SOIL HEALTH INSTITUTE
Enriching Soil, Enhancing Life

Benchmarking Soil Health

Southern Coastal Plain, North Carolina

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.

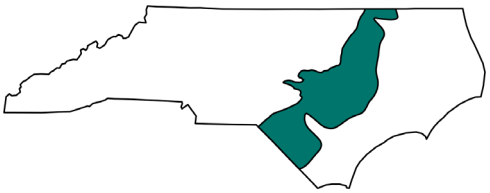
To address this gap, the Soil Health Institute compares minimally disturbed **REFERENCE** sites where soil health is optimal to two types of crop production systems in the same region: typical **BASELINE** management and regenerative **SOIL HEALTH PRACTICES**.

In 2024, SHI sampled soils at 92 North Carolina fields in the Southern Coastal Plain, Major Land Resource Areas 133A, representing 880,000 acres of cropland.

The results show that growers in the Southern Coastal Plain improved their soil health by adopting management practices to reduce soil disturbance and maximize living roots.

BASELINE	SOIL HEALTH PRACTICES	REFERENCE
Dryland cotton-peanut and corn-soy rotations with disk tillage or strip-till and deep ripping with or without occasional cover crops	Dryland cotton-peanut and corn-soy rotations with strip-till or no-till and annual cover crops for at least 8 years	Grazed pastures, hayfields, pine stands
		
25 FIELDS	39 FIELDS	28 FIELDS

About the region



- **37% of the region is used for crop production, primarily cotton, peanut, corn, and soy.**
- **Conventional tillage (e.g., chisel, disk, and field cultivator) is used on 36%, reduced tillage on 22%, no-till on 41%, and cover crops on 11% of cropland in this region.**
- **Mean annual temperature for the region ranges from 59 to 63°F, and mean annual precipitation ranges from 47 to 59 inches.**
- **Most crop production is on intermediately to well drained soils with loamy sand and sandy loam surface textures.**

Crop production challenges include:

- Sandy soils with low organic matter and low water holding capacity
- Sandy soils prone to surface sealing, leading to decreased germination and infiltration
- Compaction/hardpan formation from historical tillage that restricts root growth
- Erosion of bare soil due to wind and rain
- Inconsistent rainfall throughout the growing season
- Heavy rainfall events during hurricane season can damage crops, reduce yields, and erode soils

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) is the amount of CO_2 produced by soil microbes after rewetting the soil. Increases in carbon mineralization potential indicate a greater biological capacity to cycle nutrients and plant residues.

To give growers an estimate of their soils' current and potential carbon storage, we calculated **organic carbon stock** (0 to 12 inch depth) — the amount of organic carbon stored in the soil — using both soil organic carbon concentration and bulk density measurements. We also calculated **available water holding capacity**, predicted from soil texture and soil organic carbon, to show the amount of water the soil can store in the top 6 inches and provide to plants, improving resilience to drought and flooding.

What we found

In the fields sampled, **BASELINE** row crop practices included dryland cotton-peanut and corn-soy rotations with disk tillage or strip-till and deep ripping with or without annual cover crops for less than 3 years. **SOIL HEALTH PRACTICES** included dryland cotton-peanut and corn-soy rotations with strip-till or no-till and annual cover crops for at least 8 years. All row crop fields sampled were irrigated. **REFERENCE** fields included grazed pastures, hayfields, and pine stands.

In addition to management, soil texture influenced the essential indicators. The table below shows average values for two representative soil textures in the Southern Coastal Plain.

	LOAMY SAND SOIL (7% CLAY)			SANDY LOAM SOIL (16% CLAY)		
	BASELINE	SOIL HEALTH PRACTICES	REFERENCE	BASELINE	SOIL HEALTH PRACTICES	REFERENCE
Organic carbon concentration (%)	0.64	0.69	1.31	0.80	0.86	1.64
Aggregate stability (Index from 0 to 1)	0.77	0.81	0.90	0.69	0.74	0.86
Carbon mineralization potential (mg C/kg soil/day)	7	7	18	9	9	23
Organic carbon stock (metric tons C/acre)	8	9	14	10	11	17
Available water holding capacity (inches)	.69	0.70	0.81	0.76	0.77	0.91

Values were calculated using hierarchical models to adjust for differences in soil texture, pH, mean annual temperature, and mean annual precipitation across sampled locations.

Comparing minimally disturbed **REFERENCE** samples to row crop fields with **BASELINE** practices shows just how much healthier soils in crop production systems in the region can be.

Compared to BASELINE, samples from REFERENCE fields had on average:

- **+105%** organic carbon concentration
- **+167%** carbon mineralization potential
- **+17%** predicted available water holding capacity
- **+21%** aggregate stability
- **+65%** organic carbon stocks

What's working?

Compared to BASELINE, samples from fields with SOIL HEALTH PRACTICES had on average:

- **+8%** organic carbon concentration
- **+6%** carbon mineralization potential
- **+1%** predicted available water holding capacity
- **+6%** aggregate stability
- **+6%** organic carbon stocks

In addition, some growers in the region were able to achieve 50% or more of the soil health values seen in minimally disturbed **REFERENCE** fields.

Crop fields sampled achieving 50% or more of REFERENCE values:

- **27%** — **17 of 64 fields** organic carbon concentration
- **6%** — **4 of 64 fields** carbon mineralization potential
- **100%** — **64 of 64 fields** predicted available water holding capacity
- **81%** — **52 of 64 fields** aggregate stability
- **62%** — **40 of 64 fields** organic carbon stocks

These results indicate that **using no-till and cover cropping every year are improving soil health and resilience to water stress for cotton and peanut farmers in the Southern Coastal Plain of North Carolina**. With no-till used on 41% of cropland and cover crops used on 11% of cropland, more farmers in the region could benefit from improving the health of their soils.

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