

What Management Practices Most Influence Soil Health in Corn Production?

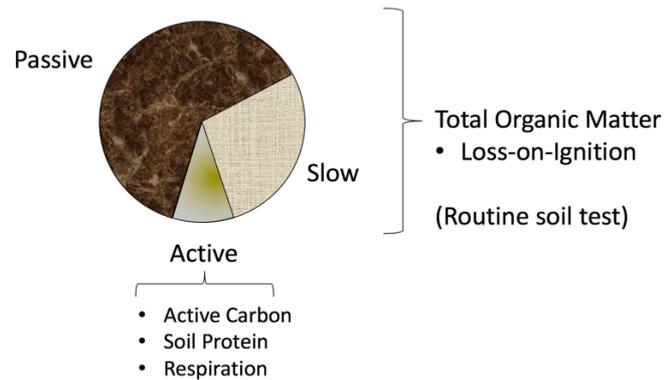
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**THE OHIO STATE
UNIVERSITY**

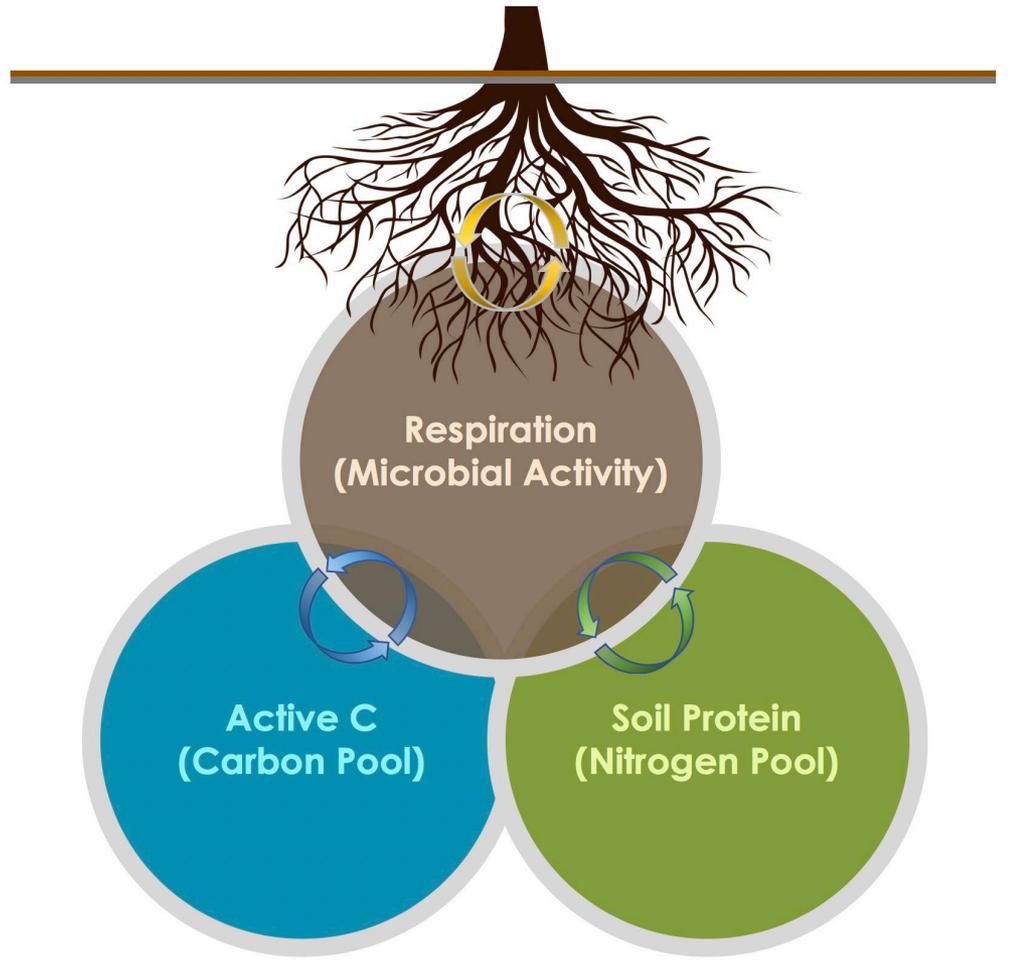
The Importance of Soil Health at Local and Regional Scales



- 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



Key Soil Health Indicators



Soil Health Promoting Practices

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



On-Farm Tradeoffs: Soil Health and Tillage



Farmer Questions on Soil Health Testing

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

Building a Regional Soil Health Database

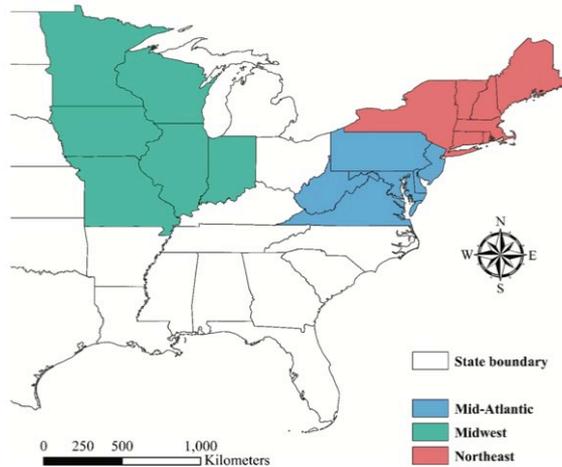


Fig. 1. Mid-Atlantic, Midwest, and Northeast regions of the United States as defined for this study. Comprehensive Assessment of Soil Health (CASH) samples from each region were aggregated into subdatasets for regional comparisons of soil health status.

