SOIL HEALTH INSTITUTE
Enriching Soil, Enhancing Life

Benchmarking Soil Health

Dairy Soil & Water Regeneration

Eastern Wisconsin

Long-term adoption of soil health management systems can reduce production costs, build resilience to extreme weather, and increase yield. What's been missing, however, is an understanding of how healthy local soils can be and which management practices are helping growers in the region improve their soil health.

To address this gap, the Soil Health Institute sampled soils at 31 fields in eastern Wisconsin in spring 2022, representing over 700,000 acres of alfalfa and corn silage production.

The results show that growers in eastern Wisconsin improved their soil health by adopting management practices to reduce soil disturbance and maximize living roots.

> **We've seen excellent results terminating the cover crop in the spring and then no-tilling the hay crop. I don't have to worry about erosion, and we're improving our soil biology. We've seen better water infiltration, and we're increasing our organic matter.**
>
> **If you're new to it, don't try to do everything at once. Take it one bite at a time and go off of what other farmers have experienced.**



DUANE DUCAT
Deer Run Dairy
Kewaunee, WI

HIGH TILLAGE, LOW LIVING ROOTS



LOW TILLAGE, HIGH LIVING ROOTS



About the region



- **Home to over 600,000 milking cows at nearly 2,000 dairy operations**
- **17% of cropland is used to grow corn silage and alfalfa**
- **Reduced tillage is used on 37%, no-till on 38%, and cover crops on 8% of cropland**
- **Typical soils are loess-mantled, till-derived Alfisols and Mollisols, typically loamy and moderately well to somewhat poorly drained**

What we measured

At each location, we measured these essential indicators of soil health:

- **Organic carbon concentration** (0 to 6 inch depth) promotes soil structure, microbial activity, plant-available water, and plant-available nutrients.
- **Aggregate stability** (0 to 3 inch depth) measures soil structure and resistance to disturbance. Soils with greater aggregate stability are more resistant to erosion and have improved aeration, water infiltration, and water storage.
- **Carbon mineralization potential** (0 to 6 inch depth), the amount of CO_2 produced by soil microbes after rewetting the soil. Increased carbon mineralization potential indicates a greater biological capacity to cycle nutrients and plant residues.

What we found

To assess the current and potential health of soils in the region, we sampled row crop fields with different types of tillage and crop rotations, including cover cropping.

We split the row crop fields based on their alignment with NRCS soil health principles, living roots and physical disturbance (i.e. tillage), based on their last five years of management.

Increasing Living Roots in Row Crops

Fields with **HIGH LIVING ROOTS** had better soil health compared to fields with **LOW LIVING ROOTS**. **HIGH LIVING ROOTS** fields had corn, alfalfa, and/or cover crops in the rotation, with living roots for more than 60% of the year. **LOW LIVING ROOTS** fields had annual crops like corn and soybean but no alfalfa or cover crops.

SOIL HEALTH INDICATOR	LOW LIVING ROOTS (11 FIELDS)	HIGH LIVING ROOTS (20 FIELDS)	DIFFERENCE
Organic carbon concentration (%)	1.94	2.31	19%
Aggregate stability (Index from 0 to 1)	0.58	0.70	21%
Carbon mineralization potential (mg C/kg soil/day)	27	29	6%

Decreasing Tillage in Row Crops

Fields with **LOW TILLAGE** intensity had higher organic carbon concentration and aggregate stability than fields with **HIGH TILLAGE**, but the effect was smaller than the living roots effect. **HIGH TILLAGE** fields included one or more of these implements: cultivator, chisel, or disk. **LOW TILLAGE** fields were either no till or used a vertical tillage implement.

SOIL HEALTH INDICATOR	HIGH TILLAGE (21 FIELDS)	LOW TILLAGE (10 FIELDS)	DIFFERENCE
Organic carbon concentration (%)	2.08	2.39	15%
Aggregate stability (Index from 0 to 1)	0.64	0.70	10%
Carbon mineralization potential (mg C/kg soil/day)	28	28	0%

What's working?

Row crop dairy farmers in eastern Wisconsin showed the greatest improvements in soil health with planting perennials or cover crops, with smaller improvements due to reducing tillage. About 3 out of 4 row crop fields in the region have low tillage intensity, yet only about 1 in 12 fields use cover crops, indicating a strong opportunity to enhance soil health through wider adoption of cover cropping.

The sampling is part of the Dairy Soil & Water Regeneration project, which Dairy Management Inc. (DMI) initiated along with the Soil Health Institute in collaboration with research institutions in six states. The project is largely supported by the Foundation for Food & Agriculture Research with matching funds from companies like DMI, Newtrient, Nestlé and Starbucks.

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