# Soil Health 101

**One of the world's most precious resources deserves special management attention on farms and ranches. Two soil advocates explain why.**

*by **Kindra Gordon,** field editor*

"Soil is naked, hungry, thirsty and running a fever." That's how Ray Archuleta describes much of the soil in the United States — and even around the world. Archuleta is a conservation agronomist at the Natural Resources Conservation Service (NRCS) East National Technology Center in Greensboro, N.C. He is a frequent speaker to farmer and rancher groups — and his enthusiasm for soil health during the past decade has earned him the nickname "Ray, the Soils Guy."

Archuleta asks producer groups to ponder a sobering question: "Are we creating our own droughts?"

He believes the answer is "Yes," and says, "We are taking too much cover."

Conventional farming — and haying — is mining the soil, rather than rebuilding it, he explains. "Most soils have been tilled for many years and are degraded."

To demonstrate just how crucial soil health is, Archuleta often shows his audiences two clods of soil from different farms. One clod is from a field tilled annually under a corn-soybean rotation, while the other is from a field that hasn't been tilled in more than a decade and has a more diverse rotation with cover crops.

When placed in a tall tube of water, the tilled clod dissolves and turns into brown sediment at the bottom. The no-tilled clod flakes a little but holds together. A good, healthy soil will hold together, and it holds its integrity and structure, he explains. Archuleta says healthy soil should look like "black cottage cheese."

A similar demonstration shows how water is absorbed by untilled soil with vegetative cover, such as rangeland, while the water runs off of tilled soil and often takes soil particles with it.

Specifically, Archuleta says, "Carbon [from vegetation] is so powerful."

He adds, "Haying is one of the most destructive things done on farms," and explains that removing the vegetation and the nutrients also depletes the soil. "You've removed carbon, phosphorus — everything."

Rather, plant vegetation and roots are needed to help soil bond and mycorrhizal fungi in the soils absorb water and nutrients. His rule is this: Cover the soil at all times.

## Best practices

Archuleta is an ardent proponent of no-till — or never-till — farming practices, and he also advocates for the use of cover crops and livestock to help improve soil health on farms. For instance, once a crop is harvested, a cover crop — with a mix of cool-season plants — is seeded into the ground. Then the roots provide food to soil microbes, and the tops can provide forage to livestock [or wildlife], who in turn leave urine and manure that add nutrients to the soil, as well.

Most importantly, Archuleta emphasizes that soils want to hold water, and they want to filtrate. He believes America does not have a runoff problem — but instead an infiltration problem because of poor soil health.

He shares the analogy that nature is high in diversity and low in disturbance. Conversely, farming is high in disturbance, but low in diversity — resulting in a broken system with degraded soils.

Ideally, he says, a system with minimal or eliminated tillage and diverse mixes of cover crops that are grazed will produce gains in soil health — over time. It may take five years or more under this management to move soil organic matter up 1%.

A primary indicator of soil health is earthworms. Archuleta likes to see four to five earthworms per shovelful of soil. He calls them the tillage machine or recyclers, and says, "In 27 years, they'll turn over 6 inches on top of the soil."

## Brown's revolution

Near Bismarck, N.D., Gabe Brown and his family began no-till farming in 1993 and have integrated cover crops and livestock grazing into their holistic management. Brown reports that his soil organic matter was less than 2% in the early 1990s, and rainfall infiltration rates were less than ½ inch (in.) per hour. Today, organic matter levels have increased to more than 6%, and infiltration rates are now 8 in. per hour. Carrying capacity has increased from 100 commercial cow-calf pairs to 350 cow-calf pairs and several hundred yearlings.

Brown credits the diversity that cover crops add to the improvement in soil health on his land. He says these crops "provide armor on the soil surface and a living root for the microbes below the surface."

The extra cover also helps capture moisture. Brown explains, "It's not about how much rain you get, it's about how much you can infiltrate and store for plants to use later."

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He and his son Paul now grow cover crops on all of their cropland — before a cash crop, as a companion alongside or mixed in with a cash crop, or after a cash crop has been harvested. Having living roots in the soil nearly year-round, Brown explains, is essential to feeding the soil biology and ensuring nutrient cycling.

He emphasizes that to be most effective, cover crops should be seeded as a multispecies mix. He usually includes seven to 10 different species, but has seeded a mix with as many as 25.

Livestock are also critical to the Browns' system. They are carefully rotated through about 100 small pastures, as well as the cover crops on the cropland — along with a flock of sheep, pastured hogs and 600 free-range laying hens.

Brown says, "I can't figure out why any producer with livestock wouldn't grow cover crops." He cites the livestock gains, the weed suppression and the manure fertilizer as benefits.

He adds, "Livestock are a missing link to make nutrients more available in the soil … Animals have not been integrated into farming systems today. But building soil health needs living things above and below ground."

That said, he emphasizes the importance of grazing management to soil health. His rule of thumb is to take one-third of the forage above ground and leave the remaining two-thirds for the "critters" (i.e., microbes) below ground. He re-emphasizes, "You've got to keep armor (vegetation) on the surface and feed the soil microbes."

All total the Brown operation includes 2,000 acres of native prairie, 2,000 acres of cropland and 1,000 acres of tame pasture. The Browns intend to seed more cropland back to perennial native pasture.

The Browns are also finding a direct-to-consumer market for their grass-finished beef and lamb, pastured hogs, as well as broilers and eggs. With the diversity of products they've added to their operation, Brown concludes, "If you think there are no opportunities for young people in agriculture today, that's bull."

AJ

**Editor's Note:** *Kindra Gordon is a cattlewoman and freelance writer from Whitewood, S.D.*

## Soil stats

Have you ever stopped to ponder that soil is a finite resource — just like water and oil? As the world works to increase agricultural production to feed the growing global population, a new emphasis is being put on soils and the important role they have to environmental health and biodiversity, as well as to human health because of the direct link soils have to growing food.

The United Nations Food and Agriculture Organization (FAO) has declared 2015 as the International Year of Soils.

Here are some interesting considerations about soil.

- Between 1982 and 2007, 14 million acres of prime farmland in the United States were lost to development.
- There are more living organisms in a single teaspoon of healthy soil than there are people on the earth.
- Soil health is not the same as soil quality. Anything can have "quality," but only living things can have health.
- For every 1% increase in organic matter, the soil can hold an additional 27,000 gallons of water per acre.
- Most soil organic matter can be increased in three to 10 years with proper management practices.

Learn more about the International Year of Soils at *www.nrcs.usda.gov/wps/portal/nrcs/main/soils/yos/*, and be sure to check out the monthly video series on soils on the NRCS YouTube Channel at *https://www.youtube.com/playlist?list=PL4J8PxoprpGZ3*.