

Weed Management and Soil Quality Outcomes of Non-Chemical Weed Control Tactics



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Consumer demand for local and organic



http://i.ndtvimg.com/i/2015-10/organic_625x350_61446119613.jpg

- Organic producers sold \$6.2 billion in 2015, up from \$5.5 billion in 2014 (USDA-NASS 2016).
- Number of farmer's markets increased 180% between 2006 and 2014 (USDA-ERS 2015).
- Direct to Consumer farm sales increased 32% between 2002 and 2007 (USDA-ERS 2015).

National Organic Standards Board - Organic Agriculture is:

“A production system that responds to site-specific conditions by integrating cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity.” (USDA Code of Federal Regulations 2016)

“Organic crop producers build soil quality via inputs” (USDA Introduction to Organic Practices 2015)

Indices of Soil Quality

Physical

Aggregation, bulk density/compaction, and water holding capacity/infiltrability.

Chemical

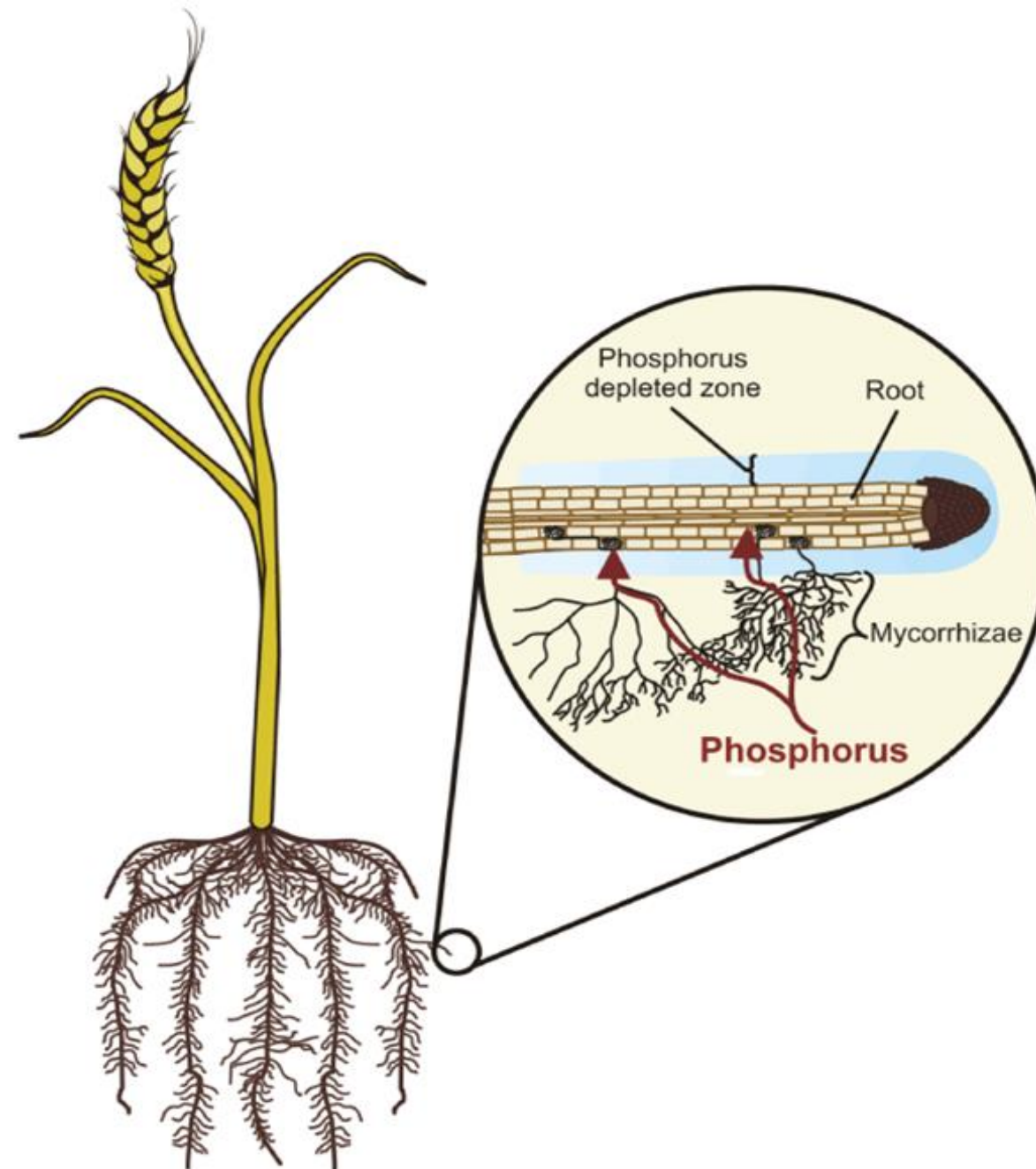
Carbon pools, cation exchange capacity, nutrients, and electrical conductivity

Biological

Macrofauna (collembola, earthworms, etc.)

Microfauna (bacteria, fungi)

Arbuscular Mycorrhizal Fungi (AMF)



Crop/AMF symbioses

AMF/soil aggregates

Tillage vs AMF

AMF inoculant?

Weed management in organic:



Weed management is a primary concern to organic producers (Sooby et al. 2007).

Tillage is often the primary means of managing weeds.

Goals of project:

Research relevant to small scale vegetable producers



Evaluate a deep mulch no-till system for weed management.

Determine effects on soil health indices.

Research objectives

Quantify effects of till vs deep mulch no-till and AMF inoculant on:

1. Weed community/seedbank density
2. Soil aggregate stability
3. Active carbon
4. Soil respiration

Hypotheses

1. Deep mulch no-till will be associated with reduced weed density, and reduced weed seedbank density.
2. Deep mulch no-till and AMF inoculation will be associated with:
 - Increased aggregate stability
 - Changes in active carbon
 - Increased soil respiration

The Experiment:

Field sites:

Absaraka

Dickinson

Pea, Onion, Beet, Squash

2015-2017



Mulch and Tillage Application



AMF Application

AMF inoculant applied at time of planting for each crop species during each year.

