

Understanding nutrient release from cover crops

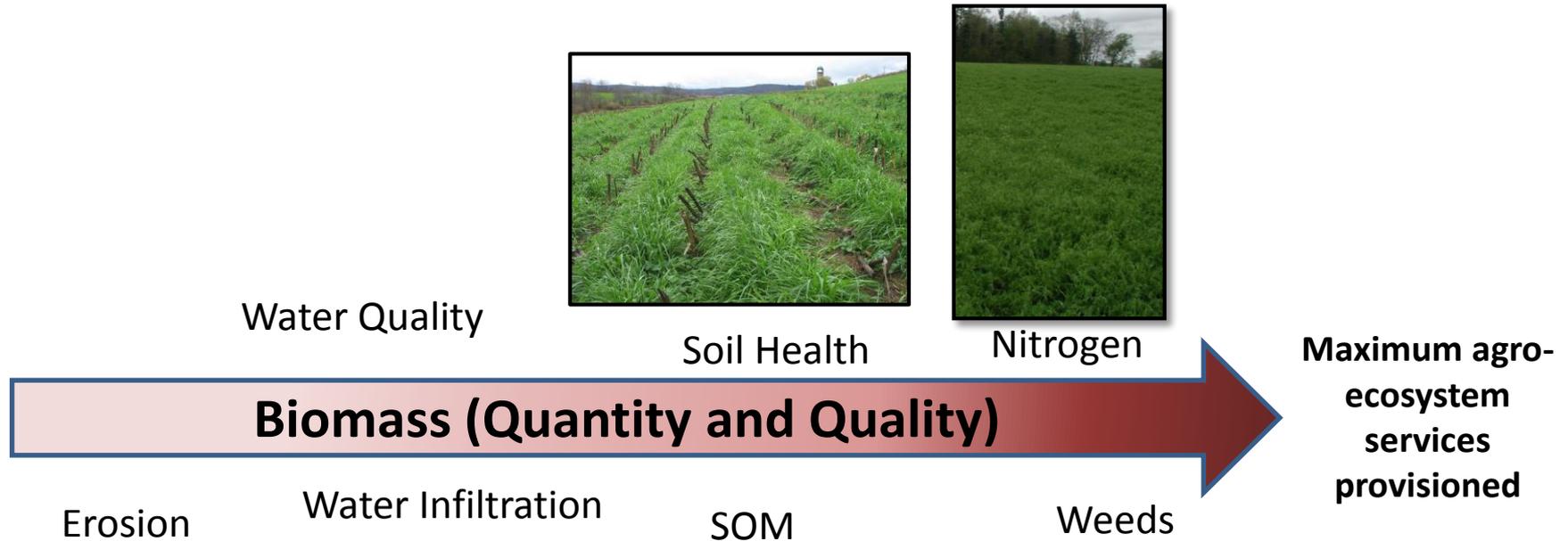
Steven Mirsky
USDA-ARS, Beltsville, MD



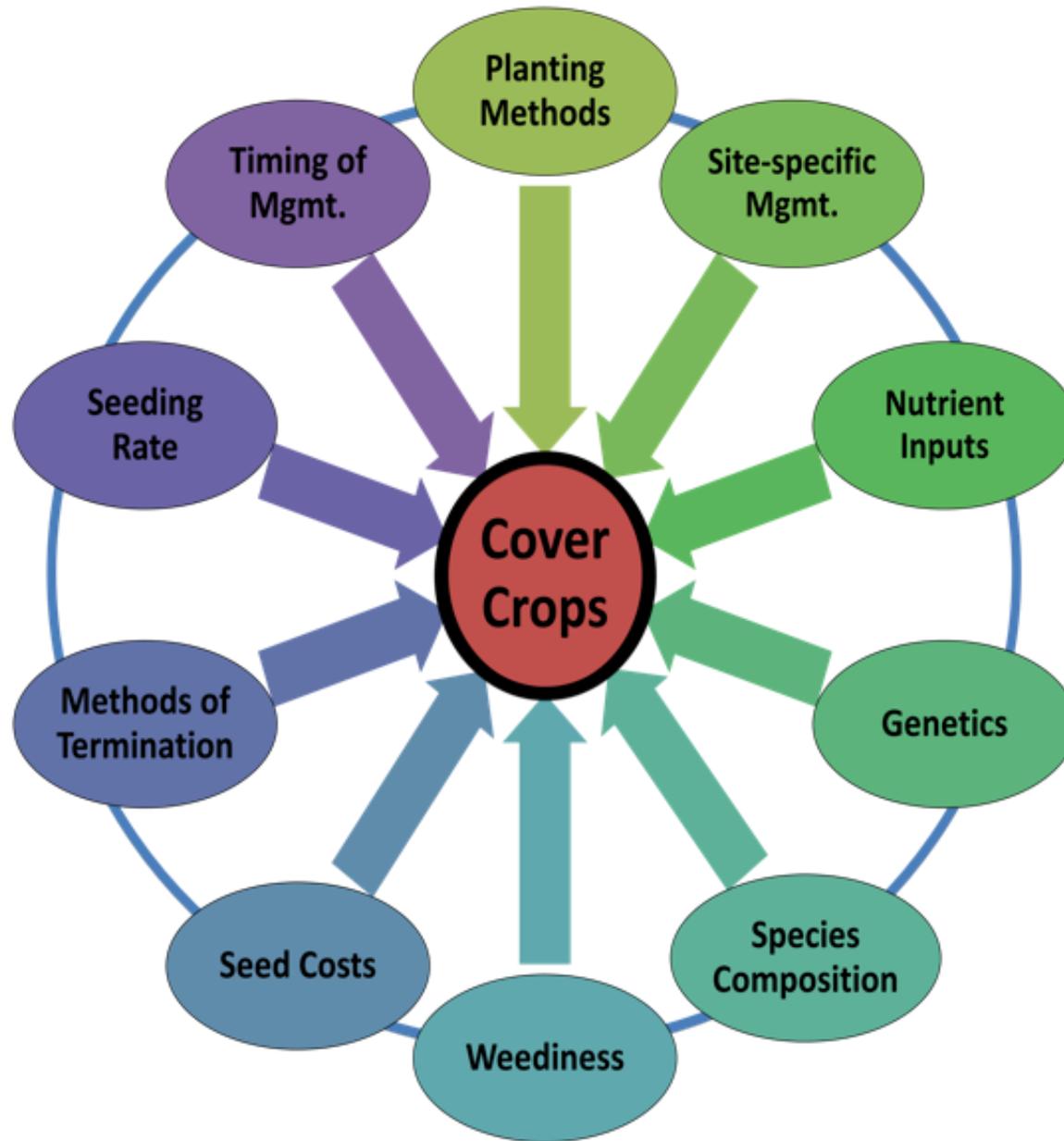
Agricultural Research Service

Sustainable Agricultural Systems

The spectrum of agro-ecosystem services based on cover crop biomass



Cover crop management drives performance

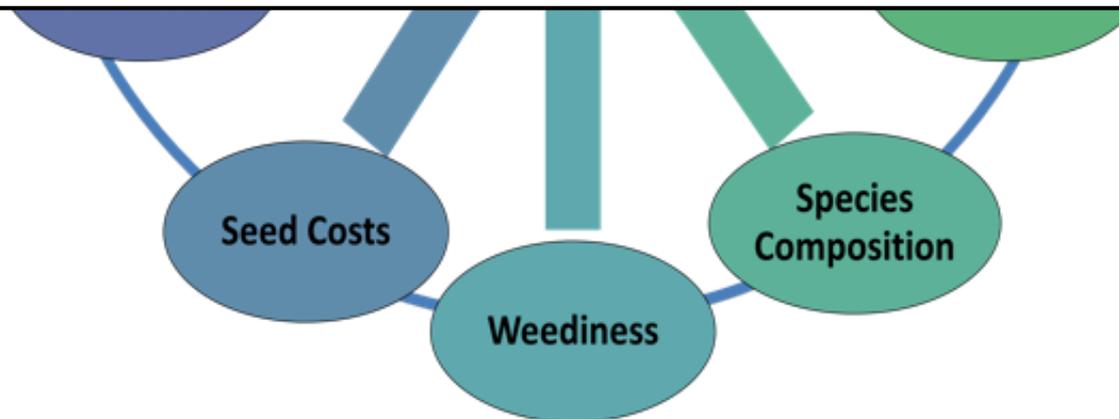


Cover crop management drives performance



Performance: **(biomass quality and quantity)**

- Intrinsic (climate and soil)
- Management



Legumes

- Fix nitrogen
- High tissue N concentration (3-4% N)
 - C:N ratio < 20
- Rapid N mineralization during decomposition
- Not very good at reducing N leaching



