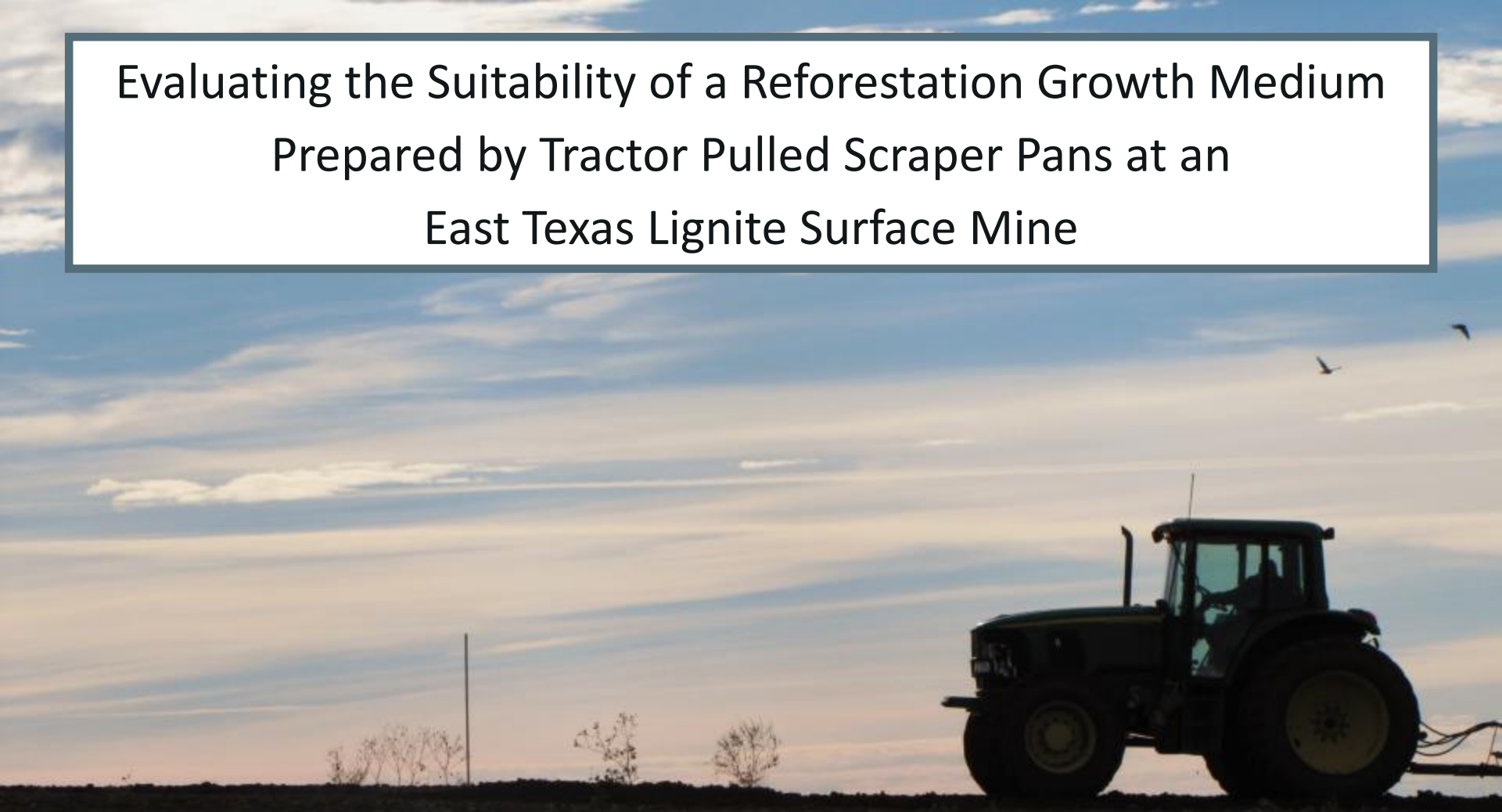
Evaluating the Suitability of a Reforestation Growth Medium Prepared by Tractor Pulled Scraper Pans at an East Texas Lignite Surface Mine



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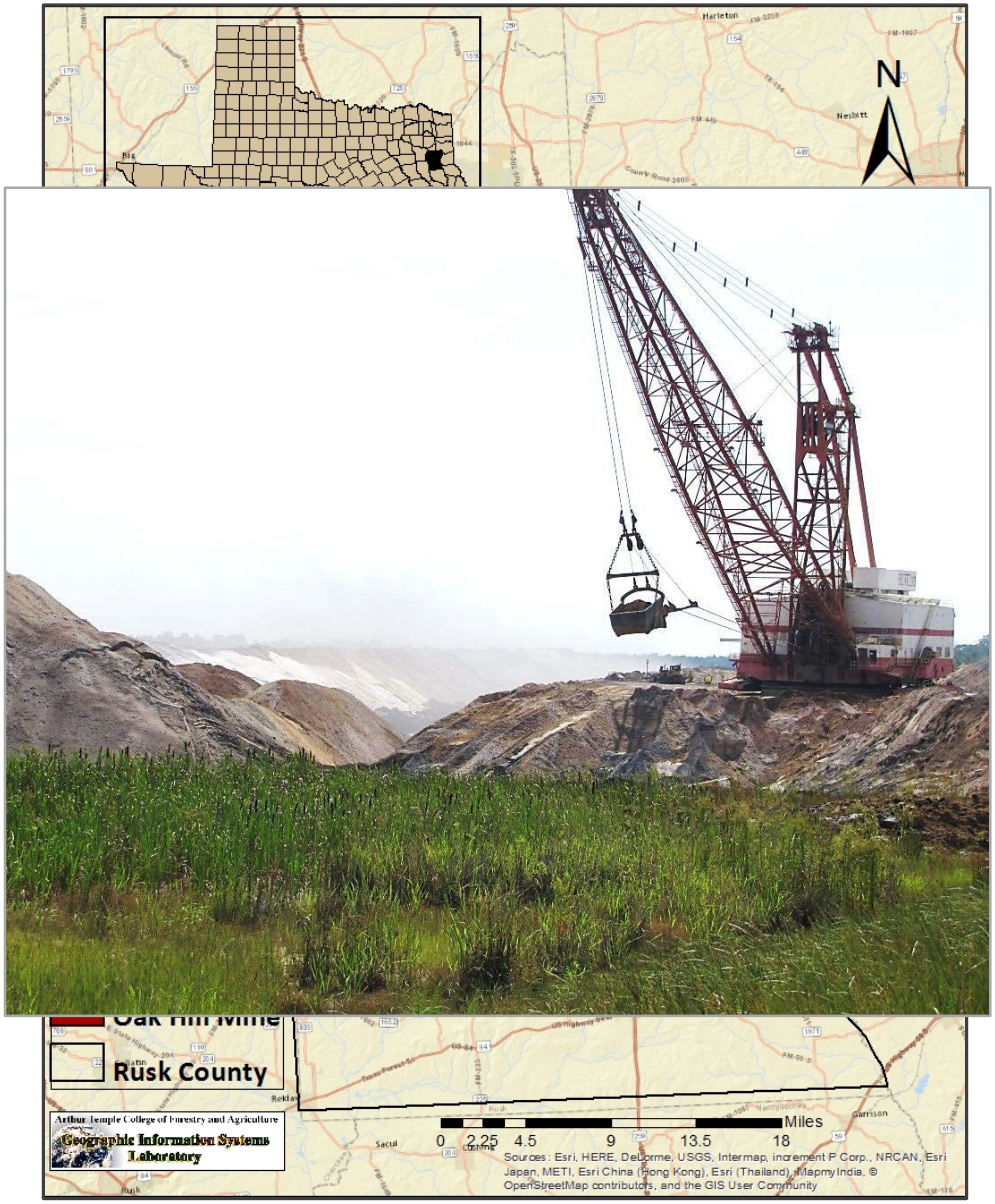
American Society of Mining and Reclamation