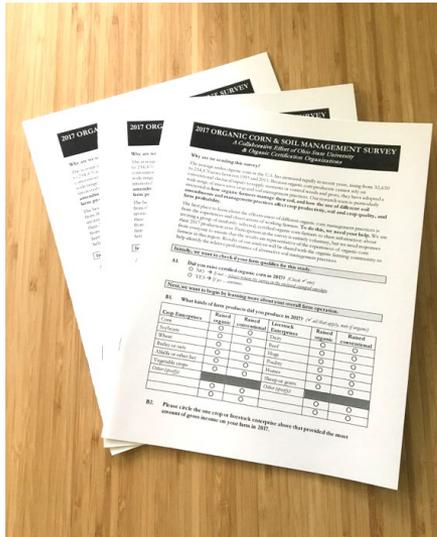
Fine et al. 2017

- 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)

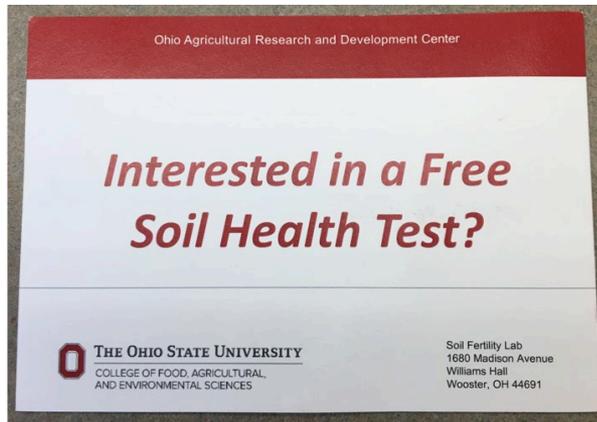
Research Questions

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

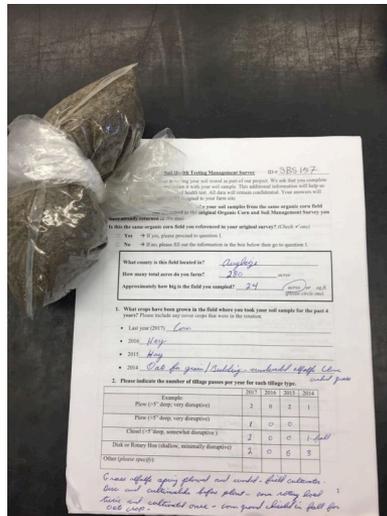
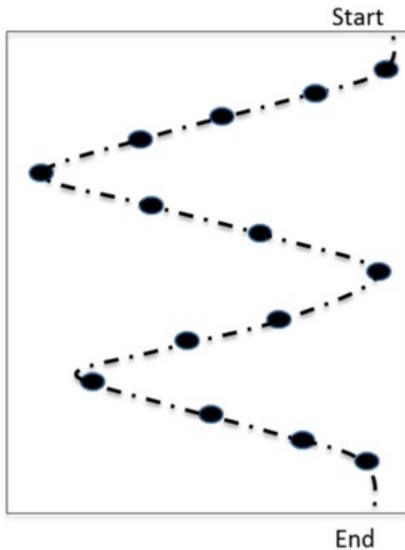
Methodology



- 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.

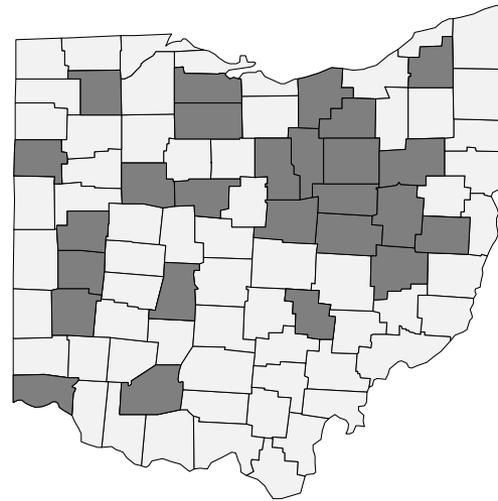
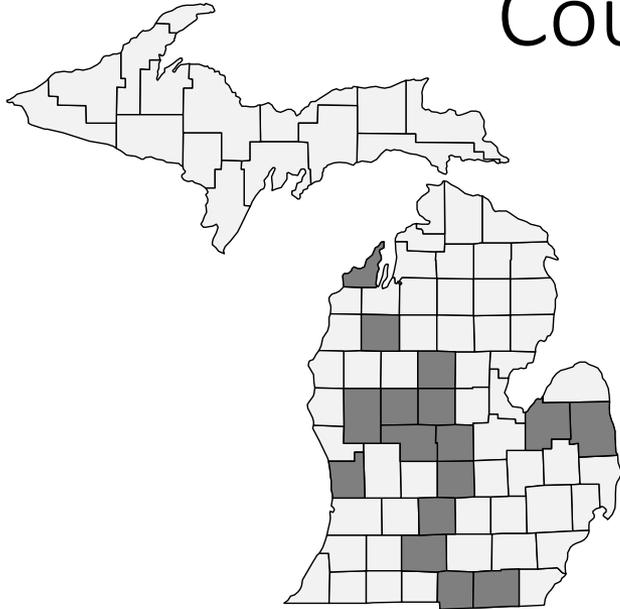
- Last year (2017) hay
- 2016 hay
- 2015 hay
- 2014 corn