Legumes

When compared to:

1. Mineral fertilizers
 - Slower release rates
 - Lower energy use
 - Renewable resource
2. Animal Waste
 - No new P
 - No transport costs
 - Low volatility



Intrinsic (climate and soil) and management

(USDA hardiness zone: 5a to 8a)

University of Massachusetts

Masoud Hashemi

Cornell

Matt Ryan

Penn State

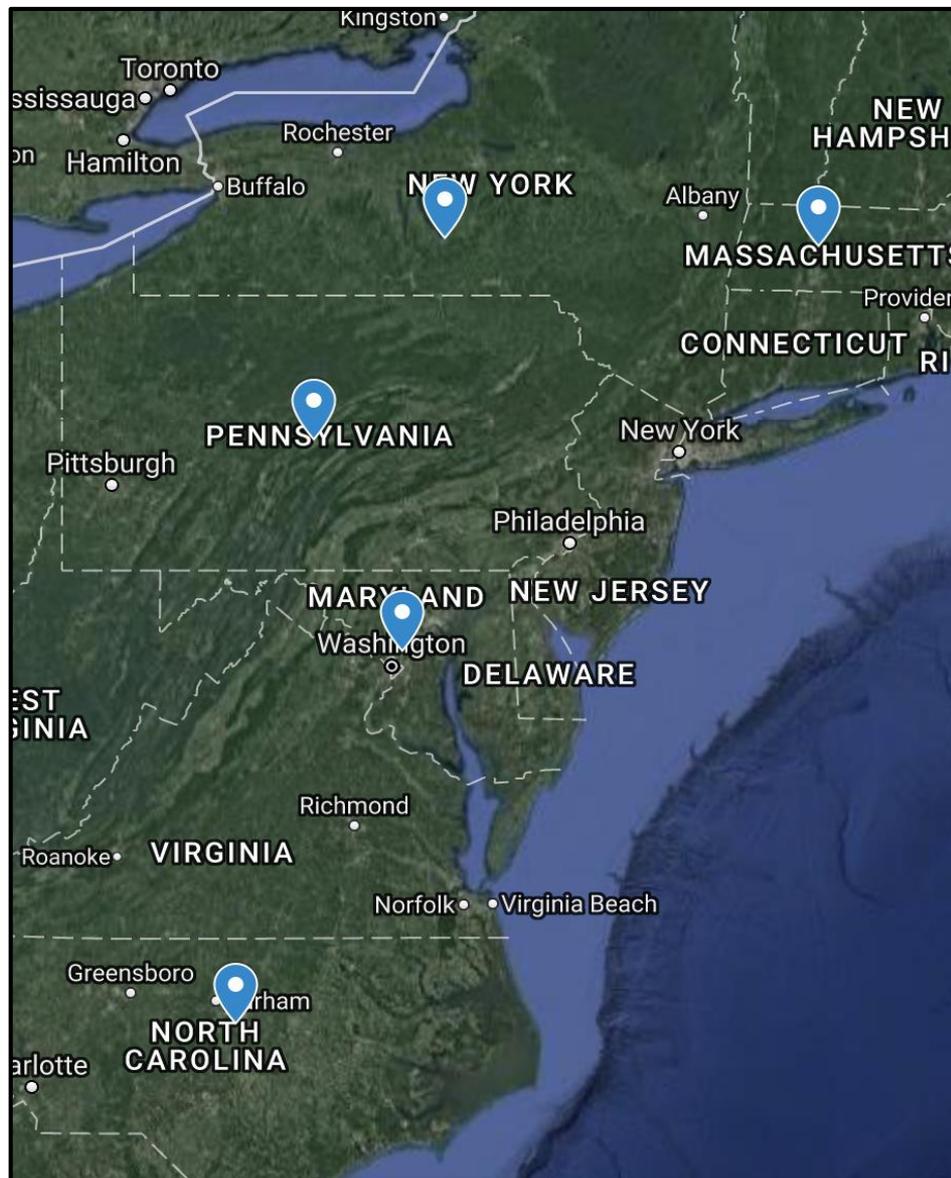
Bill Curran and John Spargo

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Steven Mirsky

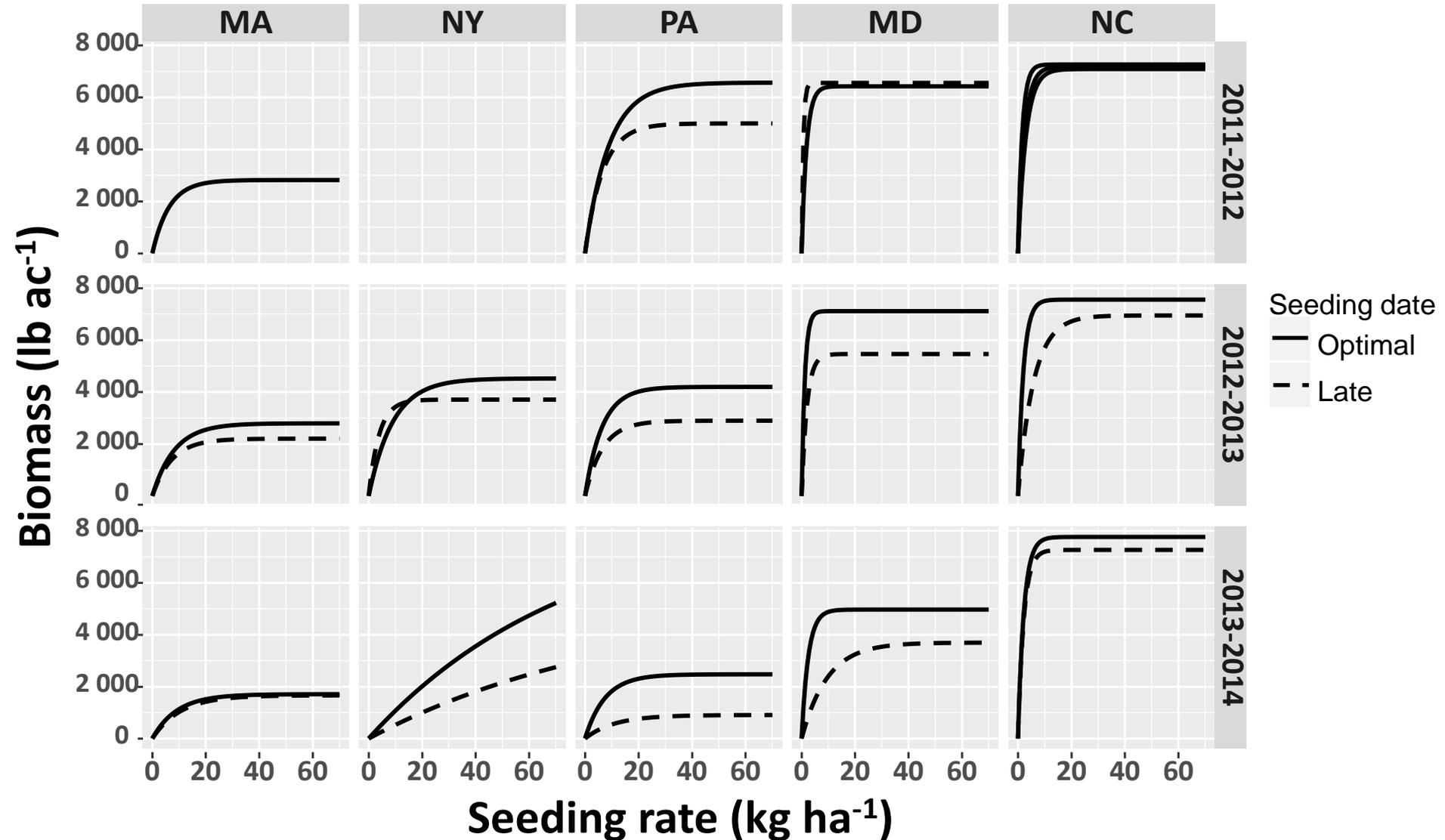
North Carolina State University

Chris Reberg-Horton

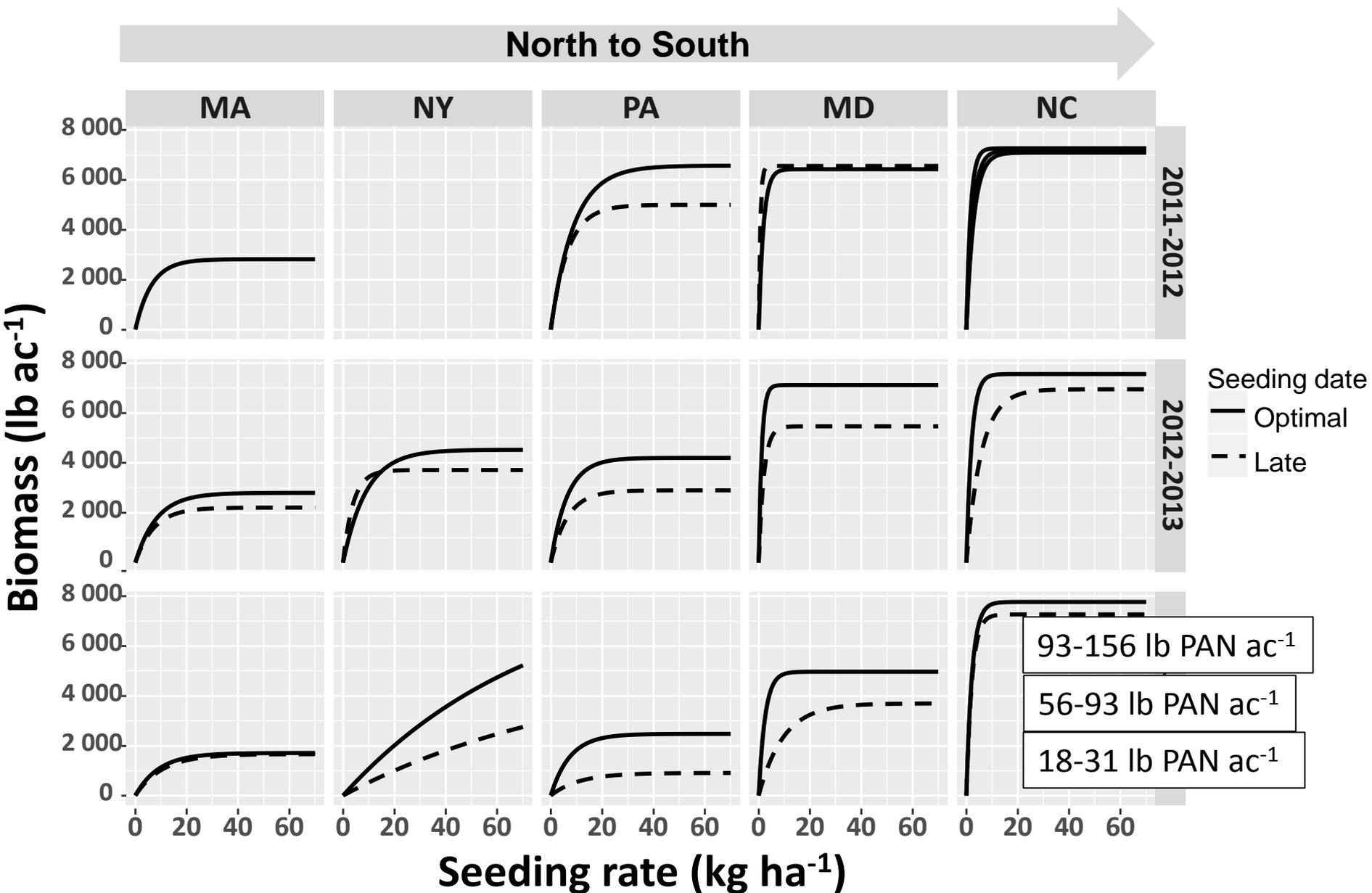


Hairy vetch biomass across a seeding rate, latitude, and planting date gradient

North to South 



Hairy vetch biomass across a seeding rate, latitude, and planting date gradient



Grasses

- Tremendous N scavenging
- Erosion control
- Weed suppression as a mulch
- Growth limited by soil N
- Lower tissue N concentration (1-2%)
 - C:N ratio > 25
- Possible N immobilization during decomposition
