

Which Management Practices Most Influence Soil Health in Organic Corn Production?

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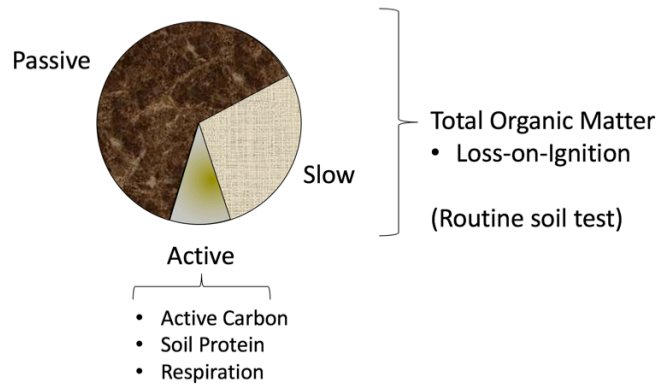
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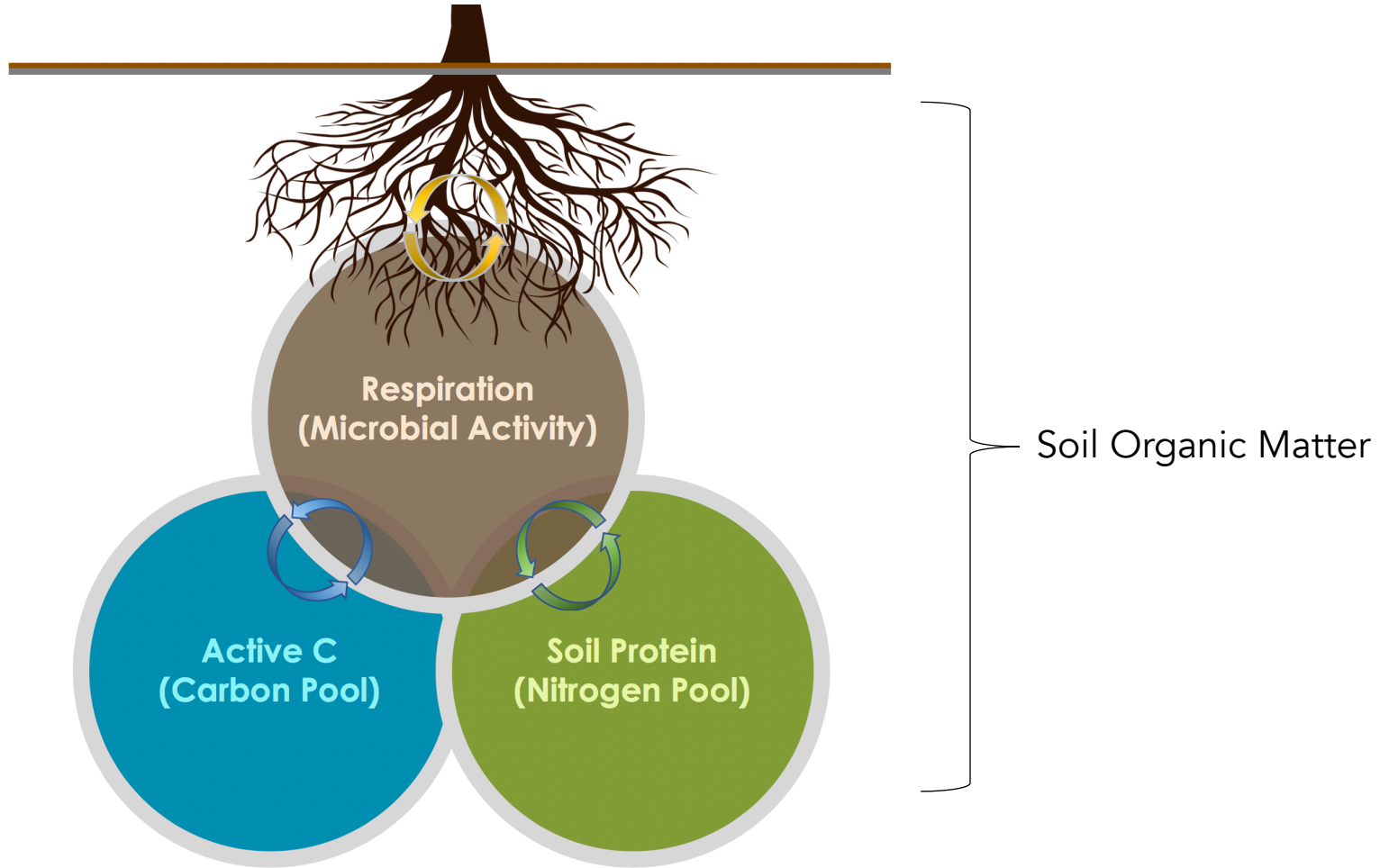
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The Importance of Soil Health at Local and Regional Scales



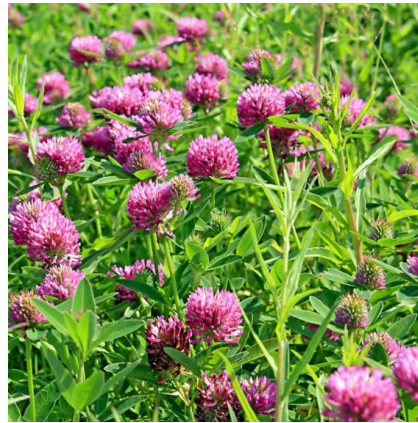
- Farmers want more information from current soil testing
- Enthusiasm for tests that are more sensitive to management
- Pressure to improve soil health and retain nutrients
- The link between soil health and soil organic matter

