Kansas Department of Health and Environment

**Livestock Watering**
**Source: Cheney WRAPS**

**Irrigation Supply**
**Source: Kansas State University**

KANSAS

**Drinking Water Supply**
**Source: KDHE Watershed Management**


**Groundwater Recharge**
**Source: USGS: 2016-5042**

**Industrial Supply**
**Source: Google Earth Pro**

# Investigating Regenerative Agriculture Practices' influence on Soil Nitrogen in Northeast Kansas (ROAR) Project: Applied Research Collaboration

Scott Satterthwaite KDHE Bureau of Environmental Field Services Watershed Management Section, Topeka, KS
Kansas Water Symposium Volume 2 March 7, 2026

# Watershed Management Section (WMS)

- This presentation will be trifecta in presentations:
    - Scott S., KDHE Bureau of Environmental Field Services, Watershed Management Section, will provide background of how this project fits into the WMS framework.
    - Emily Nusz, EPA Region 7 has provided some slides describing how the project originated and site selection concept.
    - Lena Wang, a research fellow scientist with EPA Office of Research and Development, Corvallis, Oregon, provided slides on the details of the project from.

# ROAR (Project): Applied Research Collaboration

## Watershed Management Section (WMS)

- Through Environmental Protection Agency (EPA) Section 319 and State Water Plan Funds.
  - Develops and Implements the Nonpoint Source Management Plan.
    - Plan is required to obtain Clean Water Act (CWA) EPA Section 319 Funds.
      - Like any plan it includes:
        - Background.
        - Identifies sources of (water quality) concerns.
        - Potential solutions to address the concerns.
        - Funds to implement the solutions.
        - Partnerships to leverage other resources.

**All at the State and Watershed Scale for the Next Five Years.**

# Watershed Management Section (WMS)

**Who we are?** A section of the Kansas Department of Health and Environment who inform the public about the expectations and regulations (water quality standards) regarding water quality in Kansas and assistance in meeting the needs to protect and restore water quality. At times, a messenger between the regulated public and the state of Kansas.

**What we do?** Administer a program that tries to be agile enough to meet the current needs and progressive enough to look at future needs of support to restore and protect the waters of the state.

**Our Involvement in Addressing Water Quality Issues in Kansas –** Use our relationship and partnership building, technical and financial assistance to meet the water quality goals and expectations of Kansas citizens.

# Watershed Management Section Water Quality Goals

- No violation of water quality standards for designated uses due to nonpoint sources.
- All of Kansas' nonpoint sources use water quality protection measures.
- Achieve Kansas Water Plan Objectives.

# Watershed Planning
# Watershed Restoration and Protection Strategies (WRAPS)

- 1998 Clinton Administration Clean Water Action Plan.
  - WRAS-Watershed Restoration Action Strategy

- Restoration of Impaired Waters was based on monitoring, standards and pollutant loading. (Total Maximum Daily Loads)

- What about protection?
  - WRAPS – Watershed Restoration and Protection Strategy was initiated by Kansas Department of Health and Environment (KDHE) Watershed Management Section (WMS).

# A Collaborative Solution – KS-WRAPS

- Provides a framework for multi-faceted stakeholder leadership teams and other stakeholders to protect and restore Kansas watersheds through a collaborative planning and management process.
- This process consists of:
  - Identifying watershed restoration and protection needs.
  - Establishing watershed goals.
  - Creating plans to achieve goals.
  - Implementing plans.

**kswraps.org**

Source: KDHE

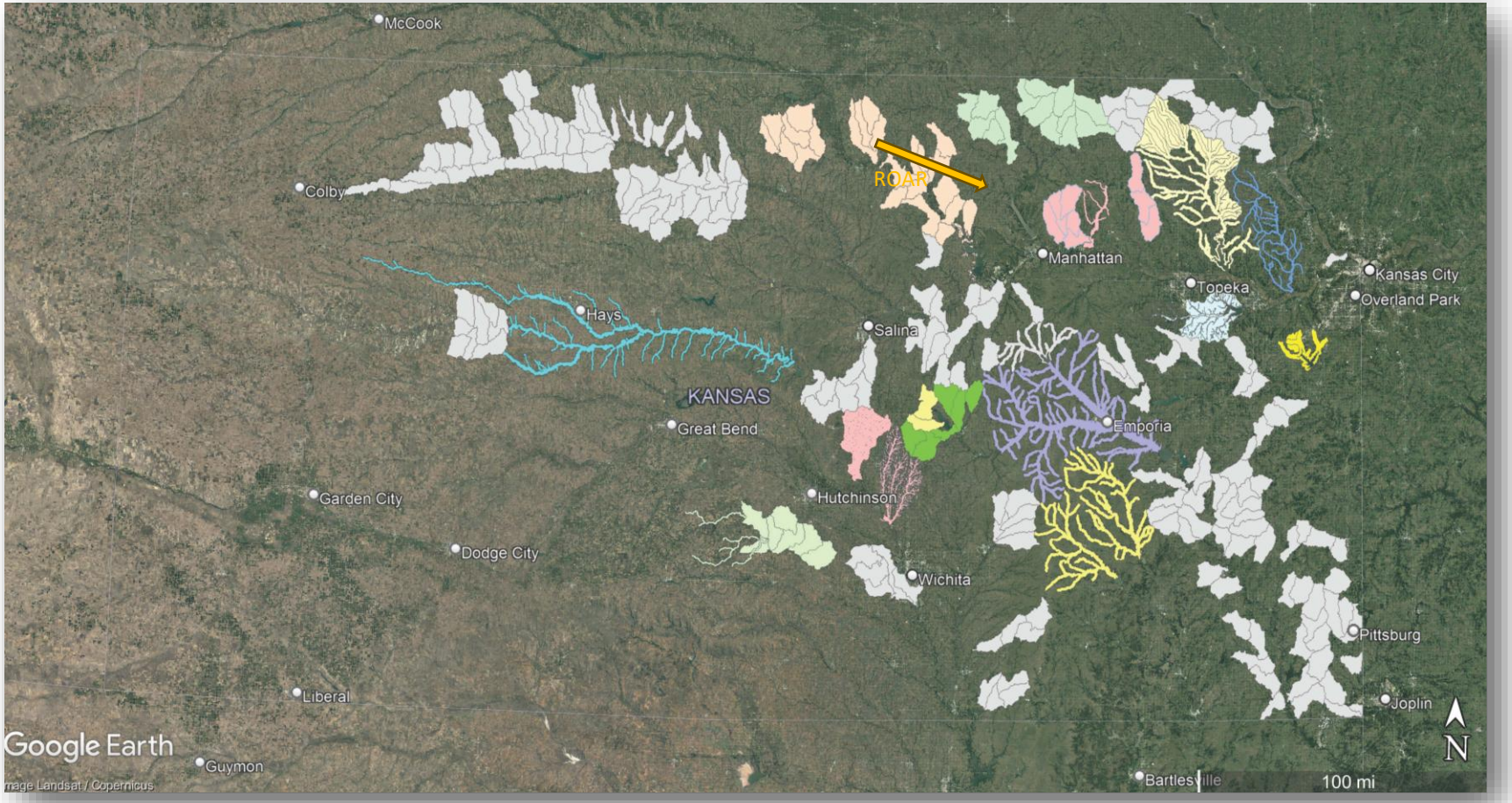
# WRAPS Partnerships – Funding Diversification

- Leverage Existing Resources
  - Natural Resources Conservation Service (NRCS): National Water Quality Initiative and Regional Conservation Partnership Program.
  - Division of Conservation.
  - Kansas Association of Conservation Districts.
  - Non-governmental organizations (NGOs).

- Pursue New Funding Sources
  - State Water Plan line items.
  - Municipalities.
  - Corporate.

