SOIL HEALTH INSTITUTE
Enriching Soil, Enhancing Life

Benchmarking Soil Health

Blackland Prairies, Alabama

Minimizing soil disturbance and maximizing living roots can reduce production costs, build resilience to extreme weather, and increase yield by improving soil health over time. What's been missing is knowing how healthy a region's soils can become through these practices. Our benchmarking approach shows what optimal soil health looks like in a region, reveals what's working to move row crop production toward that standard, and helps growers and advisors set achievable, locally relevant goals.

In Alabama's Blackland Prairies, we found that **using strip-till and annual cover crops improves soil health and resilience to water stress for cotton and grain farmers**.

Comparing row crop soils to minimally disturbed sites

In 2024, we sampled 66 fields in MLRA 135A, representing 50,000 acres of cropland, with 3% of the region used for crop production, primarily cotton, corn, soy, and peanut. To find out how healthy the region's soils can become, we looked at minimally disturbed **REFERENCE** sites with optimal soil health. We then evaluated two types of row crop production: typical **BASELINE** management, and fields where growers use additional **SOIL HEALTH PRACTICES** beyond the baseline for the region.

BASELINE

Irrigated and dryland cotton-corn-soy and cotton-peanut rotations with disk tillage



12 FIELDS

SOIL HEALTH PRACTICES

Irrigated and dryland cotton-corn-soy and cotton-peanut rotations with strip-till and annual cover crops



14 FIELDS

REFERENCE

Unirrigated grazed pastures, unirrigated hayfields



40 FIELDS

At each location, we measured these essential indicators. As these scores improve, growers may see benefits including increased yield, profitability, drought resilience, and flood management.

- **Soil organic carbon:** Measures organic matter in soil. Management that increases organic carbon content helps make nutrients and water more available to crops, making soil more productive.
- **Aggregate stability:** Small clumps of soil create needed space for water, air, and roots. When these aggregates are strong, they prevent erosion and let the field absorb water.

We use soil texture and soil organic carbon to predict **available water holding capacity**: the amount of water the soil can store and provide to plants, improving resilience to drought and erosion. To give growers an estimate of their soil's current and potential carbon storage, we calculate **organic carbon stock** — the amount of organic carbon in the top 12 inches of soil — using soil organic carbon and bulk density measurements.

Along with management, soil texture (sand/clay content) also affected the indicators we measured, so we evaluated the results by clay content.

How healthy can Alabama Blackland Prairie soils become?

Here's what minimally disturbed REFERENCE soils looked like, and how the two types of row crop management compared to reference values across both soil textures.

	SANDY LOAM SOIL (9% CLAY)			CLAY SOIL (58% CLAY)		
	BASELINE	SOIL HEALTH PRACTICES	REFERENCE	BASELINE	SOIL HEALTH PRACTICES	REFERENCE
Soil organic carbon (%)	0.99	1.06	1.72	1.99	2.13	3.44
Aggregate stability (Index from 0 to 1)	0.67	0.73	0.83	0.41	0.48	0.63
Organic carbon stock (metric tons C/acre)	13	14	21	24	25	38
Available water holding capacity (inches)	0.96	0.97	1.06	0.72	0.75	1.05

Values were calculated using hierarchical models to adjust for differences in soil texture, pH, mean annual temperature, and mean annual precipitation across sampled locations. Available water holding capacity and organic carbon stock are estimated based on soil organic carbon plus soil texture and bulk density measurements, respectively.

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

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

+74% soil organic carbon

+57% organic carbon stock

+49% aggregate stability

+28% predicted available water holding capacity

How are management changes improving soil health?

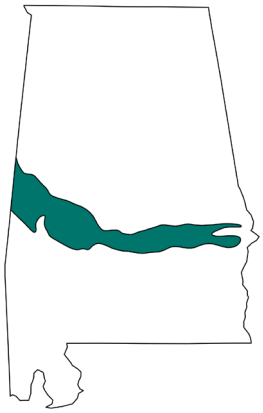
Compared to BASELINE, samples from fields with SOIL HEALTH PRACTICES had on average:

+8% soil organic carbon

+6% organic carbon stock

+17% aggregate stability

+2% predicted available water holding capacity



Challenges that soil health practices can address in the Alabama Blackland Prairies include:

- Inconsistent rainfall throughout the growing season
- Low water infiltration rates for high-clay soils, especially from soil compaction
- High-clay soils susceptible to waterlogging and erosion
- Calcareous clayey soils prone to shrink-swell behavior, restricting root growth and making tillage and planting windows difficult to manage

With reduced tillage on 16%, no-till on 18%, and cover crops used on 9% of cropland, many more farmers in this region could benefit from improving the health of their soils.

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