Management Survey: Quantifying Tillage Passes

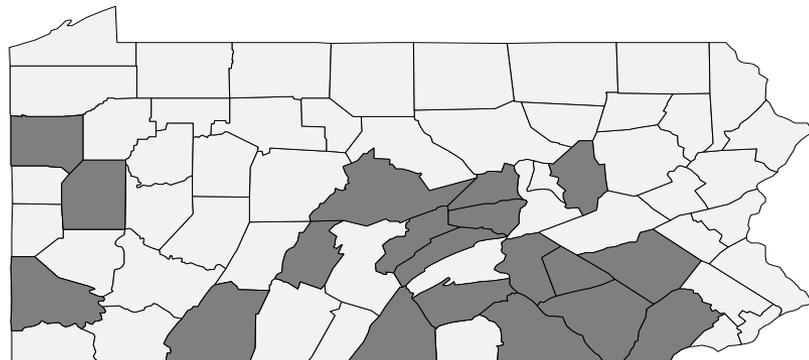
2. Please indicate the number of tillage passes per year for each tillage type.

	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>):				

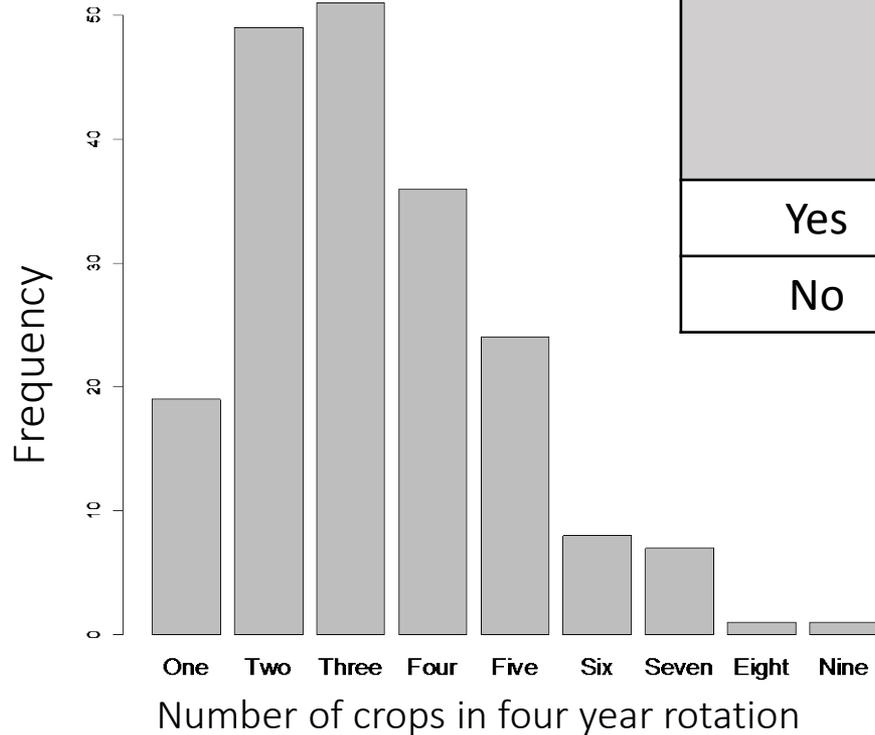
County Representation



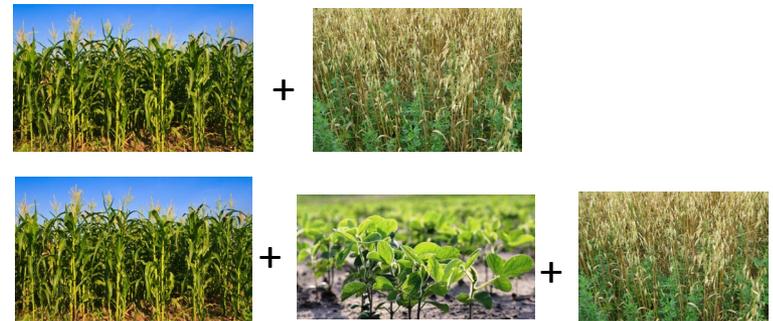
- Four States
- 73 Counties
- 197 Soil Samples