- Excellent at reducing N leaching



Cover Crop Biomass and Nitrogen Content at Select Growth Stages

Species	Cover Crop Biomass (lb ac ⁻¹)			C:N
	<i>(low range)</i>	<i>(mid range)</i>	<i>(high range)</i>	
<u>Grasses</u>				
- Tillering	300-700	700-1100	1100-1500	18:1
- Stem elongation	1000-1600	1600-2400	2400-3000	24:1
- Boot	1500-2500	2500-3500	3500-4500	35:1
- Anthesis	2000-4250	4250-6750	6750-9000	50:1
<u>Legumes</u>				
- Early termination	1000-2000	2000-3000	3000-4000	13:1
- Mid termination	3000-4000	4000-5000	5000-6000	13:1
- Late Termination	4000-5000	5000-6000	6000-7000	13:1

*Grasses include wheat, rye, barley, and triticale;
Legumes is hairy vetch and some averaging from clovers

Cereal rye (*Secale cereale*)



Early Termination

- Low C/N ratio (~27:1)
 - Mineralization
 - Grown ~7 months
- Terminated early spring



Late Termination

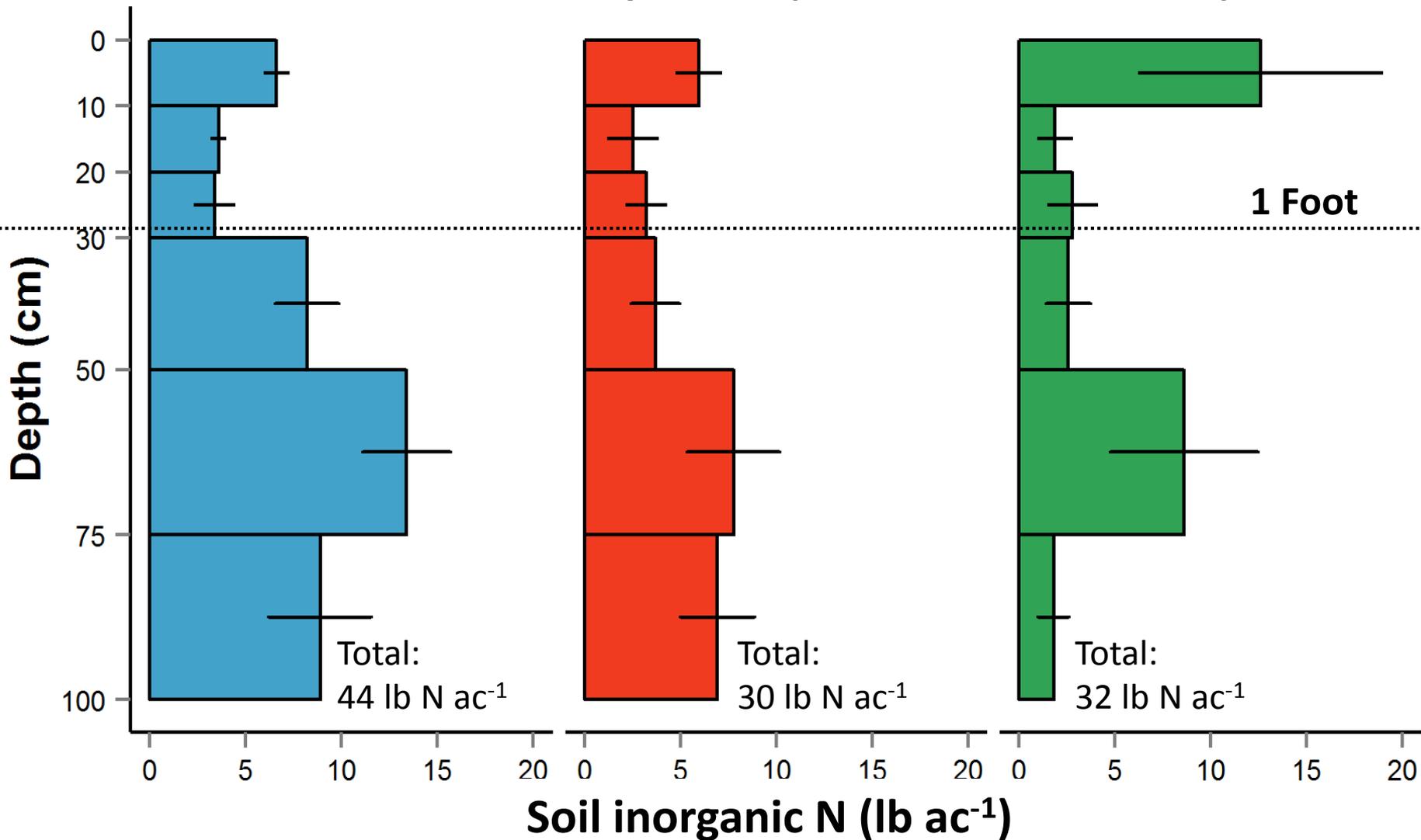
- High C/N ratio (~48:1)
 - Immobilization
 - Grown ~8 months
- 2.5x more biomass
- Terminated late spring

