

Probing the secrets of soil:

How are microbes reacting to our demands?

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United States Department of Agriculture

Agricultural Research Service

Outline

Specific questions...

- ✓ Do cover crop mixtures increase microbial biomass and/or activity?
- ✓ If so, can better production be achieved?
- ✓ How can we practically measure soil biology on farms?

- ✓ Importance of residues and roots in soils with low organic matter
- ✓ How decomposition of plant residues releases nutrients



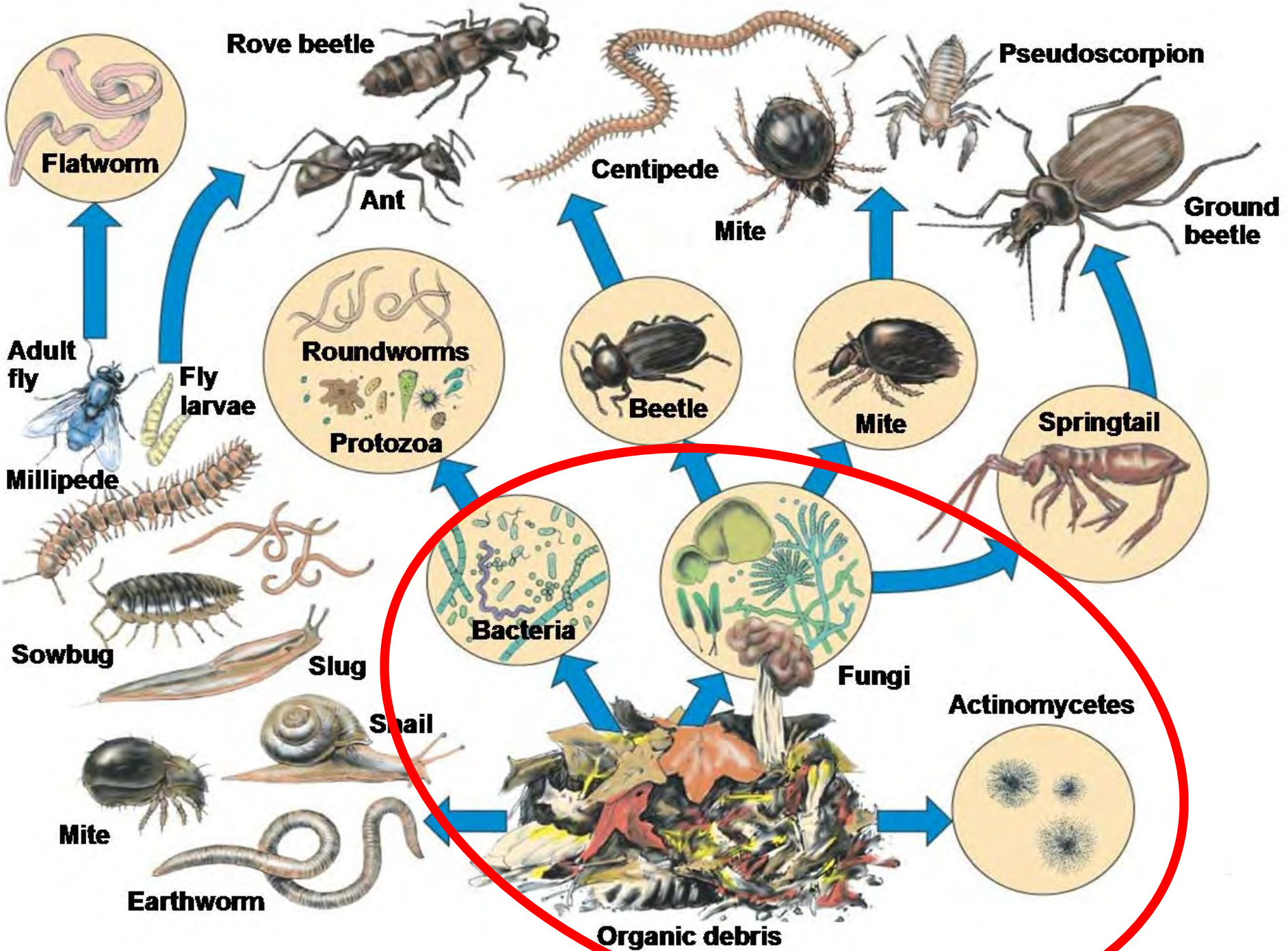






What is soil biology





A photograph showing the root system of a plant, likely a grass, growing in dark, rich soil. The roots are visible as a dense network of light-colored fibers extending downwards from the soil surface. The plant's green leaves are visible at the top. Three text overlays are present: 'Surface residues important' at the top, 'Fueling soil biological activity' in the middle, and 'Roots important' at the bottom.

Surface residues important

Fueling soil biological activity

Roots important

What do soil organisms need?



