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Agronomy and Soil

Soil Health in Conventional and Cover Crop Fields in Central Tennessee

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Conventional annual cropping systems rely on annual tillage operations, which can contribute to soil erosion, nutrient leaching, water pollution, and reduced resilience (Paustian et al., 2026). More resilient crop production systems are needed to improve soil health through the use of conservation practices such as conservation tillage and cover crops. While TN leads the nation in the adoption of conservation tillage, cover crops adoption has lagged. The use of cover crops provides several ecosystem services in cropping systems including soil health improvements, soil moisture conservation, weed suppression, and improved nutrient cycling (Hobbs et al., 2008). Healthy soil can support diverse soil microbial groups and build soil organic carbon, which improves the retention of water and nutrients and enhances cropping system resiliency.

In Tennessee, few studies have examined the precise effects of cover crops on soil health indicators including soil organic carbon (SOC) and soil microbial communities in corn-soybean production compared to a conventional production system that remains fallow during winter. However, on-farm assessment of cover crop-associated soil health benefits in producer-managed fields is still lacking. This study aims to compare the effect of a few years of cover crop adoption on key soil health indicators in several producer-managed fields in central Tennessee. The study included 14 farm pairs (six in Giles County and eight in Franklin County) (Fig. 1) with similar soil type, in which one farm in each pair was under a conventional production system while the other was under cover cropping.

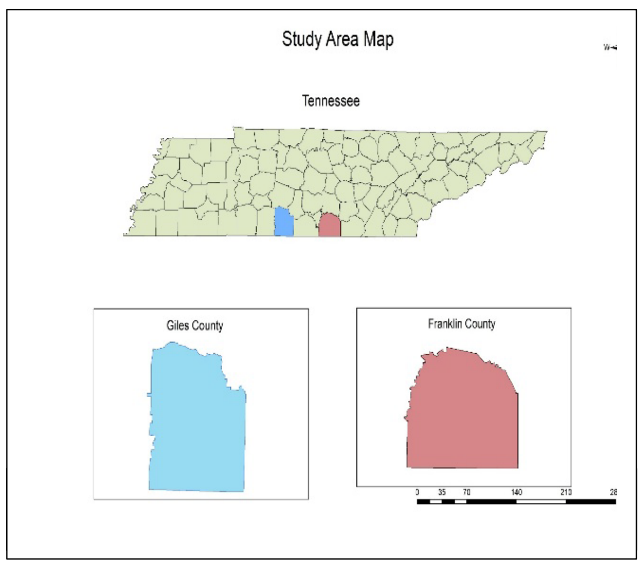

Figure 1. County map of Tennessee showing the counties sampled for soil health assessment

Field sampling and laboratory analysis

Surface soil samples from 0-6 inch depth were collected from a total of 28 (14 pairs) producer-managed fields in Giles County near Pulaski and Franklin County near Winchester (Fig. 2) in Tennessee in December of 2024 and 2025.

Soil physical (water holding capacity), chemical (soil organic carbon), and biological (total living microbial biomass and respiration) indicators of soil health were determined.

Figure 2. Convention (**top**) and cereal rye cover crop (**bottom**) used for sampling in Winchester, TN.

The water holding capacity measures the total plant available water a soil can hold and make it available for a growing crop. Soil organic carbon (SOC) gives carbon content within soil organic matter which includes decaying plant and animal matter, microorganisms, and microbial byproducts-crucial for soil fertility, water retention, and nutrient availability (Lal, 2004).

The total living microbial biomass provides the fungal and bacterial populations, which gives critical information about soil's microbial health (Acosta-Martinez et al., 2010). Soil respiration measures the potential microbial activity in the soil by measuring the carbon dioxide (CO_2) produced by soil microorganisms as a byproduct of the breakdown of soil organic matter.

Soil physical and chemical indicators

The water holding capacity (physical-Fig. 3; left**)** and soil organic matter (chemical-Fig. 3; right) were mildly elevated in cover crop fields compared to conventional fields in 2024 and 2025. These are slow-changing indicators and typically require a longer period of time to show a more pronounced effect from change in management practice. Farmers may need to use cover crops for longer-term to see the positive effects on water holding capacity and soil organic carbon.