Late-March

Bare Ground

Early Cover Crop Termination

Late Cover Crop Termination

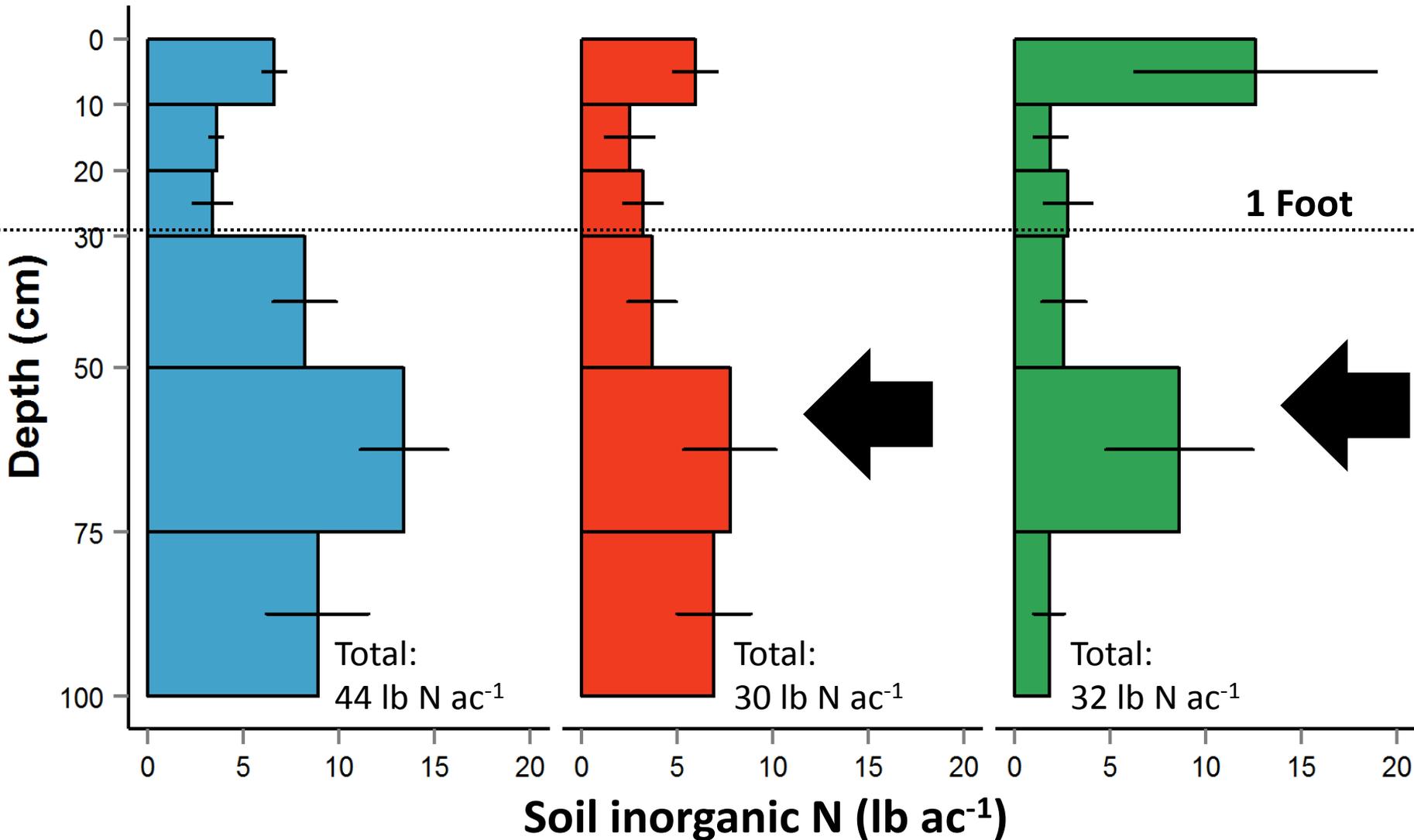


Late-March

Bare Ground

Early Cover Crop Termination

Late Cover Crop Termination

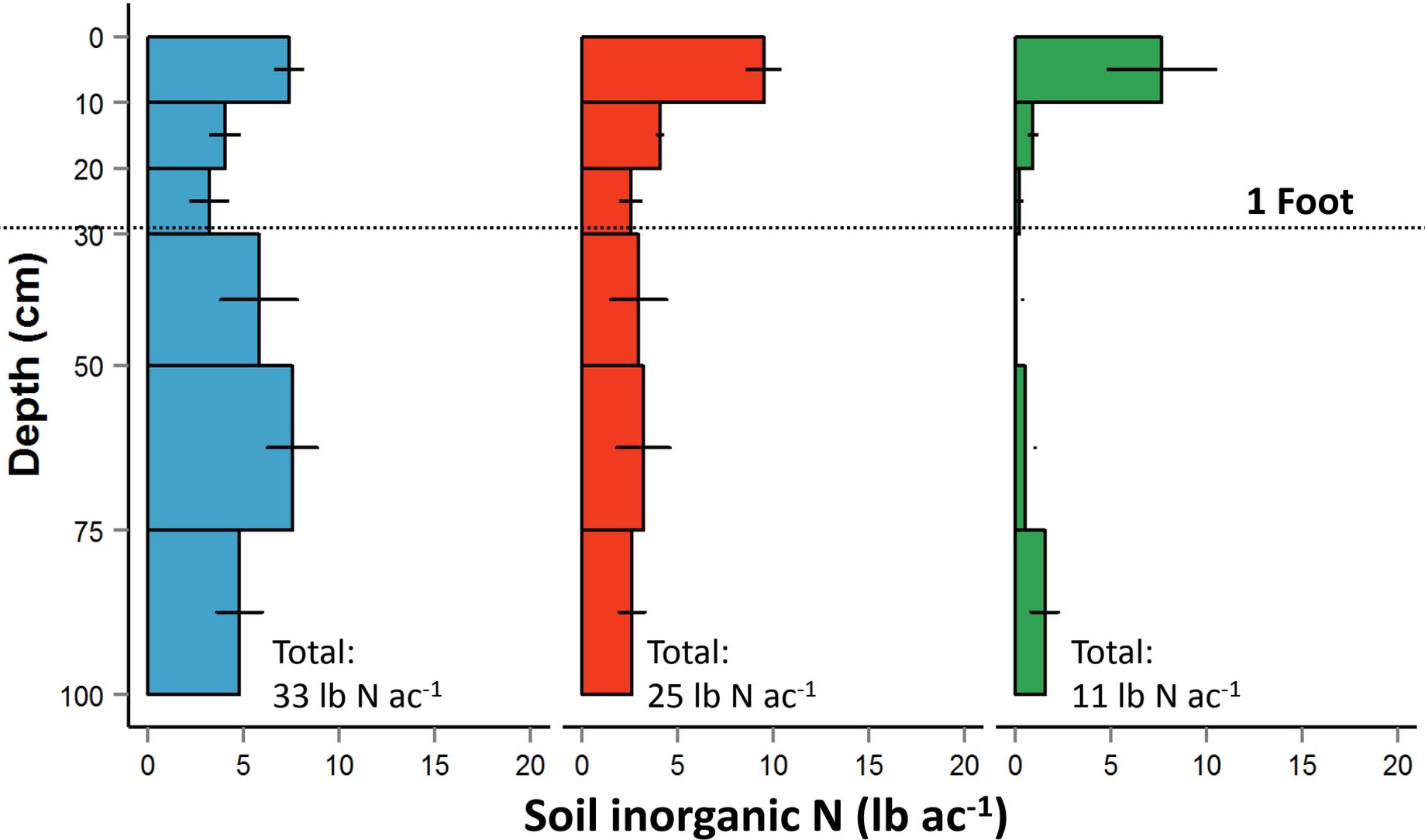


Early-May

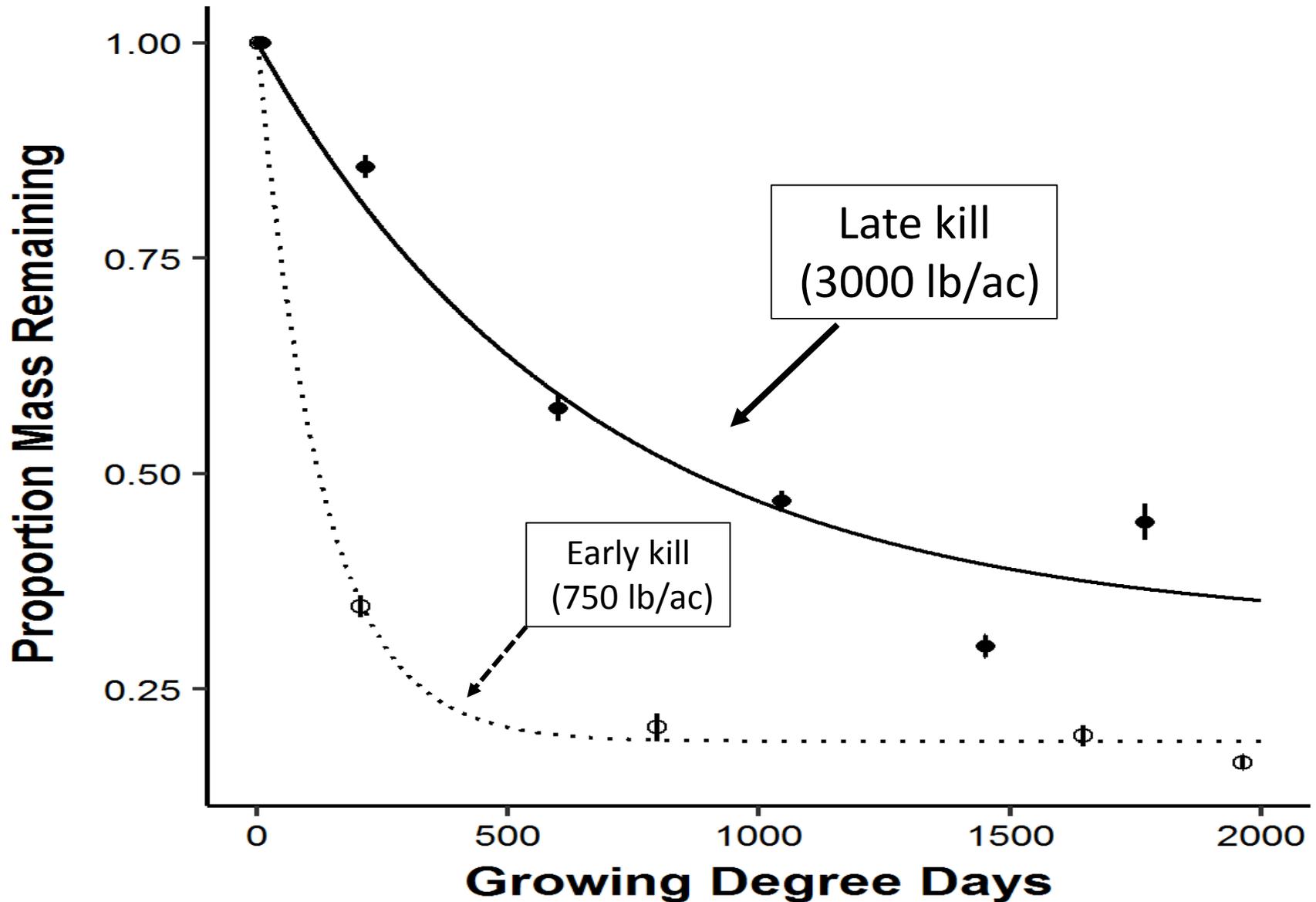
Bare Ground

Early Cover Crop Termination

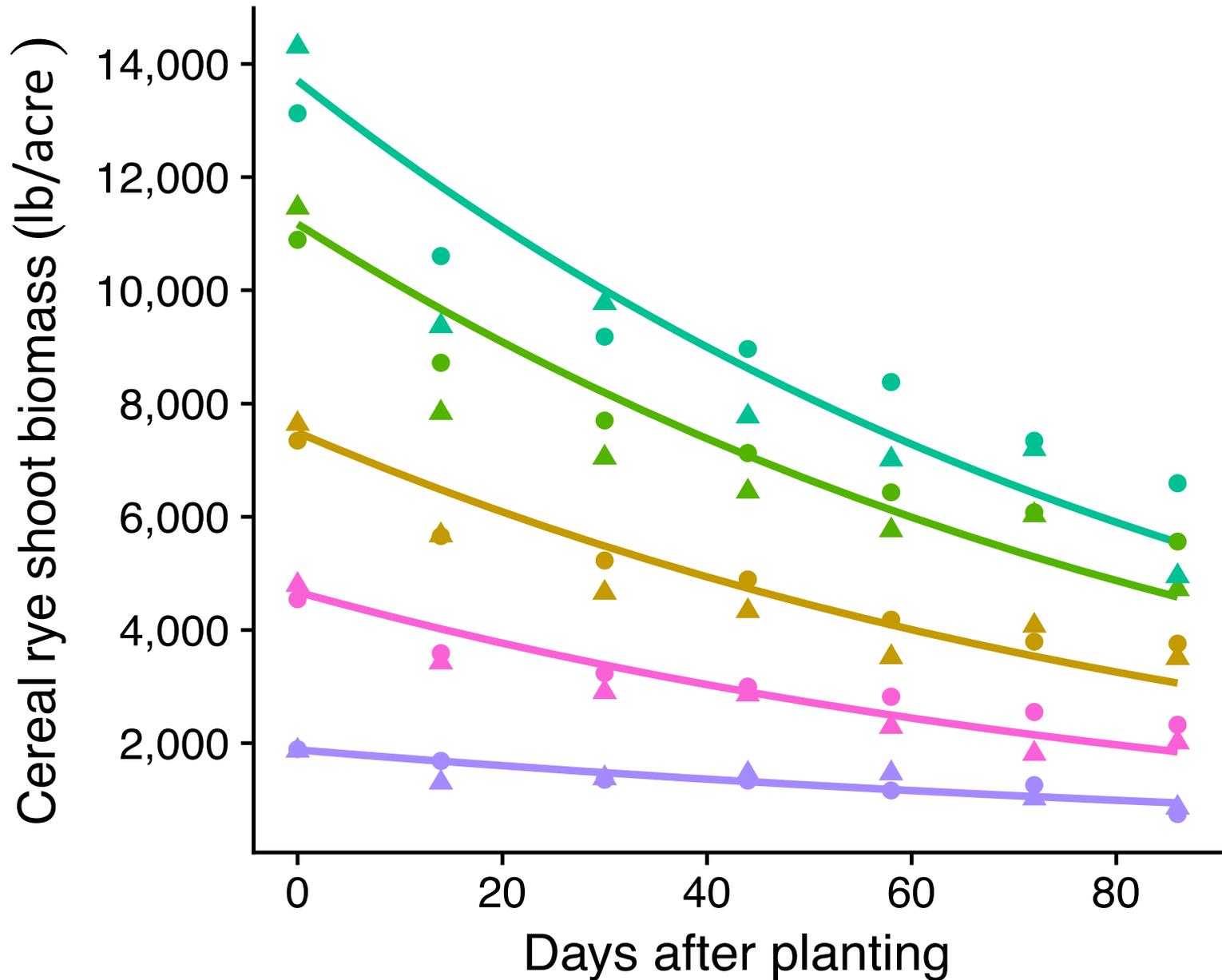
Late Cover Crop Termination



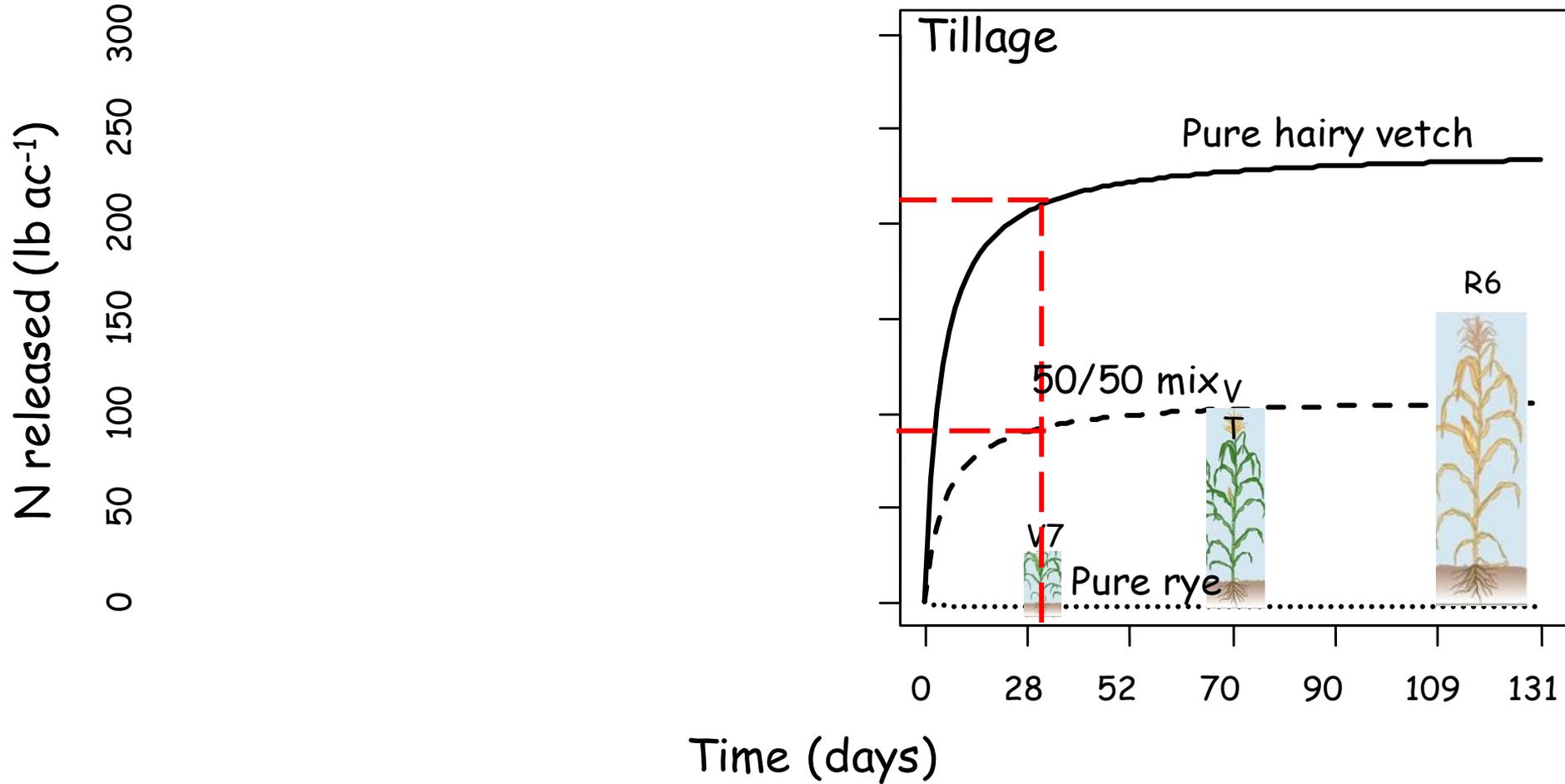
Cereal rye decomposition in field corn



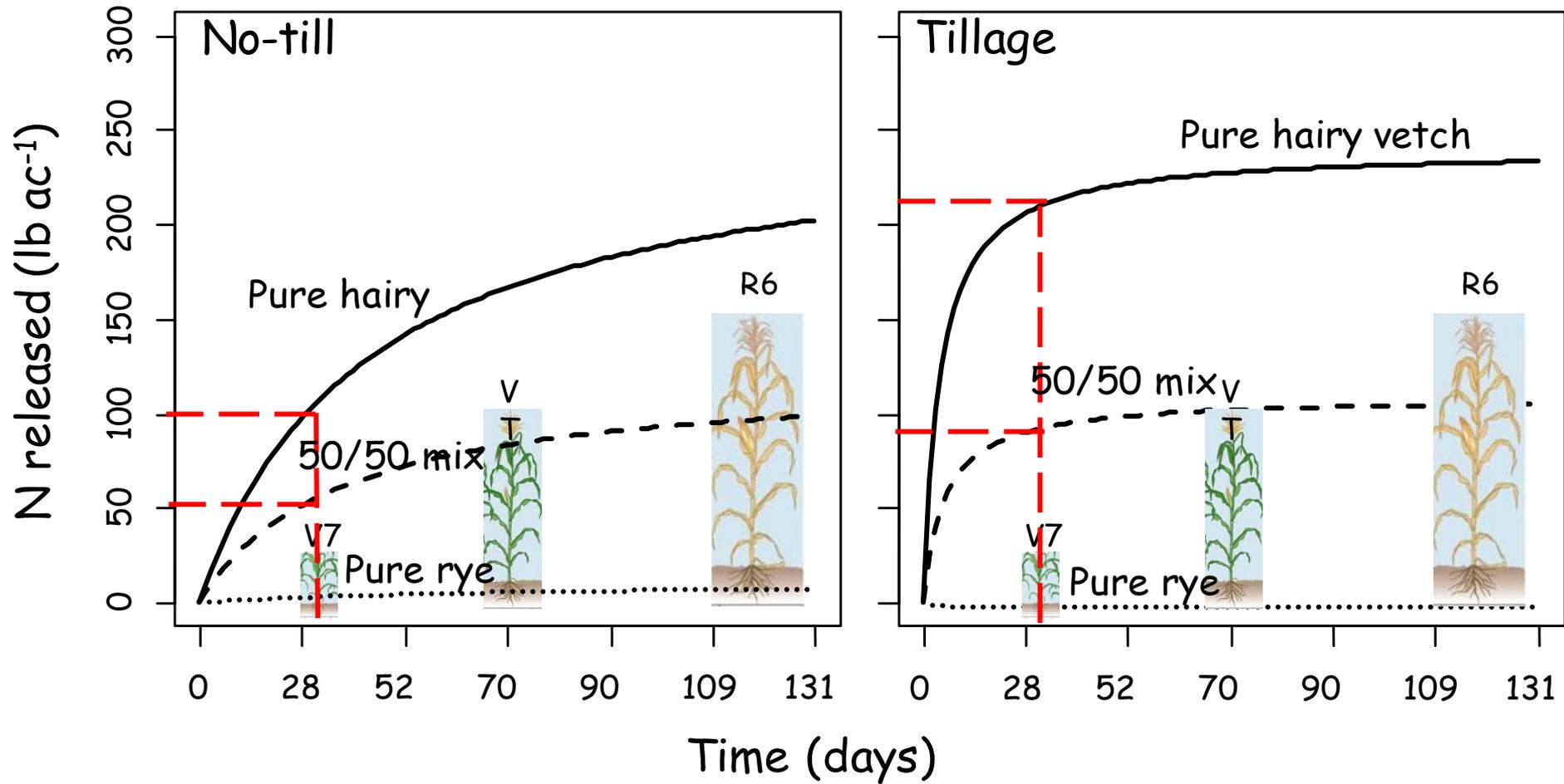
Cereal rye decomposition



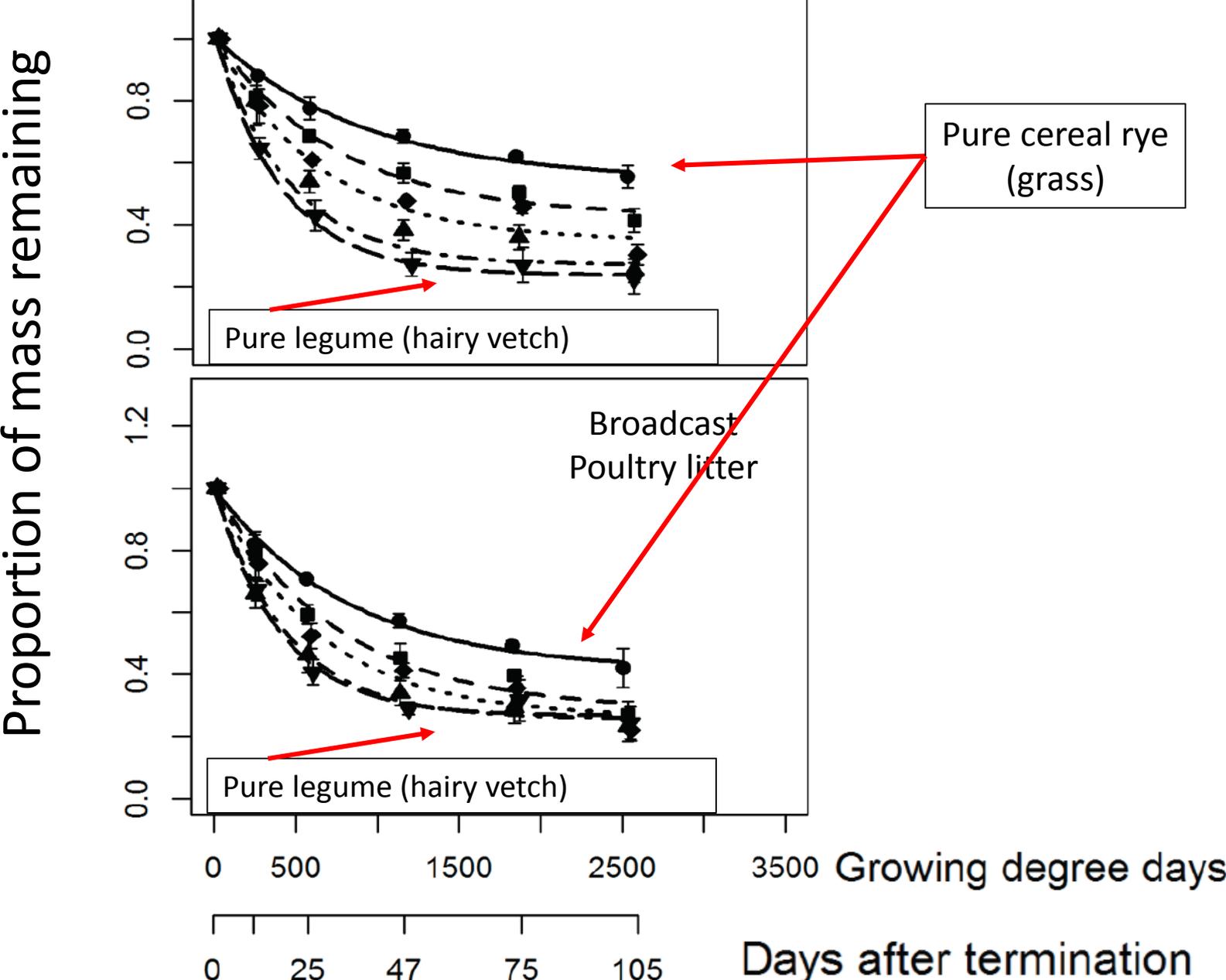
Nitrogen release over time



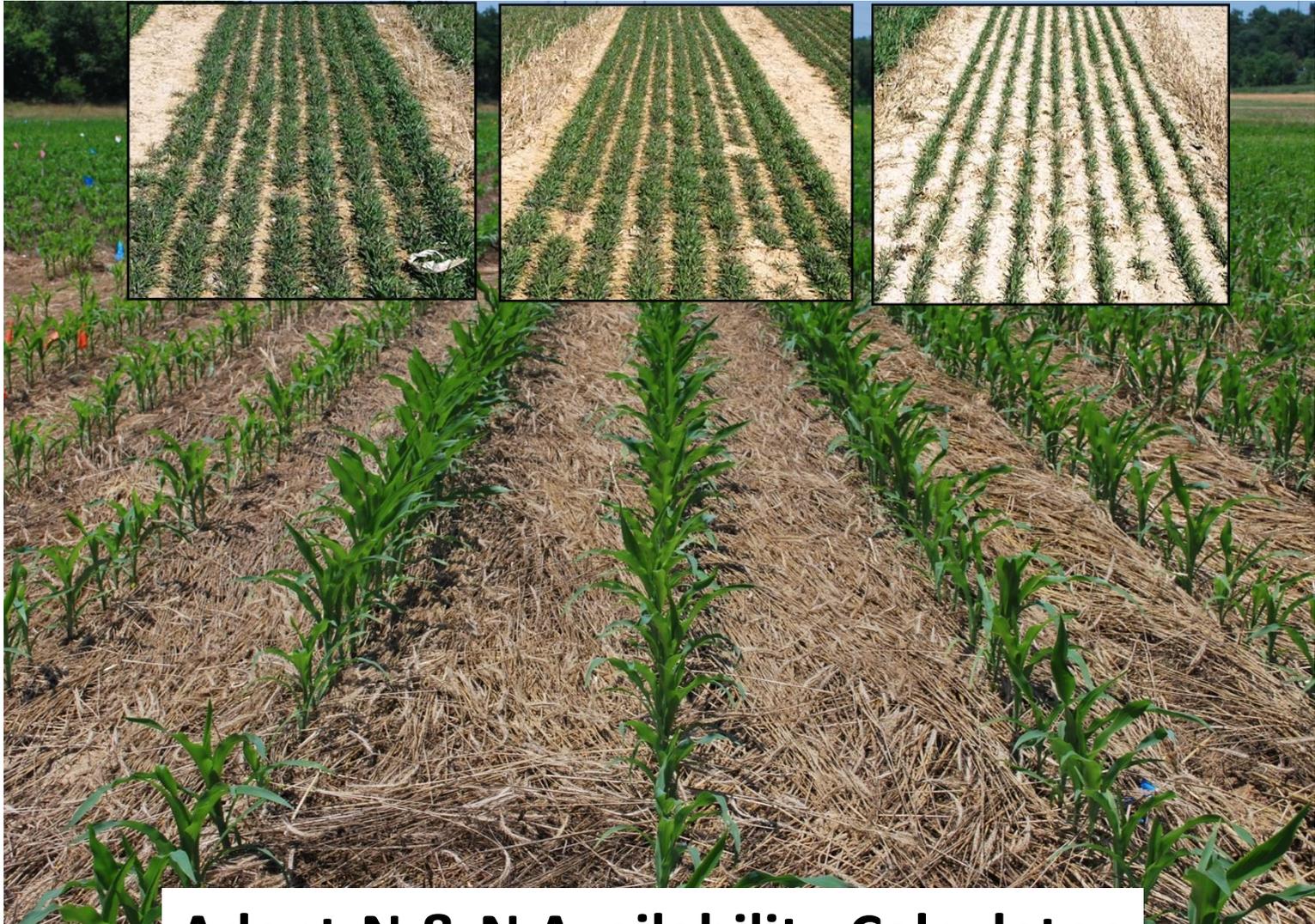