Applied 42.5 g L⁻¹ H₂O.

Commercially Available

Species:

- *Glomus intraradices*
- *Glomus mosseae*
- *Glomus aggregatum*
- *Glomus etunicatum*

Indices of soil health

28 soil cores, at 0-15 cm depth
(5 cups) per plot

“W” pattern across plot

Cornell Soil Health Testing Lab

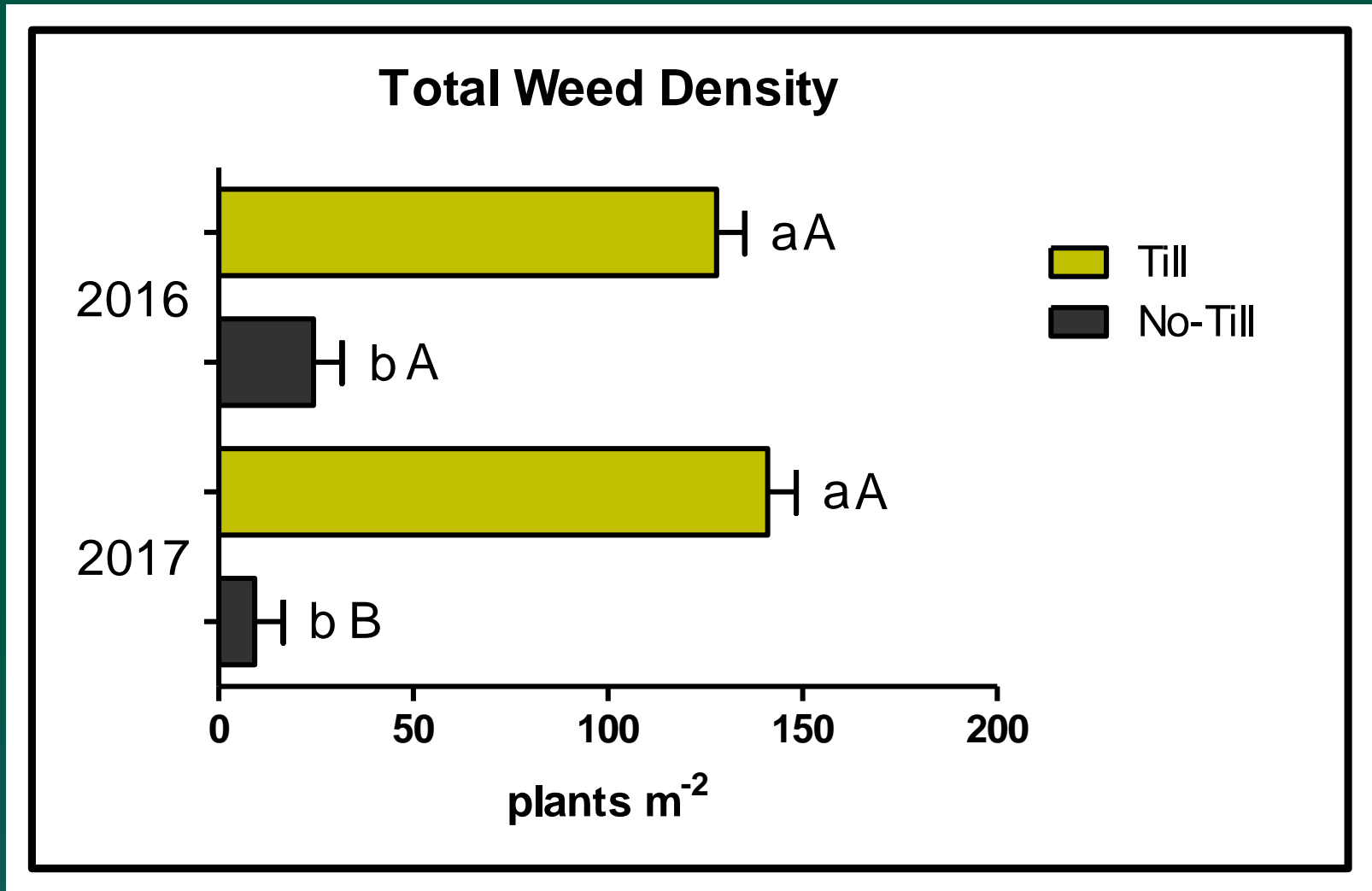
1. Wet Aggregate Stability
2. Active Carbon
3. Soil Respiration