Key Soil Health Indicators

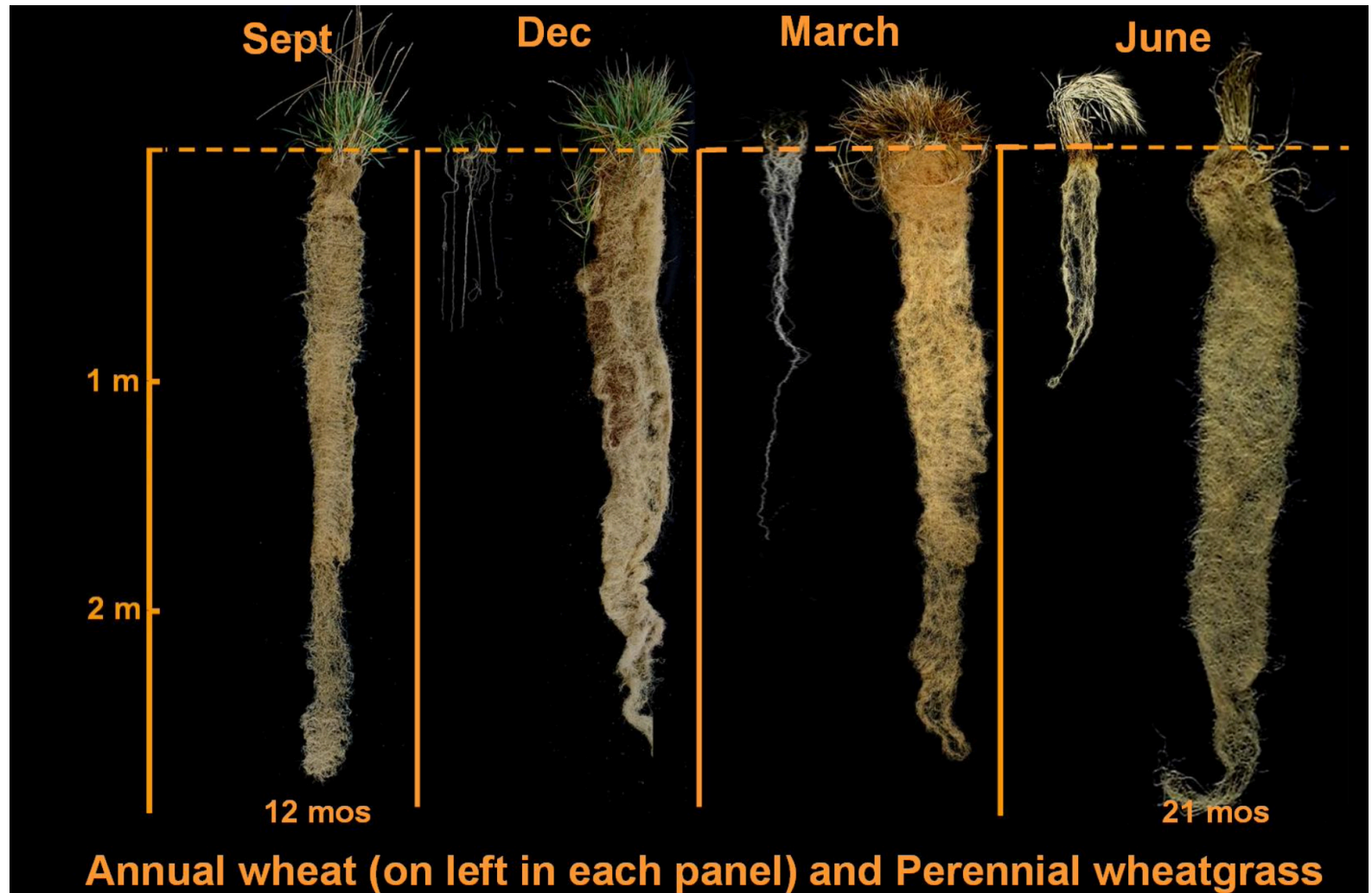


Soil Health Promoting Practices

- Increase organic matter inputs
 - Reduce soil disturbance
 - Year-round ground cover



The Importance of Perennials



Nutrient inputs



- Compost
- Manure additions

On-Farm Tradeoffs in Organic Systems: Soil Health and Tillage



Farmer Questions on Soil Health Testing

- How do I improve soil health on my farm?
- What crops should I grow in my rotation to improve soil health?
- What is a “good” value for a given soil health indicator?
- How do my soil health test values compare to others?

Research Questions

- How does soil type influence soil health indicator values and distributions?
- What management practices most influence soil health in corn production across Indiana, Michigan, Ohio, and Pennsylvania?