Nitrogen release over time



Decomposition of grass:legume cover crop mixtures

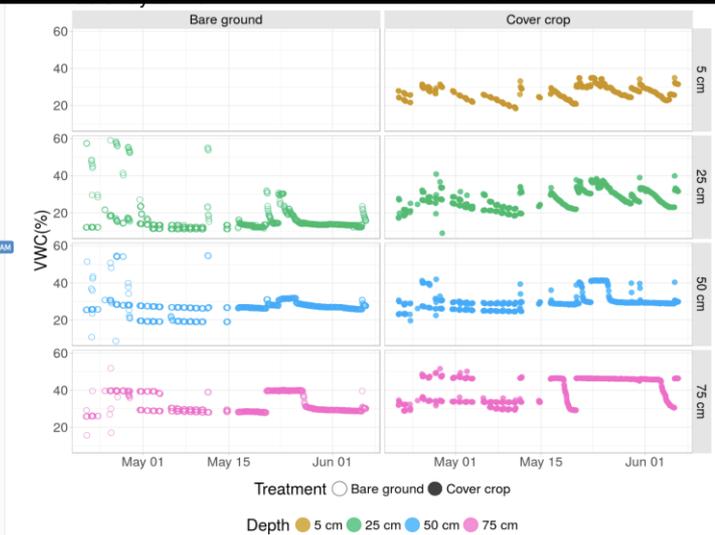
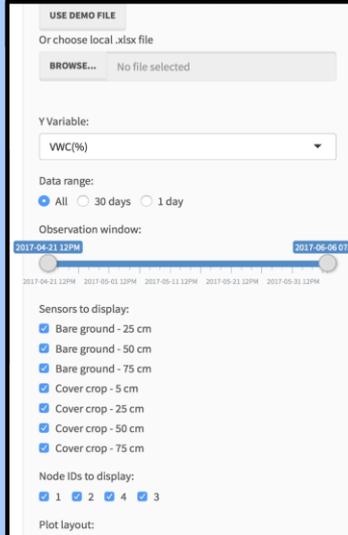
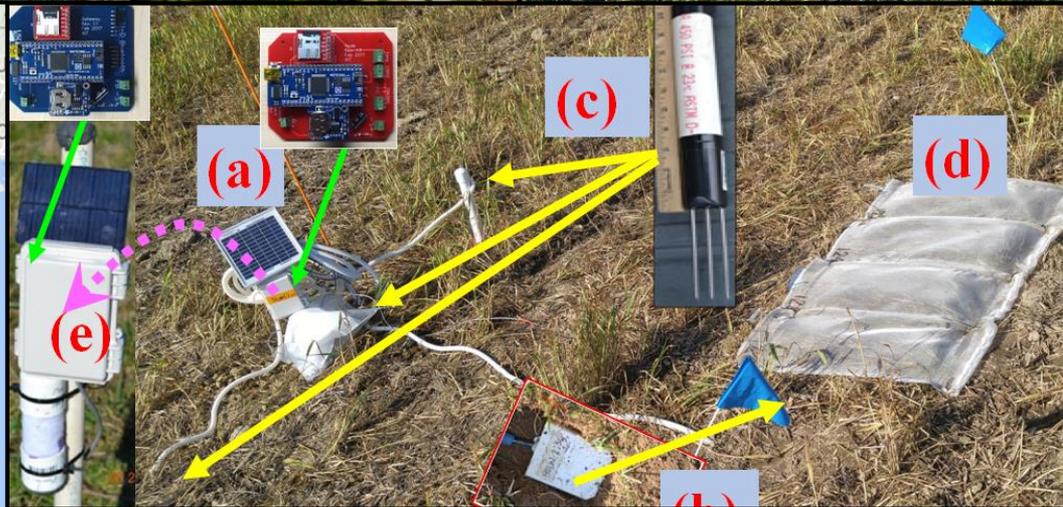


Decision support tools for adaptive nitrogen management



Adapt-N & N Availability Calculator

Water and Nitrogen Dynamics on mid-Atlantic and Southeastern Farms



Water and Nitrogen Dynamics on mid-Atlantic and Southeastern Farms





Calculator Outputs

COVER CROP NITROGEN AVAILABILITY CALCULATOR

CALCULATOR

INSTRUCTIONS

CONTACT

If you need instructions, click the **Instructions** tab above.

Please answer the questions below and click "Next Page" when complete.

