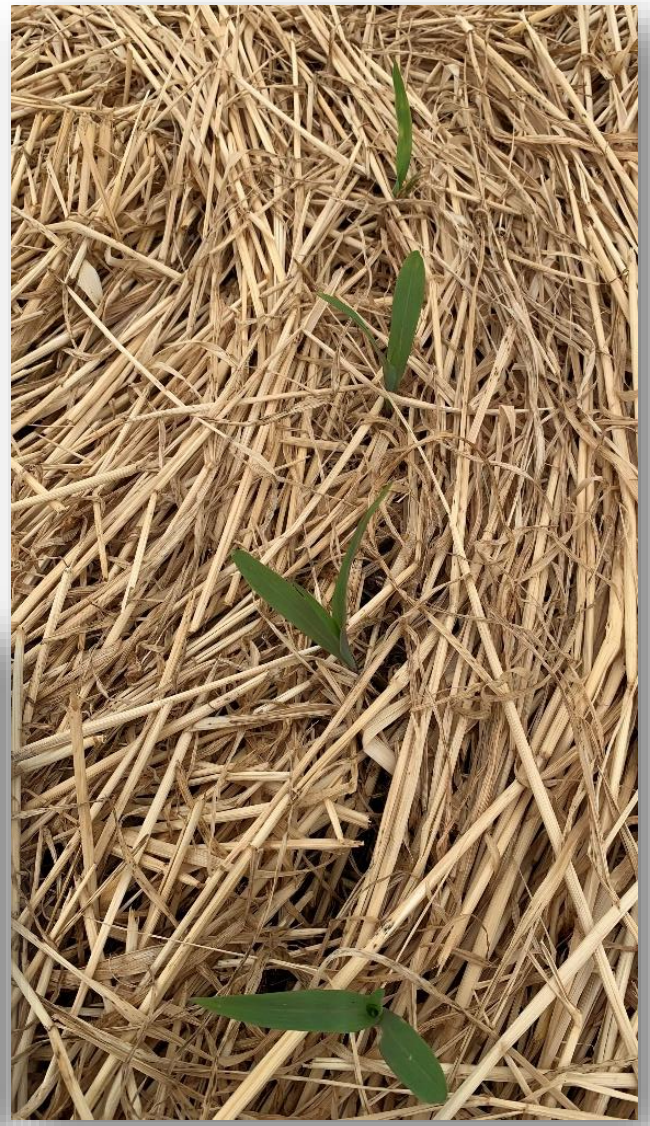
New Cover Crop and Soil Organic Matter-Based Nitrogen Recommendations for Corn

