PLOUGH to PANTRY

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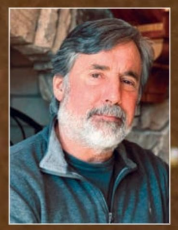

By Robert Turner

The AMAZING, INCREDIBLE MICROBE and the KEY TO CLIMATE CHANGE

I'm not a soil scientist, but the world of micro-organisms living in the soil never ceases to amaze me. It's worthwhile to reflect on the wonder beneath our feet—there are more microbes in a tablespoon of healthy soil than there are people living on earth. There's a lot going on down there, and scientists are just now scratching the surface.

Plants, of course, are special because of their ability to turn the energy from the sun into carbon-based fuel for the growth and energy of almost all living things, including the animals who feed on the plants. In the miracle of photosynthesis, the hydrogen atoms from water are bound to carbon dioxide molecules to create simple carbohydrates such as the sugar glucose.

Plants capture carbon from the atmosphere, turn it into usable energy for life on earth and store a lot more carbon underground. And, as it turns out, this natural process of carbon storage is the most cost-effective way to pull carbon from the atmosphere and mitigate climate change. Farmers and tiny microbes in the soil might just save us all.

What exactly is the process that can store excess carbon in the soil? One of the more remarkable things that soil scientists are learning about plants and soil organisms is that they seem to have co-evolved in a mutually beneficial relationship—an amazing carbon cycle that just might be our ticket to a sustainable future in the face of climate disaster.

Since the dawn of the Industrial Revolution, we've been pulling gigatons of carbon out of the ground in the form of fossil fuels and burning it and pumping it into the atmosphere. We've also released carbon from the ground through harmful agricultural practices like over-tilling the soil or burning and clearing forests to create more agricultural land.

The simple solution to climate change is this: Excess carbon needs to go back in the ground where it belongs and where it can do some good. And there is a natural process that we're just now discovering that is key to this underground carbon sink.

All life forms on this planet are carbon-based and need to consume carbon, including micro-organisms in the soil. How do microbes get the carbon that they need? They earn it—by partnering with plants for their mutual benefit.

Plants and microorganisms in the soil co-evolved together over hundreds of millions of years in a symbiotic relationship that pulls carbon from the atmosphere and stores it in the ground. Here's how it works. Plants create carbon-based sugars (carbohydrates) through the process of photosynthesis that give the plant energy and help it grow. But the plant also leaks, or exudes, some of these sugars from its root system in order to attract and feed microbes in the soil. Why?

Because microbes, like bacteria and fungi living in the soil, reciprocate; they play a key role in making sure the plant gets enough water, minerals and nutrients.

Just as there are millions of bacteria and other microorganisms living in our own gut biome helping us digest and process foods, plants depend on microbes in the soil to help them break down and "digest" the nutrients that they need, like nitrogen and phosphorous. Mycorrhizal fungi surround the roots and use their long-reaching web of tentacles to locate and draw in water and other nutrients to the plant roots, greatly expanding the reach of the plant root system.

Healthy soil is alive with these little critters that not only help feed the plants but also help them fight off harmful bacteria and other pests. The plant is their food source and they want to protect it.

Some scientists estimate that 85 to 90 percent of the nutrients that a plant gets come from this exchange—where root exudates provide microbes with energy in exchange for minerals or trace elements otherwise unavailable to the plant.

When talking about carbon storage, I had always believed that carbon was stored in the plants, the roots and organic matter in the soil. And a lot of it is. But the real carbon sink appears to be related to this relationship between plants and microbes.

It now appears that plants can leak an incredible amount of this "liquid carbon" into the soil, and that, it turns out, is the key to mitigating climate change. Estimates vary, but between 20 and 40 percent of the carbon that a plant has fixed by photosynthesis is transferred to the ground and into the rhizosphere (the soil zone immediately surrounding the roots).

The sheer scale of this process is incredible. One study has shown that an acre of wheat can absorb about 9,000 pounds of carbon in a single year and store it in the ground long-term. And that's now carbon that is no longer in the atmosphere contributing to global warming and climate change.

Modern, conventional agriculture is harmful to the microbial life in the soil and disrupts nature's carbon storage capacity. Heavy cultivation (tilling) or the use of synthetic nitrogen fertilizers reduces the fungal population. Pesticides can have harmful effects on helpful bacteria.

Organic and regenerative agriculture, on the other hand, helps protect and build the microbes in the soil that play such a major role in carbon sequestration. Sustainable, carbon storage practices include low-till or no-till agriculture, cover crops, crop rotations and getting cattle back on pasture in a rotational pasturing program. These are the four key practices that build microbial life, pulling carbon out of the atmosphere and storing it back in the ground, where it belongs.

Robert Turner is the director of the Creekside Farm Education Center and the author of Carrots Don't Grow on Trees: Building Sustainable and Resilient Communities. To learn more, visit EatYourView.com.

(Background) Bacteria and mold from soil samples growing on agar plates in a microbiology lab