SOIL HEALTH INSTITUTE
Enriching Soil, Enhancing Life

# Benchmarking Soil Health

## Gulf Coast Plain, Alabama

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.

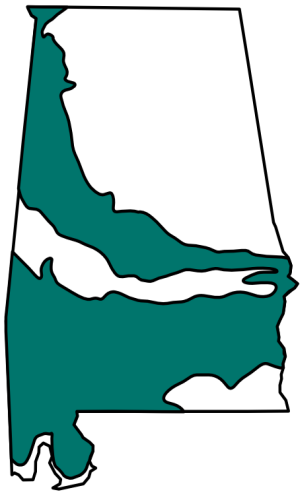
To address this gap, the Soil Health Institute compares minimally disturbed **REFERENCE** sites where soil health is optimal to two types of crop production systems in the same region: typical **BASELINE** management and regenerative **SOIL HEALTH PRACTICES**.

In 2023, SHI sampled soils at 59 fields in the Gulf Coast Plain, Major Land Resource Area 133C, representing 260,000 acres of cropland.

**The results show that growers in the Gulf Coast Plain of Alabama improved their soil health by adopting management practices to reduce soil disturbance and maximize living roots.**

| BASELINE | SOIL HEALTH PRACTICES | REFERENCE |
|---|---|---|
| Dryland cotton-peanut rotations with disk tillage or strip-till | Dryland cotton-peanut rotation with strip-till or no-till and annual cover crops for at least 10 years | Unirrigated grazed pastures, pine plantations |
|  |  |  |
| 26 FIELDS | 14 FIELDS | 19 FIELDS |

## About the region



- **3% of the region is used for crop production, primarily cotton and peanuts.**
- **Conventional tillage (e.g., chisel, disk, and field cultivator) is used on 57%, reduced tillage on 21%, no-till on 22%, and cover crops on 9% of cropland in this region.**
- **Mean annual temperature for the region ranges from 59 to 69°F, and mean annual precipitation ranges from 51 to 80 inches.**
- **Most crop production is on intermediately to well drained soils with sandy to sandy loam surface textures.**
- **Crop production challenges include:**
  - Limited water availability in sandy and well drained soils
  - Intense downpours
  - Potential for hurricanes/tropical storms
  - High pest and weed pressure

## 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 rotations with disk tillage or strip-till. **SOIL HEALTH PRACTICES** primarily involved dryland cotton-peanut rotation with strip-till or no-till and annual cover crops for at least 10 years. **REFERENCE** fields included unirrigated grazed pastures and pine plantations.

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

| | LOAMY SAND SOIL (8% CLAY) | | | LOAM SOIL (20% CLAY) | | |
|---|---|---|---|---|---|---|
| | BASELINE | SOIL HEALTH PRACTICES | REFERENCE | BASELINE | SOIL HEALTH PRACTICES | REFERENCE |
| **Organic carbon concentration** (%) | 0.68 | 0.75 | 1.06 | 0.98 | 1.09 | 1.53 |
| **Aggregate stability** (Index from 0 to 1) | 0.50 | 0.57 | 0.82 | 0.43 | 0.50 | 0.77 |
| **Carbon mineralization potential** (mg C/kg soil/day) | 10 | 12 | 16 | 12 | 14 | 20 |
| **Organic carbon stock** (metric tons C/acre) | 10 | 11 | 14 | 14 | 15 | 19 |
| **Available water holding capacity** (inches) | 0.69 | 0.70 | 0.76 | 0.84 | 0.86 | 0.94 |

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:**

- **+57%** organic carbon concentration
- **+71%** carbon mineralization potential
- **+10%** predicted available water holding capacity
- **+68%** aggregate stability
- **+38%** organic carbon stocks

## What's working?

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

- **+11%** organic carbon concentration *(not statistically significant)*
- **+21%** carbon mineralization potential
- **+2%** predicted available water holding capacity
- **+15%** aggregate stability
- **+9%** organic carbon stocks *(not statistically significant)*

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:**

- **80%** **32 of 40 fields** organic carbon concentration
- **80%** **32 of 40 fields** carbon mineralization potential
- **100%** **40 of 40 fields** predicted available water holding capacity
- **60%** **24 of 40 fields** aggregate stability
- **92%** **37 of 40 fields** organic carbon stocks

These results indicate that **reducing tillage and adding annual cover crops are improving soil health and water-holding capacity for cotton and peanut farmers in the Gulf Coast Plain of Alabama**. However, with these practices used on around 30% of cropland, many more farmers in the region could benefit from improving the health of their soils.

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