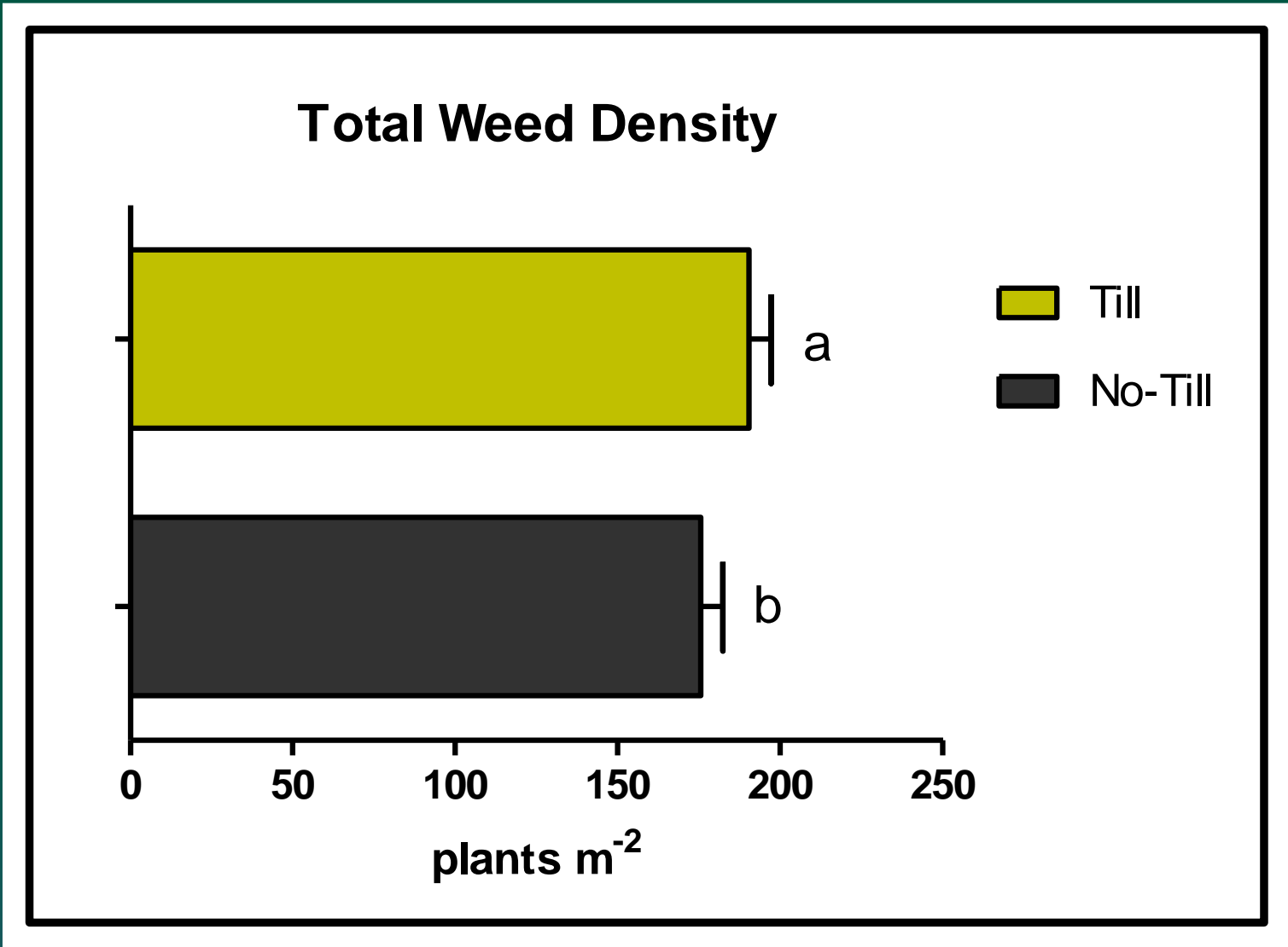
Quantified realized weed community with 3 events year⁻¹ (4, 7, and 12 weeks after planting).

Quantified seedbank
Density change over time.