Spokane, Washington

June 8, 2016

Research Location

- Luminant Oak Hill Mine
  - 10,000 ha
  - Martin Lake Power Plant
- Area Mining Method
  - Dragline Operation
- Reclamation Approach
  - Oxidized Material Haulback



Oxidized Material Haulback Methodologies

Truck-Shovel Combination

Tractor Pulled Scraper Pans

Literature Overview

- Productivity levels similar to unmined lands in East Texas
  (Priest et al. 2015)
- Mine soil compaction indicated
  (Yao & Wilding 1994; Barth & Hossner 2000)
- Alleviating mine soil compaction increases tree growth
  (Burger & Evans 2010; Powers et al. 1999)

Oak Hill Mine Reforestation

Research Questions

- What is the impact of the truck-shovel and scraper pan methodologies on mine soil properties?
- Can mine soil compaction be alleviated using different surface and subsurface tillage techniques?
- How do such tillage techniques influence mine soil properties and vegetative response?

Objectives

Truck-Shovel Site

1. Evaluate and compare soil physical and chemical properties between three soil depths

Scraper Pan Site

2. Evaluate and compare soil physical and chemical properties between tillage treatments at three soil depths

3. Investigate the influence of tillage treatments on herbaceous aboveground biomass and tree seedling establishment

Study Sites

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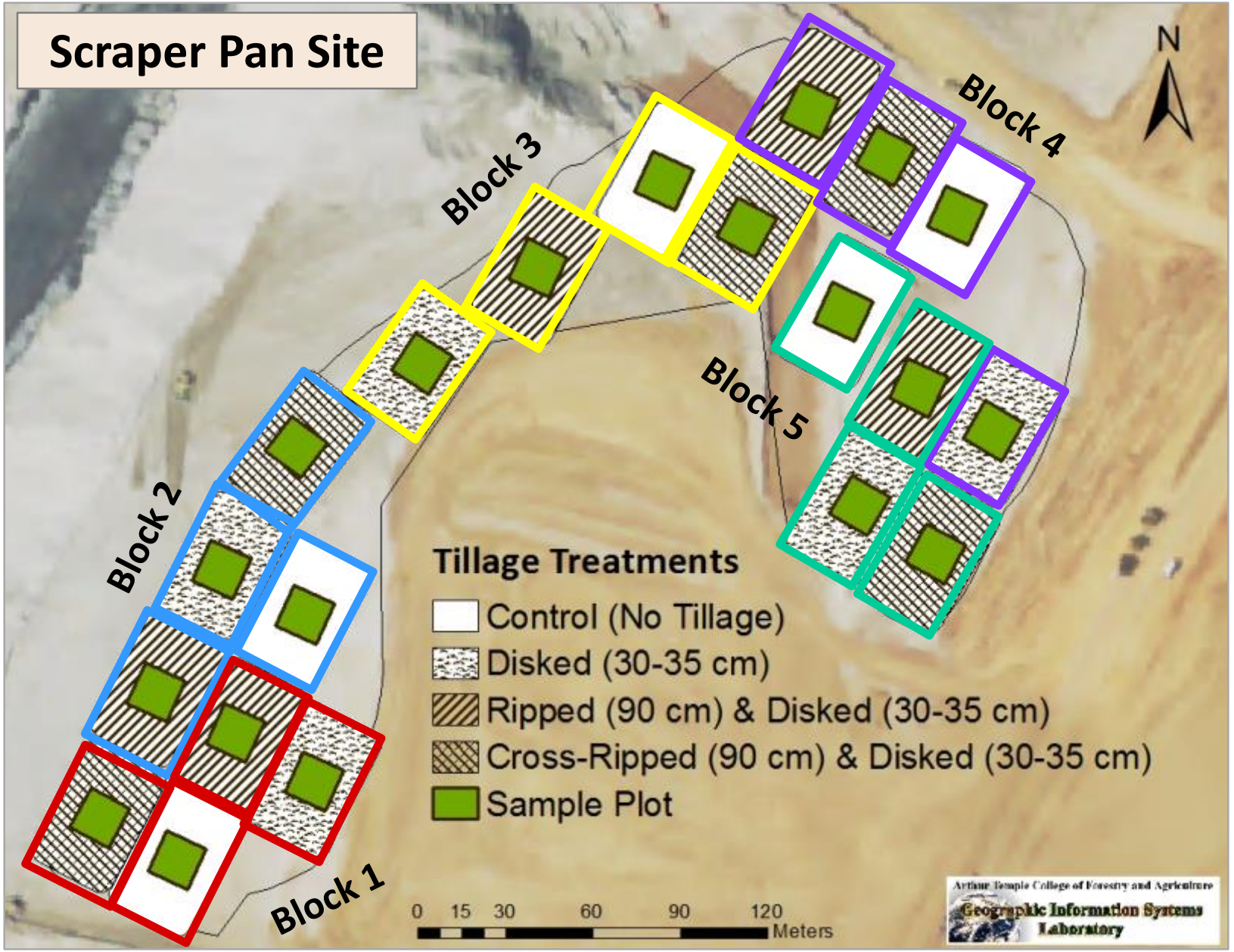
Luminant