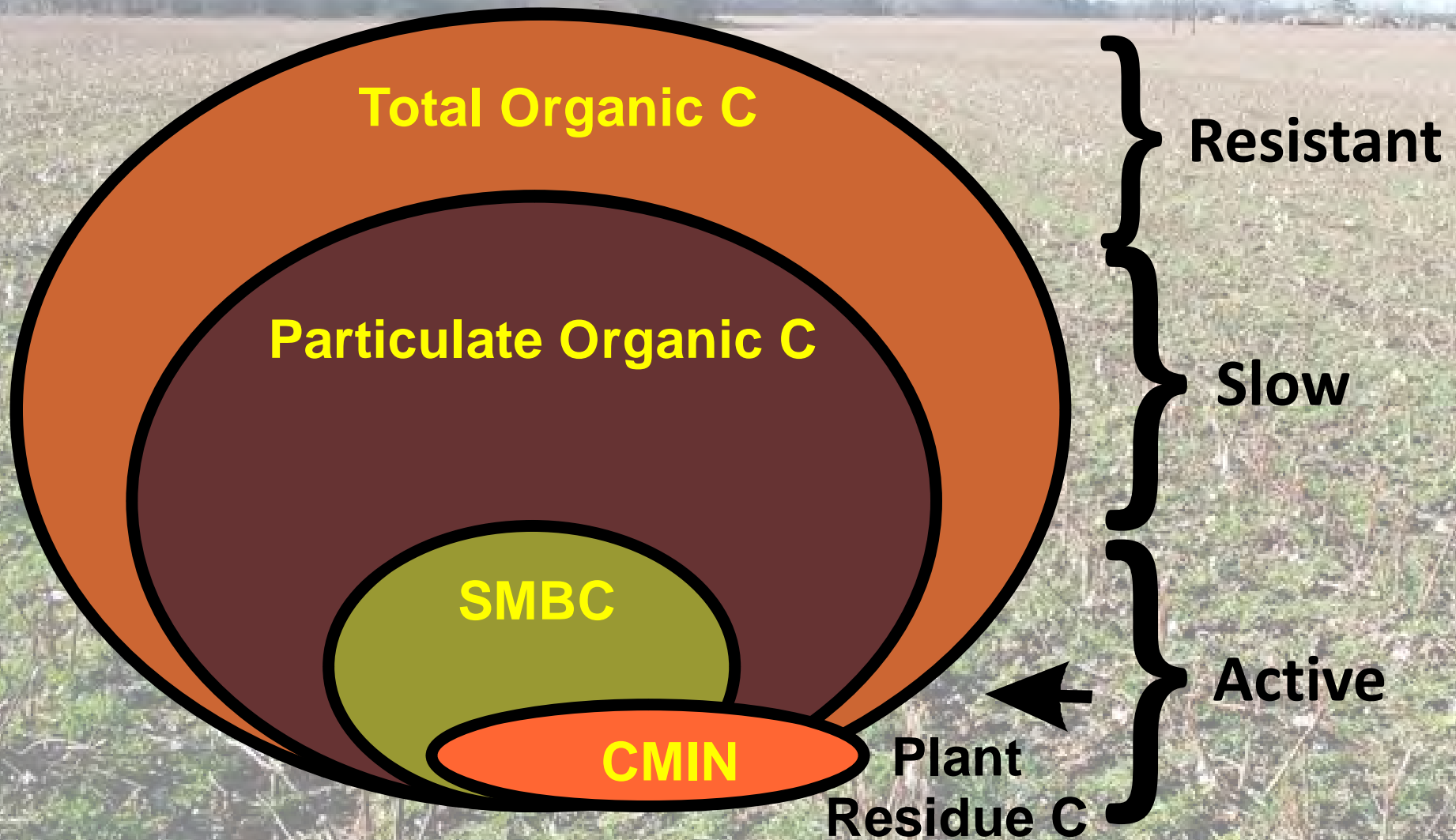
✓ Suitable habitat

- Something to hold onto
- Water
- Oxygen
- Balanced pH

✓ Carbon sources to consume

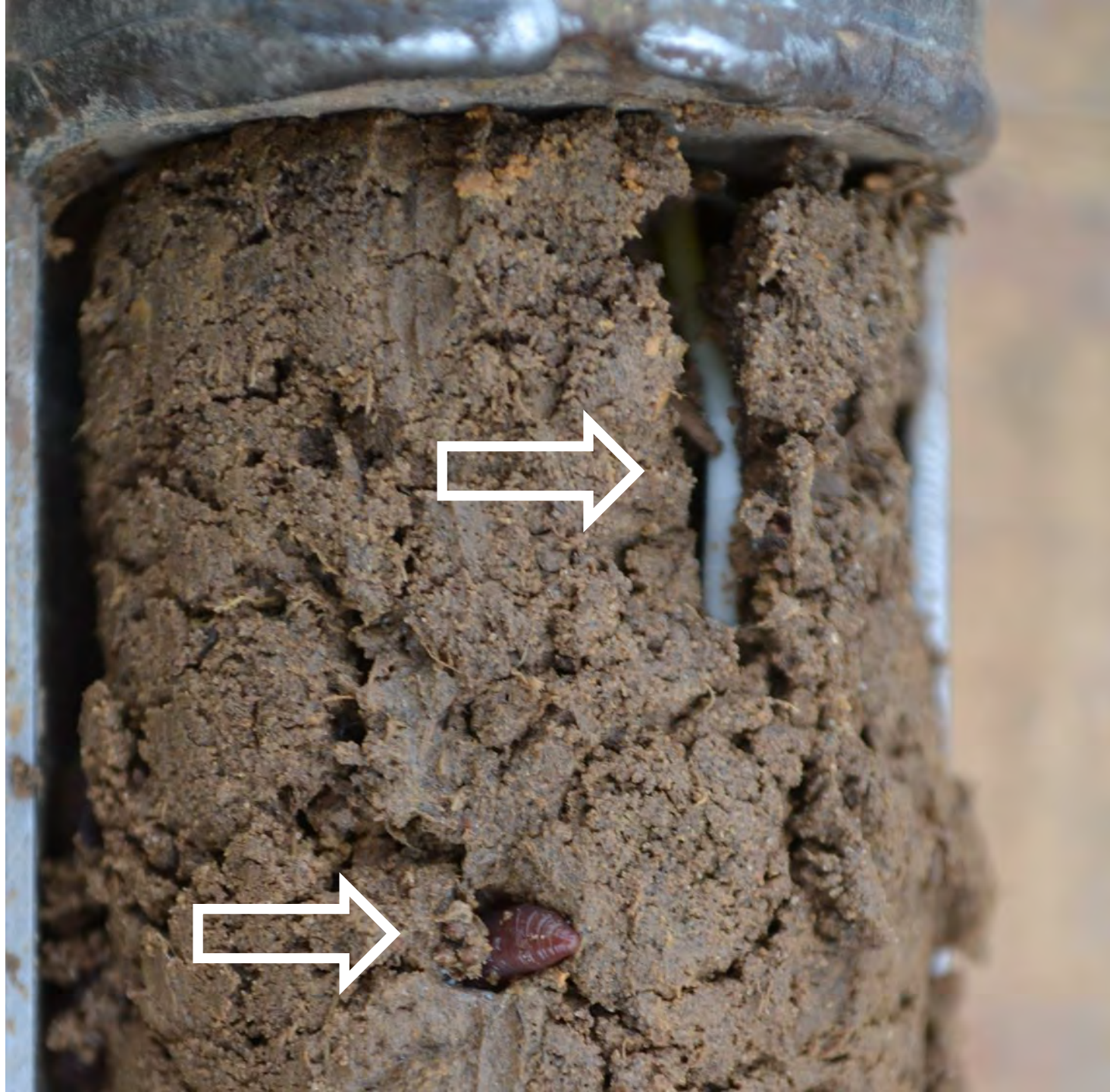
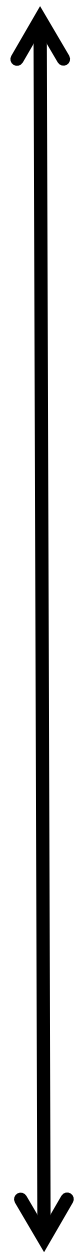
✓ Access to nutrients