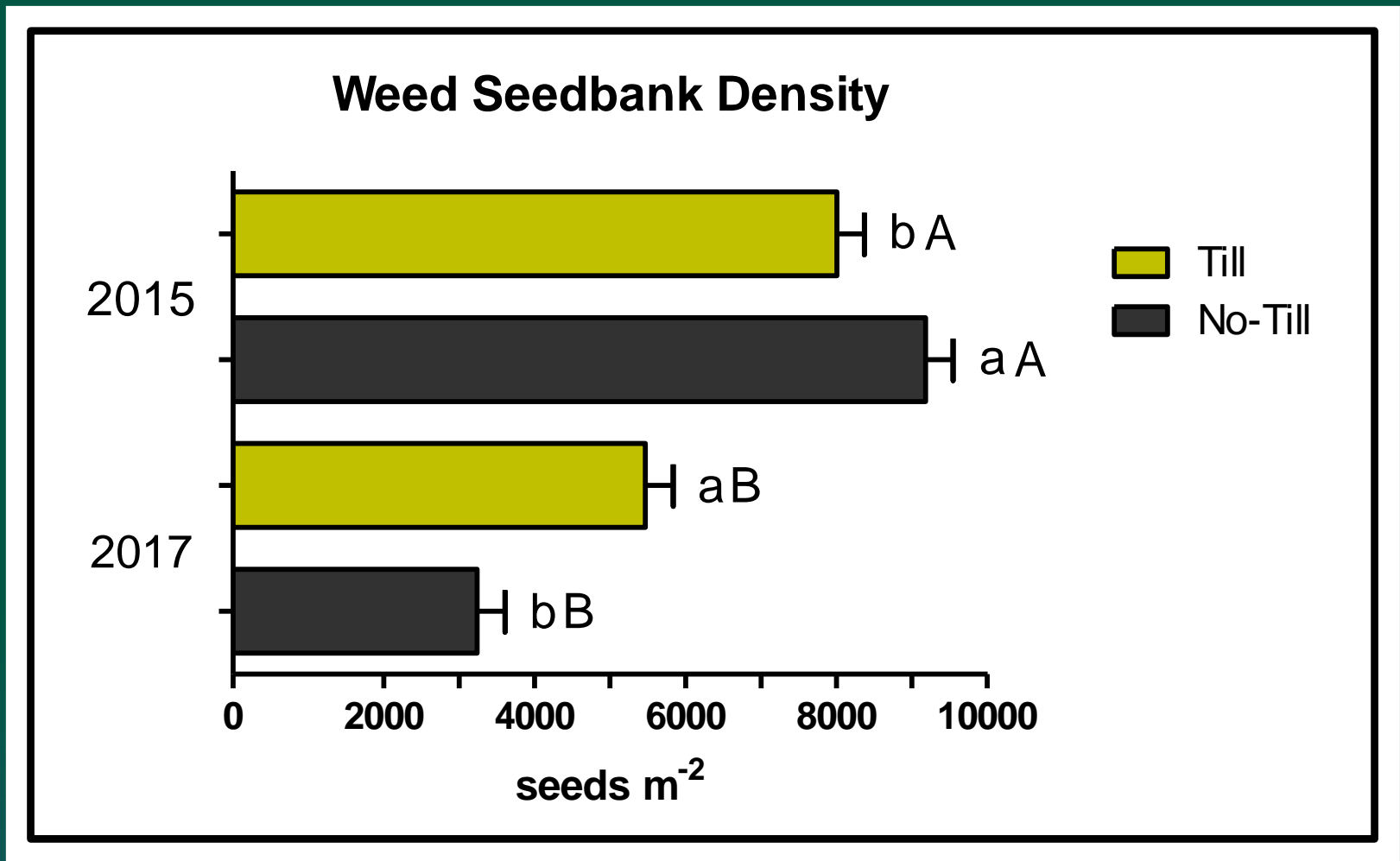




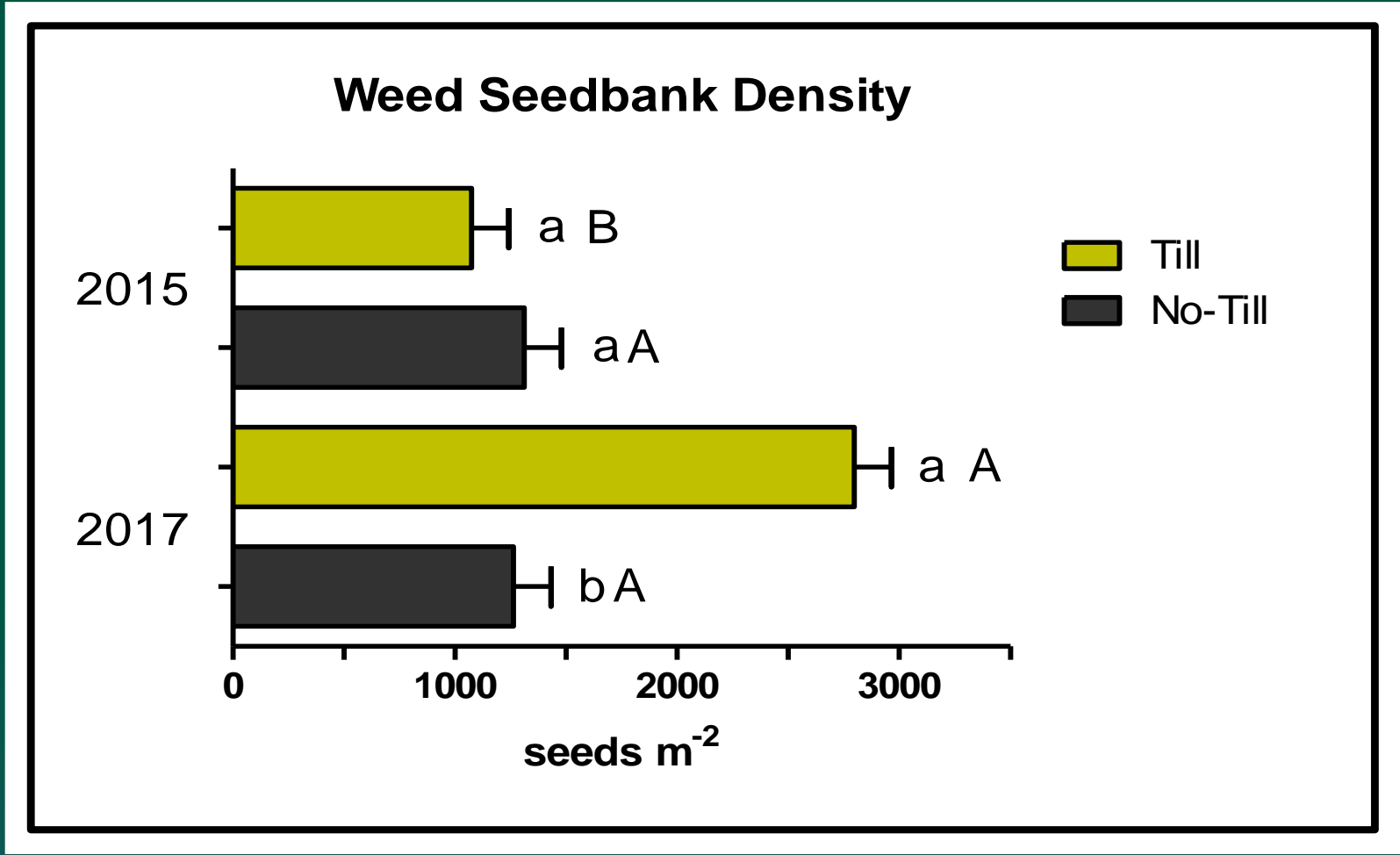
No-till treatments resulted in lower weed densities over the growing season in both 2016 and 2017.