Truck-shovel site



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Scraper pan site

Treatment Installation

Surface Tillage Treatment

control (no till) vs disking (30-35 cm depth)

Subsurface Tillage Treatment

single-ripping vs cross-ripping (90 cm depth)

Subsurface Tillage Treatment

single **or** cross-ripped + disked

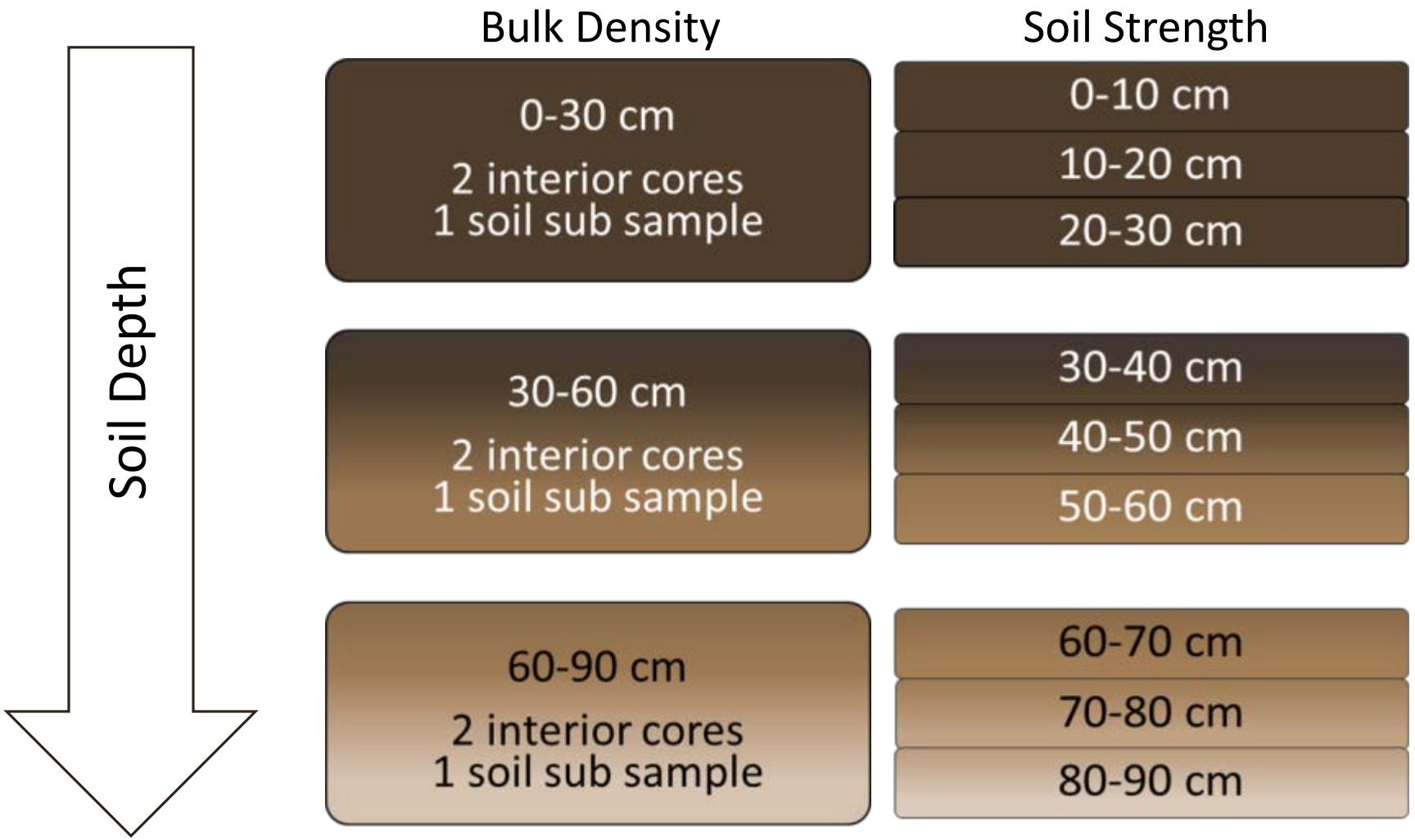
Site Preparation: November 2015

Tree Planting: January 2016

Loblolly pine (*Pinus taeda*) 1-0 bare-root seedlings at 2 x 3 m spacing

Methods of Study

Methods of Study: Soil Test Pits



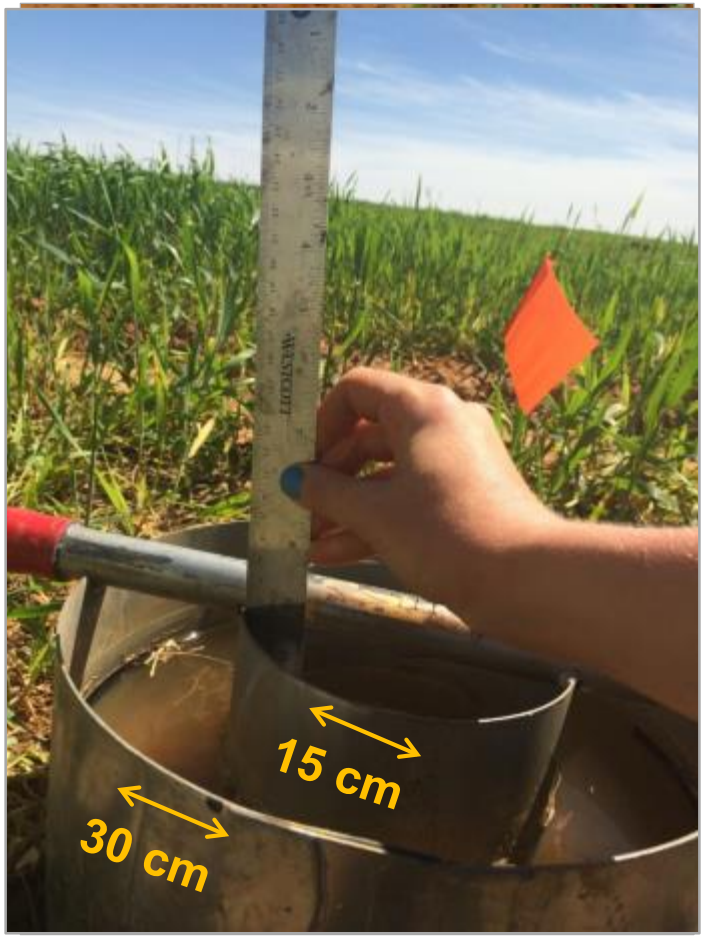
Methods of Study
Soil Physical Properties

