# Impacts of a Modified Forestry Reclamation Approach on Seedling Growth and Survival on Reclaimed Mines in the Western Gulf

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# Surface Mining on the Gulf Coastal Plain

- Texas is the leading producer of lignite coal
  - Surface mines are then reclaimed to forest or grasslands
- Surface Mining and Reclamation Control Act (1977)
  - Promoted land stability but created high soil compaction
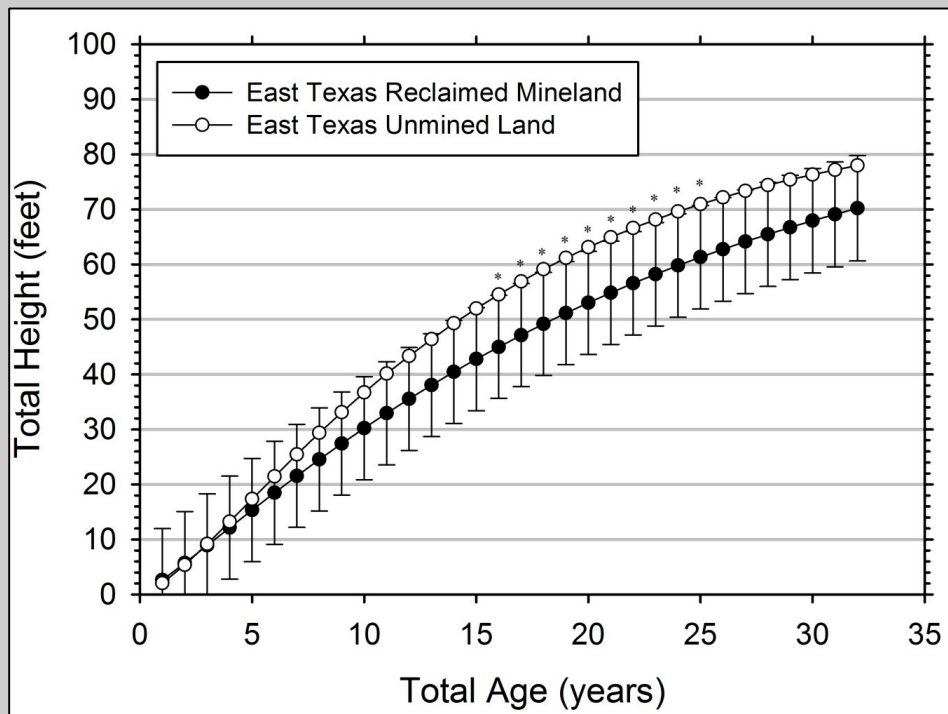


*Priest et al. 2016 – Forest Science*

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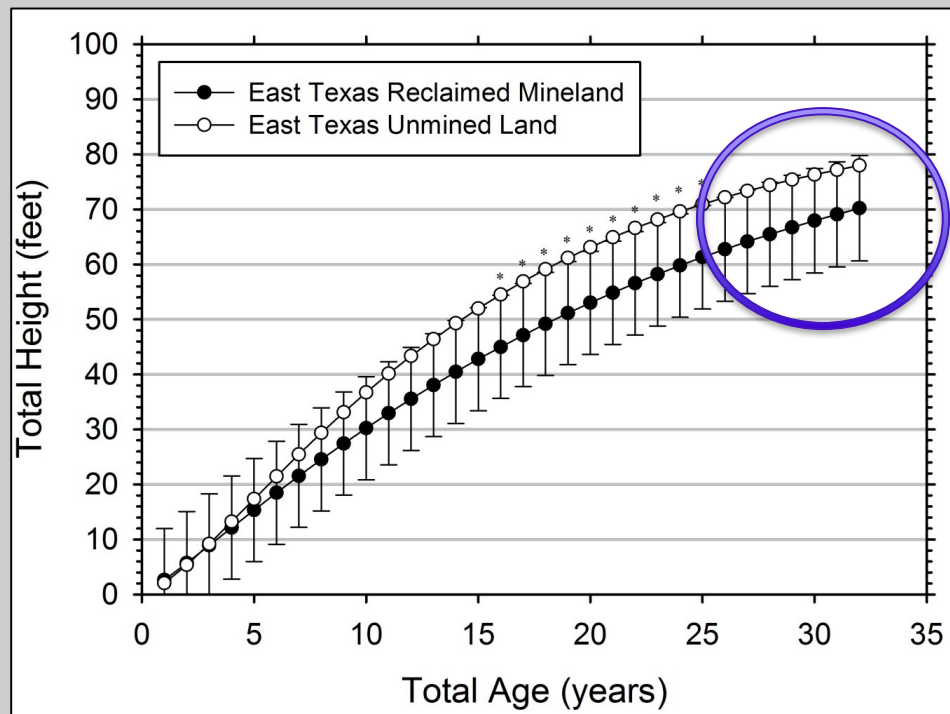
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Can we do better?