# ROAR (Project): Applied Research Collaboration

## WRAPS Priority Areas



# ROAR (Project): Applied Research Collaboration

## Mechanisms for Most Water Quality Protection
## Nonpoint Source Pollution Control and the Runoff Pollutants they Address

- Filter: nutrients, sediment
- Cover: living-nutrients, sediment, pesticides; non-living- sediment, nutrients
- Settle-nutrients: sediment
- Catch and Detain: nutrients, sediment
- Infiltrate and percolate: reduce runoff, nutrients, sediment, bacteria, pesticides
- Transform: nutrients, pesticides
- Neutralize/kill: pesticides, bacteria
- Minimize: commercial nutrients, sediment, bacteria, pesticides
- Product/practice: Alternatives-nutrients, sediment, bacteria, pesticides
- Avoidance: physically or using alternatives
- Stream or shoreline stabilization: nutrients, sediment
- Removal (dredge sediment): nutrients, sediment -most costly

# Watershed Wide Soil Health

## Six Soil Health Principles

1. Know your context.
2. Minimal disturbance.
3. Cover and build surface armor.
4. Diversify plantings.
5. Keep living root in the soil.
6. Grow healthy animals and soil together.

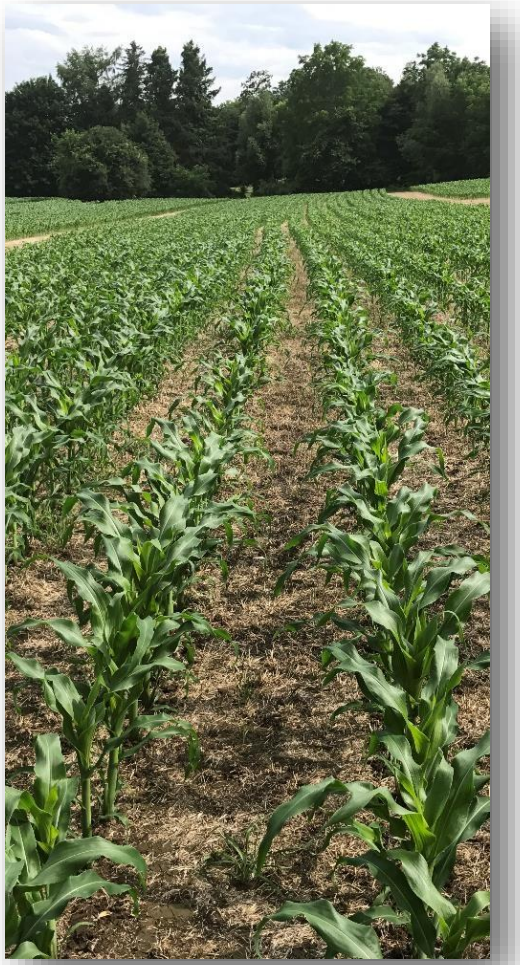

Source: KDHE

# Why KDHE WMS promotes soil health principles including rotation and cover crops?

- Increase infiltration and reduce runoff and associated materials.
- Decrease erosion.
- Reduce chemical inputs.
  - Fertilizer
  - Pesticides
- Improve crop production (win-win).
  - Increase organic matter.
  - Increase nutrient cycling.
- Provide extended grazing season.
  - Quicker profit and return on investment to encourage producer and maintain practices.
  - Reduce need for confined or congregated feeding.

Source: envcoglobal.com

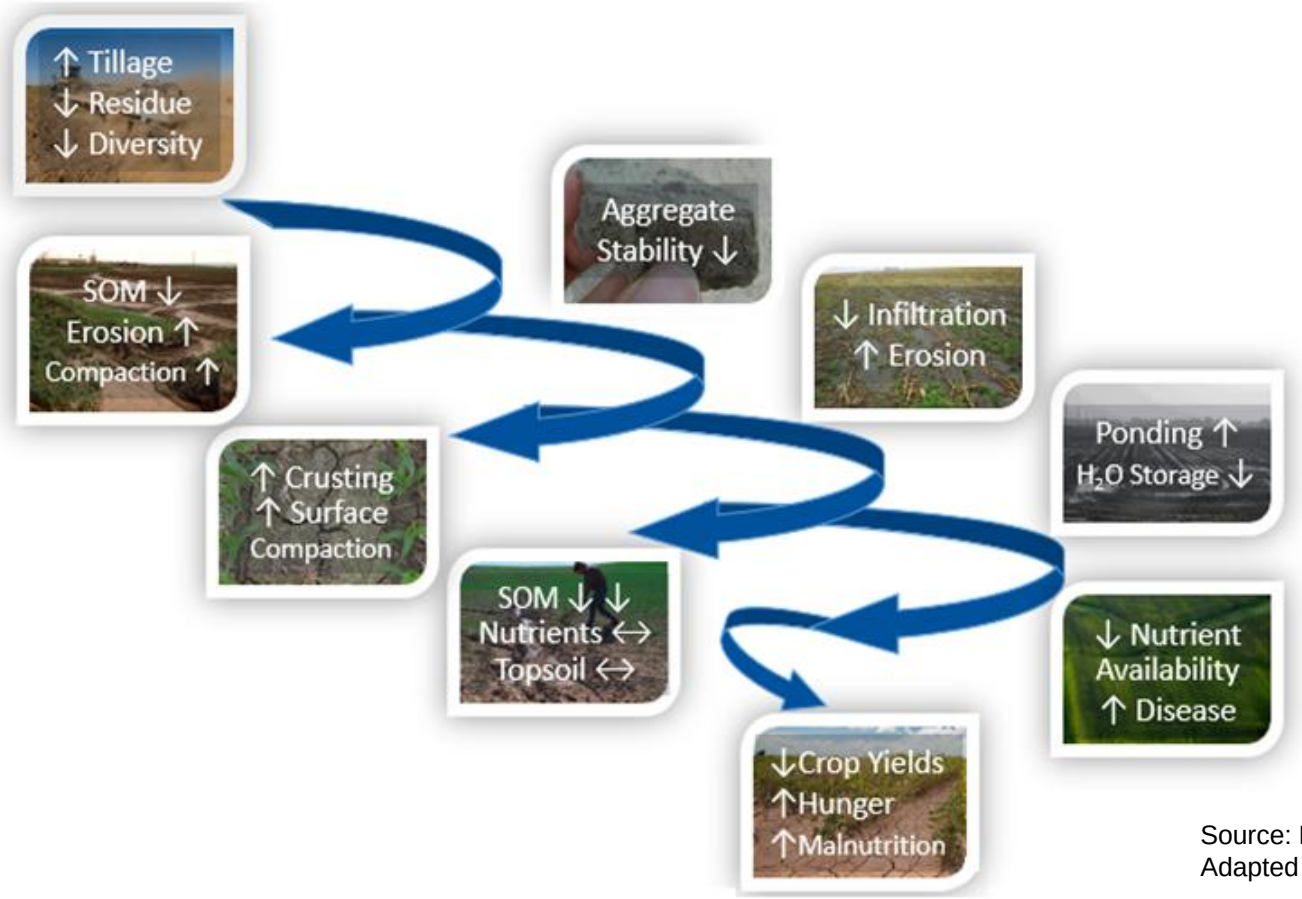
# What functions would we like our soil to provide?



- Produce food, feed, fiber, biofuels and medicine.
- Capture, filter and store water.
- Cycle and recycle nutrients.
- Resilience to drought, flood and temperature extremes.
- Protect plants from pathogens and stress.
- Detoxify pollutants.
- Store C (Carbon) and moderate release of gases.
- Resist erosive forces.

Source: Natural Resources Conservation Service

# Downward Spiral of Soil Degradation




Source: Natural Resources Conservation Service
Adapted from Building Soils for Better Crops, 3rd ed.

# Next Up!

The next slides will be from Ms. Emily Nusz- EPA Region VII Lenexa, KS and Ms. Lena Wang was ORISE (Oak Ride Institute for Science and Education) research fellow at the US EPA ORD (Office of Research and Development) is Corvallis, OR. (Unfortunately, she has moved on to the state of Idaho for their water quality protection program. Jana Compton with US EPA ORD is the best contact).