Fractions of soil organic carbon





~2"



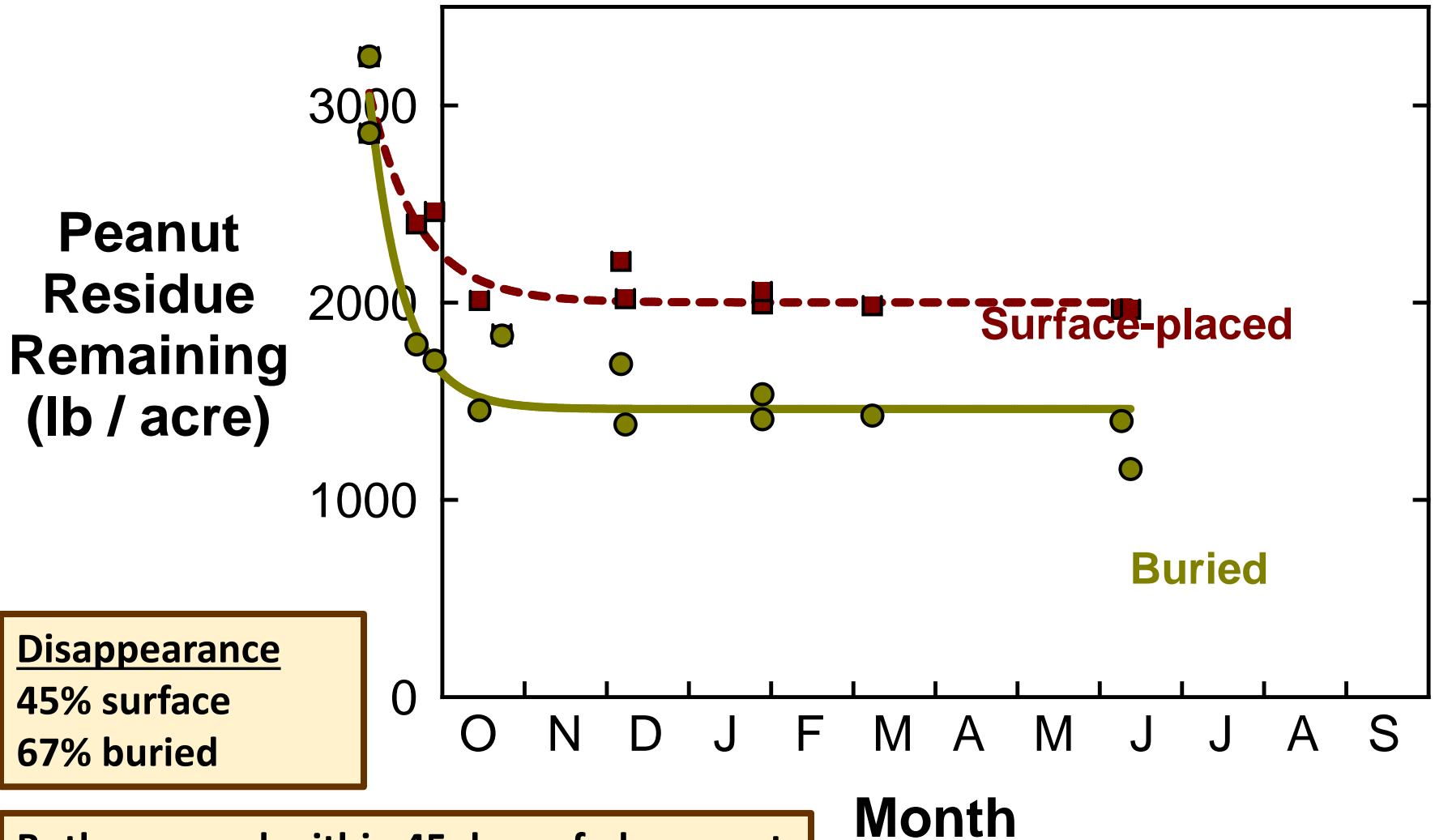


Impact of soil biology on plant residues

Fungal mats can sometimes be seen decomposing plant residues



Decomposition dynamics of peanut residue



Disappearance
45% surface
67% buried

Both occurred within 45 days of placement

Do multi-species cover crops increase soil microbial biomass and activity?