Charlie White
Andrew Lefever
Plant Science Department, Penn State

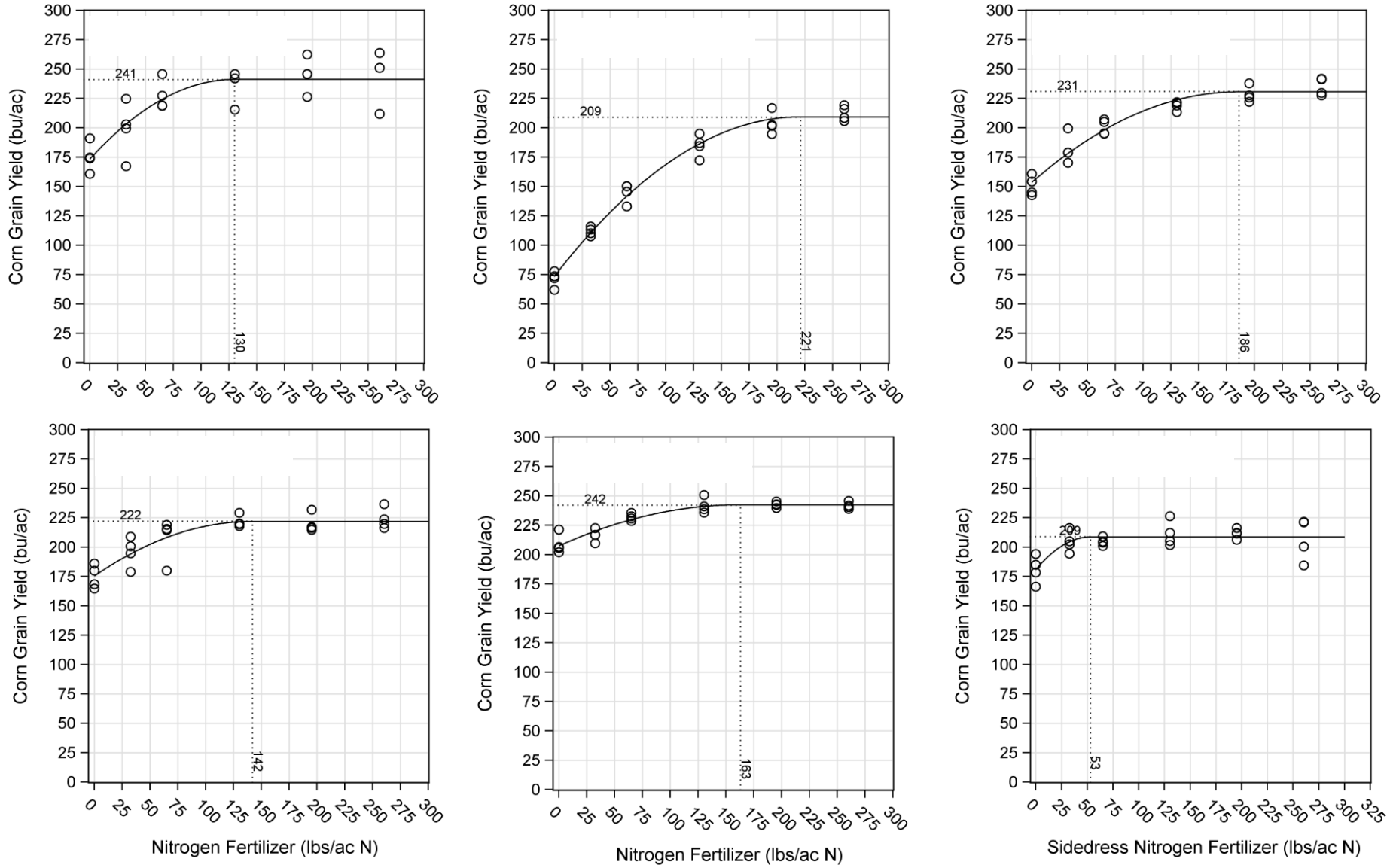
PennState Extension

Cover cropping and building soil health make N management more complicated

- Mineralizing vs. Immobilizing cover crop residues
- Different cover crop species blends and termination methods
- Long-term vs. short-term soil organic matter management



Nitrogen requirements for corn are farm and field specific



Six farms, six different N response curves

Developing the new N recommendation tool has been a community effort

- **Collaborating Farmers**
  - Leslie Bowman, Bill Hoover, John Harrell, Jon Stutzman, David Hernley, Penn-England Farms, Cotner Farms, Darwin and Bernard Nissley, Jay Lehman, Ron Kopp, Lucas Crisswell, Caleb Bacha and Leroy Bupp, Jim Hershey, Rodney Wolgemuth, Mike Cassel, Kevyn Musser, Jere Rutt

- **Grad Students, Post-Doc and Technicians**
  - Sarah Tierney, Anthony Colin, Zack Sanders, Brosi Bradley, Zoelie Rivera-Ocasio, Raziel Ordonez, Andrew Lefever, Leidy Fernandez