Building a Regional Soil Health Database

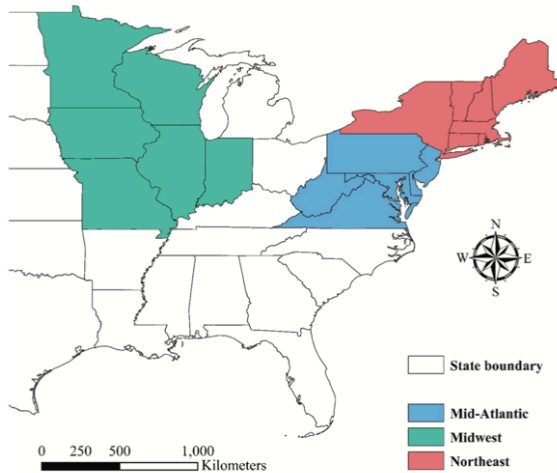
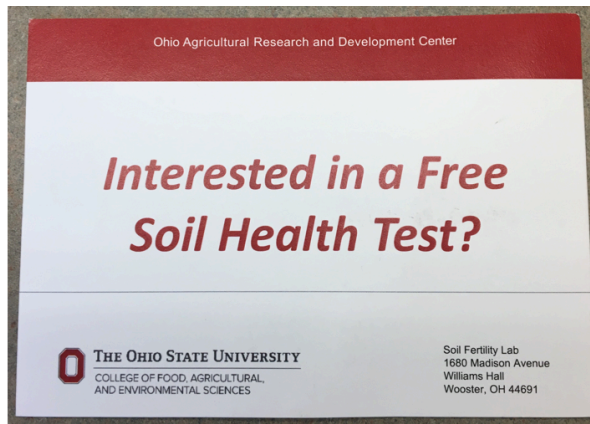
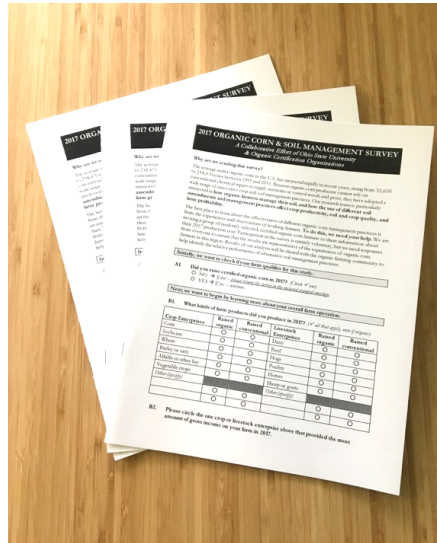


Fig. 1. Mid-Atlantic, Midwest, and Northeast regions of the United States as defined for this study. Comprehensive Assessment of Soil Health (CASH) samples from each region were aggregated into subdatasets for regional comparisons of soil health status.

Fine et al. 2017

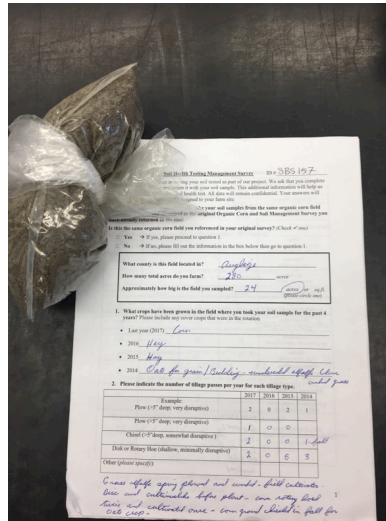
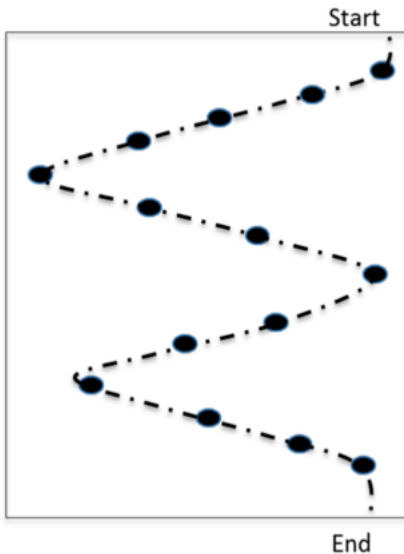
- Develop distributions of soil health indicators across the Great Lakes Region
- Assess the extent to which various management practices influence soil health
- Use more regionally-relevant soil test extractant (Mehlich-3 vs. Modified Morgan)

Methodology



- Interdisciplinary research
 - Collaboration with social scientists
- Survey sent to every organically certified corn grower in Ohio, Michigan, Indiana, and Pennsylvania
- Farmers offered free soil health test for completing survey

Soil Testing and Analysis



- Select soil sampling area (<5 acres)
- 10 cores or slices to a depth of 20 cm
- Send composited soil samples (3 cups) with additional management survey
- Soils were sieved to 8 mm and ground <2 mm
- Soils analyzed for chemical, physical, and biological properties
- Farmers received comprehensive soil test report if management survey was sent in.

Management Survey: Crop Rotations

1. What crops have been grown in the field where you took your soil sample for the past 4 years? Please include any cover crops that were in the rotation.