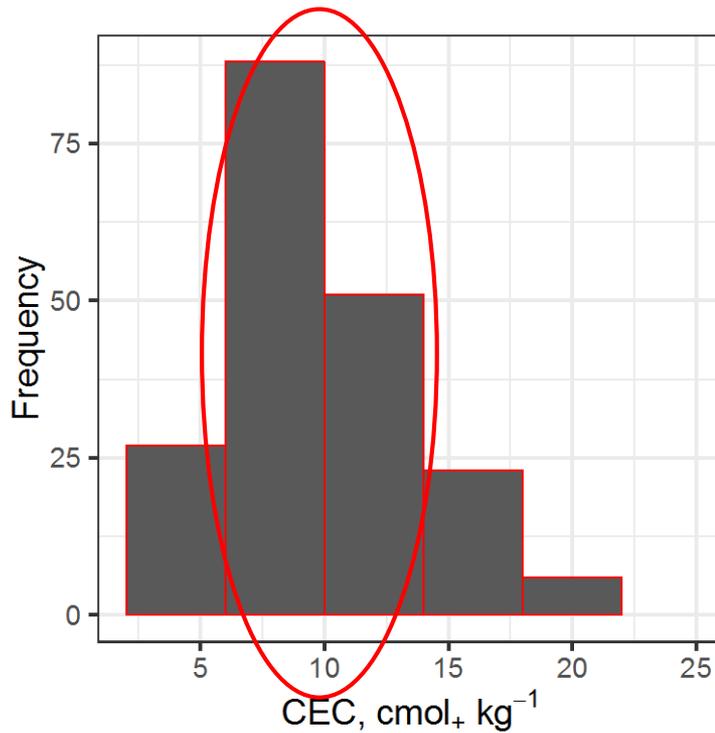
Survey of Management Practices



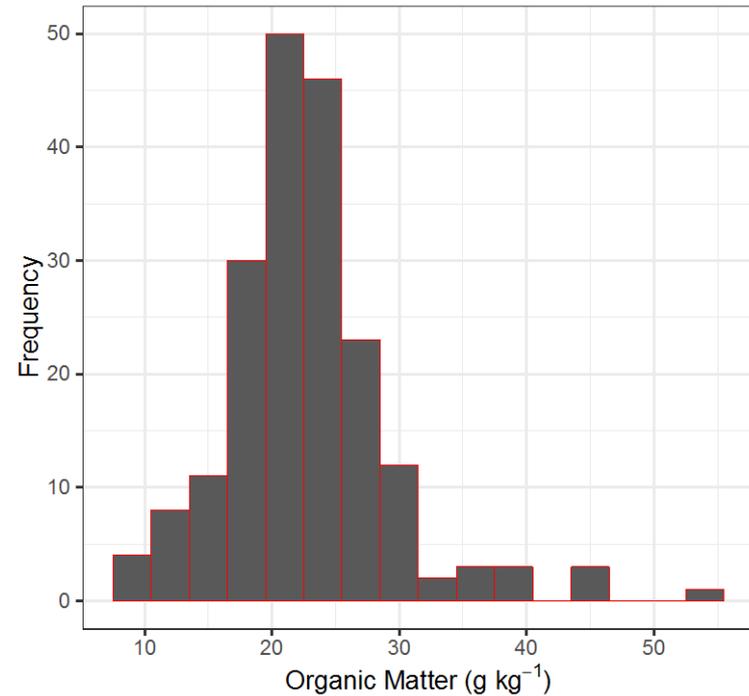
	Manure	Cover Crop	Perennial present in rotation
Yes	169	92	148
No	28	105	49



Distributions of Key Soil Characteristics

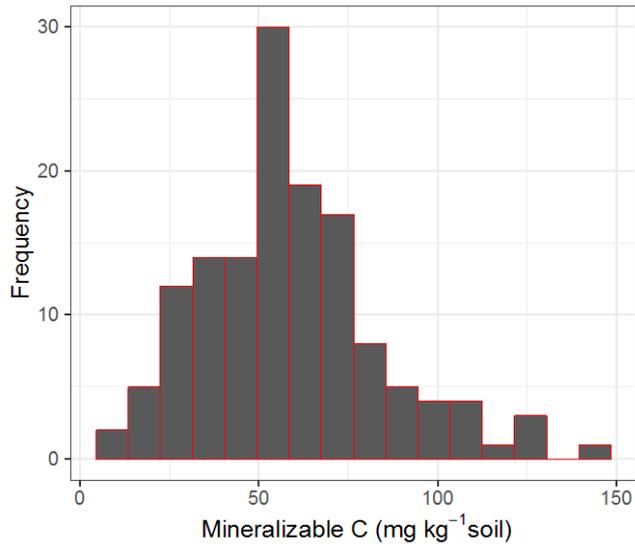


Range: 2-22 $\text{cmol}_+ \text{kg}^{-1}$
Mean: 9.8 $\text{cmol}_+ \text{kg}^{-1}$

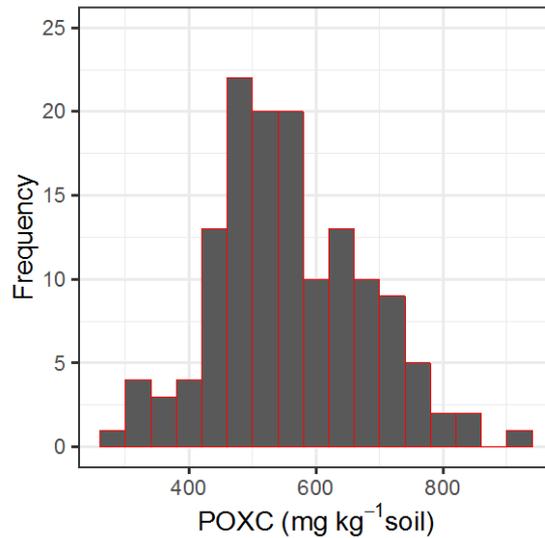


Range: 9-54 g kg^{-1}
Mean: 22.74 g kg^{-1}

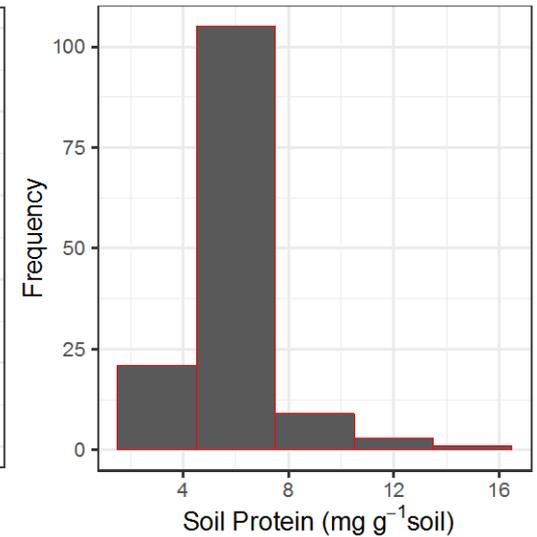
Soil Health Distributions Silt Loam Soils



