Transitioning to ecologically functional production systems

By examining crop-microbe interactions in multiple landscape positions, PIs identified which cropping systems were best suited to increase soil carbon storage. They found that across all landscape positions switchgrass had more roots than corn, which increased the activity of soil microorganisms, especially when crops were full grown. More roots and greater microbial activity coincided with greater soil aggregation. Soil aggregation is important for storing carbon, nitrogen and water.

What was done and why?
Understanding the relationship between live roots and microbial breakdown of plant and soil organic carbon (C) pools is essential for evaluating the long-term value of each cropping system. The project team assessed differences in C storage potential among cropping systems and landscape positions by measuring microbial biomass and activity, root turnover and soil C pools. This provides a mechanistic understanding of why certain cropping systems have the potential to enhance C storage and reduce CO₂ emissions, allowing for more accurate assessments of C storage capacities.

The objectives were to:
1. Compare the microbial response (i.e., microbial biomass, extracellular enzyme activity) to conventional and alternative cropping systems grown on different landscape positions,
2. Quantify root inputs and turnover rates among conventional and alternative cropping systems grown on different landscape positions,
3. Compare soil C pools among cropping systems and landscape positions, and
4. Enhance understanding among agricultural stakeholders in how to quantify and manage soil C.

What did we learn?
Overall, this research demonstrates that perennial cropping system can enhance plant-microbe interactions, resulting in a greater capacity for improved soil quality on working farms. In combination, research results indicate that through increased root productivity, slower decomposition and enhanced soil aggregation, switchgrass has greater ability than corn to promote soil organic matter formation and soil C storage. The data demonstrate that these differences are driven by augmented root inputs in the switchgrass system, which enhances microbial enzyme activity, resulting in greater soil aggregation, which ultimately supports the potential for greater overall soil C storage.