- Soil Bulk Density (Db)
  - Slide hammer method
  - Total of 50 soil test pits
- Two Interior Db Cores
  - Water concentration
  - Total porosity
  - Particle density
  - Field capacity
  - Permanent wilting percentage

Example of Soil Test Pit

Methods of Study
Soil Physical Properties

- Soil strength
  - Hand-held electronic cone penetrometer
- Surface water concentration
  - Wet and dry limits
  - 0-30 cm depth
  - Soil auger
  - Pseudo-time domain reflectometer
- Saturated infiltration rates
  - Double-ring infiltrometer



Methods of Study

Soil Lab Analyses

- Soil composite sample
  - Soil pH
    - Glass electrode pH meter
  - Soil texture
    - Standard hydrometer method
  - Elemental concentration (C, N, Ca, Mg, K, P)
    - Inductively coupled plasma analyzing unit

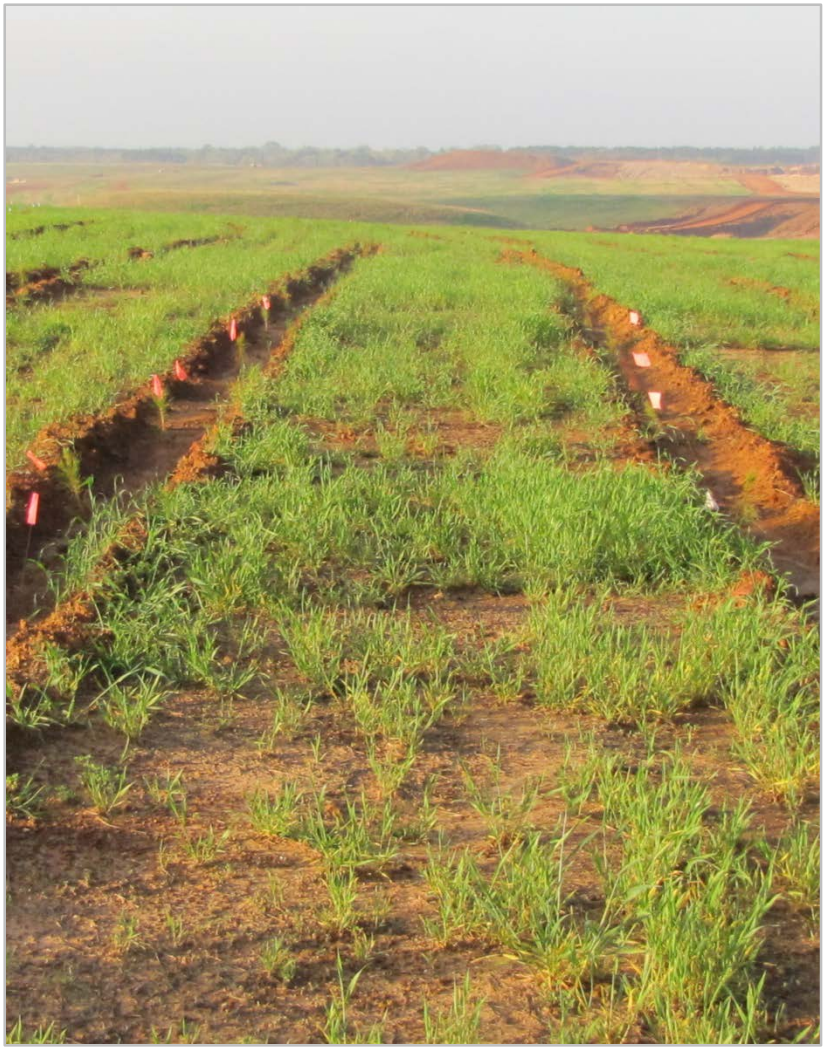
Methods of Study
Tree Seedling Response

- 40 trees per sampling plot
  - Seedling volume index
  - Ground line diameter
  - Height
- First year survival and growth
  - October 2016
- First year biomass production
  - Above and belowground
  - Regression analysis


Cross-ripped + disked
Control

Cross-ripped

Control



Methods of Study

Herbaceous Aboveground Biomass

Winter wheat
(*Triticum* spp.)

Crimson clover
(*Trifolium incarnatum*)