Range: 9-147 mg kg⁻¹ soil
Mean: 58.97 mg kg⁻¹ soil



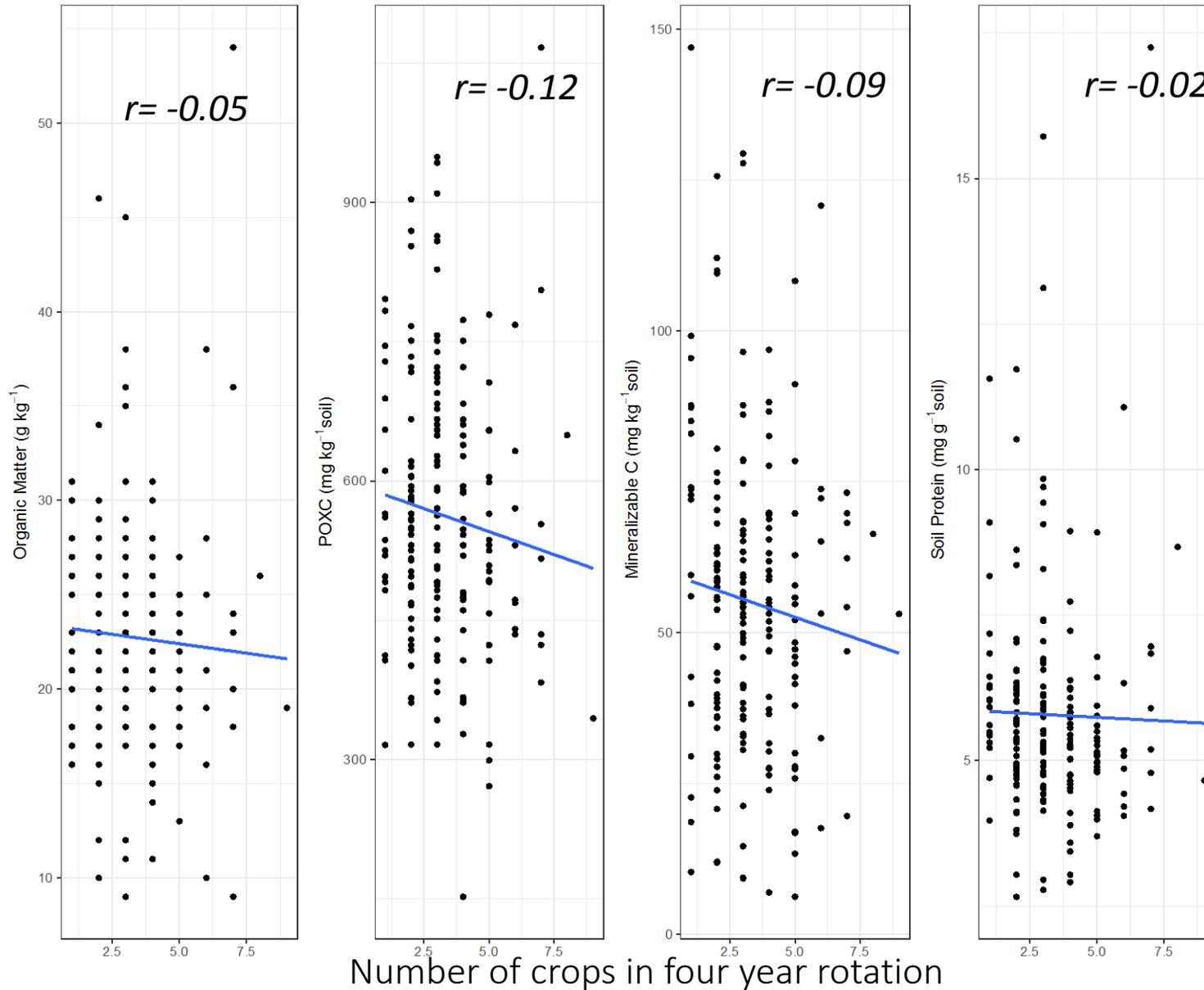
Range: 299-910 mg kg⁻¹ soil
Mean: 559 mg kg⁻¹ soil