Managing Multi-Species Cover Crops in the Southeastern USA

Executive Summary of NRCS Conservation Innovation Grant #69-3A75-14-233

Partners



Natural Resources Conservation Service
Agricultural Research Service



NC FOUNDATION for
SOIL & WATER
CONSERVATION



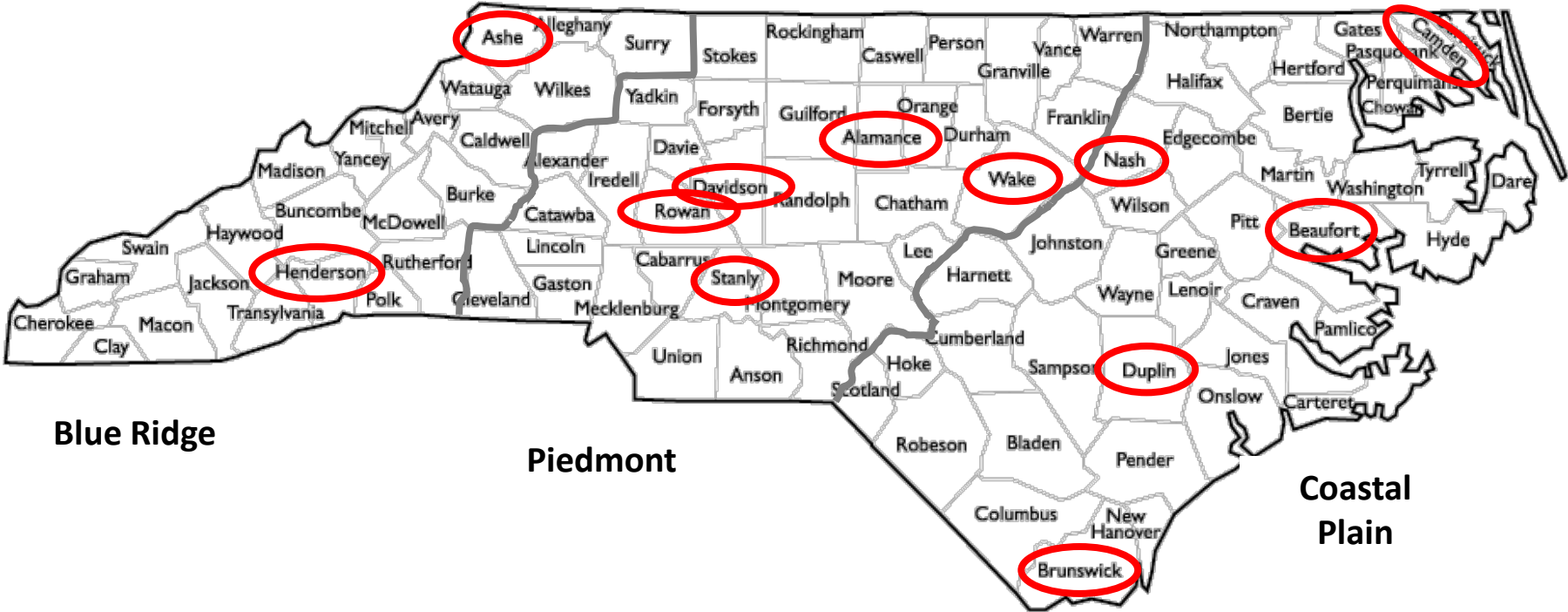
Cotton
Incorporated



Crop & Soil
Sciences



Location of on-farm trials

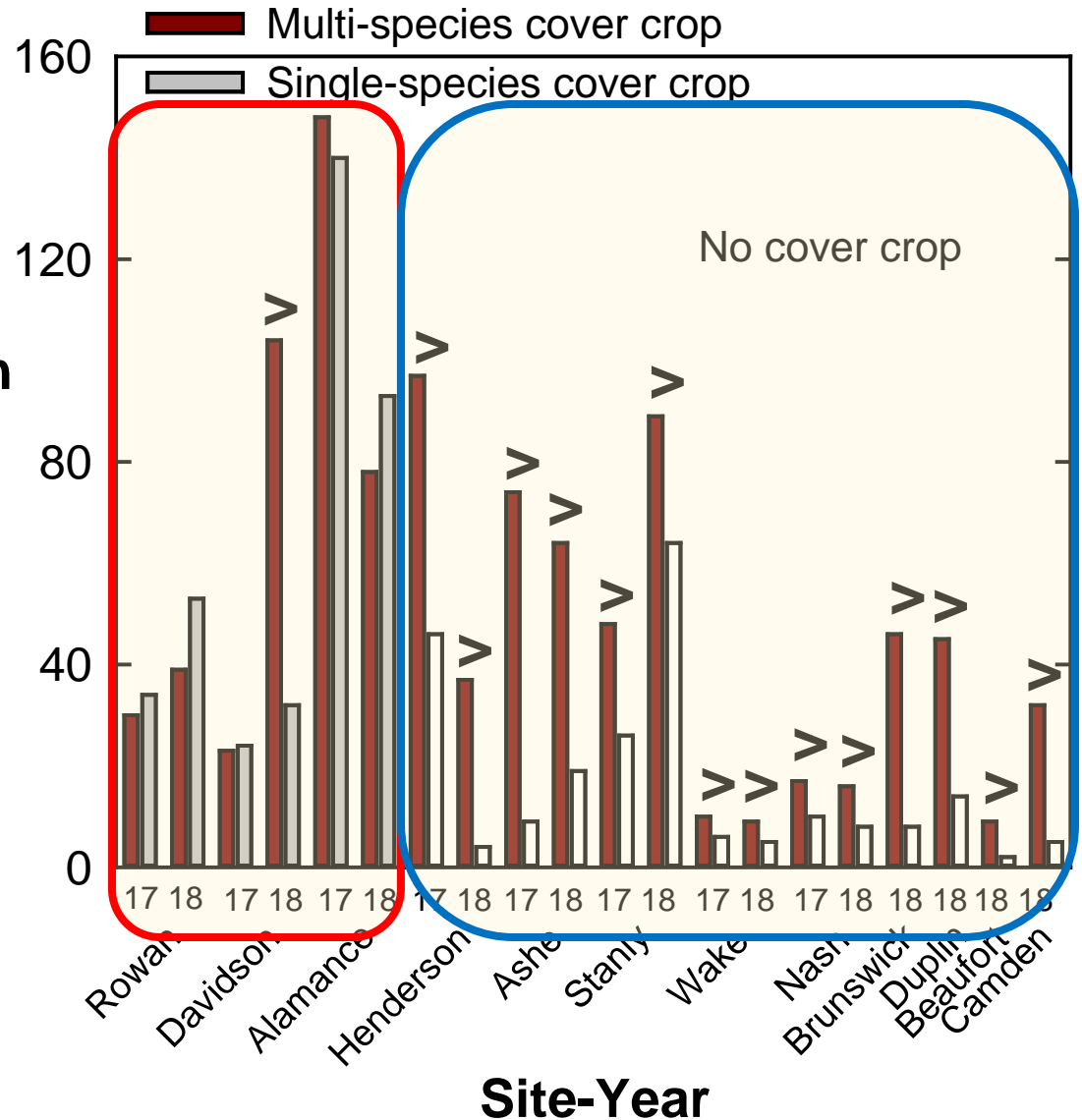


