: *Curvularia protuberata.*

Rusty Rodriguez: Exactly. That's exactly right. And the obvious question to ask was Gee I wonder if it has anything to do with heat tolerance?

Ed Yong: Time for an experiment.

Rusty Rodriguez: The simplest experiment anybody can do, right? So how high a temperature can they survive when they're separated from one another?

Ed Yong: They separated the *Curvularia* fungus from the plant and then cranked up the heat on each of them individually.

Rusty Rodriguez: What we found was that neither the fungus nor the plant could grow above that temperature.

Ed Yong: So neither of them could survive?

Rusty Rodriguez: Right.

Ed Yong: Were you surprised?

Rusty Rodriguez: That was a holy [bleep] moment. (laugh) It was like you got to be kidding me you know.

Rusty Rodriguez: We discovered that some organisms don't necessarily adapt to stress. They require something else, and that something else is another organism.

Ed Yong: Instead of the plant and the fungus evolving by just changing their own genes, they instead formed a partnership. A symbiotic relationship.

Rusty Rodriguez: Right. Right. It is a symbiosis. It's achievement through cooperation. They don't work as individuals, right?

They don't survive and function out there unless they're together. Right?

Ed Yong: So do we know how they help keep each other alive in those superheated soils?

Rusty Rodriguez: Our working hypothesis for all this is that the fungi, when they are inside the plant, communicate in such a way that when the plants are hit with stress they just don't freak out.

They just kind of sit there chill, until the stress goes away.

Ed Yong: They saw that plants with the fungus used less water and were less stressed than those without. And is this just a one-of-a-kind thing, or is it evidence of a larger phenomenon?

Rusty Rodriguez: We started looking at, at other habitats, other plant species with other fungi. And in every habitat we have looked at where we could tease the system apart, take it to the lab, analyze it, look at it, it came out exactly the same as Yellowstone.

Didn't matter whether it was a salt habitat or a, a chemical contamination habitat or temperature or water stress—

Ed Yong: In each case, it was a different fungus species – not just *Curvularia protuberata.* It seems that all around the world, plants and fungi have found each other and teamed up to cope with the most extreme of environments.

Ed Yong: So, this got Rusty and Regina thinking. What about all the plants that have not found symbiotic partners? Like crops? Many plants struggle to survive in temperatures above 100 degrees Fahrenheit. Could they introduce new symbioses so that these plants could survive in much hotter temperatures?

And so they took watermelon and sprayed it with fungi much like those found in the panic grass, and then they turned up the heat.

Rusty Rodriguez: The watermelons became heat tolerant within 24 hours of putting the fungus in. And that's really when we realized the significance of what we had.

Ed Yong: Just think about it. Plant and fungus had never seen each other before, but within hours of being introduced they had gained a new superpower. The ability to withstand temperatures that would normally have killed them.

Rusty Rodriguez: That was a huge moment for us.

If we can put a fungus in a plant and give it new functionality in a short period of time, maybe this has enormous ramifications.

Ed Yong: And so Rusty and Regina started a company. They realized that their discovery had broader applications. In a warming world, fungus could be used to make our crop plants more resilient.

But is it safe? I know some fungi can produce toxins.

Rusty Rodriguez: We've done a lot of work looking at the ecology of the organisms. We had it tested for toxicity and pathogenicity, so we lose no sleep over that part.

[Music playing]

Rusty Rodriguez: We work with different group of fungi now in agriculture, but they confer heat tolerance, drought tolerance, and salt tolerance to plants, so we've been field testing this now around the world for the last five years. And the results had been just remarkable.

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Ed Yong: And the stakes are really high. We're talking about making sure we can feed the world.

Rusty Rodriguez: Our population is increasing significantly. The climate is changing and greatly impacting our food supply.

Ed Yong: And it's amazing that something so small can make such a difference.

Rusty Rodriguez: The world functions through cooperation. We achieve things through cooperation. In the biological realm, it is highlighted dramatically by the interaction between things we can see and things we can't see.

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Ed Yong: And our future, our own survival might depend on our partnerships with this invisible world.

If that fascinating story about fungi and plants has left you with burning questions about the usefulness of microbes in our lives, then leave them in the comments below. We answered an earlier set of questions in a Q&A video from December which you can watch by clicking the link below. And we've got another such video lined up for you in a couple of weeks.

END OF EPISODE