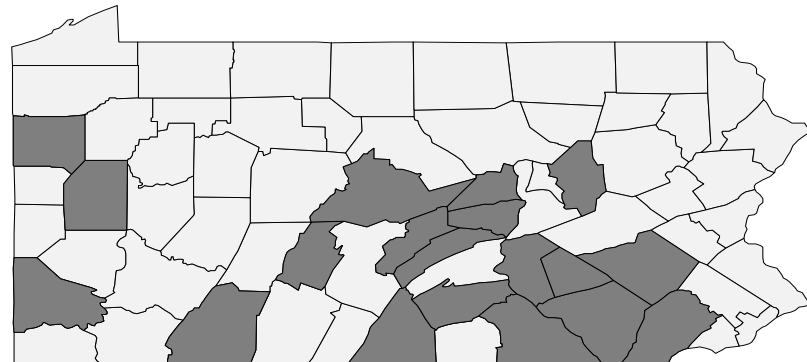
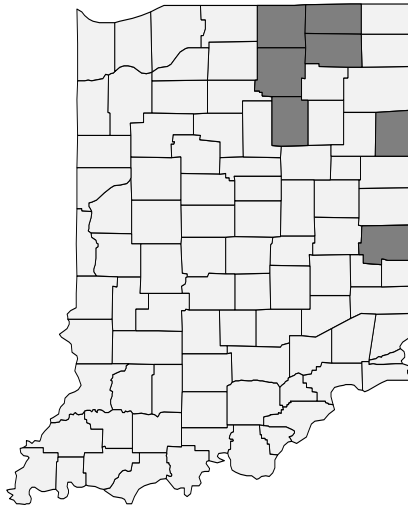
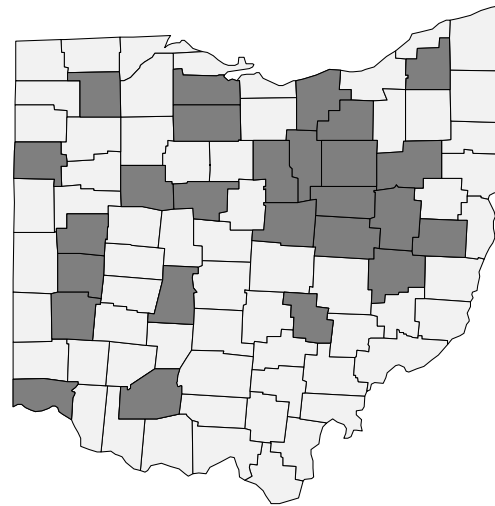
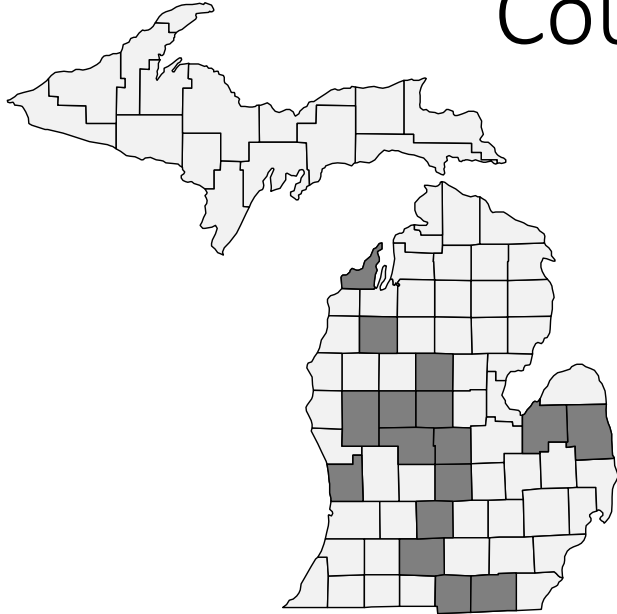
- Last year (2017) hay
- 2016 hay
- 2015 hay
- 2014 Corn

Management Survey: Quantifying Tillage Passes

2. Please indicate the number of tillage passes per year for each tillage type.

	2017	2016	2015	2014
Example: Plow (>5" deep; very disruptive)	2	0	2	1
Plow (>5" deep; very disruptive)	1	1		1
Chisel (>5" deep, somewhat disruptive)				
Disk or Rotary Hoe (shallow, minimally disruptive)			1	
Other (<i>please specify</i>):				

County Representation



- Four States
- 73 Counties
- 195 Soil Samples

Summary of Management Practices Represented in Study

Table 1. Key characteristics of participant farms in this study (n=195)

Organic Cropland (hectares)	% of participant farms*	Row crops present at least once in 4 year-rotation	% of participant farms	Perennial crop present in 4 year rotation	% of participant farms	Subscribe to Soil Balancing?	% of participant farms
<10	8%	Corn	78%	None	24%	Yes	58%
10-50	33%	Soybeans	15%	One Year	13%	No	41%
50-100	31%	Wheat	9%	Two +	63%	NA	<1%
100-500	19%						
500+	6%						

*3% of farms did not report farm size

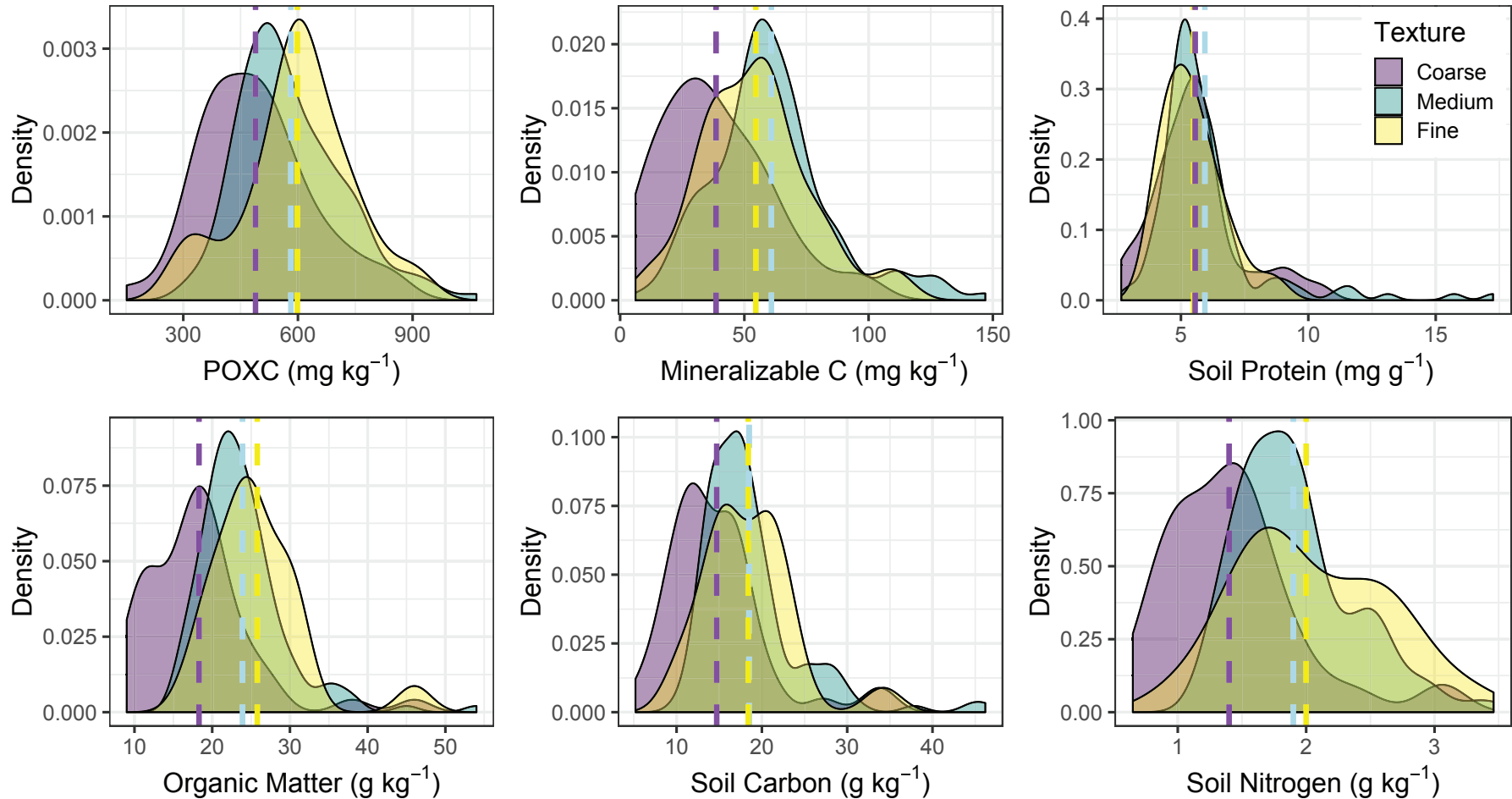
Summary of Management Practices Represented in Study