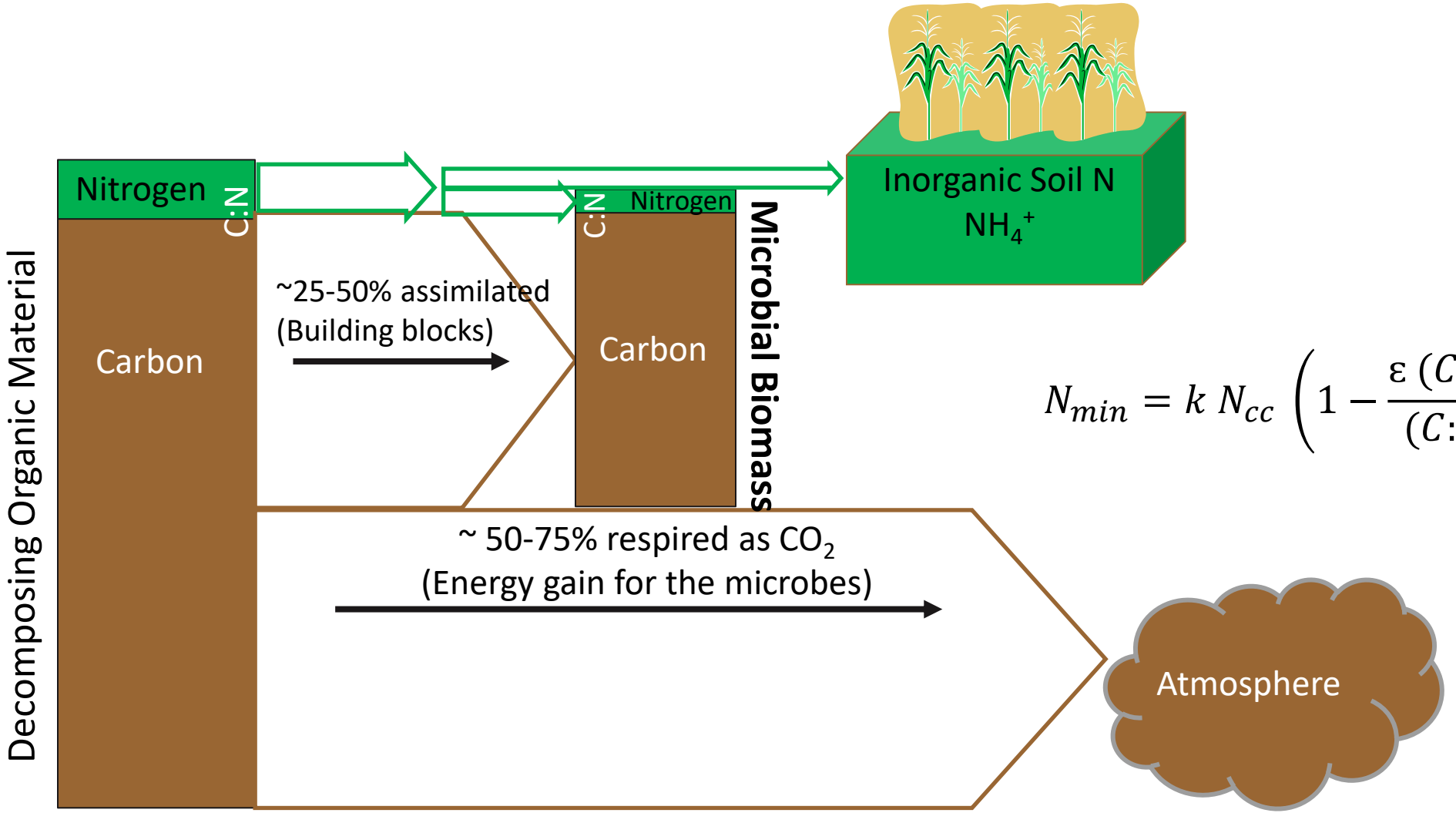
- **PSU Agronomy Research Farm and Agronomy Extension Team**
  - Hanna Wells, Al Cook, Lucas Stover, Jeff Metz, Scott Harkcom, Corey Dillon, Anna Busch, Brittany Clark

Funding Agencies and Partnerships

NFWF
USDA NIFA
United States Department of Agriculture
National Institute of Food and Agriculture
Pennsylvania Soil Health Coalition
Northeast SARE
Sustainable Agriculture Research & Education
THRIVING AG

https://extension.psu.edu/nitrogen-recommendations-for-corn

The new N recommendations account for soil N mineralization of cover crops and organic matter by soil microbes



$$N_{min} = k\, N_{cc} \left(1 - \frac{\varepsilon\,(C:N)_{cc}}{(C:N)_m}\right)$$