# The Forestry Reclamation Approach (FRA)

1. Suitable rooting medium
   - No less than 4ft deep
2. Loosely graded topsoil
   - End dumping technique
3. Use tree compatible cover
4. Plant two types of trees
5. Use proper tree planting technique
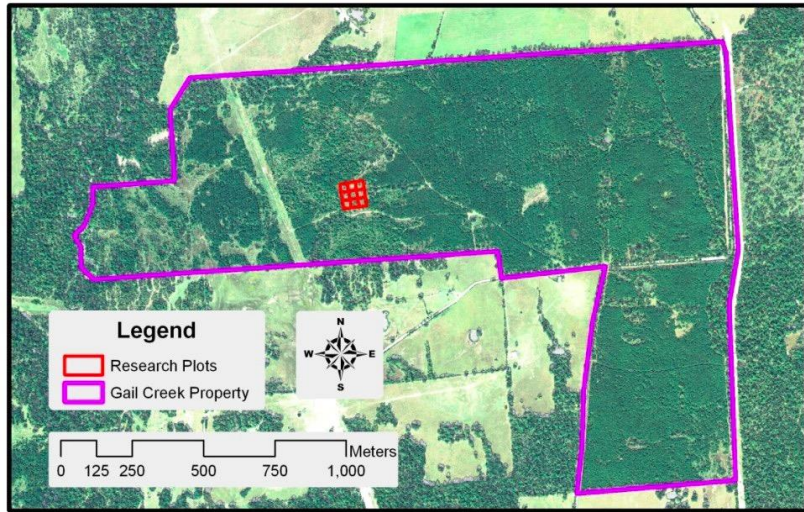
GOAL: Adapt the FRA to Western Gulf



**Appalachian End Dumping**
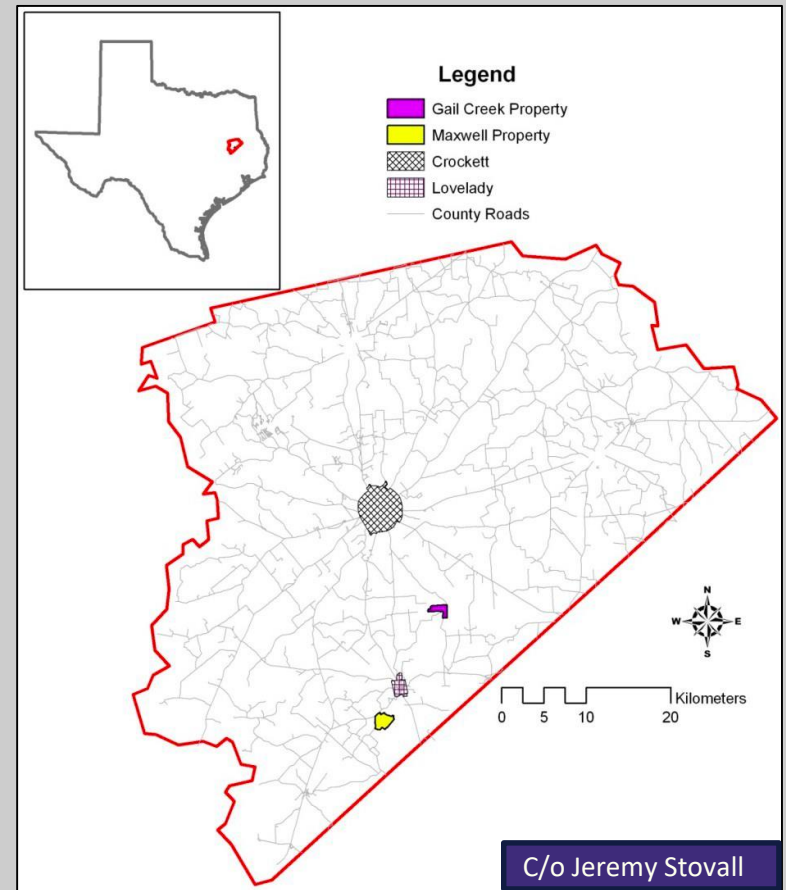*Photo from Forest Reclamation Advisory No. 3*

# Objectives

1.  Determine the effects of the Forestry Reclamation Approach on the physical and chemical properties of the soil

2.  Determine tree seedling performance based on tree physiology and competing vegetative cover

# Study Site



## Gail Creek
## Mine demonstration site

Houston Co.
2 acre site
Nine experimental plots



C/o Jeremy Stovall

FRA    Control    Scraper

Scraper    Control    FRA

Control    Scraper    FRA

- Randomized complete block design
- Three replicates
- Two buffer rows
- 48 loblolly pine seedlings per plot