Table 2. Management practices prevalent across farms producing organic corn (n=195) from 2014-2017 in Indiana, Michigan, Ohio, and Pennsylvania

	Manure	Cover Crops	Perennials in rotation	Tillage
Present	87%	47%	76%	92%
Absent	13%	53%	24%	8%

What is a good soil health value?

Distributions of Key Soil Health Indicators



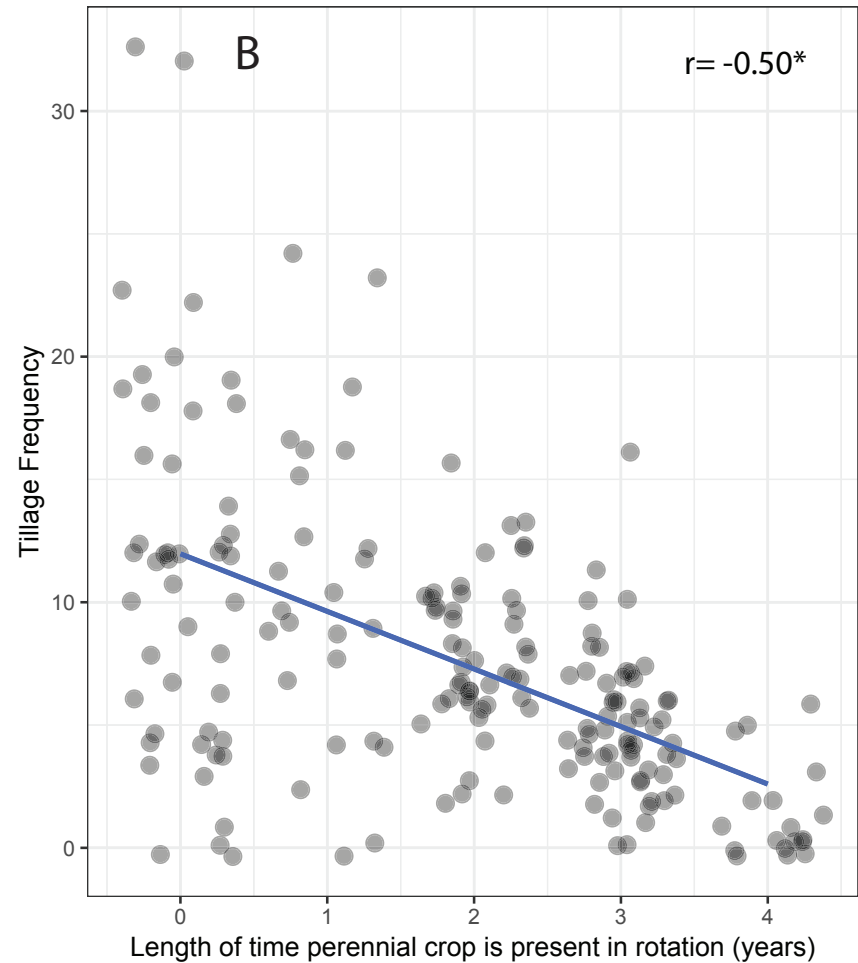
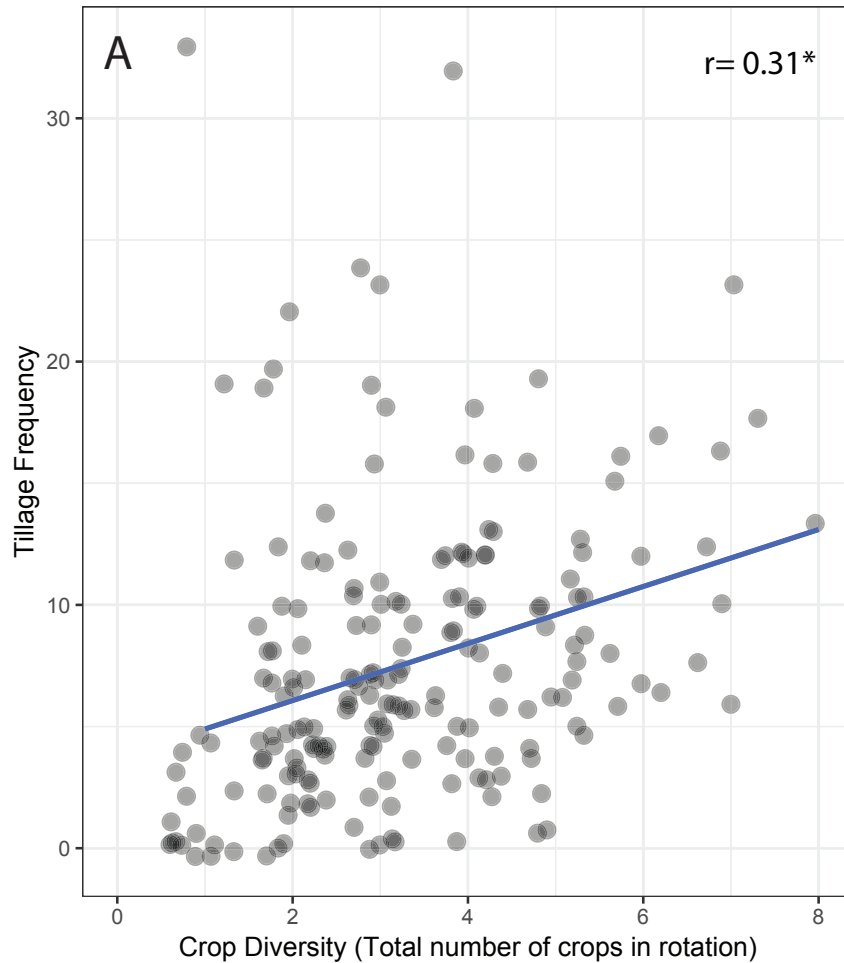
Coarse (Sandy): 1.8%