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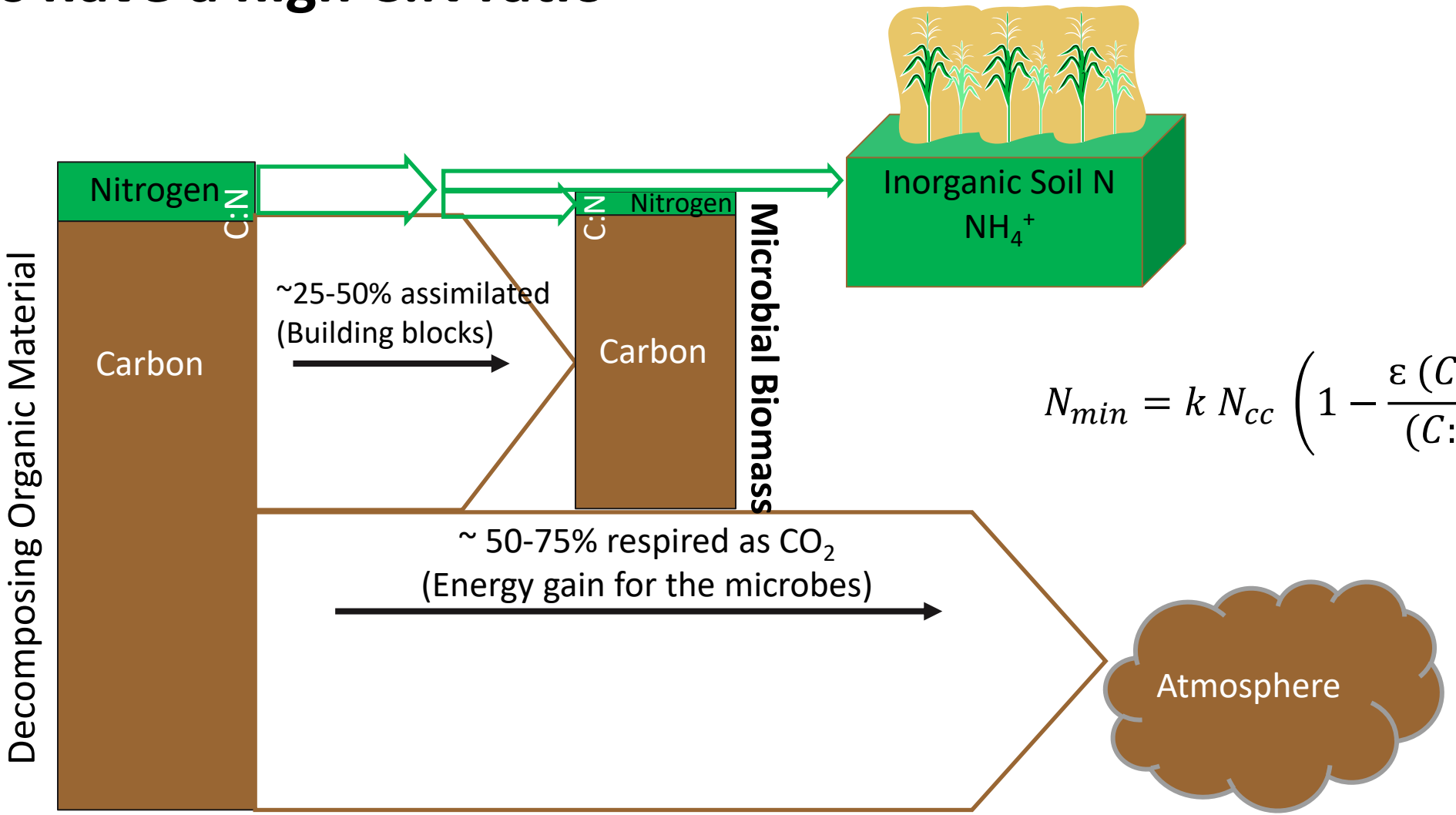
Microbes can also cause N immobilization when decomposing residues have a high C:N ratio