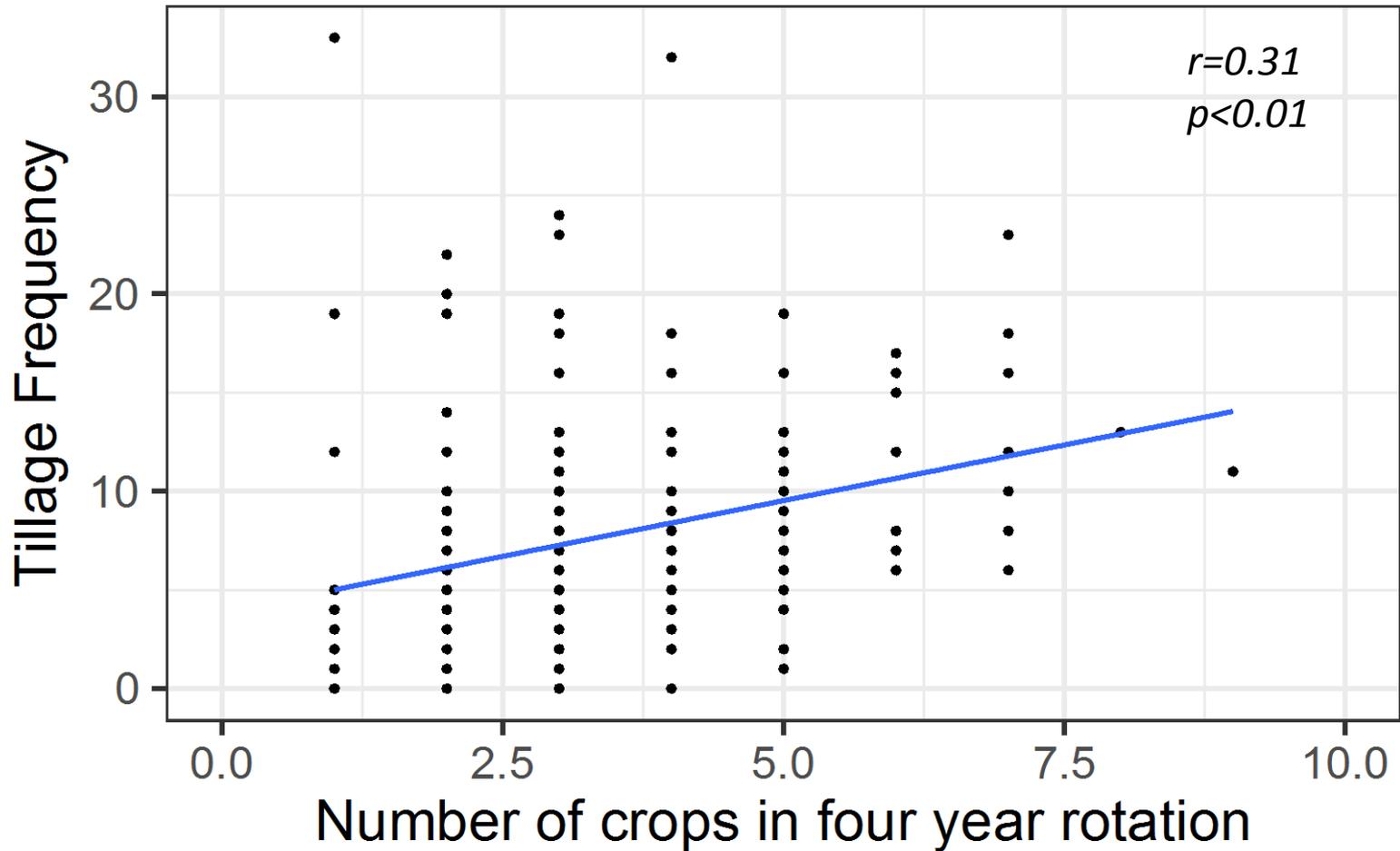
Range: 2.7-15.7 mg g⁻¹ soil
Mean: 5.7 mg g⁻¹ soil

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

Crop Rotational Complexity and Soil Health

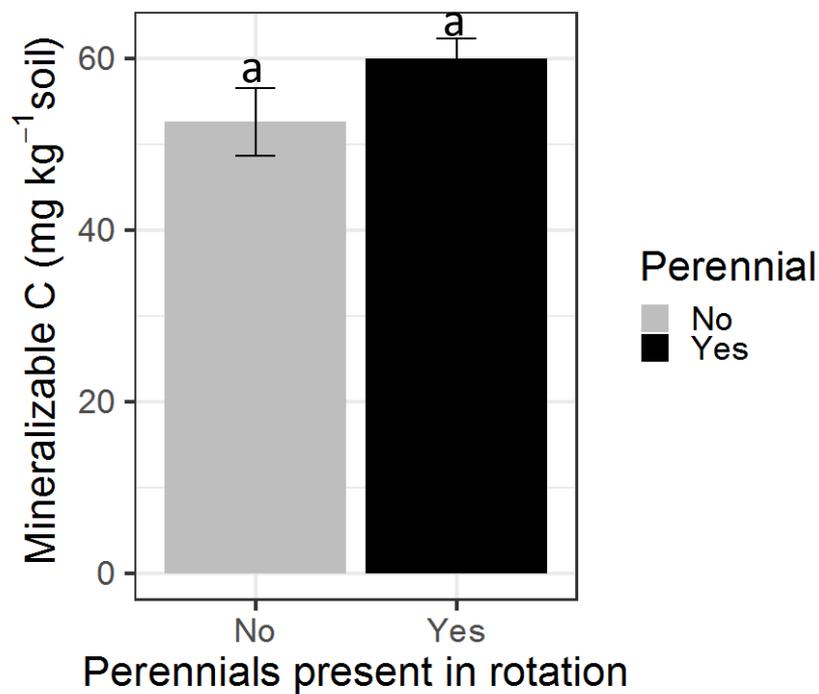
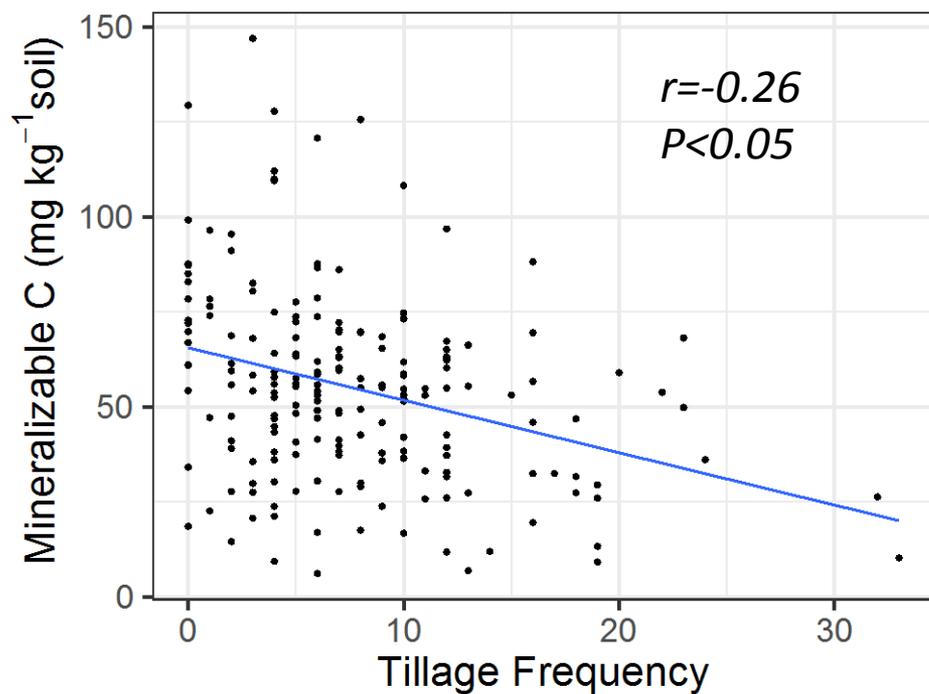


