Can perennial grains save our soils?

The Washington Post · 30 Jan 2019 · BY TAMAR HASPEL

As climate change climbs the chart of existential threats, soil is getting a lot of attention. Back when it supported forest and grassland, before we cleared it to grow crops, it stored an awful lot of carbon.

By farming the land, we released the carbon. Now, there's a major push to figure out how to put at least some of it back. The Land Institute, in Salina, Kan., is on it, and I visited there last fall.

"We lost about half the carbon in the first few decades after putting crops on prairie," said Land Institute President Fred Iutzi, who was showing me around. "In some places it leveled off at about half of what was there pre-settlement, on some places it went down to about a third."

Carbon loss dates to the first time a farmer ever turned over virgin soil, but it's only in the past couple of decades that momentum has built among farmers and researchers trying to reverse things. There's a major obstacle, though: 400 million (ish) acres of annuals, crops that have to be planted anew every year. While annuals are very good at growing seeds (usually the plant part we eat), they're not so good at locking carbon in the soil. In fact, they're pretty bad at it.

The Land Institute is trying to solve that problem by developing perennial grains: crops that come up, year after year, of their own accord. A commercial variety is years — and possibly decades — away, but consider that it took us about 80 years to get from corn that yielded 25 bushels an acre to corn that yields 170 bushels an acre. It's not unreasonable to take a couple decades to catch up.

The Land Institute's research director, Tim Crews, ran down perennial grains' virtues. First, and arguably most importantly, is their root system. Perennials devote something like half their energy to what's underground. For annuals, it's a quarter or less. That means perennials end up with root systems that are much deeper and denser. There's a lifesize picture of

perennial roots next to annual roots hanging in the Land Institute, and it's like a grown man next to a 3-year-old
child. The picture is so long that they have to hang it in the stairwell.
Those roots accomplish a couple of things. For starters, they enable the plant to take water and nutrients from deep in the soil, far beyond the reach of annuals. They also build soil structure, which helps soil-dwelling creatures move around. Their big advantage in the climate-change fight is that they add organic matter (which is about 58 percent carbon) many feet down, where it's likely to stay put.
Compare that to annuals. Most of their biomass is above ground, and although it's become standard operating procedure in many parts of the country to leave the parts of the plants you don't harvest — leaves and stems — on the ground so they return their carbon to the earth (and conserve moisture in the process), aboveground organic matter is less likely to get incorporated into the soil successfully.
In the soil health and carbon sequestration departments, perennials have it all over annuals. If only they didn't have that pesky yield problem!
If you're enough of an ag nerd to follow the perennial grain story, you've probably heard of Kernza. It's often called perennial wheat, but it's actually a wheat relative called intermediate wheatgrass. It has become the poster crop for perennial grains because it's being grown in a few places. The yield is about one-quarter that of wheat.
Nobody thinks Kernza is a viable commercial product right now. And, while yields will certainly improve as scientists continue to fine-tune the crop with breeding programs, it remains to be seen whether yields will get to the point where they're competitive with annual grains.
Flavorwise, Kernza is perfectly nice but unremarkable, something I had to go all the way to New York to find out. Will Emery, the chef at Tannat, a restaurant on the northern tip of Manhattan, is from Salina and was one of the very first to put Kernza on a menu, in a porridge flavored with an ever-changing mix of vegetables. It was parsnip when I was there, and can report that Kernza is solidly in the spelt-bulgur-freekeh axis of wheat flavors. In Kansas, I tried Kernza in beer, in which it tasted like beer.
The Land Institute is working on other grains that are further along. The biggest win so far has been perennial rice, which is planted on several thousand acres in southwest China, and yields are comparable to, and sometimes exceed, other local varieties. Then there's sorghum, which isn't an important crop in the United States, but is in parts of Africa, where varieties of perennial sorghum may increase yields.
It won't be easy getting these crops ready for prime time here. The very thing that makes perennials so good for the soil makes them bad at increasing yield: They devote half or more of their energy to what's below ground. The idea that you can have both your robust root system and your big, plentiful seeds smacks of magical thinking.
But wait! During the Green Revolution, plant breeders coaxed higher yields out of annuals, and perennials have the same potential, Crews says. "Wild plants under natural selection may

invest in structures to compete with their neighbors. It can change when they no longer have to," and it can "redirect its aboveground productivity to seed heads." It's the luxurious prerogative of a coddled plant.

Crews also points out that perennials emerge earlier in the spring, and get the jump on annuals. Because of their longer growing season, each year they convert more sunlight to biomass than annuals do. Smaller slice, but bigger pie.

Yields aren't the only obstacle to commercialization of perennial grains. One man's perennial is another man's monocrop, and when you expect a crop to be in the ground between three and 10 years, you lose the ability to do crop rotations — a key tool for pest management and soil health. Which is why Crews and Iutzi see perennial grains as being planted together with legumes. (One of the interesting things I found out while walking fields in Kansas is that farm equipment is up to the task of planting and harvesting fields that have more than one crop on them.)

Iutzi talked about such intercropping as we looked out over a patch of land that, if the records are to be believed, has never been plowed. It's the prairie as it was before it was settled. I saw it in the fall, and to a botanical layman (I'm not good with plants I can't eat) it was a mishmash. Varying shades of greens and yellows. Some tall, some short. Some flowering, some not. Mishmash is, of course, colloquial for biodiversity, and it's the vibrant mix of perennial grasses that built the carbon-rich prairie soil in a huge swath of the American Midwest, just east of the Rockies, from the Canadian border to Texas.

To rebuild that soil, the Land Institute uses prairie diversity as its model. A deep-rooted, intercropped perennial system can build soil health, sequester carbon, reduce erosion and provide a hospitable home for microorganisms that sometimes don't show up in soil until it has been undisturbed for several years.

In the years I've been writing about agriculture, I've encountered skepticism, primarily among the researchers, scientists and farmers working in the conventional food sector, about the concept of "naturalness." And, in some ways, I share it. Natural doesn't mean safe, or even safer. But when we look at the problems our agricultural system has — nutrient runoff, greenhouse gases, depleted soil — it makes sense to look hard at systems where plants (and animals) coexist and function together in a way that builds up rather than breaks down.

"We have to take our cues from natural ecosystems not because they're natural," Iutzi told me, "but because they did a really good job." Haspel writes about food and science and farms oysters on Cape Cod. On Twitter: @TamarHaspel. She will join Wednesday's Free Range chat at noon: live.washingtonpost.com.