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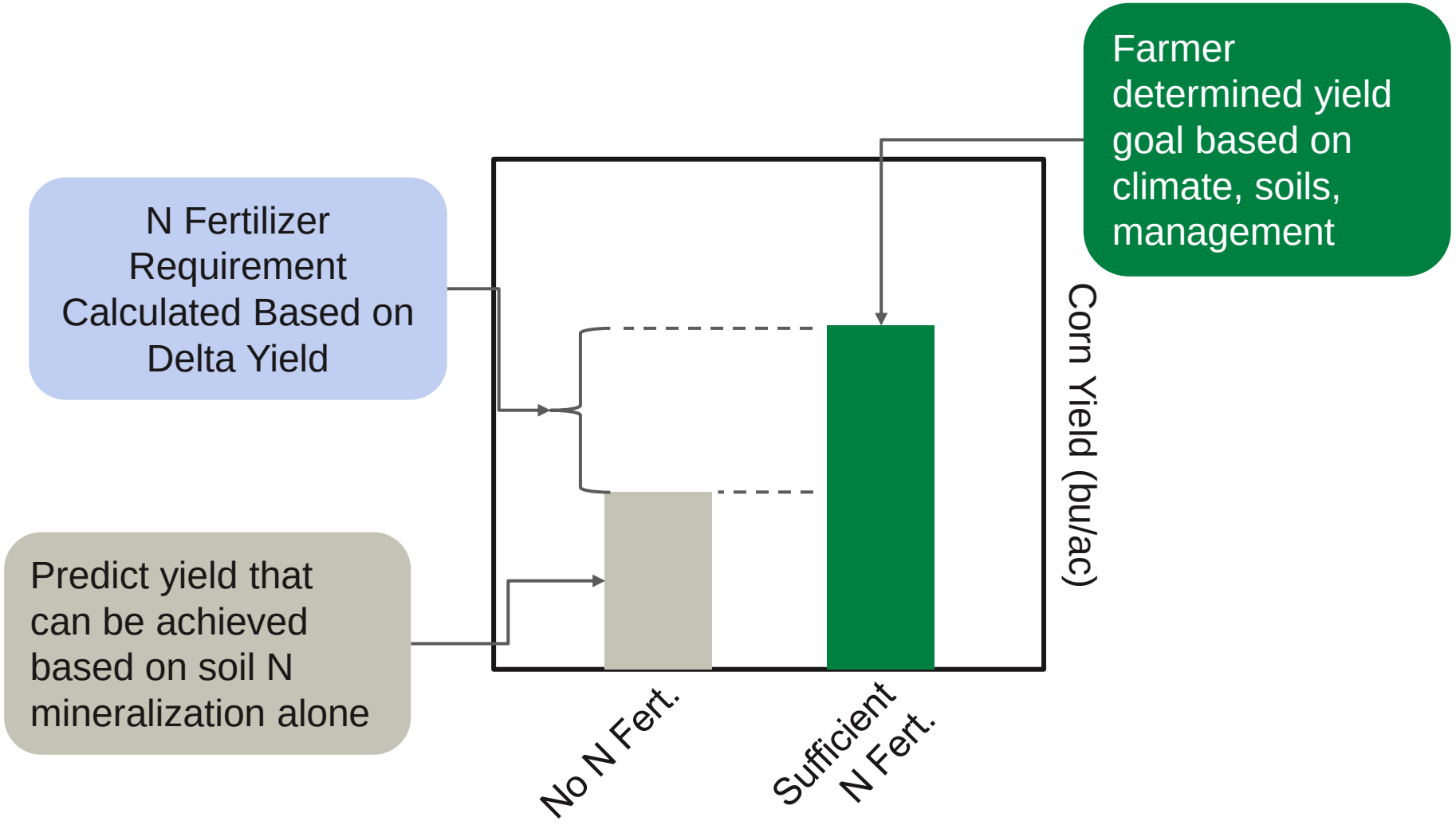
Recommendations are based on “Delta Yield” using a prediction of unfertilized corn yield



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What information is needed to develop a recommendation?

Average Corn Yield Goal

Recommendations are designed to be developed at the beginning of the growing season when yield potential for the year is not known. Therefore, use average yield from recent history in a field.

Soil and Cover Crop Inputs	Sampling and Analysis Methods
Soil % sand and % clay	**Best:** Soil sample 0-8 inch depth, lab measurement of texture **Okay:** NRCS soil survey map or texture-by-feel
Soil % carbon and % nitrogen	**Best:** Soil sample 0-8 inch depth, lab measurement of soil %C, %N, and soil C:N ratio **Okay:** Soil sample 0-8 inch depth, lab measurement of organic matter converted to %C, assume soil C:N = 10:1.
Cover crop N content (lbs N/ac)	**Best:** Cover crop biomass cut from known quadrat area, dried and weighed, lab measurement of cover crop biomass %N **Good:** Greenseeker, drone, or satellite NDVI converted to lbs N/ac **Okay:** Visual estimation
Cover crop C:N ratio	**Best:** lab measurement of cover crop biomass C:N **Good:** Cover crop biomass C:N ratio lookup table

https://extension.psu.edu/nitrogen-recommendations-for-corn

Recommendation Tool Landing Page and Quick Start Guide

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TOOLS AND APPS

APP-1014

Nitrogen Recommendations for Corn That Credit Cover Crops and Soil Organic Matter

This tool allows you to make a prediction for how much nitrogen (N) fertilizer is needed for a corn crop based on credits that are given to soil organic matter and cover crop residues.