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August 8th , 2024, Kansas Environmental Conference

# Soil Health Practices in Kansas


Emily Nusz, Chris Janssen

*U.S. EPA, Region 7*

Jana Compton, Renee Brooks, Lena Wang*, Rob Coulombe**

*U.S. EPA, Office of Research and Development, *ORISE; **CSS, Inc., Corvallis, OR*

Scott Satterthwaite, Adrienne Miller, Michael Beezhold, Joel Negrych

*Kansas Department of Health and Environment*

Shane New

*Taste of the Land Farm, Holton, KS*

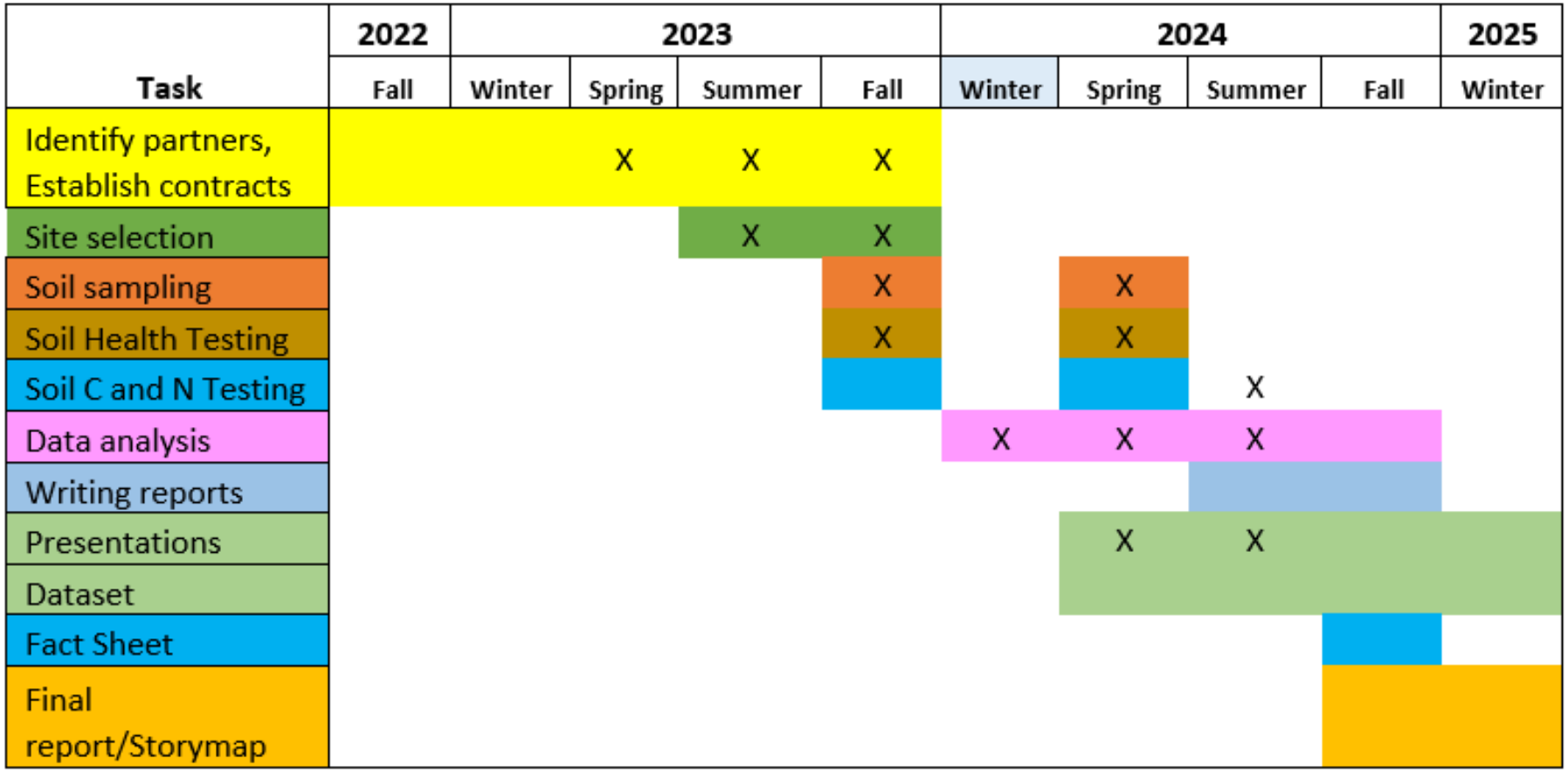
# Project Kick-Off

*KDHE, EPA Region 7, and EPA "Office of Research and Development" Collaboration*

- **Establishing a framework** *(KDHE DWPP and EPA R7)*
  - How to quantify benefits of soil health practices for groundwater mitigation?
- **Acquiring funding**
  - A Project Management Plan was sent to EPA Office of Research and Development and selected for funding in 2022.
- **Connecting with local landowners**
  - Connected with landowners with different land management practices in NE Kansas to research the impact of soil health practices on nitrate groundwater contamination.

# Timeline highlights:

- Fall 2022: Project Kick-off- Develop research concept and partners
- Fall 2023 and Spring 2024: Soil Sampling
- Spring 2024: Applied for second round of funding to continue sampling and research for 2025.



# Research Question

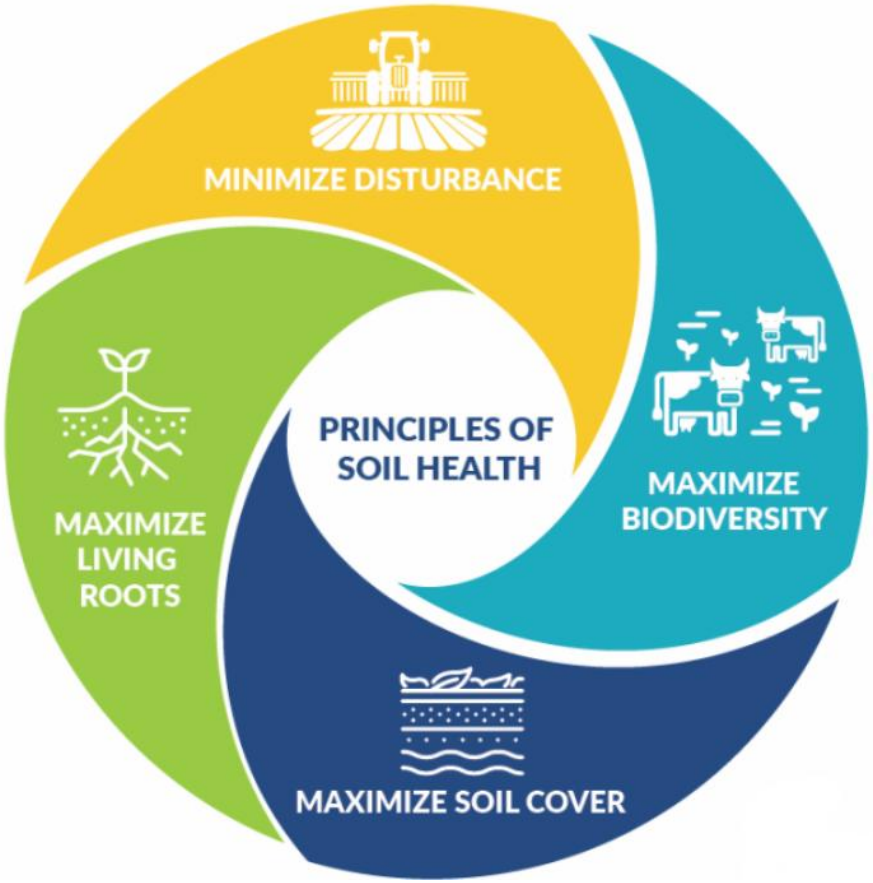
Will the implementation of cover crops result in measurable reductions in soil extractable N?

# Project Goals

*KDHE, EPA Region 7, and EPA Office of Research and Development Collaboration*

- Examine the effects of cover crops in reducing agricultural N surplus, soil N and improving soil health in Western Great Plains farm fields.
- Partner with farmers who use a range of soil health practices to sample soils during fall and spring.
- Measure soil health metrics using the Soil Health Test, including wet stable aggregates (WSA), phospholipid fatty acids (PLFA) and soil C and N.