Crop Rotational Diversity and Tillage



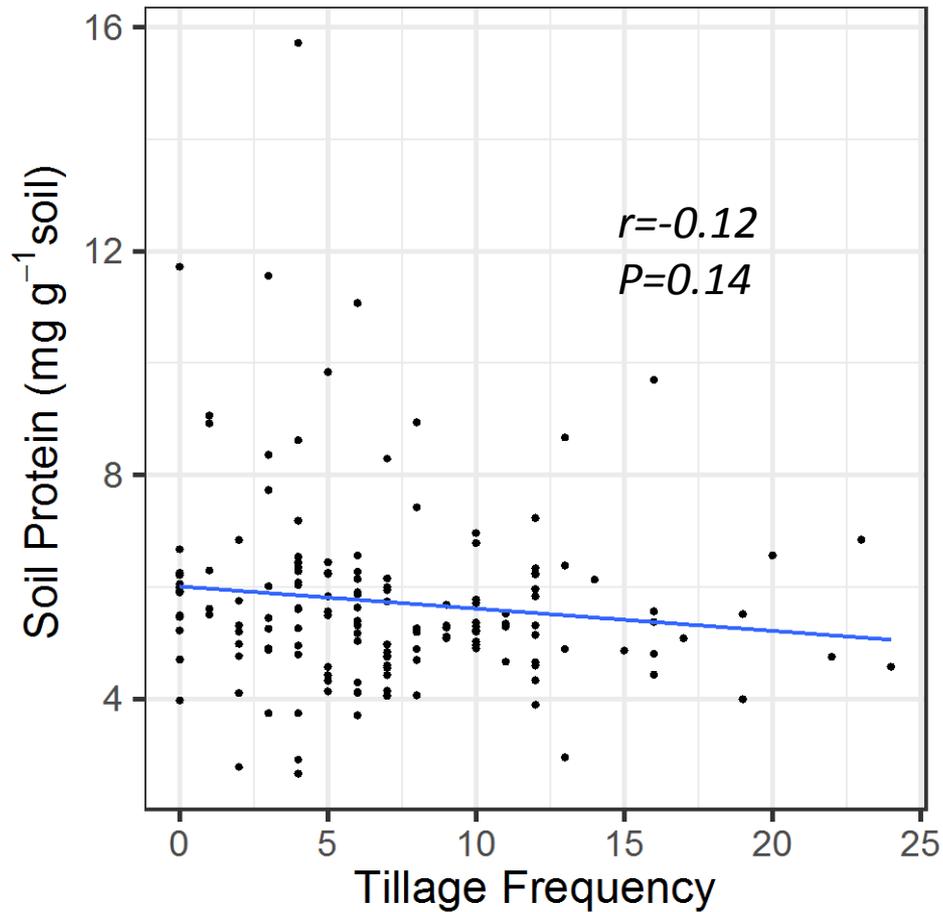
What drives soil health on organic farms
in the Great Lakes Region?