Above-ground nitrogen at cover crop termination

Trt	N	Pr > F
MSCC	70	0.59
SSCC	63	

**Cover Crop
Biomass Nitrogen
(lb N/acre)**

Trt	N	Pr > F
MSCC	42	<0.001
None	16	

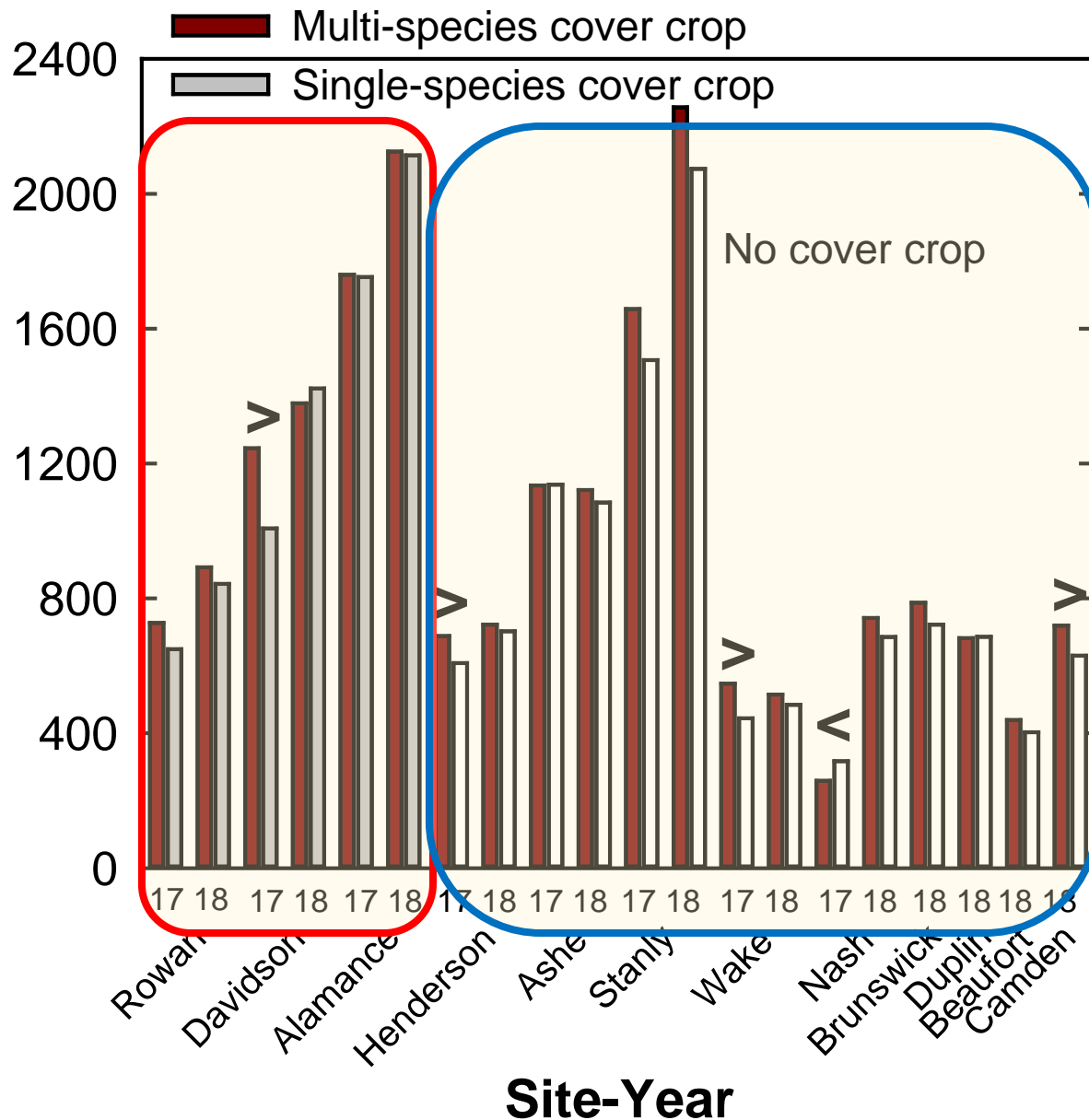


Soil response (0-5-cm depth) at cover crop termination

Trt	SMBC	Pr > F
MSCC	1355	0.22
SSCC	1298	

Soil Microbial Biomass Carbon
($\text{mg} \cdot \text{kg}^{-1}$ soil)