# What are soil health principles?




USDA, NRCS

- Maximize Presence of Living Roots and Maximize Soil Cover
  - Cover cropping throughout the year
- Minimize Disturbance
  - Reduce tillage and compaction
- Maximize Biodiversity
  - Crop diversity
  - Crop-livestock integrated farming

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# 8 fields near Holton, KS → 4 with and 4 without cover crops




| Till | No Till |
|---|---|
| No Cover Crop | Cover Crop |
| Crop Diversity < 10 | Crop Diversity >= 10 |

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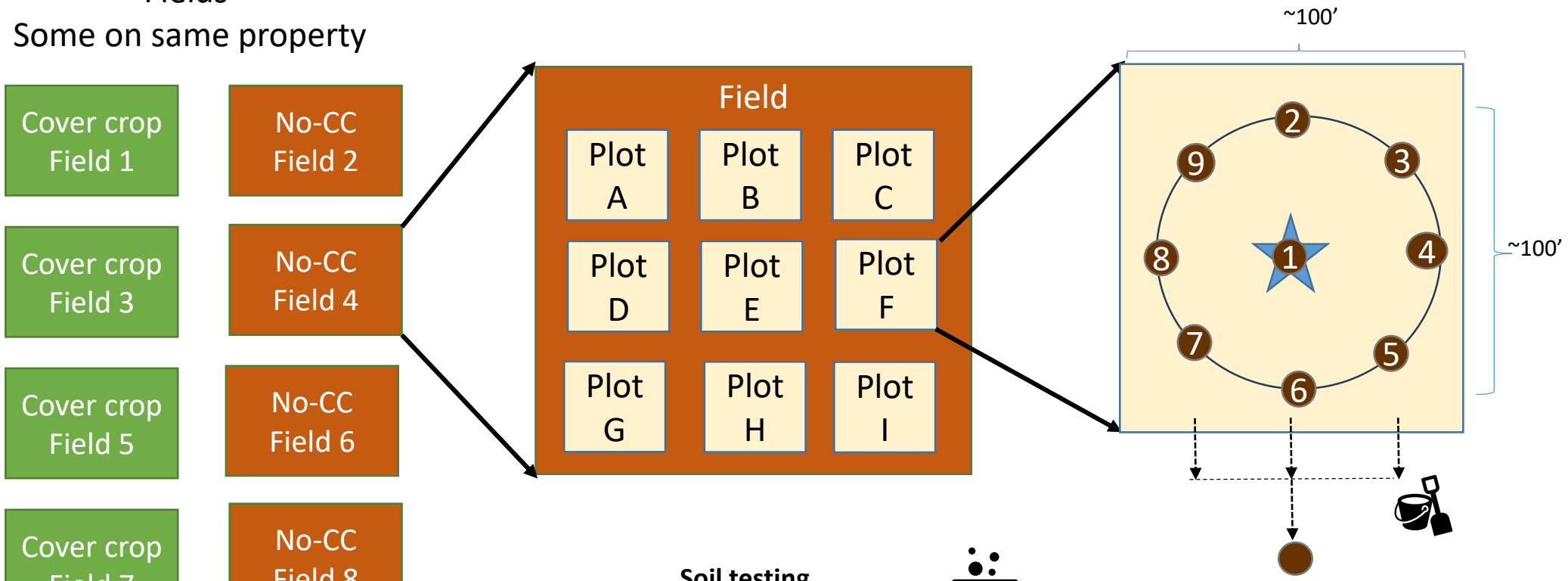
# Soil sampling design

8 fields near Holton, KS
- 4 field with and 4 without cover crops
- Fall and spring sampling

Fields
Some on same property

Each field < 20 acres

Plot ~ 1/4 acre




**Soil testing**
9 composite samples per plot
Haney test, Soil health
Soil texture, pH
PLFA, WSA
Total C, N, C and N isotopes

**Composited Grid Soil Samples**
Surface 0-8"
9 samples/subplot composited
9 samples total per field

# Soil sampling

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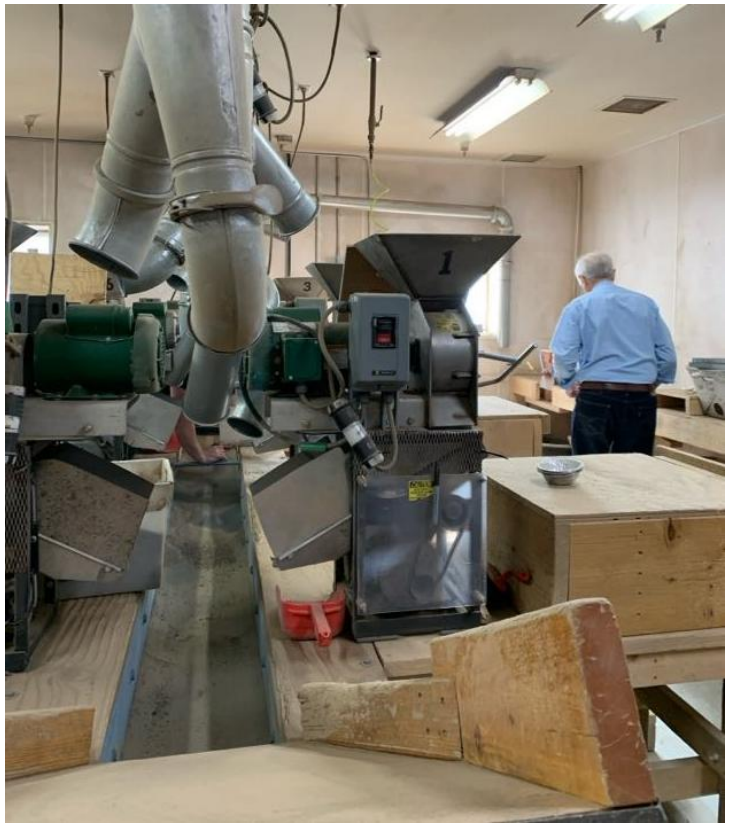
# Soil Intake, Drying, Grinding, and Sieving



Ward Labs, Kearny NE

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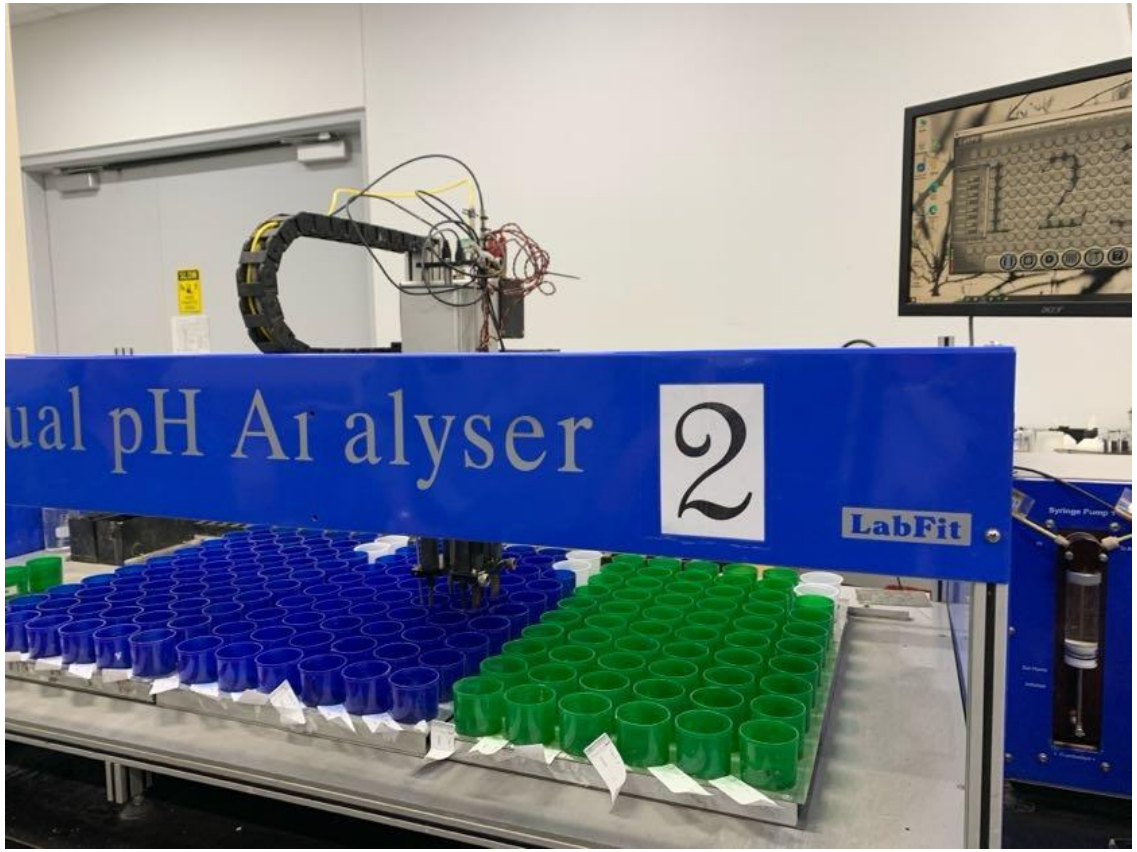
# Mixing soils with solution and measuring pH