Save for later Share | Be the first to review this product

Language

English

Files to Download

- Spreadsheet to calculate cover crop and SOM N credits for corn

Available Formats

- Web-based Application

Available in Online Interface and Spreadsheet Formats

https://extension.psu.edu/nitrogen-recommendations-for-corn

Online Interface

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Inputs

Average Corn Yield Goal (bu/ac)
150 | 150

Clay Content (%)
25 | 25

Sand Content (%)
25 | 25

Soil Carbon (%)
1 | 1

Soil C:N Ratio
10 | 10

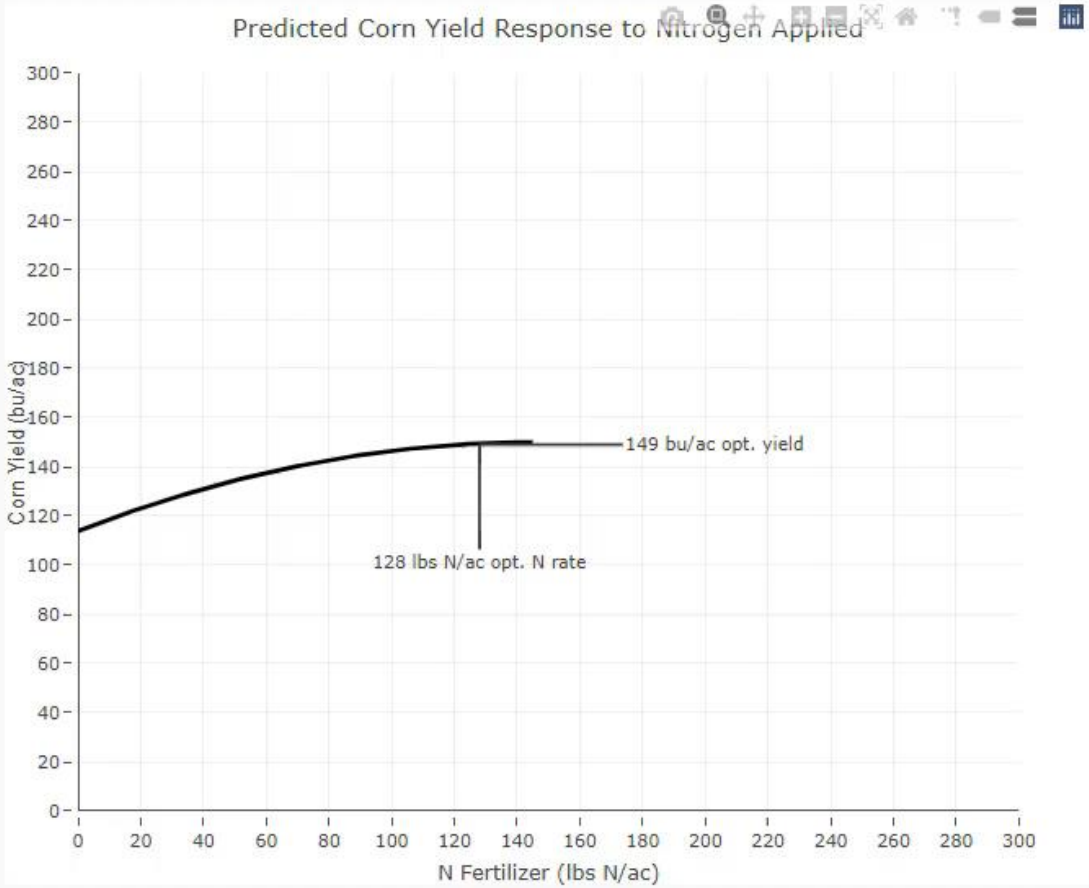
Winterkilled Cover Crop Biomass N (lbs/ac)
0 | 0

Spring Cover Crop Biomass N (lbs/ac)
0 | 0

Spring Cover Crop C:N Ratio
10 | 10

Diagnostics and Results

Critical Spring Cover Crop C:N Ratio for N Immobilization	Cover Crop Yield Credit	Additional Recommended Nitrogen
24:1	0 bu/ac	128 lbs N/ac