Medium (Silt Loam): 2.4%

Fine (Clay Loams): 2.6%

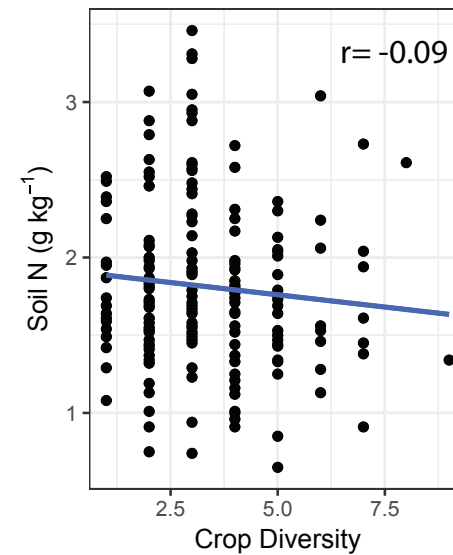
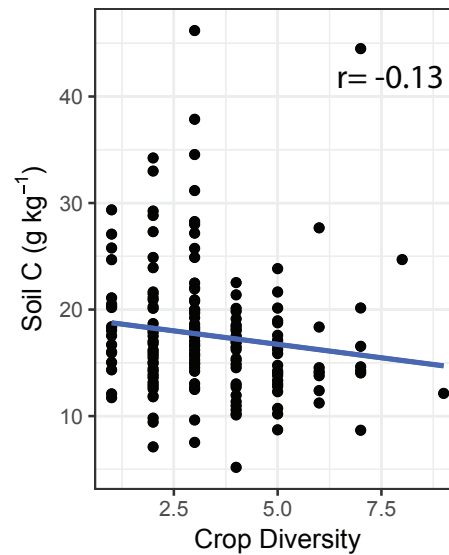
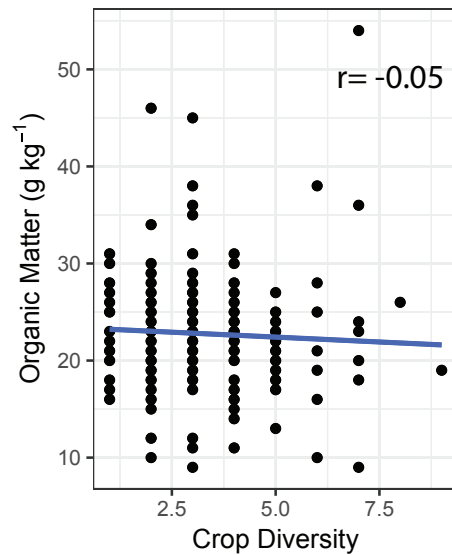
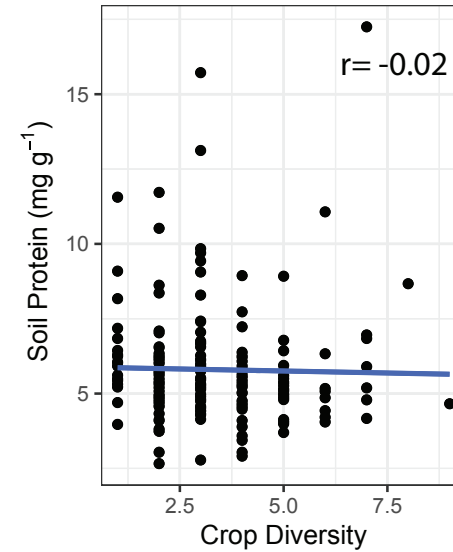
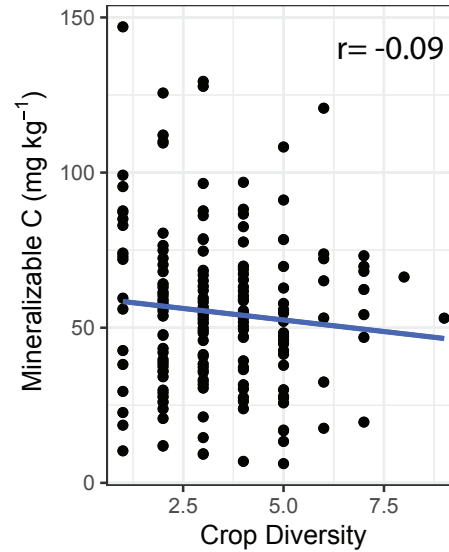
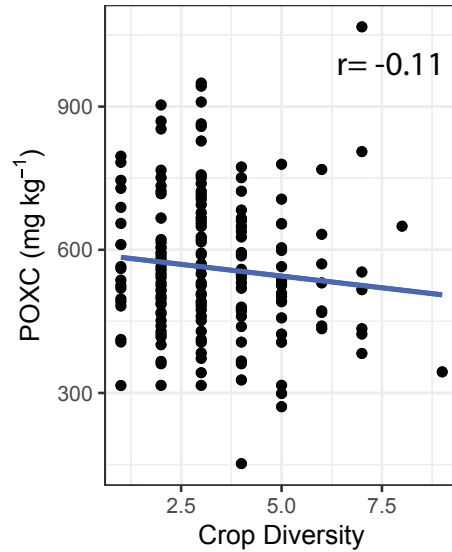
What's the relationship between
different types of management
practices?