# Rewetting soils and measuring released $CO_2$ after 24 hours

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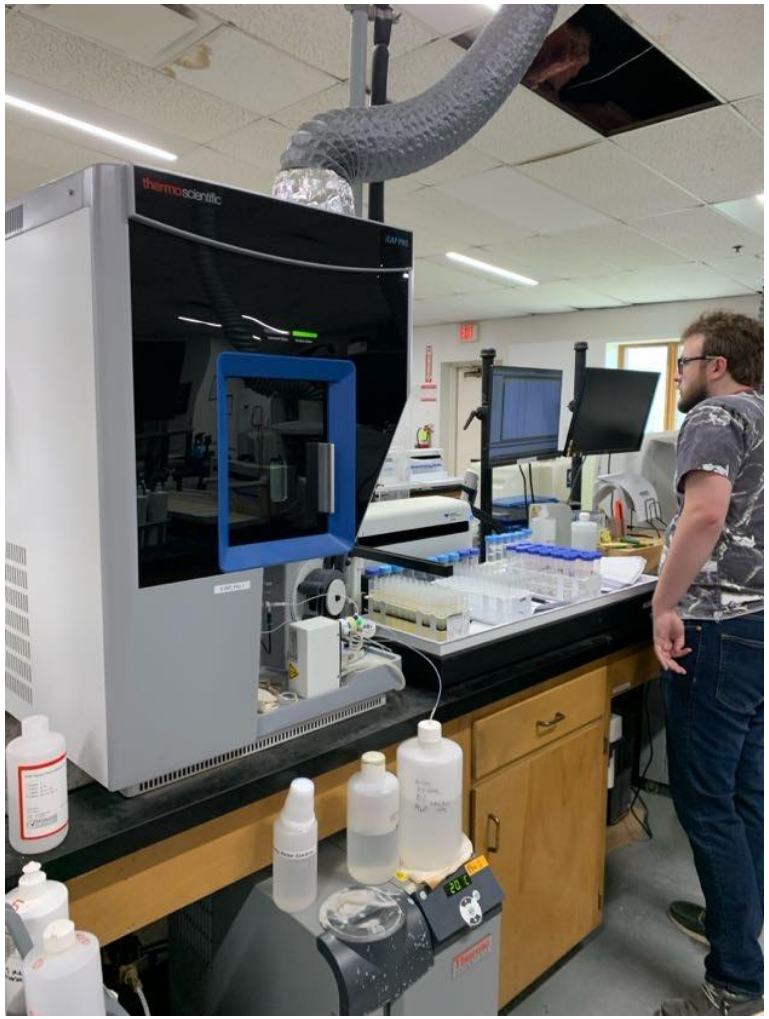
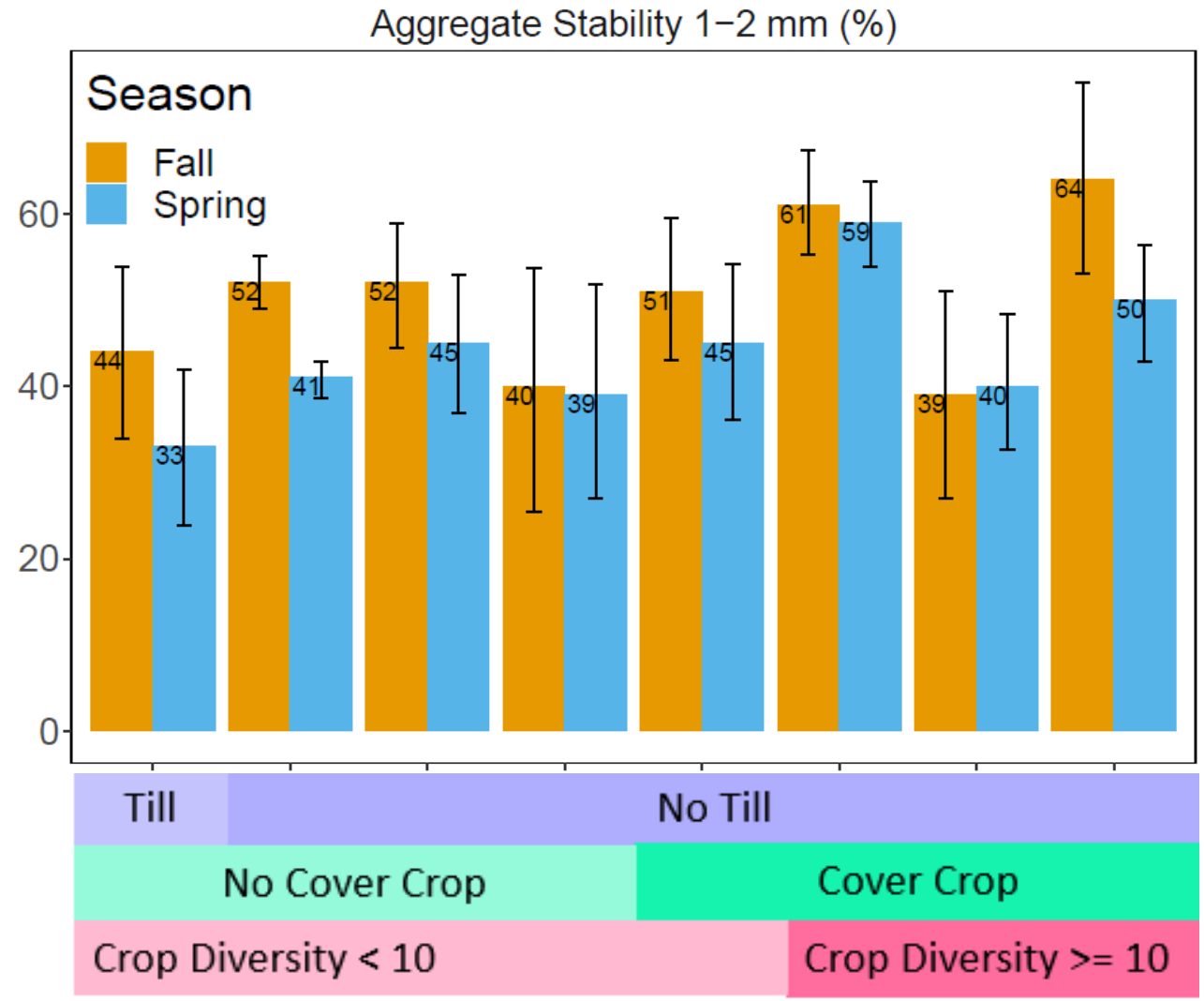
# Filtering soil extractions

