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Jay Fuhrer stands in a cover crop mix of 12 species at the Menoken Farm in Menoken, North Dakota.

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# Capturing Carbon for Healthier Soil (http://www.newgroundmagazine.com/capturing-carbon-for-healthier-soil/)

**Following five principles can provide major benefits to soil and crop production.**

After several years of taking soil tests on cropland and grassland in central North Dakota, Jay Fuhrer noticed a trend.

The U.S. Natural Resources Conservation Service soil health specialist and lead educator of Menoken Farm in Menoken, North Dakota, found that soils in crop production had half or less the amount of carbon compared to the soils in grassland.

“We’ve harvested a lot of the carbon out of crop soils,” he says. “Consequently, it’s essential to add more carbon. Carbon is the food—it’s the currency exchange in the soil.”

University of Saskatchewan agricultural scientist Kate Congreves agrees that carbon drives the fundamental soil processes.

“Having soil-organic carbon helps with things like soil aggregation, which leads to improved soil structure, and that goes hand-in-hand with the waterholding capacity of the soil,” she explains, adding that carbon also provides a source of free nutrients.

In short: crop production becomes more difficult with lower carbon levels, says Fuhrer.

The good news is, there are five principles farmers can implement to bring carbon levels up.

**Five Principles of Building Soil**

**Armor the soil.** Provide protection to the soil surface. Fuhrer says this can be achieved by leaving crop residue or by growing plants, noting that a combination of the two is the most effective.

“Most of the carbon in the dead litter goes into the atmosphere as $CO_2$, and green plants give us the inlet for carbon going into the soil,” he says.

**Minimize soil disturbance.** This principle particularly applies to physical disturbance like tillage. Tillage removes pore spaces and slowly compresses the soil together, which restricts water infiltration and air movement. It also removes any soil armor in place and releases a burst of carbon dioxide to the atmosphere.

“Every tillage operation results in this additional carbon loss,” Fuhrer says.

**Introduce more plant diversity.** This can be accomplished by growing all four crop types—cool-season broadleaves, warm-season broadleaves, cool-season grasses, and warm-season grasses. Fuhrer adds that in the Northern Great Plains it’s most effective to have a rotation heavier in high-carbon crops, such as wheat or corn, than low-carbon crops, like soybeans.

“I want the majority high-carbon because that’s what builds our soil,” he says. “That’s what brings in additional carbon into our soil profile and builds soil resiliency.”

Congreves agrees that the amount and quality of carbon from crop residue and other organic amendments heavily contribute to the amount of soil carbon.

“Crops that have different harvest indexes will influence how much material goes back in,” she says. “The biochemical makeup of that type of carbon eventually influences the balance between accumulation and loss.”

If having a majority of high-carbon crops in rotation is a challenge, farmers can help make up the difference with cover crops. For example, a farmer could plant soybeans into a living cereal rye cover crop, which would increase carbon production for the year.

**Continually grow living plants in the soil.** “Our soils were built with perennials that have a huge root mass, but we’re farming with annuals and they have a much smaller root mass,” Fuhrer says. “So we need to have a green plant growing continually because nature is a constant feed process, which continually builds soil aggregates.”

Cover crops can fill in what otherwise would be a fallow period and continue bringing carbon into the soil. Another option is to grow a perennial forage crop like alfalfa for a few years, says Congreves.

For farmers who can’t get a cover crop like cereal rye growing in the fall due to weather and timing, Fuhrer says it will likely come up in the spring and still fill in that fallow period prior to crop production.

**Integrate livestock.** Livestock create the opportunity for even more soil carbon because as the plant regrows after an animal bites it, the plant will harvest more carbon dioxide due to a delayed maturity. Fuhrer notes that farmers don’t need their own livestock to implement this principle—they just need to know someone who does and who understands the goals and challenges in bringing livestock on the land.

**Principles in Practice**

Jerry Doan can attest firsthand to the benefits of implementing these principles.

His family’s operation, Black Leg Ranch in McKenzie, North Dakota, has been no-tilling for more than 20 years, which he says has been a “no brainer” because it helps retain moisture—something they’re always short of.

In addition, they intensively graze their cattle on diverse cover crop mixes, which has not only regenerated the soil—one field tested 7,400 nanograms per gram of soil biology, the highest Doan has ever seen—but has also eliminated their winter feed costs. They also run a hunting outfitting operation, and the cover crops help propagate wildlife for it.

Doan’s sandy soils are now abundant with earthworms, and soil temperatures don’t climb on hot days. One time his soils read 68 degrees F, despite temperatures being in the mid-90s. Doan says at around 70 degrees F, biologic activity is at its maximum and 100% of moisture goes into the plant.

For farmers looking to get started with these principles, Fuhrer, Doan, and Congreves all recommend starting small, trying one principle on one field and continuing to build from there, remembering that what works for one farmer, may not work for another.

“The principles are the same,” Doan says. “Everybody operates a little differently and things fit a little differently. You’ve got to adapt how you fit them in.”

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Kate Congreves

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Jerry Doan and Jay Fuhrer examining a grass mix

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Winter Grazing Cattle