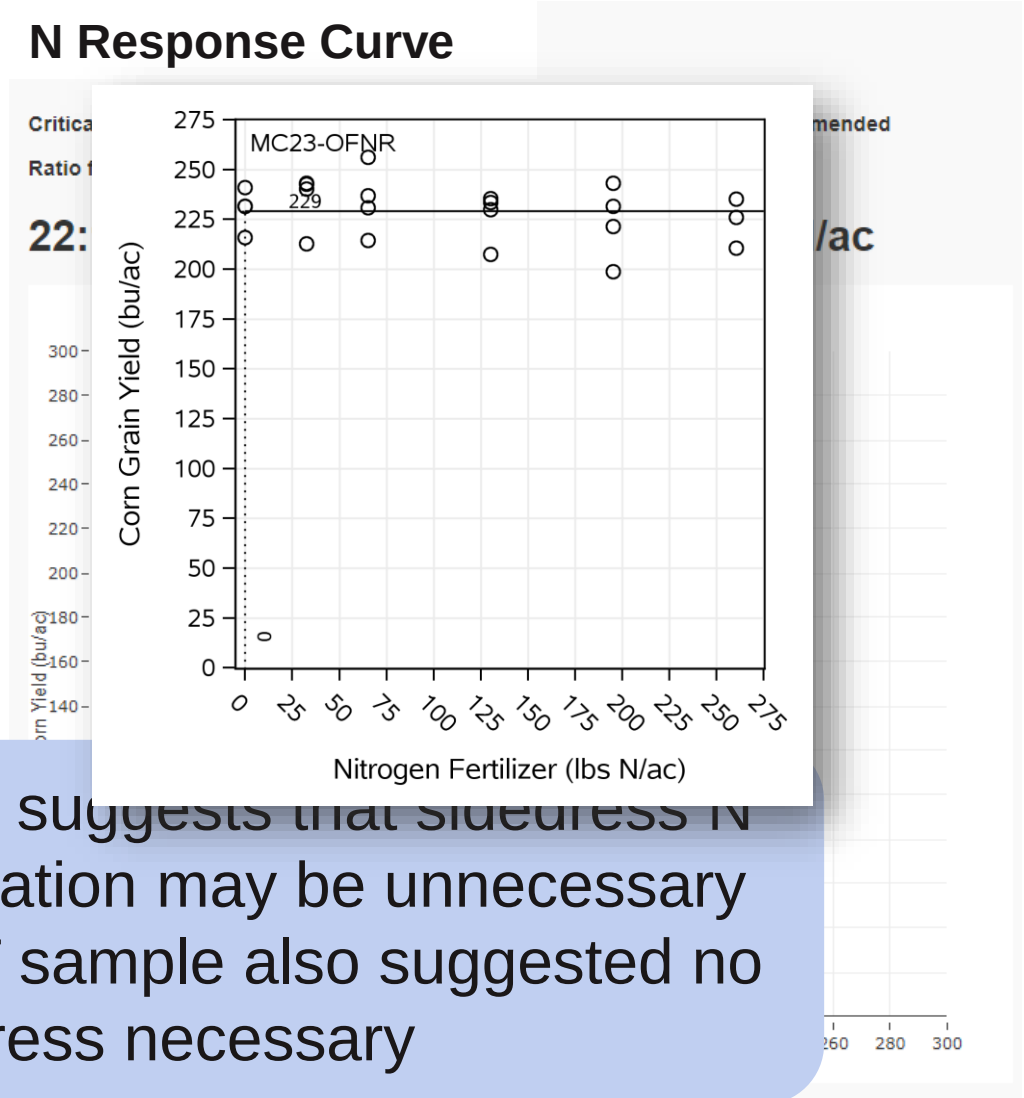


On-Farm Validation Trial #1 – Manheim

N Tool Inputs for 2023 Nitrogen Response Trial

Grower determined yield goal (bu/ac)	225 bu/ac
Soil texture (%)	31% clay, 19% sand
Soil carbon (%)	1.5%
Soil C:N ratio	9:1
Cover crop N content (lbs N/ac)	33
Cover crop C:N ratio	12:1

N Response Curve



Grower Nitrogen Management

-Liquid hog manure injected at 5,000 gal/acre
-Manure analysis – Ammonium N – 12 lbs/1,000 gal
Organic N – 26 lbs/1,000 gal
-Spring manure N credit = 113 lbs/ac
-Starter N at planting = 35 lbs/ac
-Sidedress N = 84 lbs/ac

- N tool suggests that sidedress N application may be unnecessary
- PSNT sample also suggested no sidedress necessary

To calculate manure N availability – Use Penn State Agronomy Guide Table 1.2-12

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On-Farm Validation Trial #2 – Mount Joy