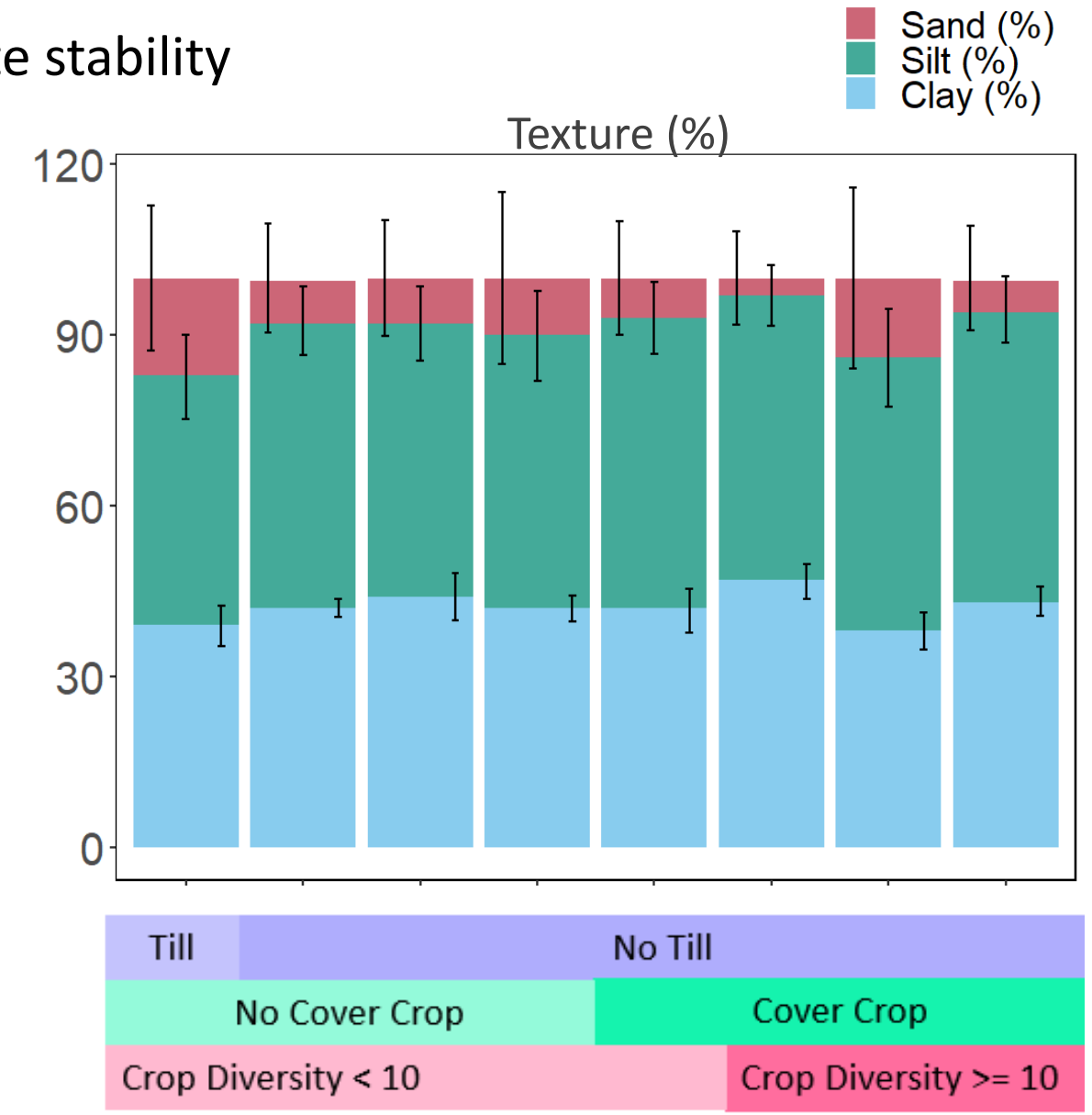
# Analyzing Extracts



# Basic Soil Properties

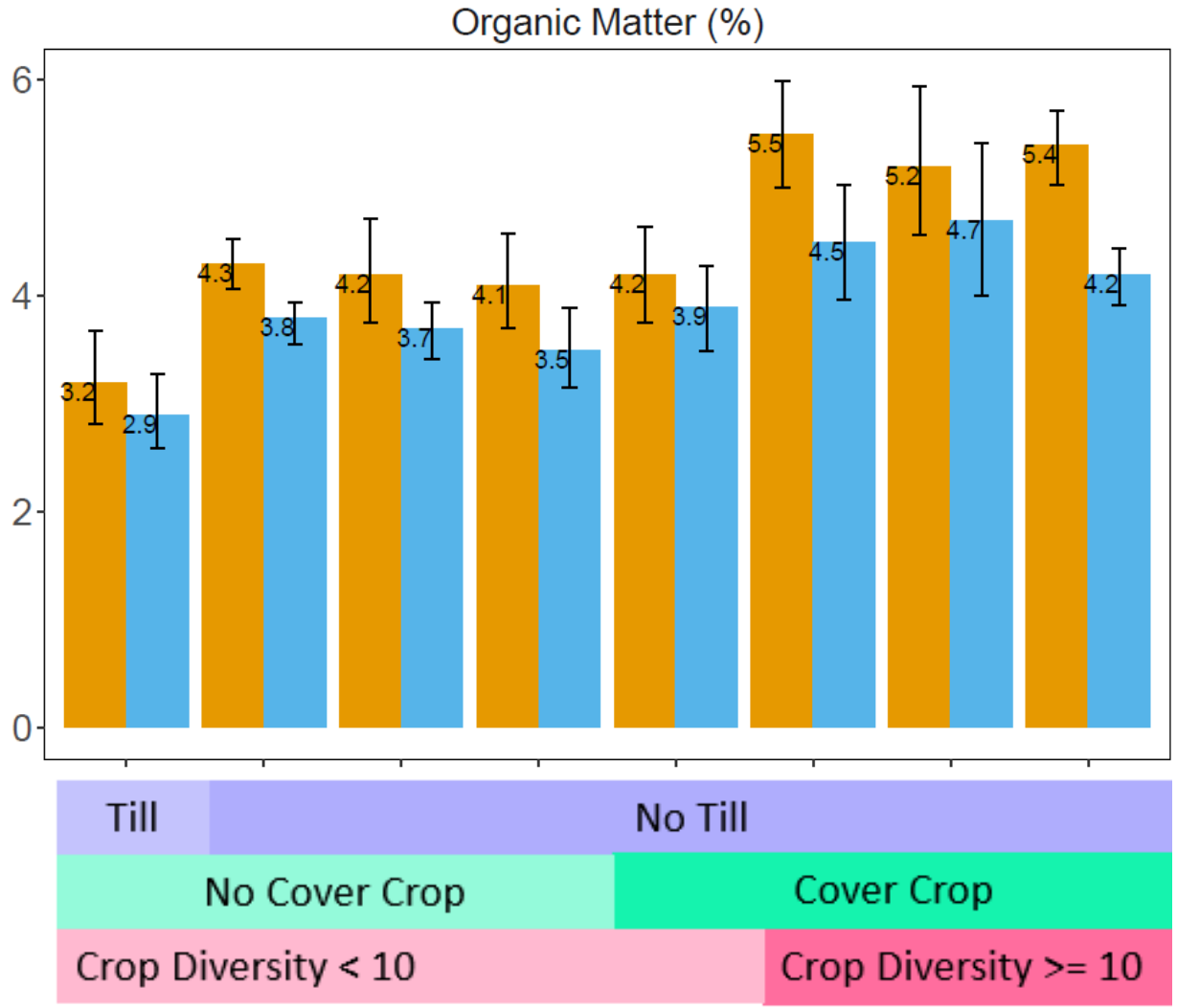
- Similar textures
- Fields have variable aggregate stability