Trt	SMBC	Pr > F
MSCC	876	0.005
None	820	

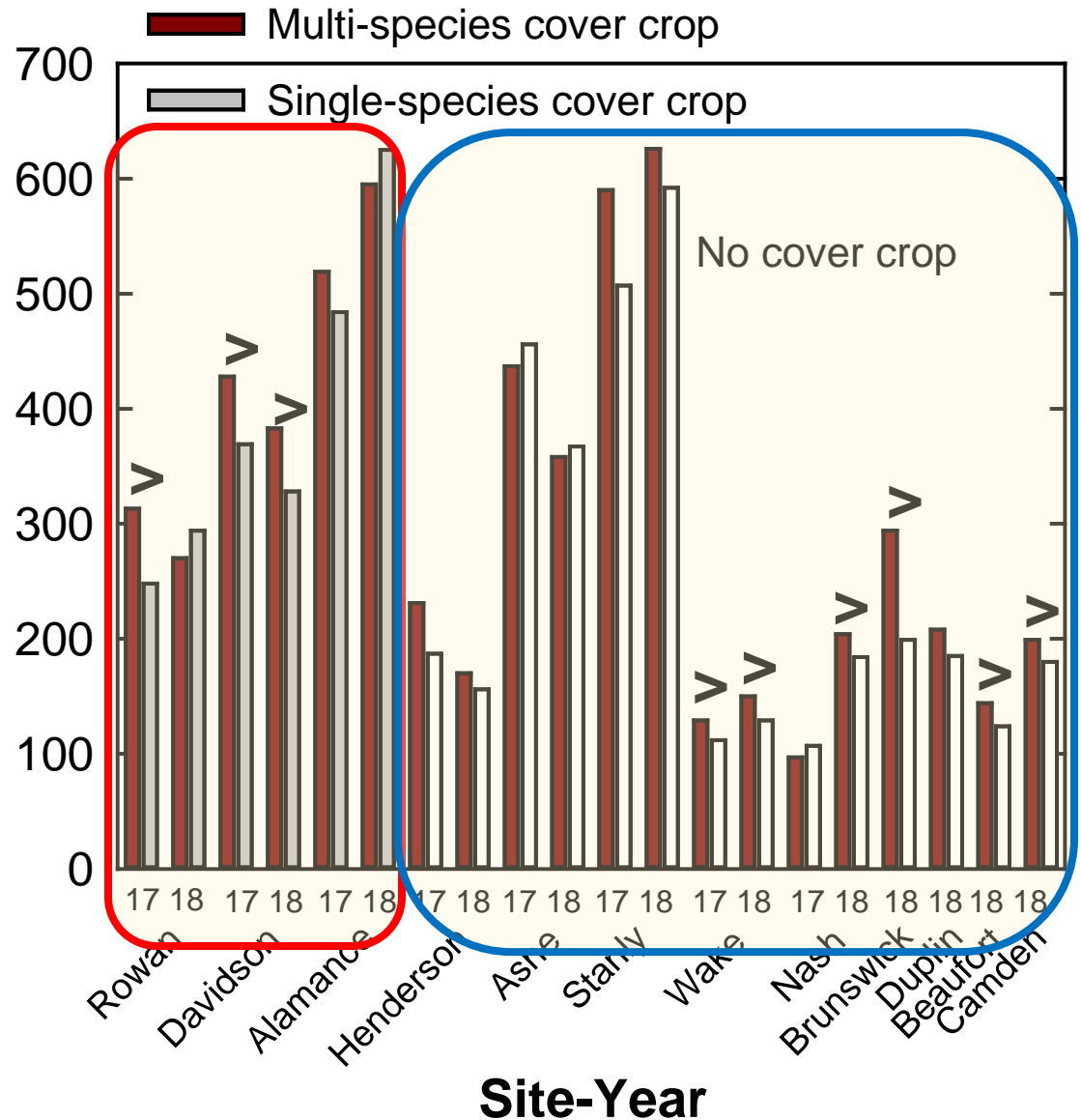


Soil response (0-5-cm depth) at cover crop termination

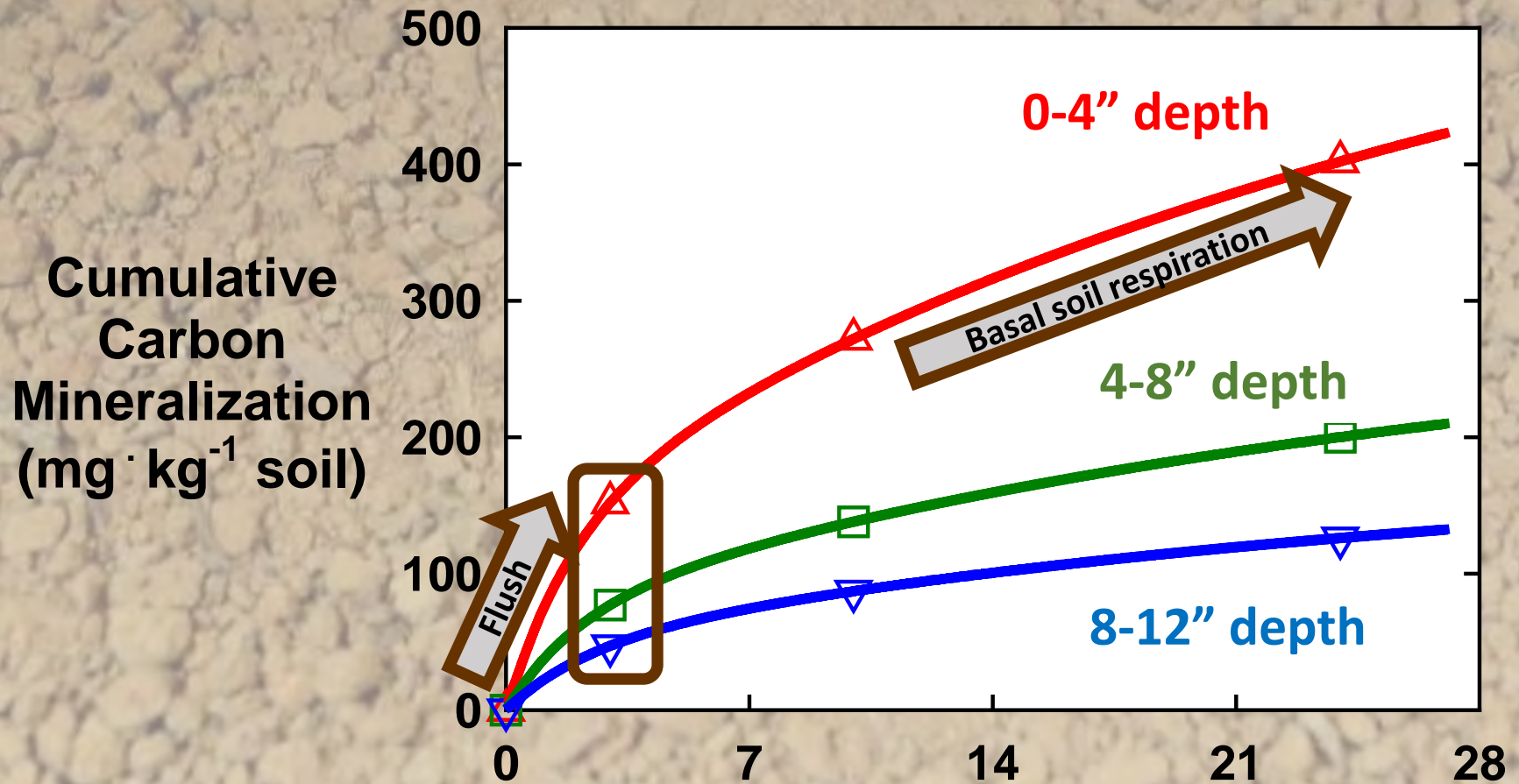
Trt	STBA	Pr > F
MSCC	418	0.19
