

Soil health boosted by adding small grains and pasture to rotations

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Including small grains and pasture in crop rotations, and in some cases reducing tillage, can have a significant effect on soil health, according to a joint Purdue-U.S. Department of Agriculture study.

The findings, reported in *Soil Science Society of America Journal*, are part of the Conservation Effects Assessment Program, a federal program designed to answer questions about the impacts of agricultural practices on [soil health](#) and water quality. They give researchers a baseline on soil health so that changes in management practices - and their effects on soil - can be measured going forward.

Diane Stott, national soil health specialist for USDA's Natural Resources Conservation Service and a Purdue adjunct professor of soil science, and Ashley Hammac, a postdoctoral research associate for USDA Agricultural Research, looked at soil samples from the Cedar Creek Watershed, which drains into the Western Lake Erie Basin in northeastern Indiana and is one of 17 study areas around the country. The soil in the study area is healthy, with scores on the Soil Management Assessment Framework (SMAF) - which grades soil using 10 quality indicators - quite high. Physical, chemical and nutrient component indices averaged 90 percent, 93 percent, and 98 percent of optimum, respectively.

There was no difference in soil health when comparing tilled vs. no-till fields, except when looking at hills. Toe slopes, the areas at the bottom of a hill, had higher physical, biological and overall scores than the soil

at the summit of a hill. That's likely because loosened soil at the summit runs downhill, taking nutrients and microbes with it.

The highest-rated soils were in land converted to perennial grasses. In many cases, these were agricultural fields in which farmers have gotten government payments to convert them to grassland because of erosion issues. While growing fields have nitrogen and phosphorus applied to improve crop growth, grasslands that aren't fertilized had the same nutrient profiles as agricultural land. It's possible, Hammac said, that a rotation of pasture could be good for soil health.

"A long time ago, perennial pasture used to be in the rotation," Hammac said. "To me, this says we need to be looking at putting two years of pasture back into the rotation of corn, soybeans and wheat if we want to improve soil quality."

Soils that included small grains, such as wheat, in their rotations were next in terms of overall health. Fields that include rotations of small grains did well in terms of macroaggregate stability, which impacts how well water can infiltrate soil rather than run off it.

"A lot of soil health is really about being able to deal with weather extremes, and a lot of it boils down to water," Stott said. "Usually, having wheat or other small grains one in three years improves the structural stability of the soil."

Crop rotations that included corn were the least healthy, with scores dropping as corn was planted more often.

Hammac said there will be a push to use the data from the CEAP sites to improve soil health indices, which can vary by region. He said scientists want to determine which measurements are most important for determining soil health to simplify the process of testing soil for farmers.

"Most farmers are not going to want to do all those measurements. It's expensive," Hammac said. "If we could say something about which indicators are important no matter where you go, that would be valuable. That would take us closer to a standard soil health assessment."

Stott said understanding soil health changes will be key in maintaining high crop yields into the future.

"We've taught our farmers really well over the years how to manage the chemistry of the soil. The physical component they do an OK job, but they're still some significant areas for improvement, especially in the biological component, which is critical for soil structure, nutrient cycling and other ecosystem services," Stott said. "Now we need to be able to accurately measure those changes."

More information: Crop, Tillage, and Landscape Effects on Near-Surface Soil Quality Indices in Indiana. *Soil Science Society of America Journal*, 2016.

Provided by Purdue University

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