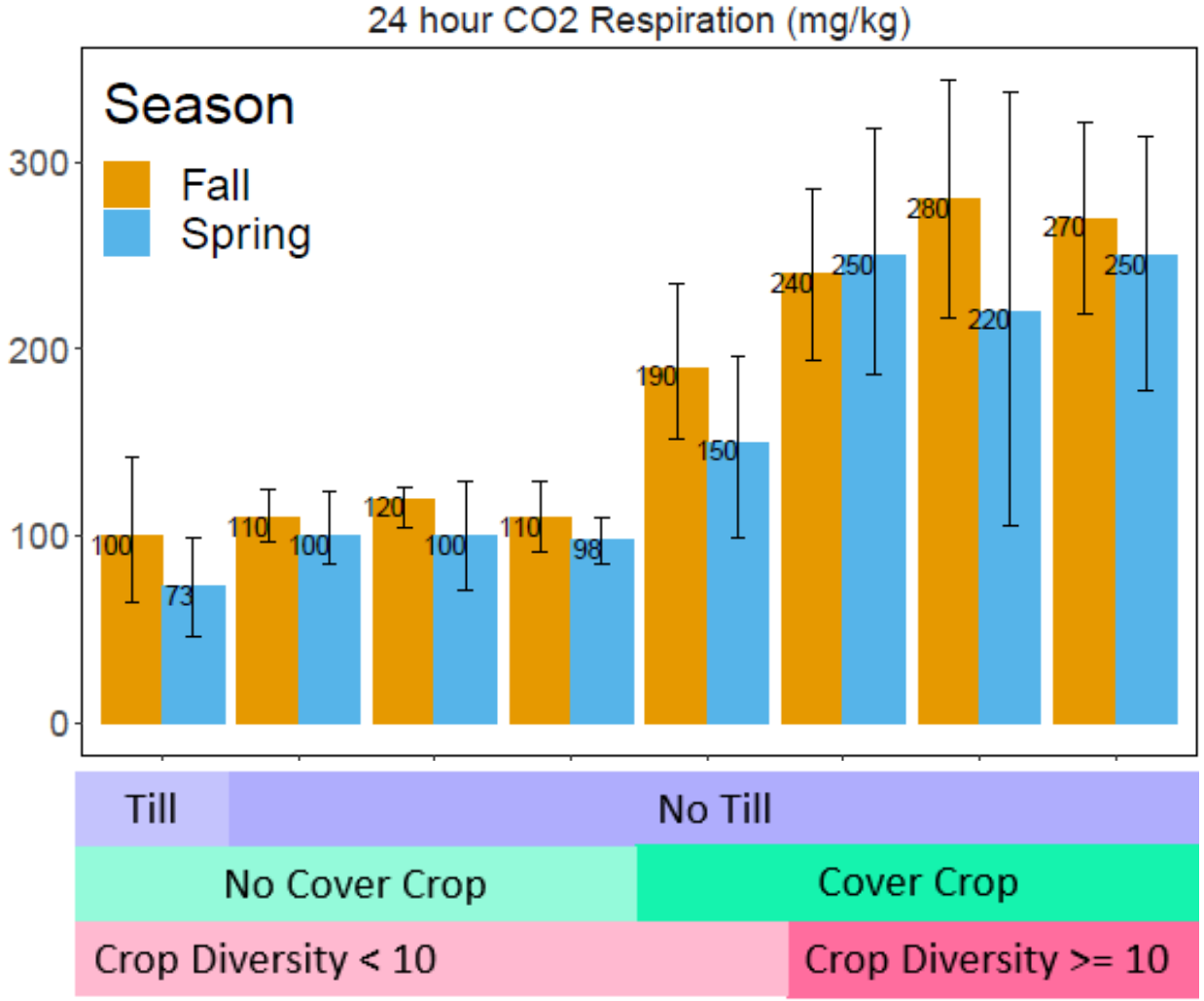


# Soil Organic Matter and Potential Respiration

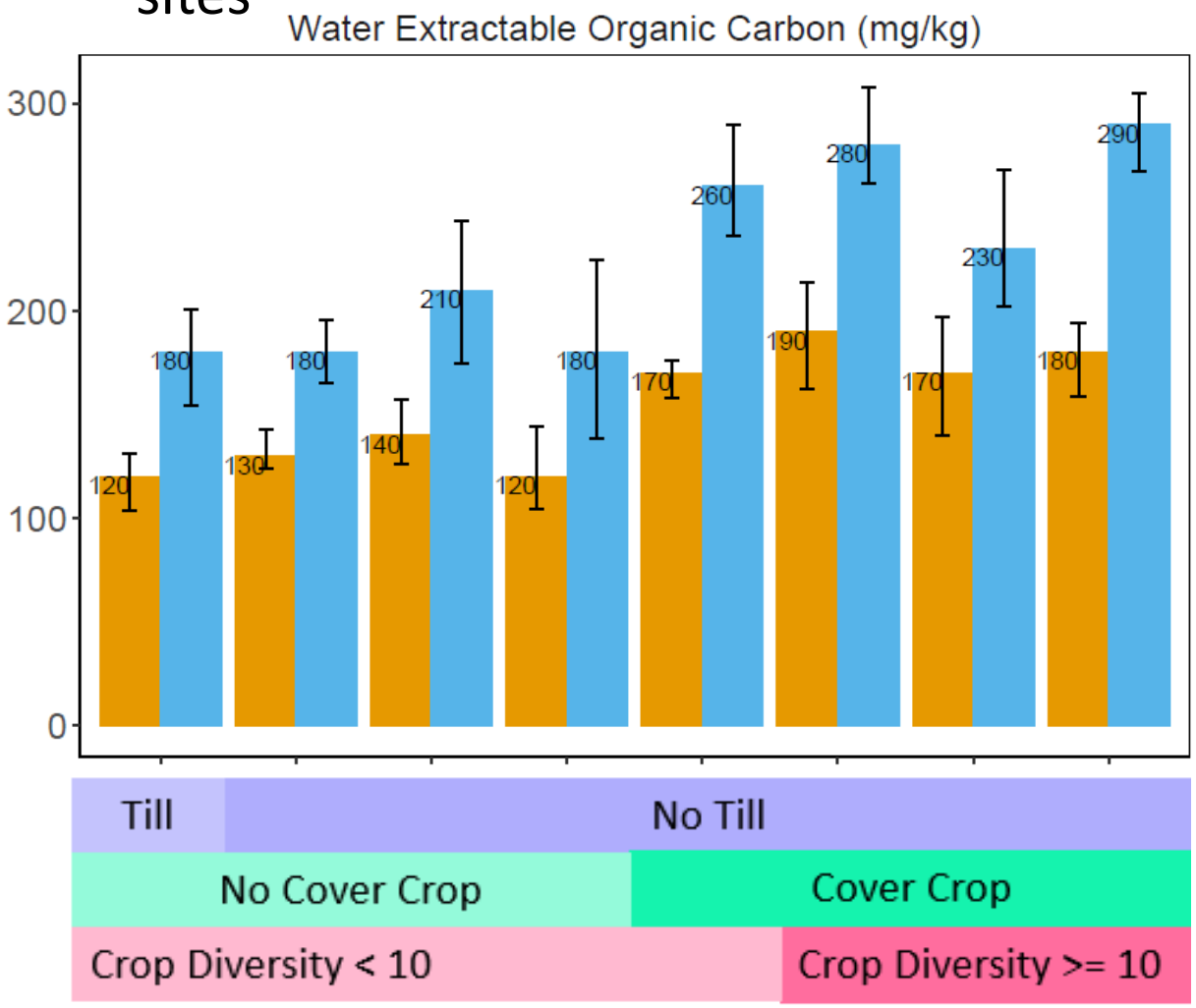
- Fields with more soil health practices have higher OM and more biological activity
- Less organic matter and less biological activity in the spring than fall