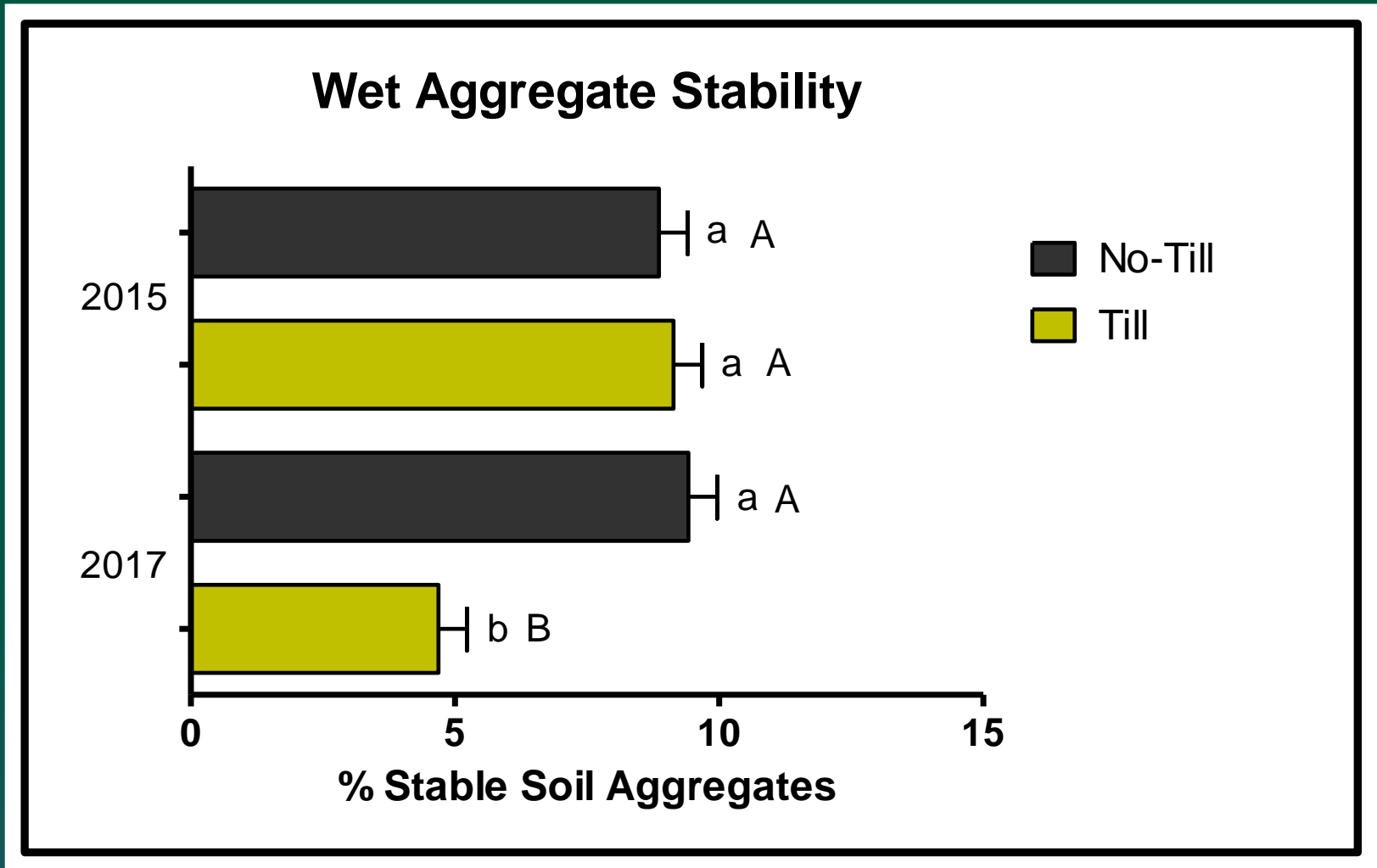
No-till plots consistently contained fewer weeds, regardless of year and entry point.



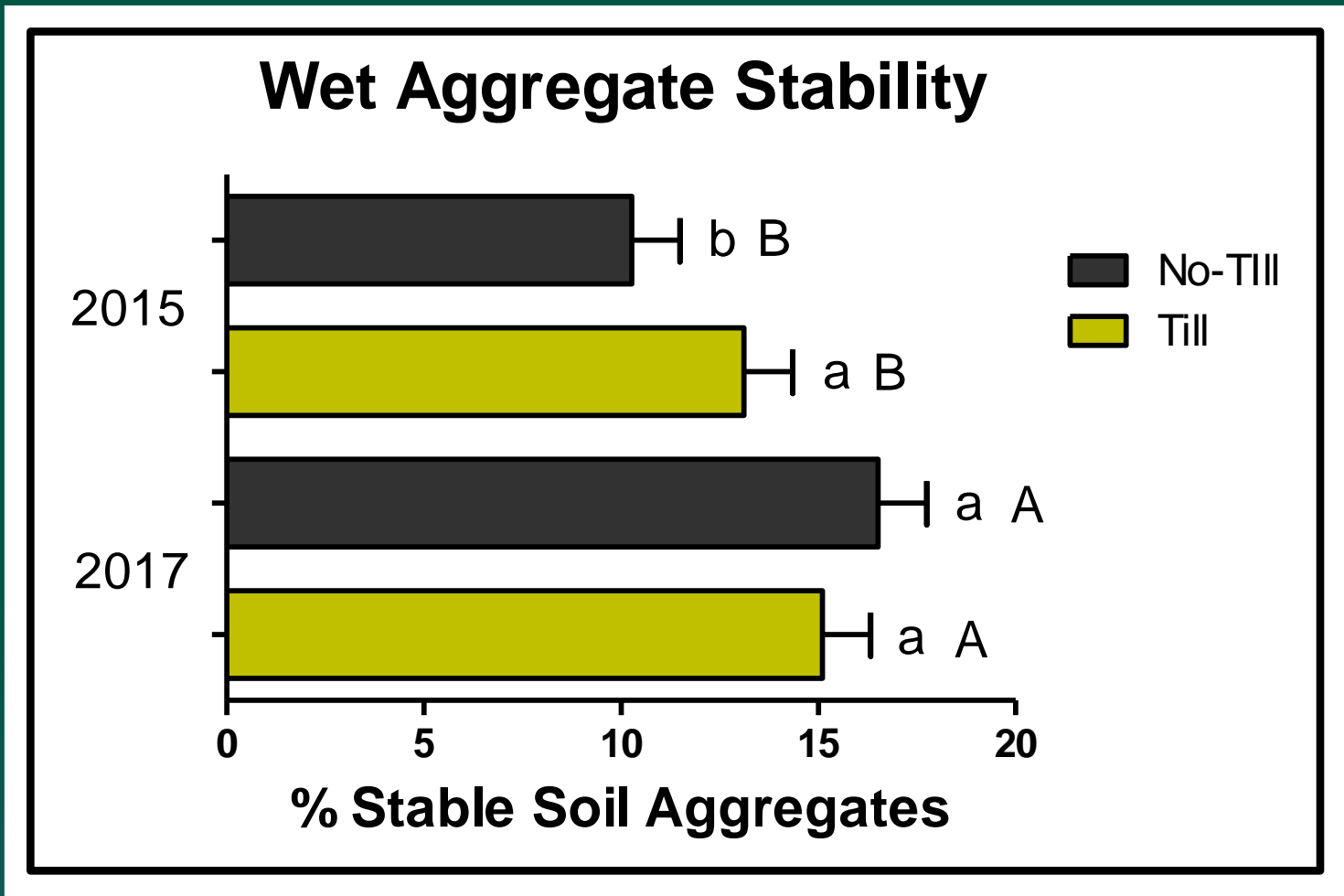
For both treatments, seedbanks declined between 2015 and 2017, due to management. However, seedbank reduction was more pronounced in No-Till.