Background

Was the cover crop residue analyzed by the Agricultural and Environmental Services Labs?

- If so, please enter the Lab Number.
- IF NOT, leave blank and enter data from another laboratory in the section below.

1567 Lab No.

Please enter the field name

Front Field

Enter the sample ID

1

To choose the closest weather station, what county is your farm located in?
(OR Choose from [interactive map.](#))

Clarke

Using weather station at:
Horticulture Research Farm

What is the CASH crop?

Select a crop Broccoli

What is your target nitrogen fertilizer rate?

150 lbs N/acre

What is the planting date?

08/24/2015 mm/dd/yyyy

What is the COVER CROP?

Select one or more cover crops Cowpeas

When was the cover crop killed or incorporated?

08/01/2015 mm/dd/yyyy

Calculator Outputs

COVER CROP NITROGEN AVAILABILITY CALCULATOR

CALCULATOR

INSTRUCTIONS

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RESULTS: –

Your cover crop was terminated on .

The cover crop is predicted to release lbs of N per acre from the aboveground biomass over three months. This is a N .

The cover crop is predicted to release:

- lbs of N per acre in the first **two** weeks after termination.
- lbs of N per acre in the first **four** weeks after termination.

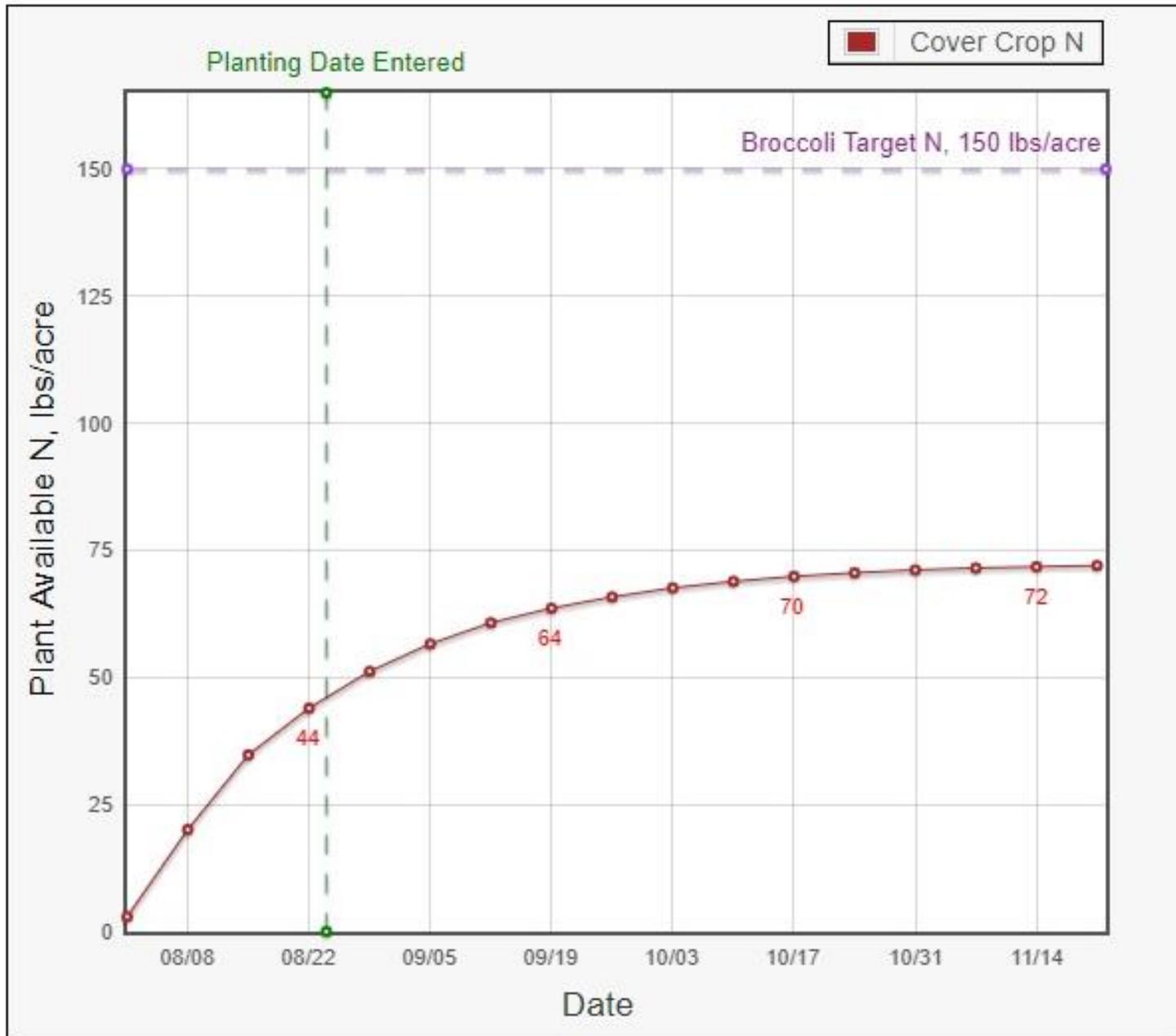
Your target nitrogen fertilizer rate was lbs N/ac.

Your recommended N after the cover crop is lbs N/ac.

The available N reported above from the cover crop decompositions is considered a N credit if positive or a debit if negative. The amount of N fertilizer recommended may be reduced by a credit or increased by a debit. Here are examples:

N Credit Example:	N Debit Example:
Recommended or Target N = 150 lbs N/ac	Recommended or Target N = 150 lbs N/ac
Predicted Cover Crop N = 50 lbs N/ac	Predicted Cover Crop N = - 20 lbs N/ac
Recommended N after Credit = $150 - 50 = \mathbf{100}$ lbs N/ac	Recommended N after Debit = $150 - (-20) = 150 + 20 = \mathbf{170}$ lbs N/ac

Calculator Outputs



Questions