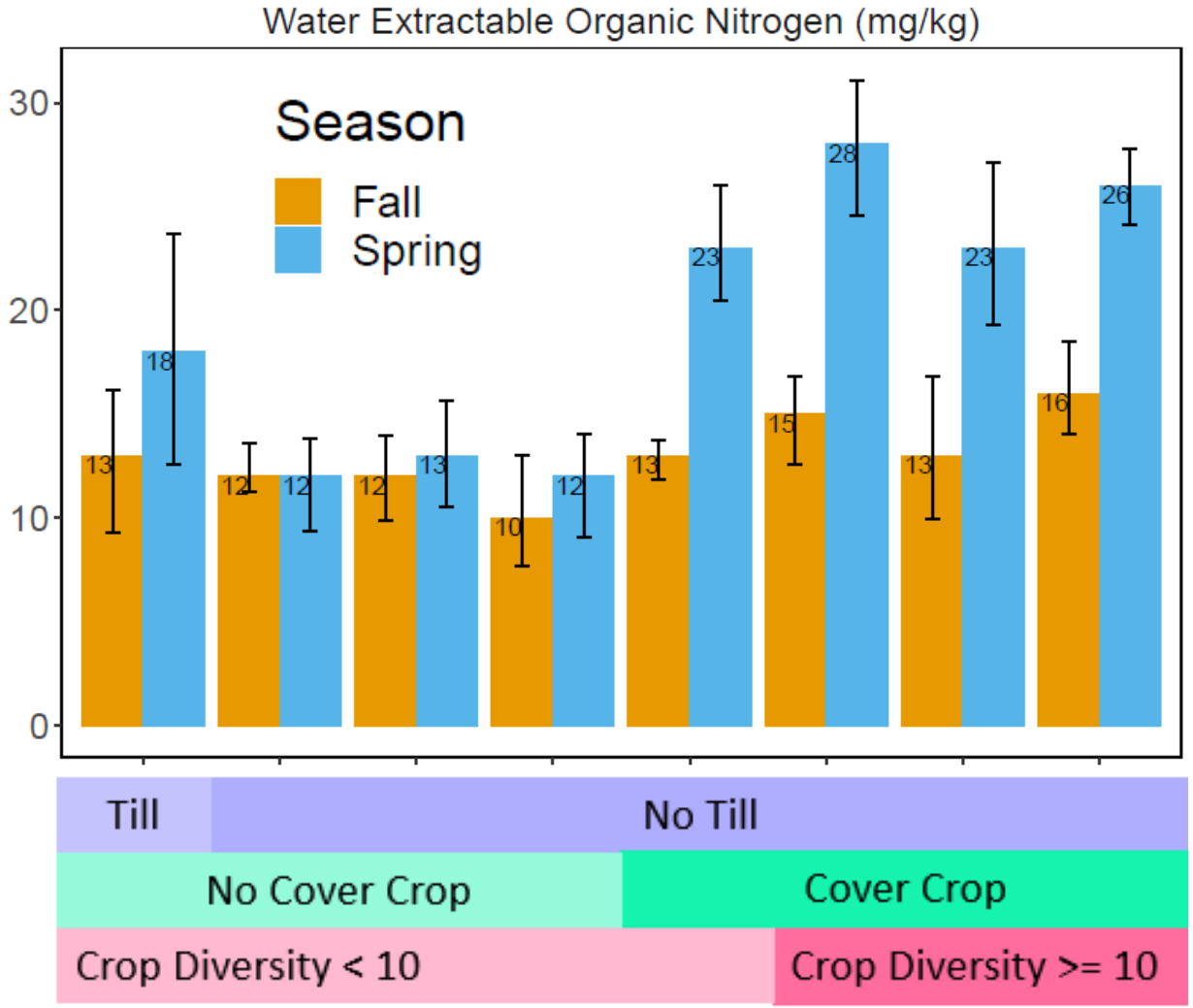


# Soil Extractable Carbon and Nitrogen: Availability and Forms

- Fields with more soil health practices have more extractable organic carbon and nitrogen
- Water extractable organic carbon and nitrogen is higher in the spring than fall across all sites



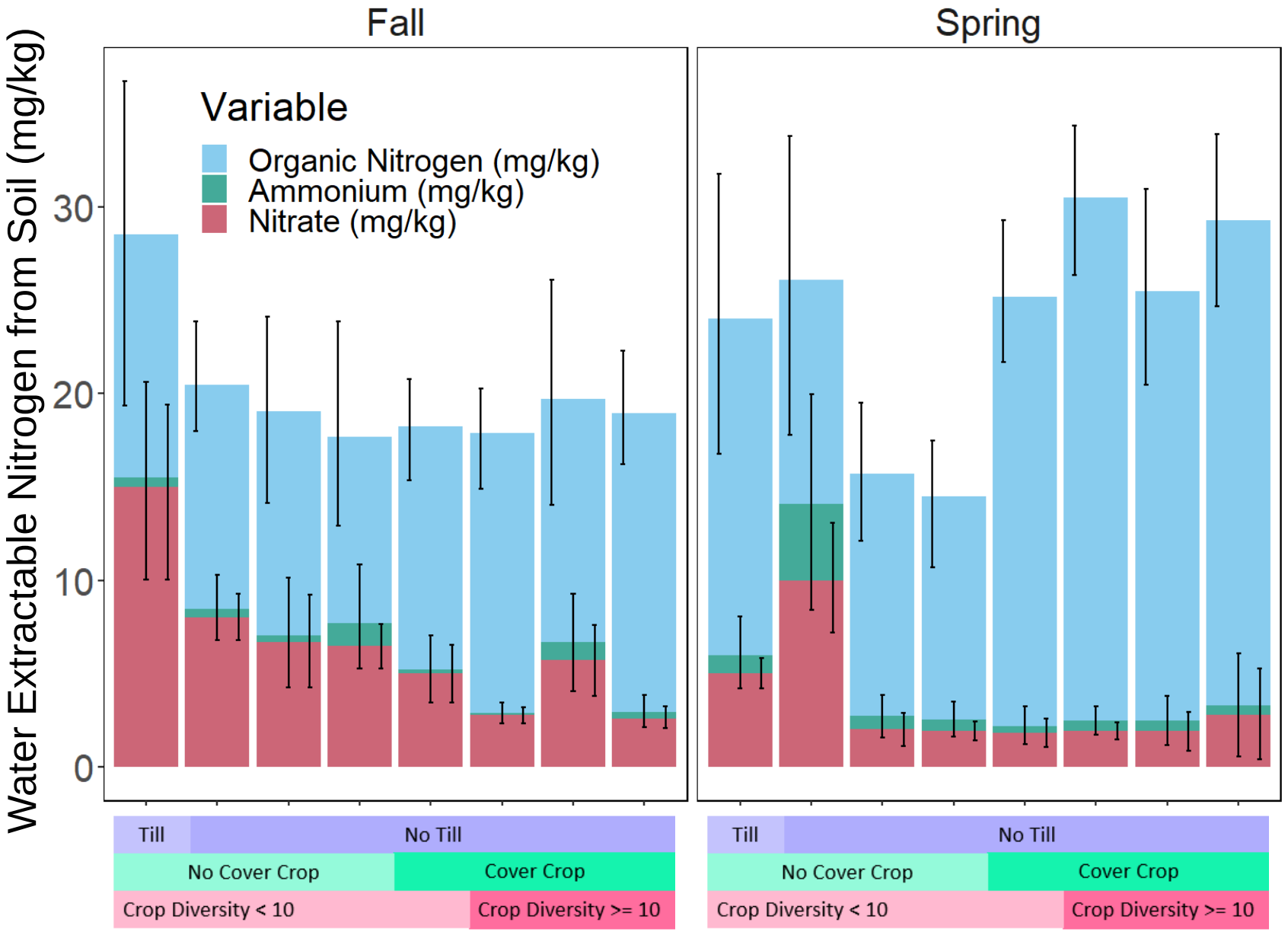



# Soil Extractable Nitrogen Forms

- Nitrate and Organic Nitrogen make up a large portion of Water Extractable Nitrogen
- Water extractable soil nitrate decreases with soil health practices

Nitrate → potential to leach

Organic N → potential to release N for crop



# Information Exchange with Farmers:

- Provide participating farmers
  - Soil test results from 0-8” soil samples
    - After harvest in 2023
    - Prior to fertilizer application for the 2024 growing season.
- Calculate field nitrogen budgets using farmer provided data
- Provide farmers a soil health assessment
- Examine the benefits of cover crops on soil health
- Farmers provide farm history and insights into nutrient management and crop yield.

# Take home messages

- Cover crops and associated soil health practices **increase** Soil %OM and active carbon and nitrogen
  - **Organic N → potential to release N for crop**

- Soil health practices **decrease** water extractable soil nitrate
  - **Nitrate → potential to leach**

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# Next steps

How to connect soil health to nitrate leaching and nitrogen in runoff?

- Measuring leaching is time consuming & expensive
- Extractable nitrate → potential to leach

Determine and share soil health metrics, including N surplus, and other information.

Connect to watershed nitrogen balances, soil health practices and surface water quality

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# Thank you - Questions?

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# ROAR (Project): Applied Research Collaboration

"BE GREAT INFILTRATE…WITH HEALTHY SOILS!!"

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