LAND STEWARDSHIP PROJECT

LSP *Myth Buster* #51

An ongoing Land Stewardship Project series on ag myths and ways of debunking them.

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➔ *Myth*: The Land Will Quickly Become Carbon Saturated

➔ *Fact*:

Since agriculture began on this planet, cultivation has destroyed at least half of the carbon we have in our soils. This is the result of the breakdown and loss of organic matter, the energy-rich portion of the soil profile that's made up of plant and animal residue, along with the tissues of living and dead microorganisms. Organic matter is made up of about 58 percent carbon, so for every percentage decrease in organic matter, there is a corresponding loss of carbon. Unbroken prairie soils can have as much as 10 percent to 15 percent organic matter. But because of intensive tillage, Midwestern soil organic matter levels have plummeted to below 2 percent, in many cases.

Why is this important? The presence of soil organic matter/carbon plays a critical role in everything from the ability of soils to manage water to the biological activities that create long-term fertility. Soil high in organic matter is also less erosive. In recent years, scientists have been paying attention to the loss of soil carbon for another reason: it is a major cause of climate change. Soil organic matter can sequester carbon dioxide, a potent greenhouse gas, through the action of plant photosynthesis. One estimate is that 5 percent to 15 percent of our annual greenhouse gas emissions could be sequestered by farming methods that build, rather that destroy, organic matter. That upper level of sequestration could be enough to head off climate catastrophe, say researchers. It's important to note that, as a strategy for addressing climate change, sequestering carbon in our soil cannot replace reduction of greenhouse gas emissions through conservation and the use of alternative energy. But without carbon sequestration, we will never reach the goals scientists say we must meet if we are to maintain a sustainable climate situation.

And as the Land Stewardship Project describes in its publication, *Soil Health, Water & Climate Change: A Pocket Guide to What You Need to Know*, farmers and researchers are already showing that soil organic carbon can be increased in a matter of a few short years. Scientists had long maintained that such a change in a soil's makeup would take decades, or even longer.

But some experts have expressed concern that even if we adopt climate smart farming practices on a wide scale basis, the ability of the land to sequester carbon is relatively limited. Our topsoil will become quickly saturated with carbon and be unable to absorb more.

However, if one thing is certain in today's fast changing world of soil health research, it's that the science is constantly shifting beneath our feet, so to speak. For example, papers published this fall in the journals *Biogeochemistry Letters* and the *Annual Review of Ecology, Evolution, and Systematics* indicate that the terrestrial Earth has a much greater capacity to store carbon than we thought. In fact, concludes this research, the Earth's soils hold about three times the carbon currently in the atmosphere—a decade ago the estimate was that soil held twice the amount of carbon that the atmosphere does.

Why is the estimated size of that carbon pool growing? It's because scientists are increasingly looking beyond the first couple feet of topsoil. It was long thought that the majority of the carbon was present basically in that zone we directly till to produce crops.

This recent research shows that the Earth can stow away carbon far deeper that we ever thought. Carbon sequestration research conducted in Australia at depths of nearly 130 feet shows that we may have just barely tapped the potential for storing greenhouse gases deep underground. That's like coming home from the store with too much food to fit in your kitchen cupboards and then discovering an extra pantry in the basement.

There's more good news: carbon found beyond the one-foot mark tends to form stronger chemical bonds than it does when found in the topsoil. That, in effect, makes it much more stable and resistant to being broken down and released. Just because it's below the layer of topsoil we normally interact with via land use practices such as farming, doesn't mean we can't have an impact on that deeper carbon storage pool.

Scientists say plants that suck greenhouse gases

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This **Myth Buster** *is brought to you by the members and staff of the Land Stewardship Project, a private, nonprofit organization devoted to fostering an ethic of stewardship for farmland and to seeing more successful farmers on the land raising crops and livestock. For more information, call 612-722-6377 or visit www.landstewardshipproject.org.*

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out of the atmosphere via photosynthesis and have root systems that extend several feet through the soil profile play a role in sequestering carbon deep beneath the surface. In fact, the *Annual Review of Ecology, Evolution, and Systematics* paper reported that roots are approximately five times more likely than an equivalent mass of litter—leaves, dead vegetation, etc.—to turn into soil organic matter. When one considers that prairie roots can extend anywhere from eight to 14 feet below the surface, the potential for soil organic matter development in grasslands is astounding.

That's why it's so important to keep living roots in the soil 365-days-a-year through the use of continuous living cover like pasture grasses and cover crops. Another paper published this fall in the journal *Global Change Biology* identified the critical role farming methods that rely on well-managed grasslands, cover crops, no-till and diverse rotations can play in sequestering carbon. Farmers are finding that they can raise organic matter levels significantly in three to 10 years. In fact, a 2015 paper published in *Nature Communications* reported managed rotational grazing of dairy cattle raised carbon amounts in formerly row-cropped fields to levels normally found in native forest soils.

Such research results reinforce the critical need to keep pushing the envelop when it comes to researching soil health, an area were new discoveries are constantly emerging from farm fields and test plots. As the saying goes, we are constantly learning just how little we really know.

More Information

- "Depth Trends of Soil Organic Matter C:N and 15N Natural Abundance Controlled by Association with Minerals" is in *Biogeochemistry Letters*, www.springer.com.
- "The Ecology of Soil Carbon: Pools, Vulnerabilities, and Biotic and Abiotic Controls" is in the *Annual Review of Ecology, Evolution*, and *Systematics*, www.annualreviews.org/journal/ecolsys.
- "Emerging Land Use Practices Rapidly Increase Soil Organic Matter" is in the publication *Nature Communications*, www.nature.com/articles/ncomms7995.
- For more on the Land Stewardship Project's pocket guide, *Soil Health, Water & Climate Change*, see http://landstewardshipproject.org/smartsoil.