Methods of Study

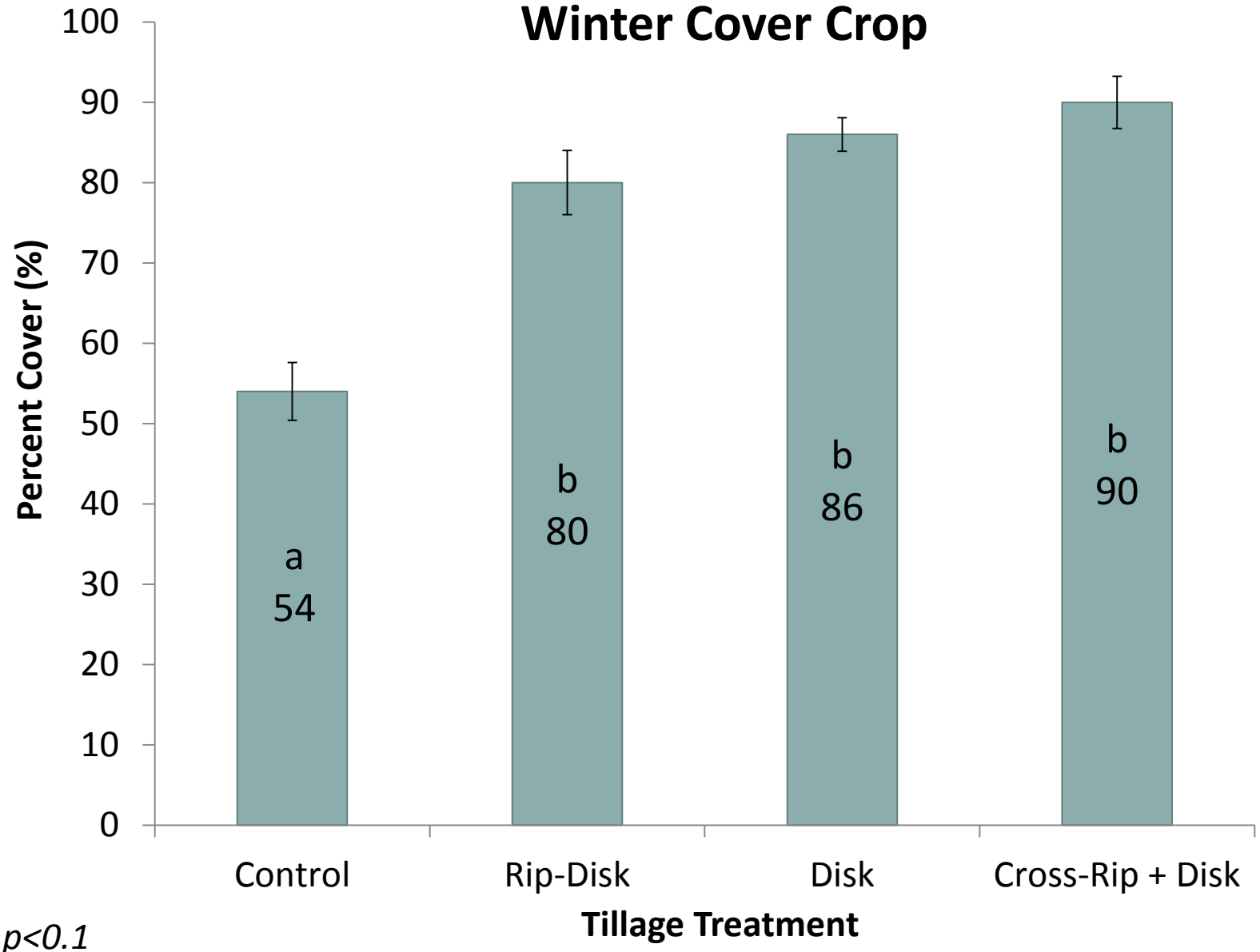
Herbaceous Aboveground Biomass

- 1 m x 1 m quadrants
  - Three per plot
- Oven dried at 60°C
- Weighed

Results

Statistical Procedure

- **Analysis of Variance**
  - SAS
  - Proc-mixed
  - Least square means test


Winter Cover Crop
Percent Cover (%)
100
90
80
70
60
50
40
30
20
10
0
a
54
b
80
b
86
b
90
Control
Rip-Disk
Disk
Cross-Rip + Disk
Tillage Treatment

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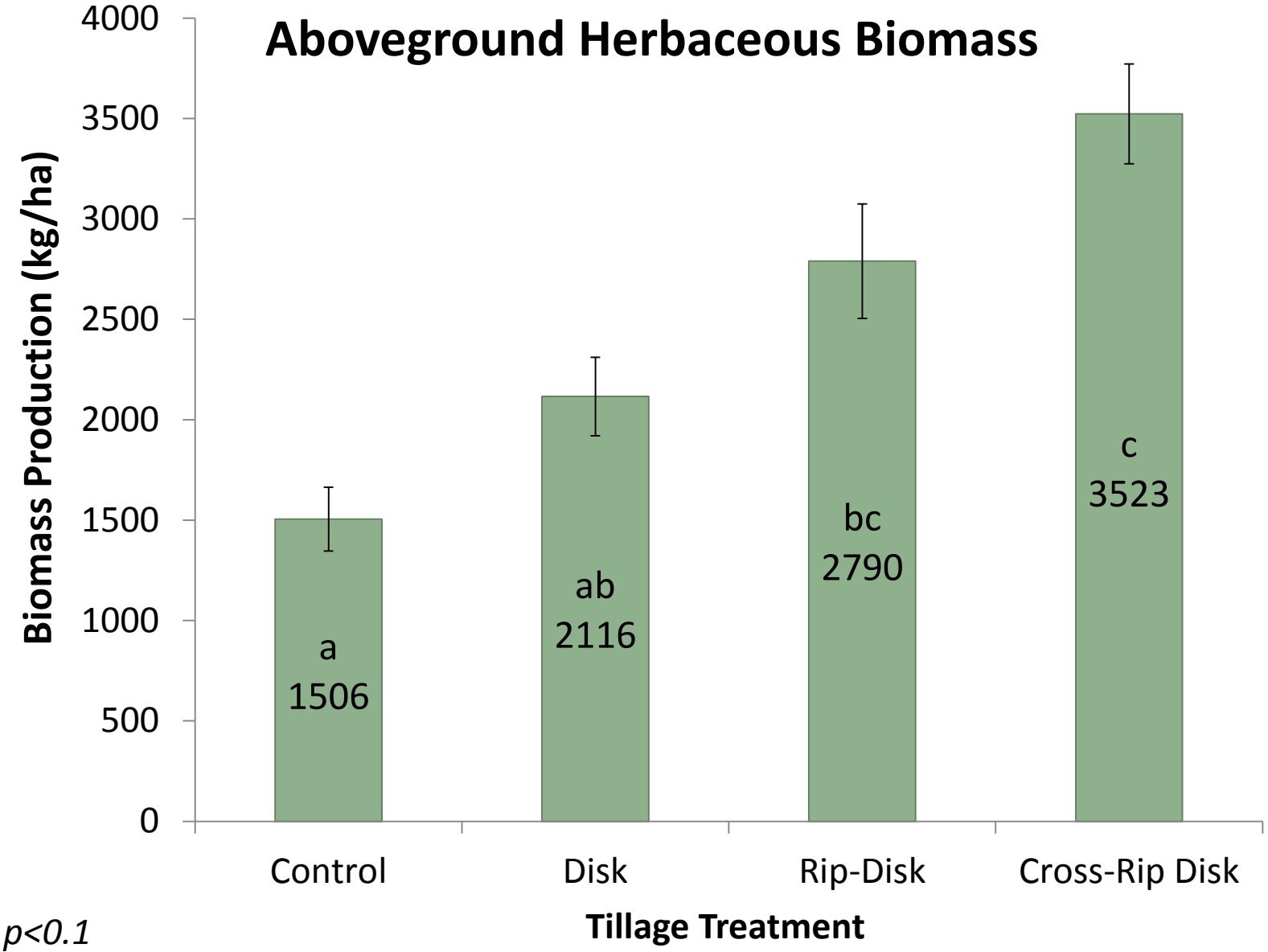