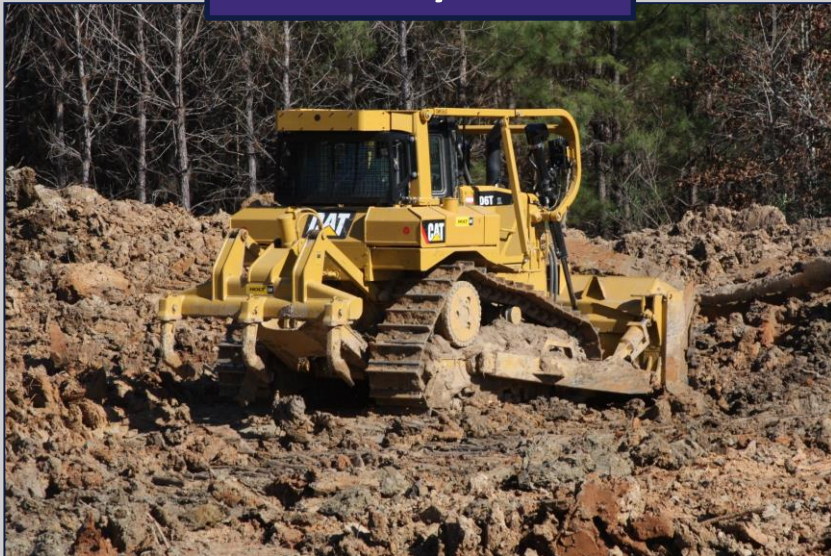Drone footage of the site taken on May 6, 2018

# Soil Information





*Very fine, smectic, thermic, **Vertic** Hapludalf*

# Reclamation Methods: 'Pan Scraper'



January 2016



- 1.3 m (4ft) deep pits

- Traditional pan scraper method could not be used

- Topsoil haul-back method was used

- Soil was replaced in 6cm layers

- Frequent trafficking simulated pan scraper method

# Forestry Reclamation Approach



- 1.3 m (4ft) deep pits

- End dumping simulated by dumping buckets of soil into the pits

# Forestry Reclamation Approach



- Each bucket of soil was dropped adjacent to the last
- Soil is left loose in piles

# Control Plot

Plots cleared of all vegetation

- International Forest Co. loblolly seedlings were hand planted on February 23, 2016
- No cover crop was used
- No erosion control was used