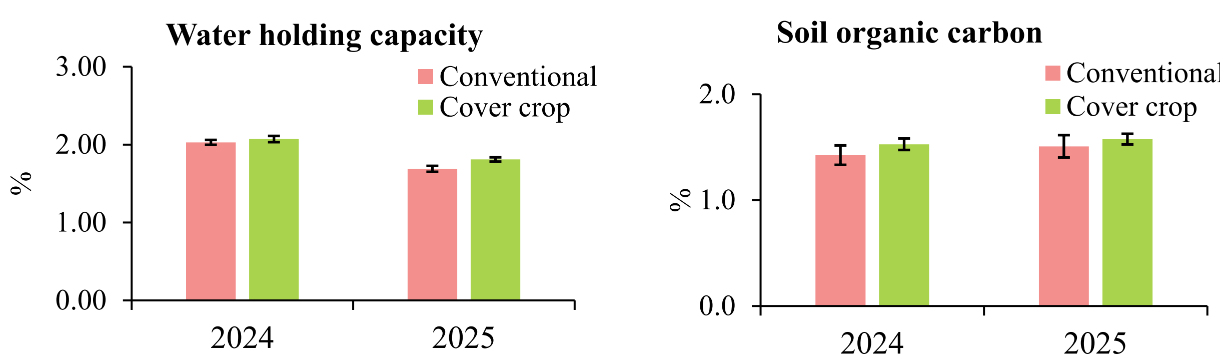

Figure 3. Water holding capacity (left) and soil organic carbon (right) in conventional and cover crop systems.

Soil biological indicators

The soil microbial indicators such as total living microbial biomass (Fig. 4; left) and soil respiration (Fig. 4; right) were significantly higher in cover crop fields (numerically higher soil respiration in 2024) compared to conventional fields. These indicators are sensitive to management practices and respond more quickly. These indicators show early changes in soil health, and farmers may need to continue the management practices if they see early positive changes.

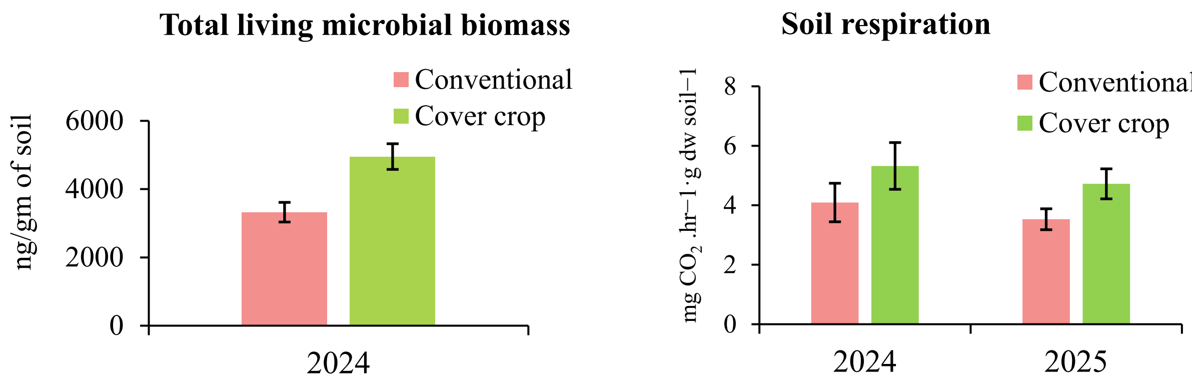

Figure 4. Total living microbial biomass (left) and soil respiration (right) in conventional and cover crop systems.

Conclusions

This study compared early changes in a few selected soil health indicators between conventional annual crop fields and cover crop fields in Tennessee. The early trends toward higher total living microbial biomass and soil respiration, and elevated water holding capacity and soil organic carbon in cover crop fields indicate the positive effect of cover crops on soil health improvements. These early positive effects indicate better water retention and healthier soil in the longer term. Longer-term comparisons are needed to detect slow changes in soil health indicators in the same producers' fields.

References

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