CHARLES PHILLIPS (D807-2)

No Shortcuts in Checking Soil Health

John Teasdale records data on weeds growing in a ripening organic wheat field next to a recently cultivated plot of organic corn.

Long-term experiments are a feature of many ARS research efforts. Whether in the Pacific Northwest, Midwest, or Southeastern regions of the United States, these kinds of studies provide valuable insights and, occasionally, unexpected results.

A relatively new long-term experiment at Beltsville, Maryland, has shown that organic farming can build soil organic matter better than conventional no-till farming can.

"It is one of a few long-term studies comparing organic farming with no-till," says John Teasdale, the lead scientist for the 9-year study. "Most others compare organic with conventional plow-tillage cropping systems." Teasdale heads the Agricultural Research Service's Sustainable Agricultural Systems Laboratory at Beltsville.

These results are the latest from several long-term projects that are part of ARS's national program in Agricultural System Competitiveness and Sustainability. This program supports production systems that enhance both profits and natural-resource quality.

Organic Builds Soil Better Than No-Till

From 1994 to 2002, Teasdale compared minimal-tillage organic corn, soybean, and wheat with the same crops grown conventionally with no-till.

Many agriculturalists believe that no-till builds soil better than organic farming, which uses tillage to incorporate manure and control weeds. Tillage is known to destroy soil organic matter. But Teasdale's study showed that organic farming built up soil better than conventional no-till because use of manure and cover crops more than offsets losses from tillage.

In a 3-year study following the 9-year system comparison, Teasdale grew corn with conventional no-till practices on all plots to see which ones had the most productive soils.

Those turned out to be the organic plots. They had more carbon and nitrogen and yielded 18 percent more corn than the other plots did.

"It takes time for organic matter to build up, so we wouldn't have seen these surprising results had we only looked after a few years," Teasdale says.

What About Weeds?

Despite organic farming's enrichment of the soil, weed problems during the 9-year study were enough to lower corn and soybean—but not wheat—yields below those of no-till crops.

But in another long-term experiment begun in 1996, Teasdale learned that adding more kinds of crops to the organic rotation helped control weeds.

"Weeds tend to adapt to crops whose growth timetable creates conditions favorable to weed growth," Teasdale says.

Planting the same summer annual crop year after year allows weeds suited to that growth cycle to keep maturing and adding their seeds to the soil. In organic systems, Teasdale showed that rotating diverse crops markedly lowers the numbers of weed seeds lying dormant in soil.

In an ongoing experiment called the "Farming Systems Project," Teasdale and ARS soil scientist Michel Cavigelli showed that after 10 years, corn yields were higher in diverse organic rotations that included a perennial legume.

"This is one of a few studies that consider the effects of rotation length and crop complexity on organic grain yields," Teasdale says.

Sustainable Surprises in Grass Seed Country

Results have also come in recently from the grass seed-growing region of the Pacific Northwest, with more pleasant surprises that showed up after years of research.

Farmers in wet western Oregon grow various grasses to produce seeds for use in lawns, sports fields, and pastures.

Meadowfoam *(Limnanthes alba),* shown on the right, has proved to be a good addition to perennial grass rotations and has an added benefit of controlling tunneling voles without the need for tillage.

BRIAN PRECHTEL (K7854-8)

In a 10-year study, scientists at the ARS Forage Seed and Cereal Research Unit at Corvallis—plant physiologists Gary M. Banowetz and Stephen Griffith, agronomist George W. Mueller-Warrant, and hydrologist Jerry Whittaker—found that rather than burn or bale leftover grass straw after harvest, farmers would do better to plant the next crop right through the straw.

"This can lead to higher yields and lower costs while also protecting soil from erosion," Banowetz says. The study was conducted jointly with Oregon State University scientists.

The team also found that no-till meadowfoam—a native winter annual—was a good addition to perennial grass rotations. "It is very suitable to no-till and low-input production. It didn't need spring fertilizer or herbicide and yielded more seed oil than meadowfoam grown with tillage," Mueller-Warrant says.

Mueller-Warrant and colleagues also found that meadowfoam and some other rotation crops help to control small rodents called "voles" without the need for tillage to disrupt their tunnels.

No-Till for Pacific Northwest Wheat

In 2006, Washington State University (WSU) and ARS scientists published a paper on an 8-year study on the wheat farm of Ron Jirava. The farm is in an area that has annual rainfall of 11 inches.

"This paper provides the first comprehensive, multidisciplinary report of long-term alternative annual no-till cropping systems in the low-precipitation region of the Pacific Northwest," says William F. Schillinger, the WSU scientist who led the study. The ARS scientists in the study were Ann Kennedy, a soil scientist with the Land Management and Water Conservation Research Unit, and Tim Paulitz, a plant pathologist with the Root Disease and Biological Control Research Unit, both in Pullman, Washington.

In that study, Douglas Young, WSU agricultural economist, found that, in years of normal precipitation, returns from growing no-till spring wheat every year were similar to returns from growing one crop of winter wheat every other year with a year of fallow in between.

In dry years, however, the annual spring wheat showed significantly more economic risk. This made the 8-year average net returns for the annual cropping lag behind the conventional summer fallow rotation by $24 to $29 per acre.

Kennedy appreciates ARS's ability to sustain research experiments for the long haul—especially collaborative research with university colleagues when grants may run out.

"We often find things that we wouldn't have found in a shorter study," she says. "This is especially true in farming, where there are so many variables, such as the weather. Even economic studies require a span of years to get a clear view of what's really happening. We need to go through enough cycles to average things out."—By **Don Comis,** ARS.

This research is part of Agricultural System Competitiveness and Sustainability, an ARS national program (#216) described on the World Wide Web at www.nps.ars.usda.gov.

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