Crop Diversity, Tillage, and Perenniality

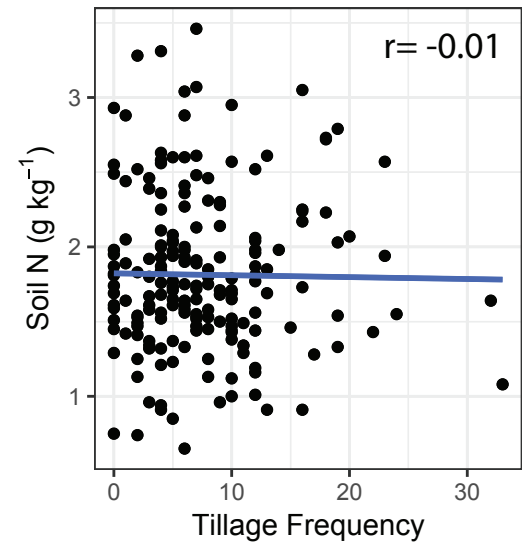
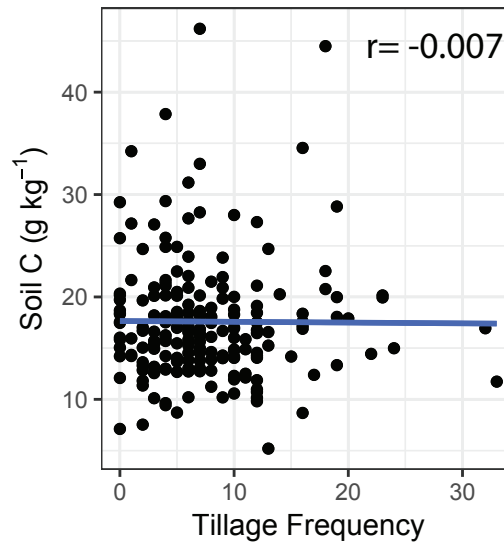
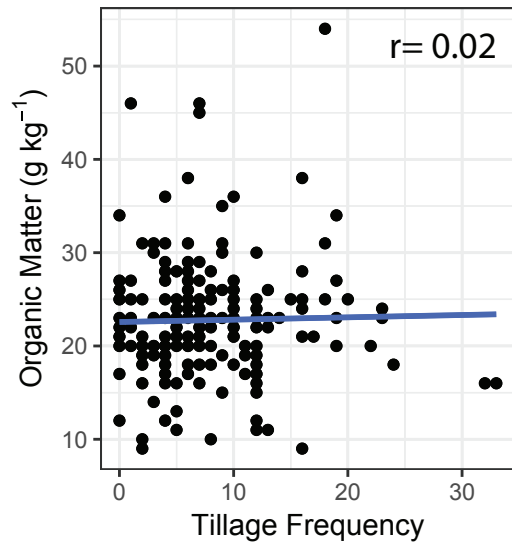
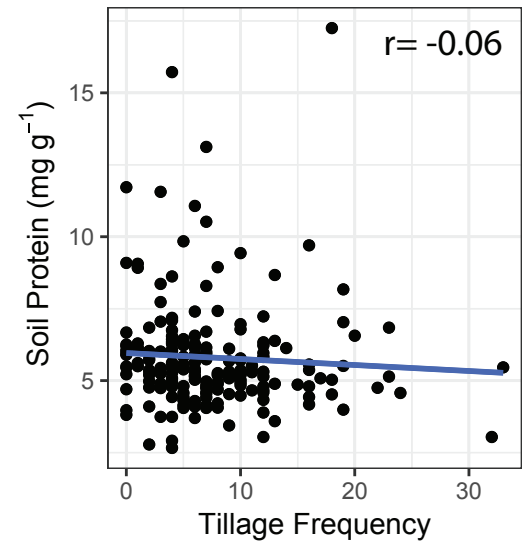
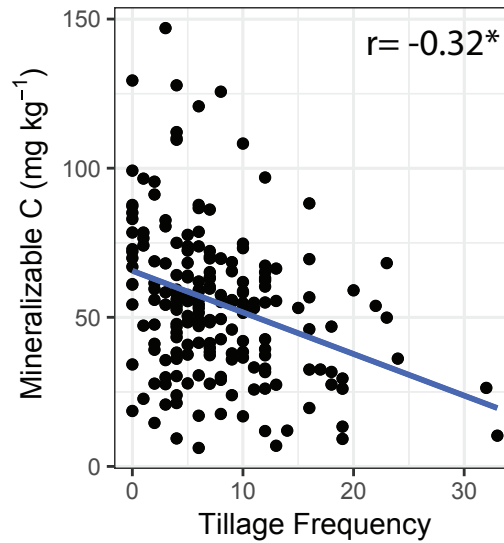
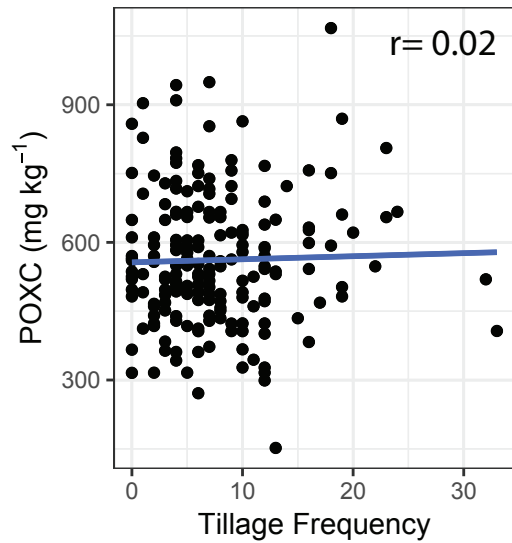