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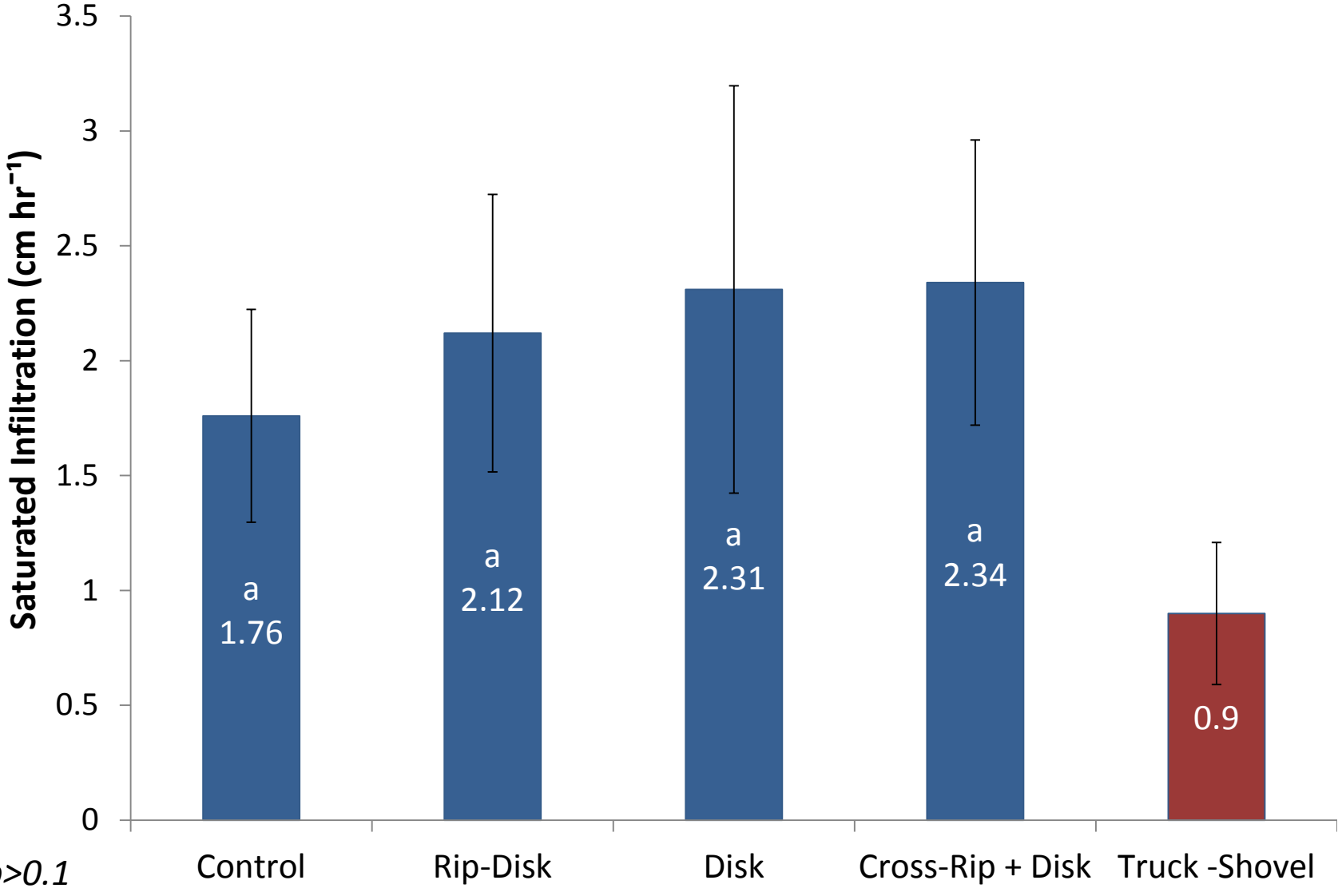
Saturated Infiltration Rates



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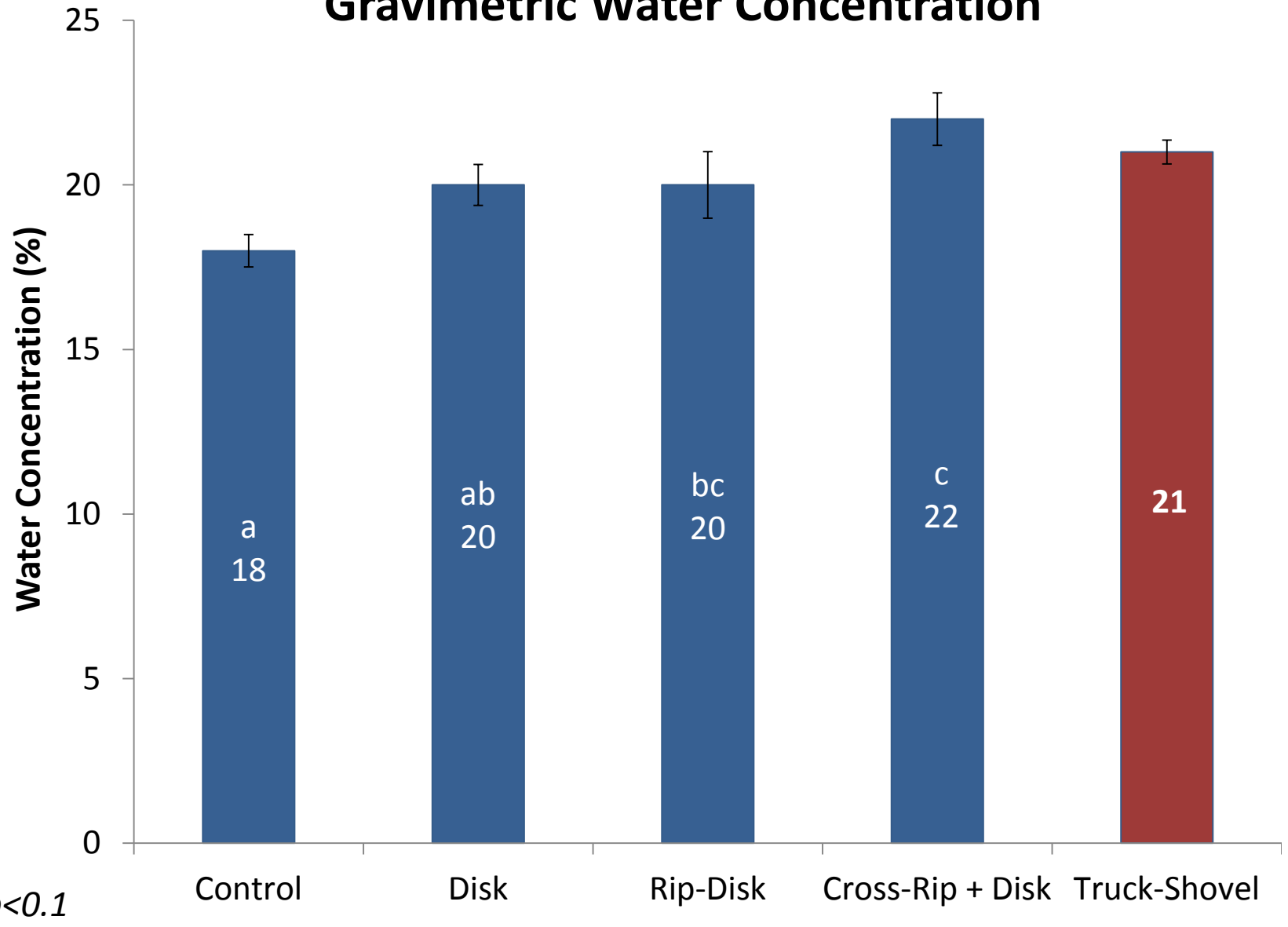
Gravimetric Water Concentration