Respiration



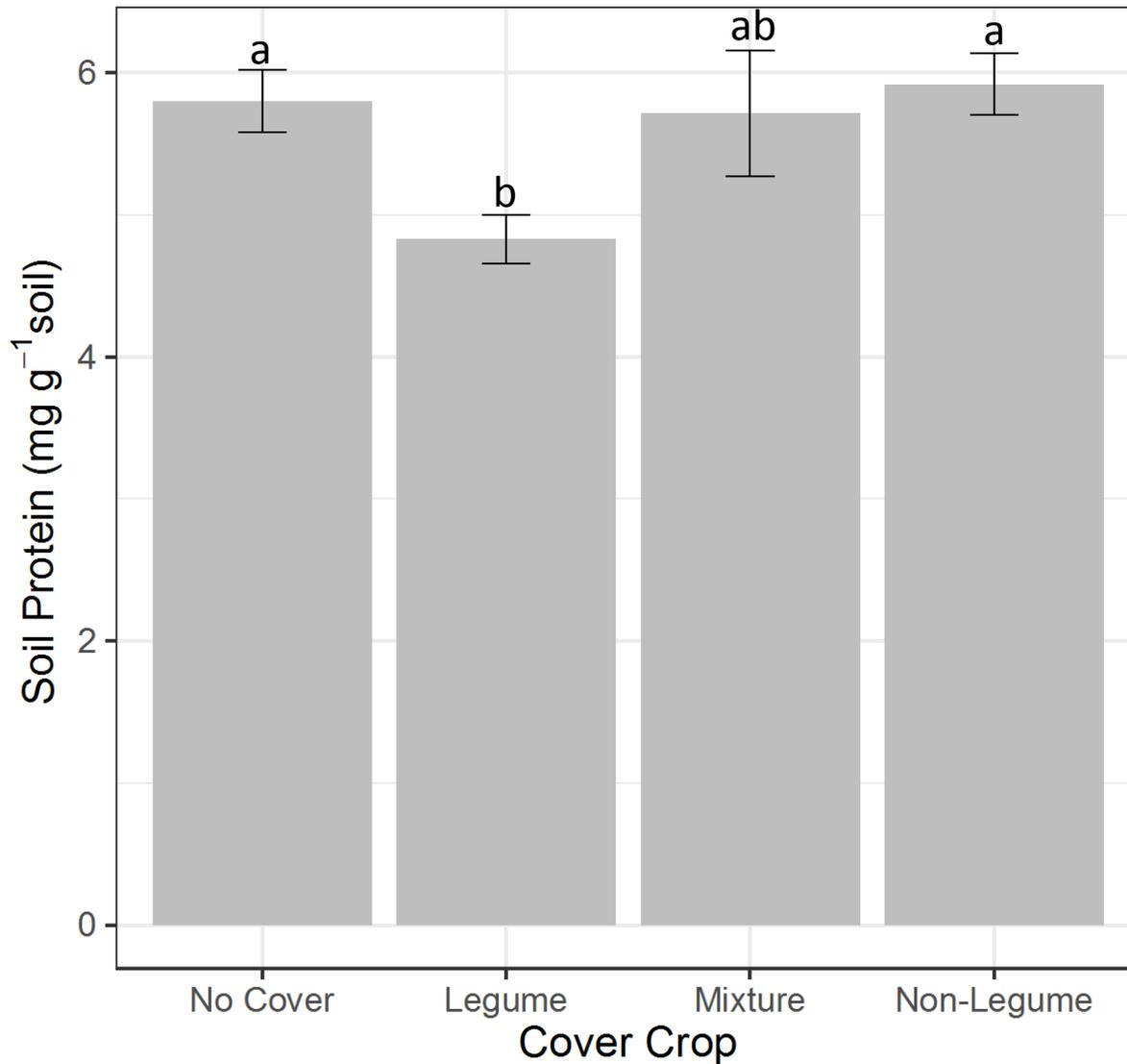
Tillage and Perenniality were the top ranked predictors

Soil Protein



Tillage a top ranked predictor

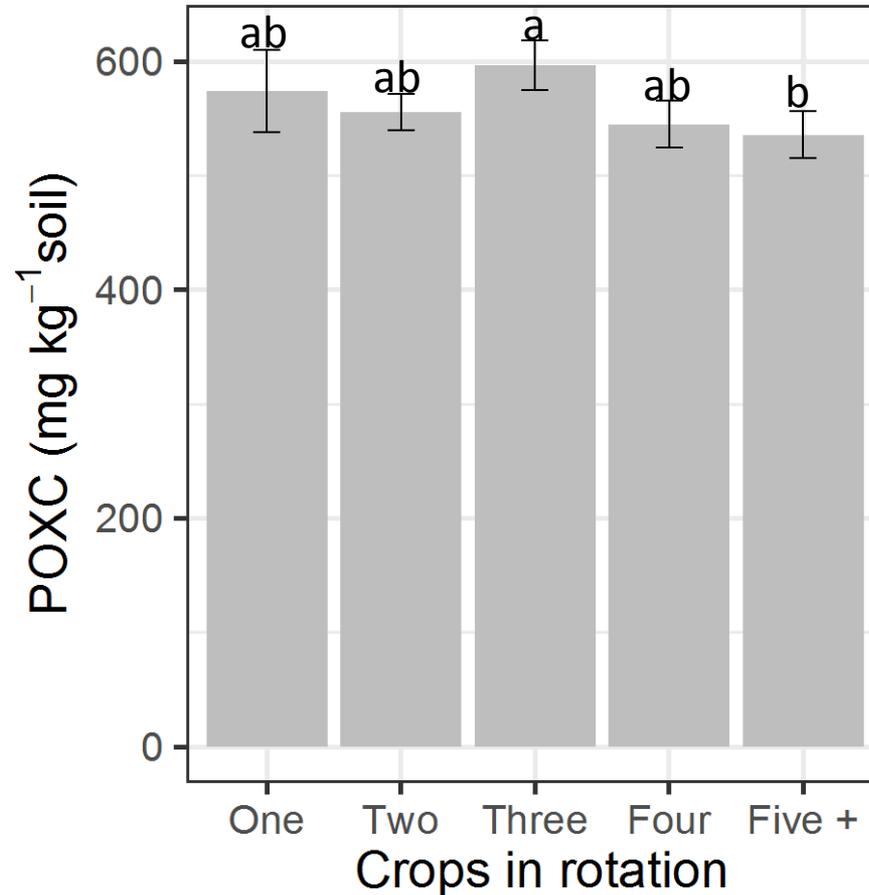
Soil Protein



Different letters =
significance at
 $p < 0.05$

Cover crop type a top ranked predictor

POXC (Active Carbon)



Total number of crops in rotation was the top ranked predictor

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
- Effective stakeholder engagement with potential for more in-depth on-farm experiments

Acknowledgments



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- The OSU Soil Fertility Lab
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- Foundation for Food and Agriculture