No-Till weed seedbank density did not change over time, however, Till treatments increased weed seedbank density in 2017.

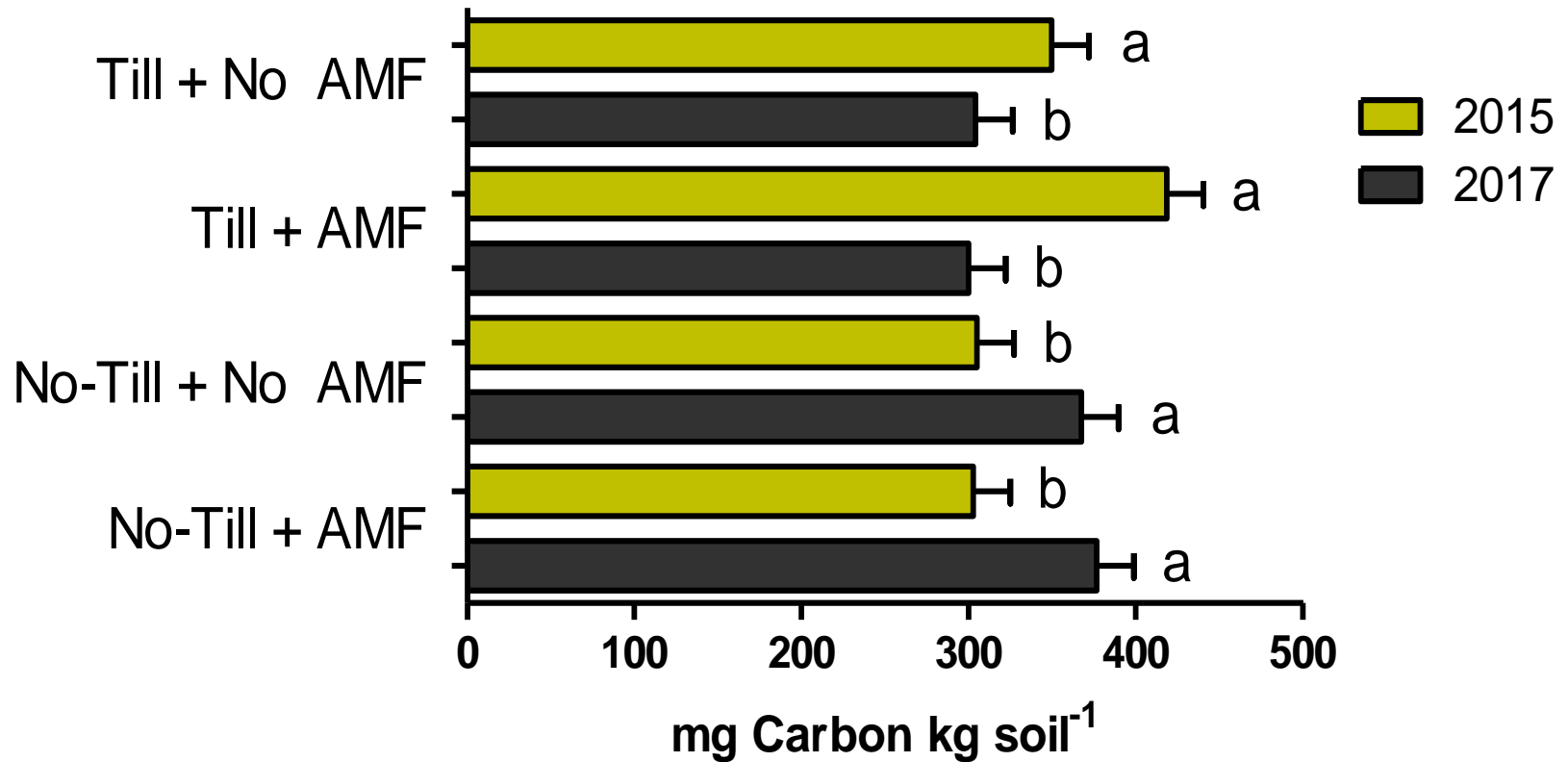


Wet aggregate stability greater in no-till plots than in tilled in 2017

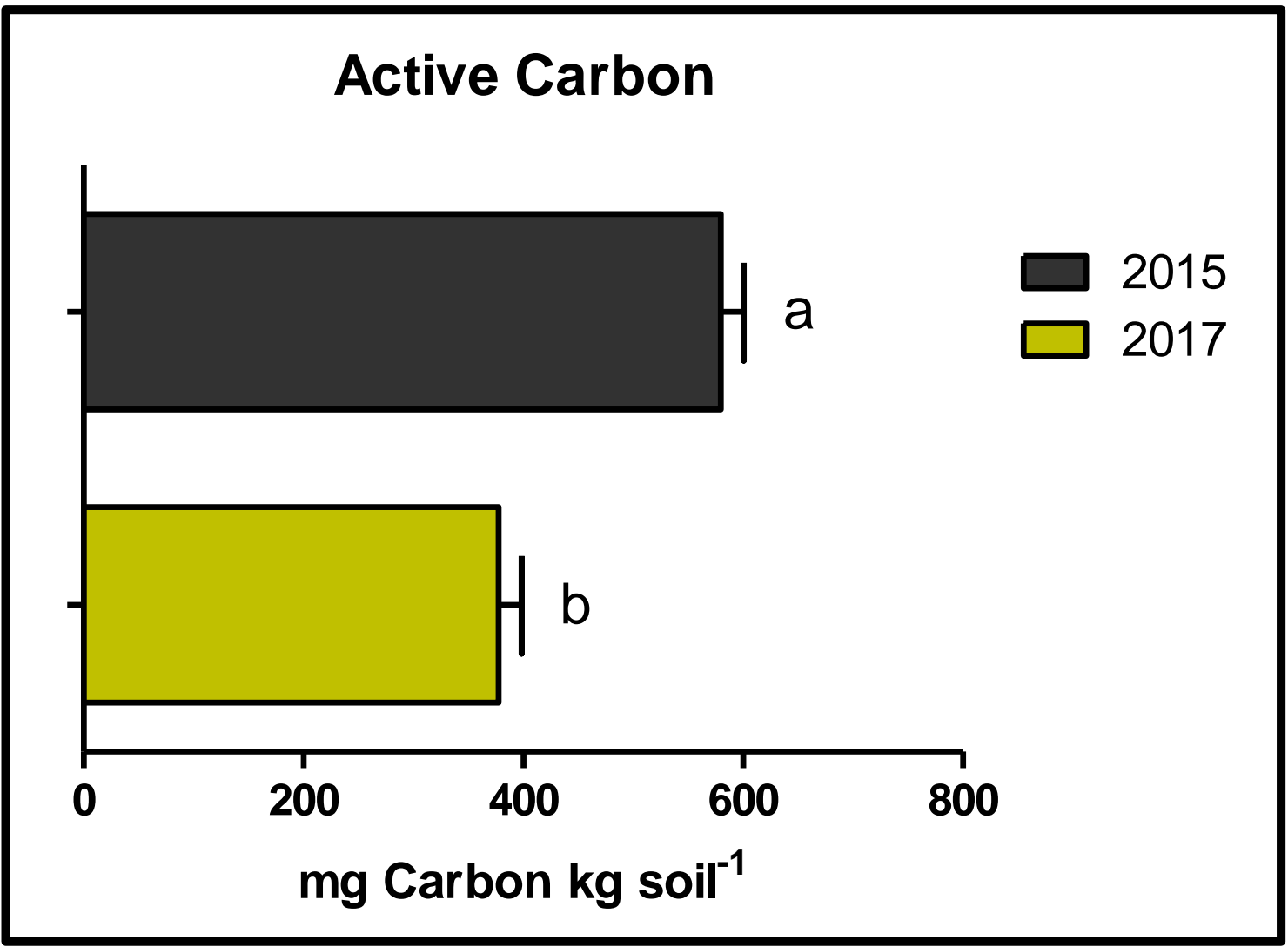


Aggregate stability increased over time regardless of tillage system, but the effect was more pronounced for no-till plots.