SSCC	391	

**Soil-Test
Biological Activity
(mg CO₂-C · kg⁻¹ soil)_{0-3 d}**

Trt	STBA	Pr > F
MSCC	274	0.01
None	249	



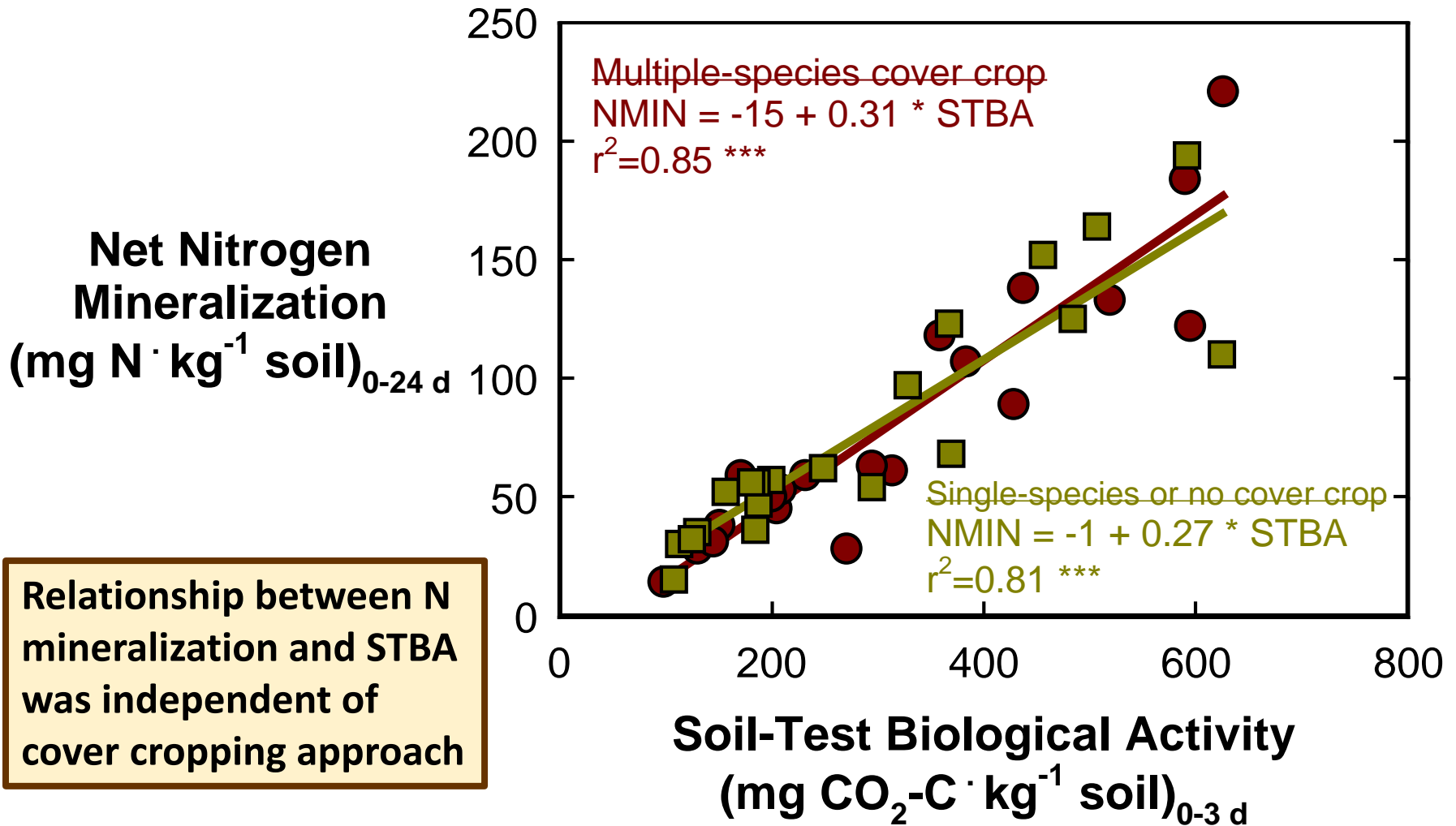
How can we practically measure soil biology on farms?