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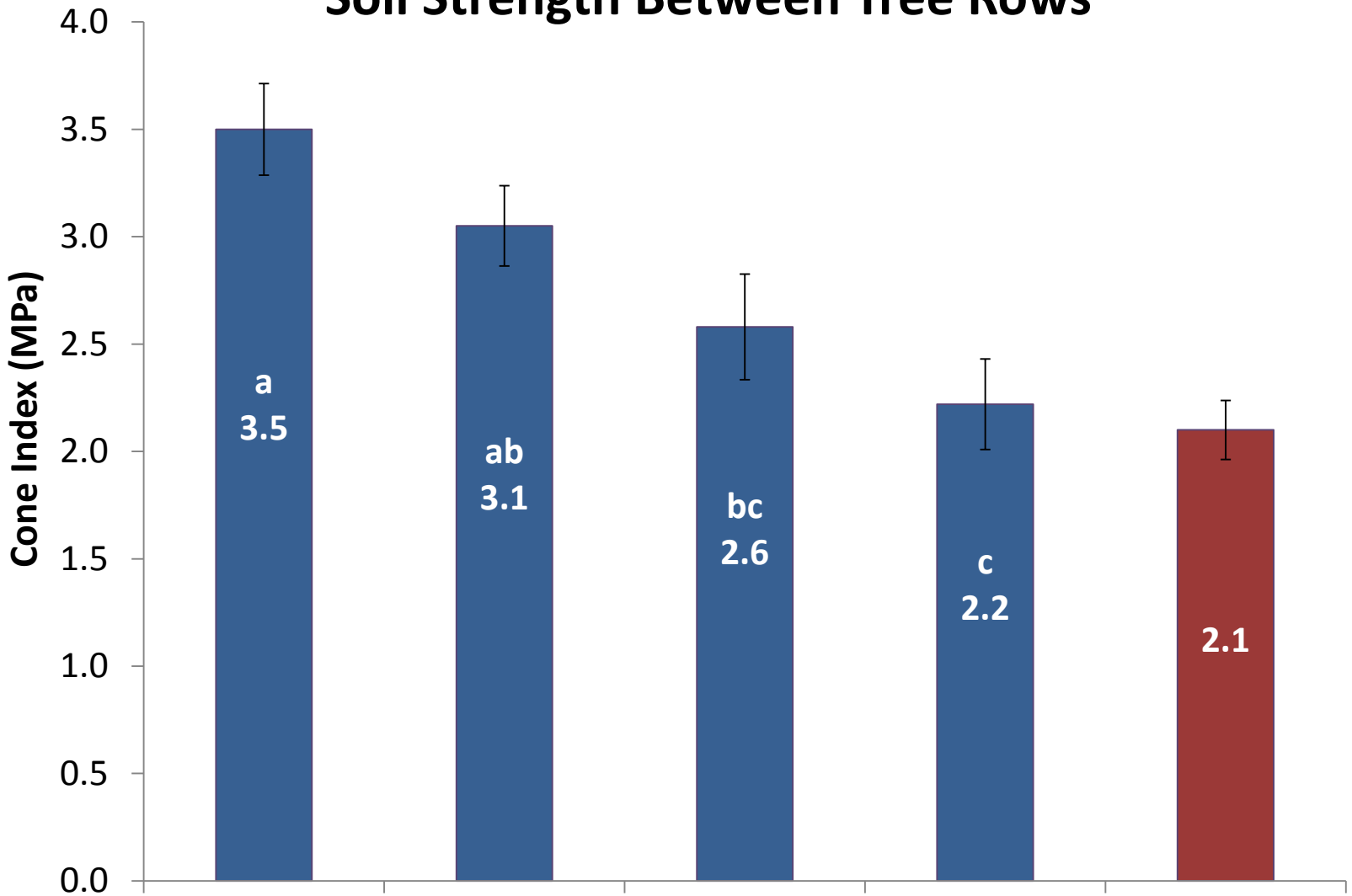
Soil Strength Between Tree Rows