How do different management practices influence soil health in corn production?

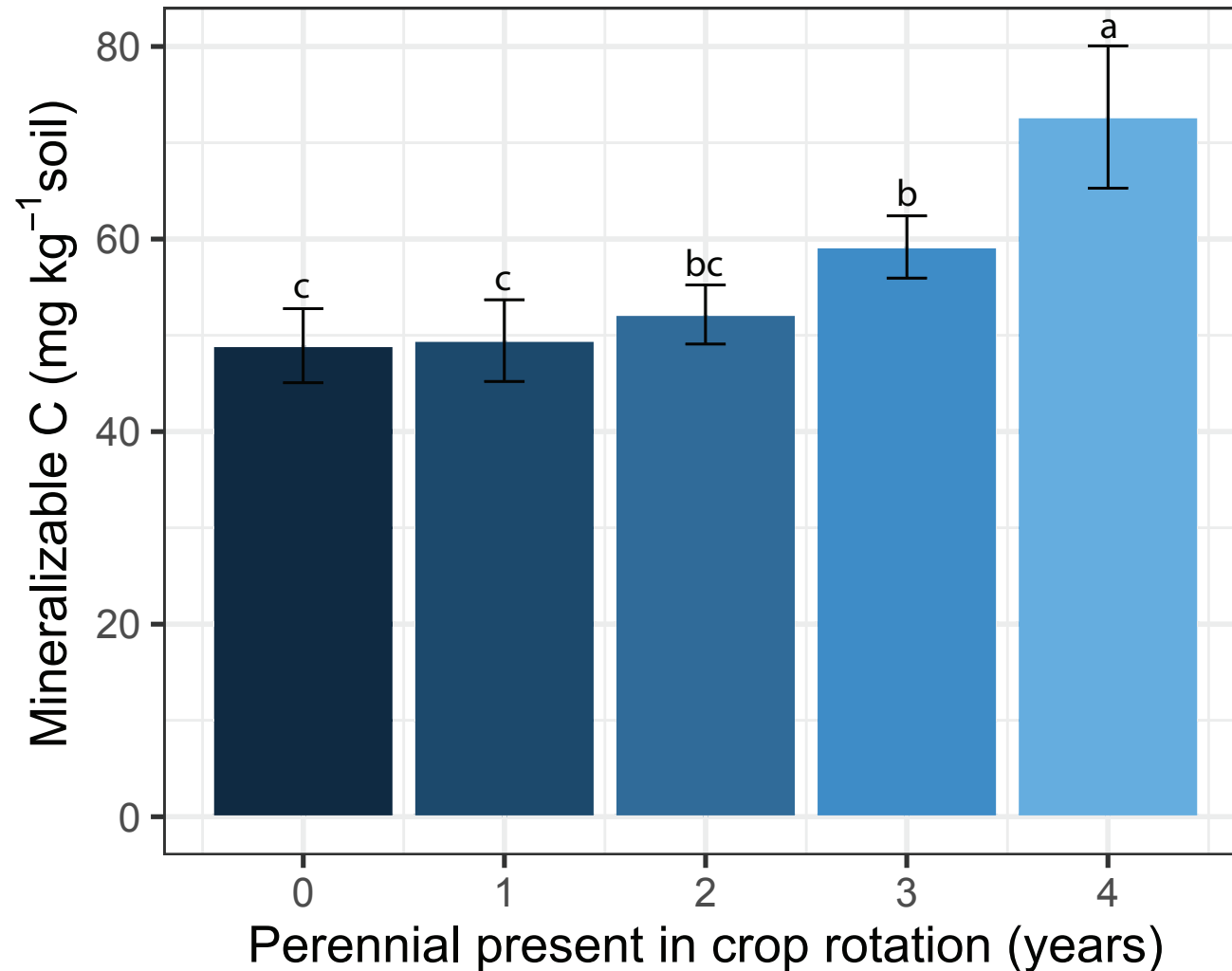
Crop Rotational Diversity and Soil Health



Tillage and Soil Health



Perennials increase soil respiration with time



Summary

- Organic farmers in the Great Lakes Region utilize a wide variety of management practices to maintain crop rotational diversity
- Crop rotational diversity has a complex relationship with soil health indicators most likely due to increased tillage frequency
 - \uparrow Crop Rotation Diversity = \uparrow Tillage = \downarrow Soil Health
 - \uparrow Perennials in Rotation = \downarrow Tillage = \uparrow Soil Health

Acknowledgments



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