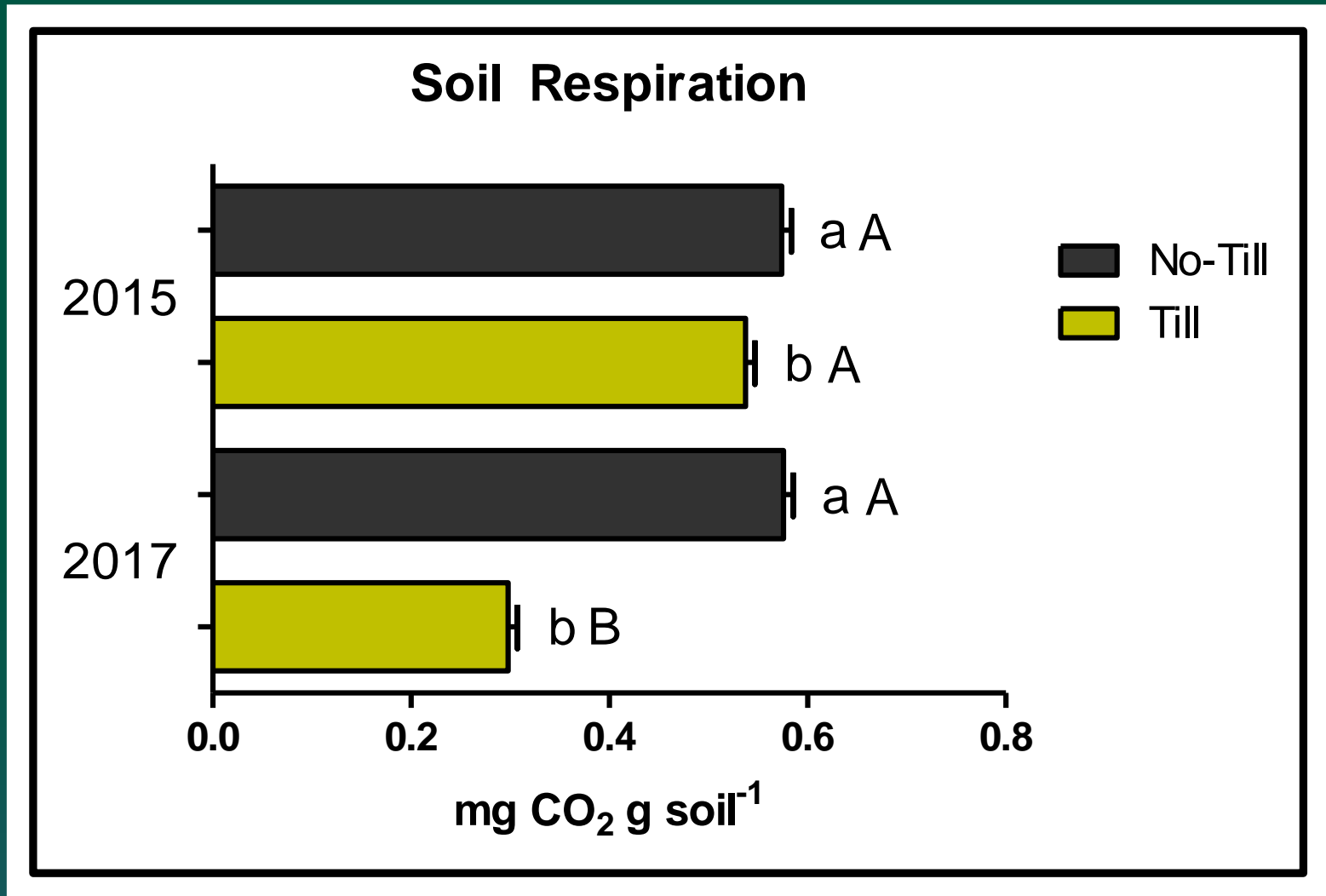
Active Carbon



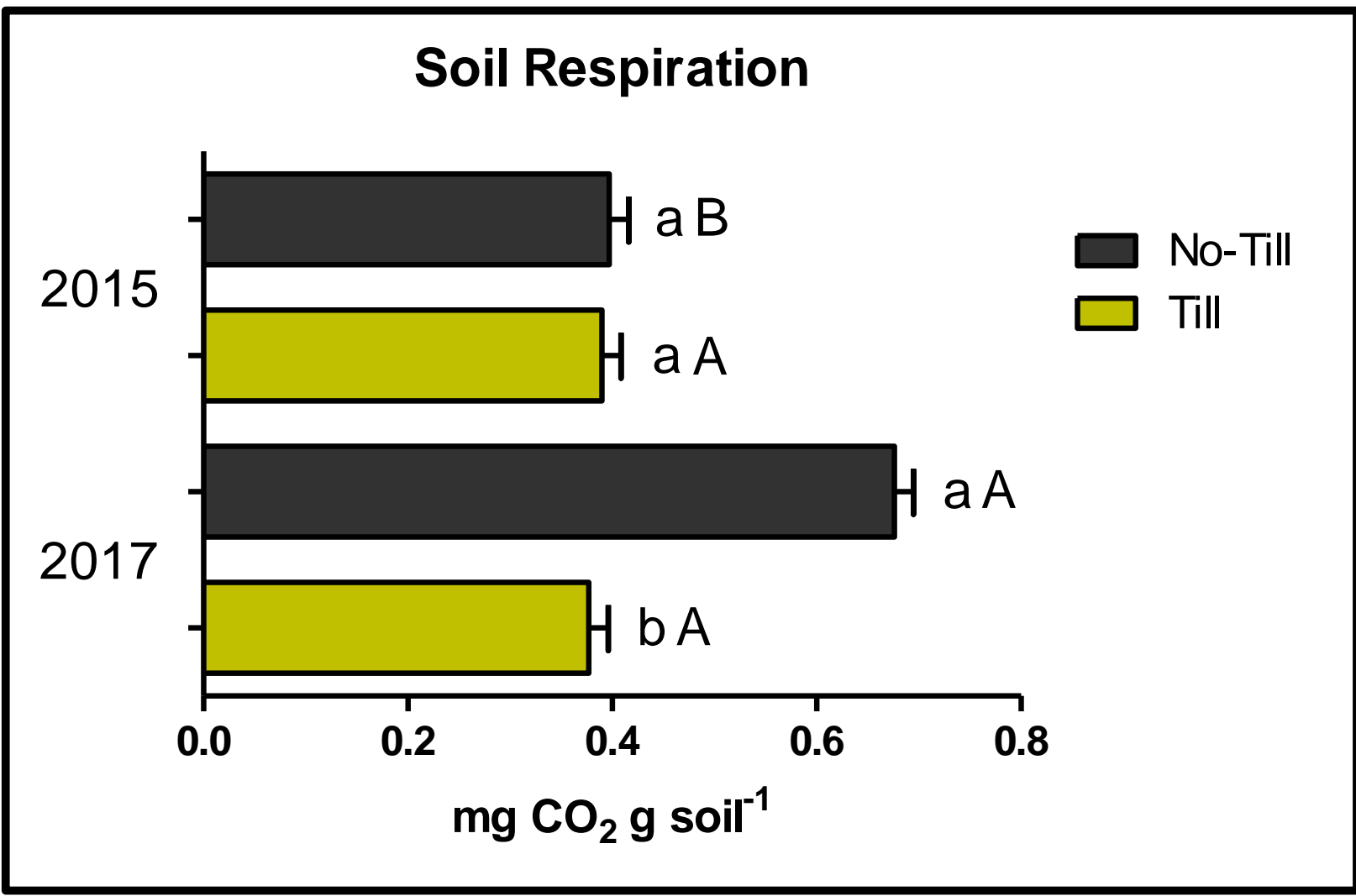
No-till treatment resulted in greater active carbon, regardless of AMF.



Active carbon declined over time regardless of other treatments.



No-till treatment had greater respiration than Till, especially in 2017.



Respiration increased over time for No-till treatment.

Additional results



No-Till increased yield and quality for all four crops.

Early analysis of AMF inoculant report no difference of root colonization %.

Acknowledgments:

The Ceres Trust



North Dakota Department of Agriculture
Specialty Crop Block Grant

Special Thanks to NDSU Committee Members:

Dr. Greta Gramig

Dr. Aaron Daigh

Dr. Laura Aldrich-Wolfe

Dr. Jose Franco

Dr. Richard Horsley



Questions?