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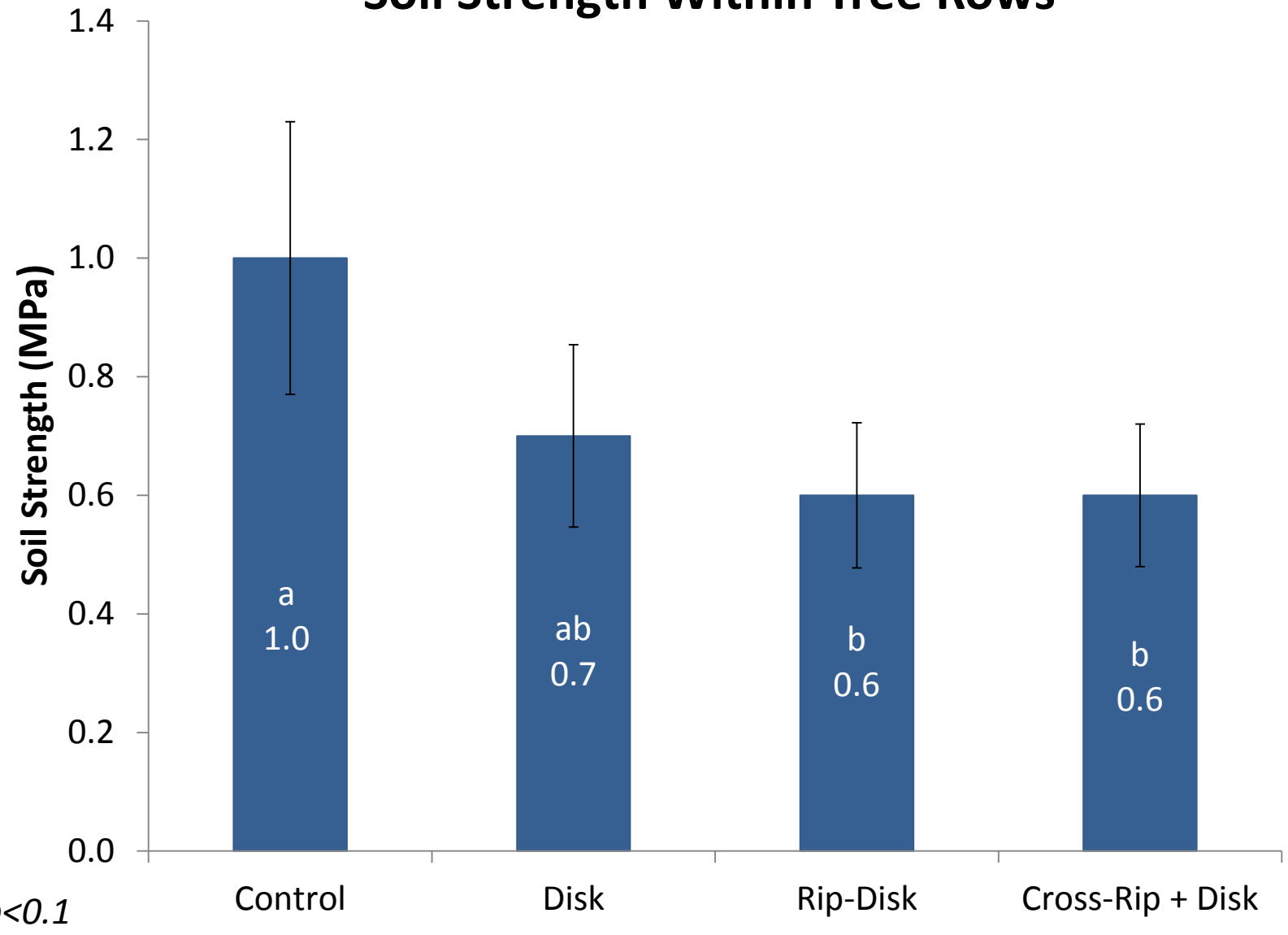
Soil Strength Within Tree Rows



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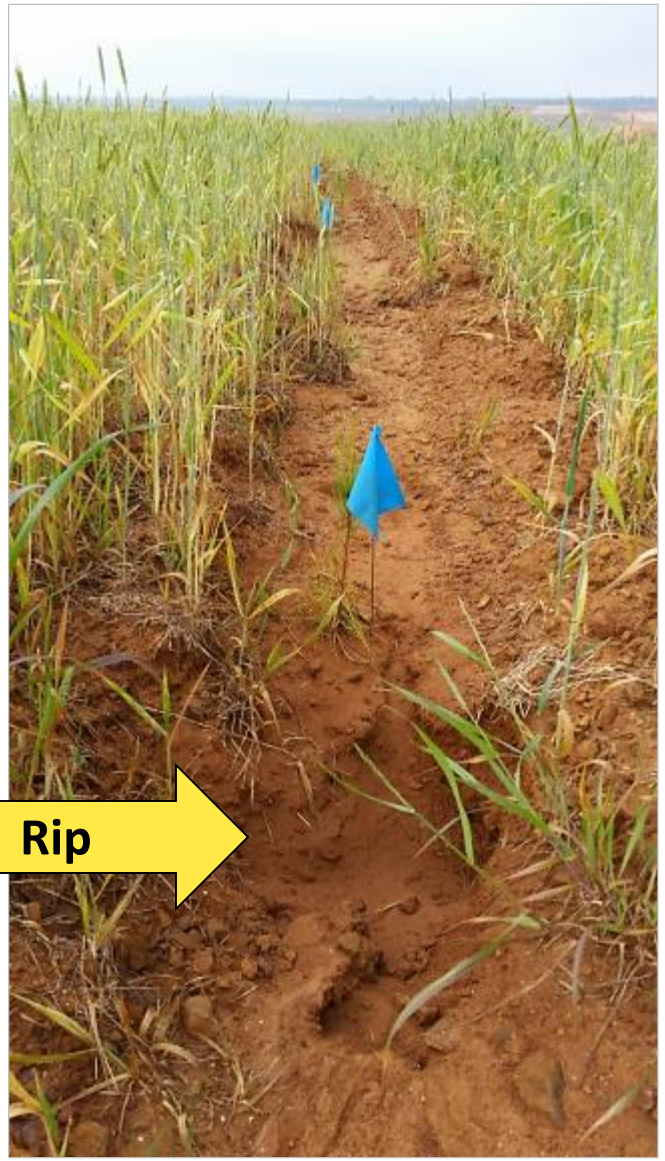
Rip

Data Collection 2016

- **To Be Completed**
  - Soil test pits – July
  - Surface soil water concentration — dry soil season
  - Lab analyses
  - First year growth and survival – October
  - Destructive harvesting – October
  - Gather reference data (unmined land)

Acknowledgements

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  - Luminant Environmental Research Program and Steering Committee
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  - Stephen F. Austin State University
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- Research Assistants
- Oak Hill Mine Environmental
  - Dan Darr, Jeff Lamb

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Any Questions?