

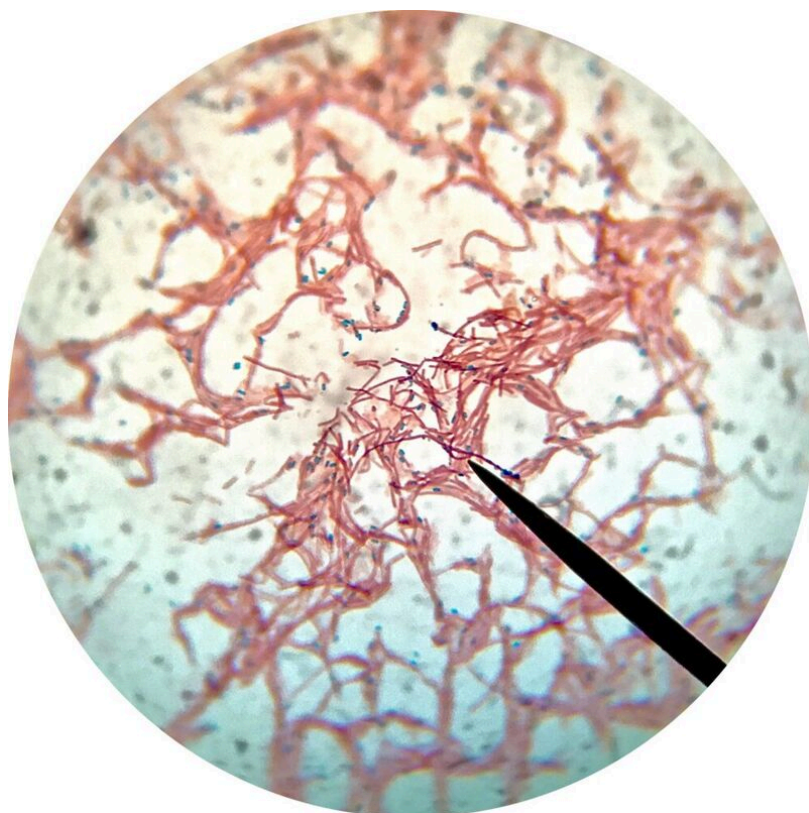
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Tiny mutualism

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Bacillus subtilis, denizen of the soil and the human gut. (Public domain)

Have you ever wondered how an old growth forest can maintain such stupendous productivity without any inputs?

Maybe you've tried to figure out how even younger forests have such resilience when the rains withhold their blessings.

On a bigger scale, you might think there are some radical carbon sequestration plans that don't get serious consideration, or even mention.

The answer to all of the above is, I am learning, the soil food web.

I have been a compost enthusiast for decades. Whether I produced it in a cylinder of chicken wire held together with nail-studded wood and twine that opened down the front (the "compost corset") or a huge licorice gumdrop of black plastic, I have wanted my kitchen scraps to become all they can be.

Typing that, I recall that in college we threw them off the deck and peed on them to keep raccoons away. Silly boys. Raccoons didn't want them, but neither did compost organisms and they took months to disappear.

In all that, I never understood exactly what was happening in compost. It was almost always well aerated, and that might be the first axiom of the soil food web: keep whatever you're working on aerobic.

Oxygen-loving aerobic bacteria and fungi are the foundation of a well-balanced soil food web that produces nutrients for all our desirable plants, in perpetuity, as long as balance is maintained. Like the succession that we see in a forest growing out of a prairie, bacteria and fungi constitute a smorgasbord for predators that eat them and defecate their remains in a plant-available form like NH_4 : ammonium.

This is not to be confused with ammonia, which signals the "denitrification" process executed by anaerobic bacteria, operating in oxygen-starved environments. The stench of anaerobic decomposition have been remarked in many a compost bin, dumpster or even ball fields where a thatch layer has retained water. Ammonia and nitrous oxide are the garbage of nitrogen squandered, vaporizing into reunification with the atmospheric nitrogen pool via a reaction with ozone.

I have long thought that in applying compost, I was applying "nutrients". It turns out that healthy compost is one of the best ways to spread the soil food web. Although compost does contain fertilizers, these were made by microorganisms that can colonize the soil around your plants and continue to make fertilizers of organic material they find around, and even the parent material of, your dirt.

Consider that even the world's worst soil contains enough nitrogen to grow corn. The textbook "Environmental Soil Chemistry" lists a study that examined three million soil samples from around the world. The median nitrogen was a whopping 2000 parts per million and the range was from 200-5000 ppm, the bottom of which is suggested for corn.

If this nitrogen is not in a plant-available form like nitrates, nitrites or ammonium, it's just another piece of mineral furniture as far as plants are concerned. Case in point: I wrote about the Haber-Bosch process for synthesizing ammonium nitrate as fertilizer a few months ago, yet nitrogen constitutes ~78% of our planet's atmosphere.

In applying synthetic fertilizers, we are wasting most of what we deploy. Of course it works in the moment, but it keeps you going back for more. And most of it (50-70% in the case of nitrogen) ultimately poisons watersheds and oceans; consider the Gulf of Mexico.

It also discourages plants from developing relationships with microorganisms to meet their needs in a cycle of life. Plants use 30-50% of their photosynthetic energy to produce root exudates, which are tailored blends of sugars, carbohydrates and proteins to lure the bacteria and fungi they want to the soil trough. These curated microorganisms live, die, and are eaten in the plant's root zone, and many of their activities have multiple beneficiaries.

More than 100 pounds per acre of any inorganic fertilizer kills microbiota and compromises the soil food web's ability to meet its own needs through mutualism. I'm glad I've never used such products, but after seeing compost tea's manifold powers last summer I'm starting to believe in better living - for all - through biochemistry.

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