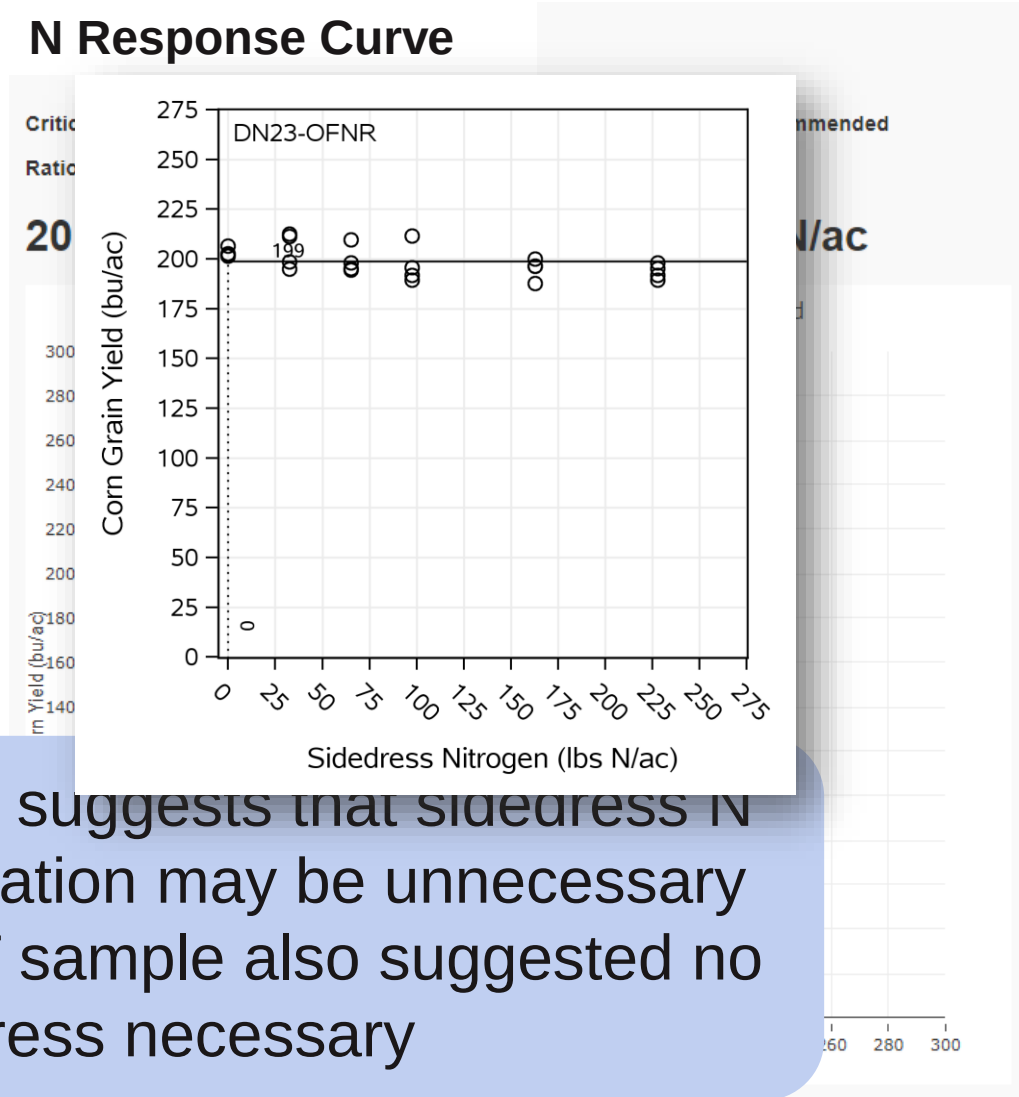
N Tool Inputs for 2023 Nitrogen Response Trial

Grower determined yield goal (bu/ac)	200 bu/ac
Soil texture (%)	33% clay, 22% sand
Soil carbon (%)	1.7%
Soil C:N ratio	9:1
Cover crop N content (lbs N/ac)	28
Cover crop C:N ratio	12:1

Grower Nitrogen Management

-Liquid steer manure broadcast at 7,000 gal/acre
-Manure analysis – Ammonium N – 25 lbs/1,000 gal
Organic N – 22 lbs/1,000 gal
-Fall manure N credit = 54 lbs/ac
-Starter N at planting = 55 lbs/ac
-Sidedress N = 58 lbs/ac

N Response Curve



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Concluding Thoughts

- New N recommendation tool accounts for the underlying biological processes that affect the soil N supply to corn
- Accommodates the diversity of practices in current cropping systems
- Community effort among researchers and farmers has been key to the development of this tool
- Recommendations will improve as we learn more
  - Better predictions of microbial carbon use efficiency
  - Cover crop C:N ratio look-up tables
  - Satellite imagery to calculate cover crop N content
  - **Continue on-farm validation of the N tool at field-scale**

Many Thanks!

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