Soil-test biological activity

– aka the flush of CO_2 following rewetting of dried soil

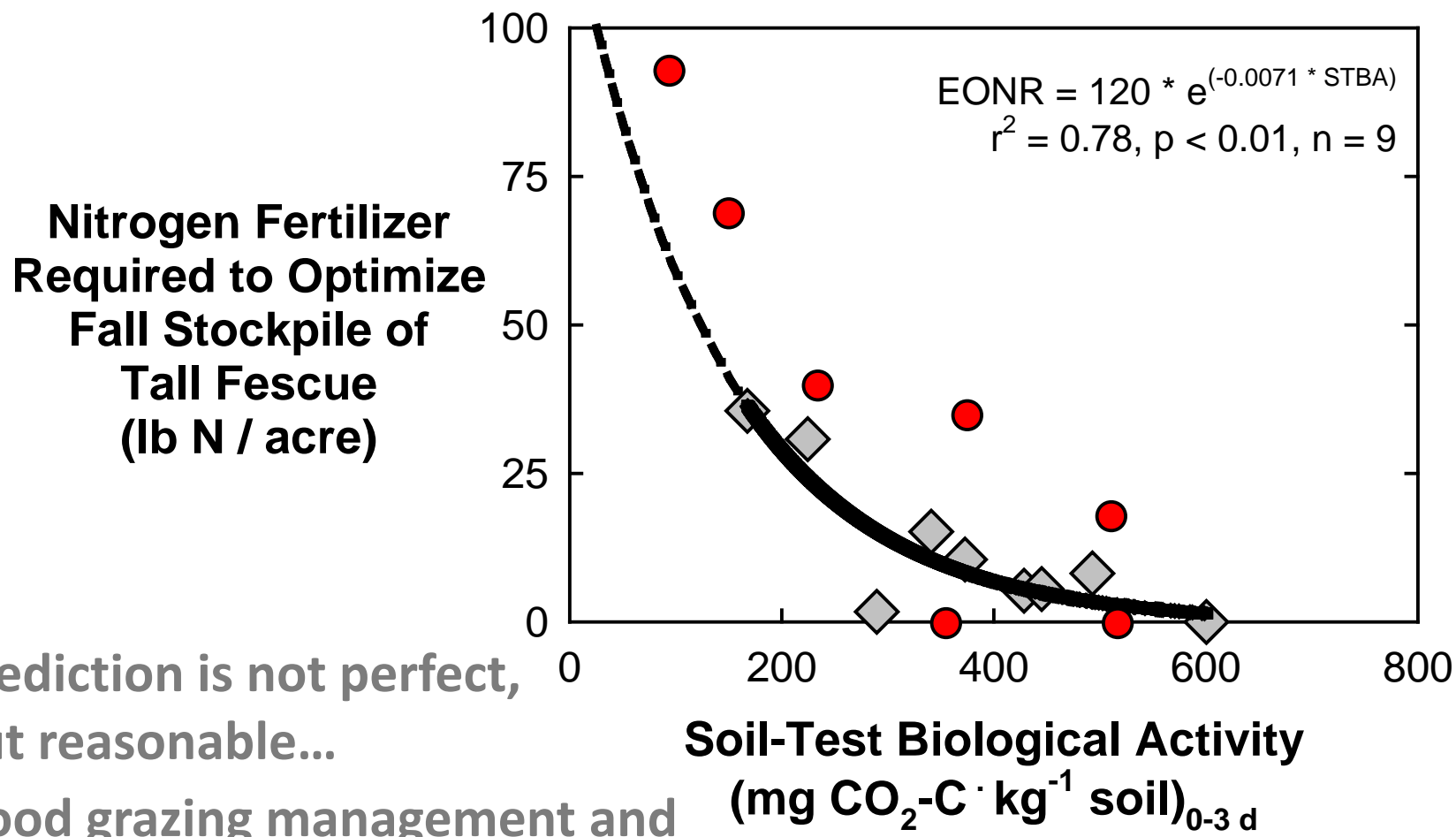
Predicting soil nitrogen availability with soil-test biological activity



Summary of corn grain yield response trials

Response	Multi-species cover crop		Single-species cover crop		No cover crop
Soil organic C (%) 0-4" depth	2.19	=	2.04	>	1.77
N mineralization (mg/kg/24d)	86	>	65	=	59
Soil-test biological activity (mg/kg/3d)	297	>	205	=	180
Maximum yield (bu/acre)	166	=	175	>	132
Relative yield (w/o sidedress N)	0.80	>	0.67	=	0.68
N factor at low CVT (lb N/bu grain)	0.88	=	0.96	<	1.42

Soil-test biological activity predicts N needs in grazing systems too...



Prediction is not perfect, but reasonable...

Good grazing management and building soil health fit together!

Summary

- ✓ **Soil-test biological activity effectively indicates greater N supply with long-term improvement in biologically active soil organic matter**
- ✓ **Soil microbial biomass and activity may be enhanced with multi-species cover crops, but any cover is better than no cover**
- ✓ **Nutrients are released slowly with decomposition of plant residues**
- ✓ **Cover crop roots and residues are important to fuel soil microbes**