# The Forestry Reclamation Approach

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# Data Collection Method

- Soil
  - Texture – Hydrometer method
  - Bulk Density – Slide hammer method
- Tree measurements
  - Ground line diamter and height
- Leaf level measurements
  - Pressure chamber – one fascicle per tree
  - LiCOR 6400-XT – two fascicles per tree
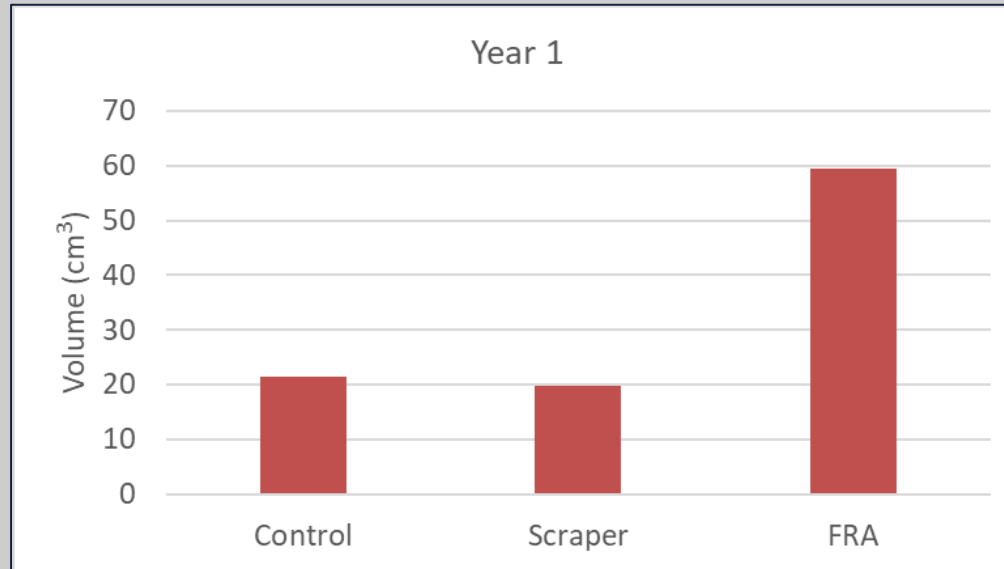
# Results: Soil Texture
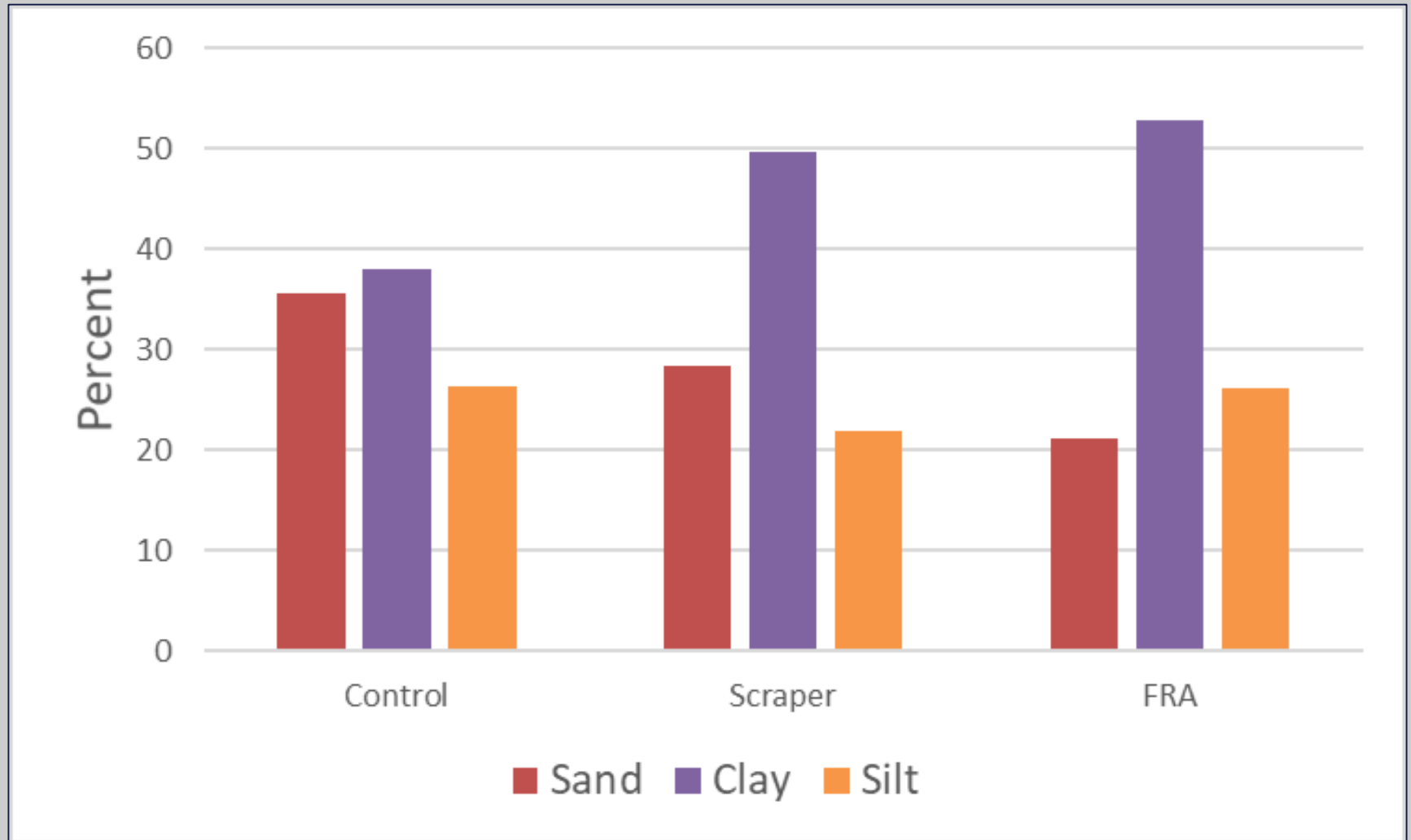
# Bulk Density
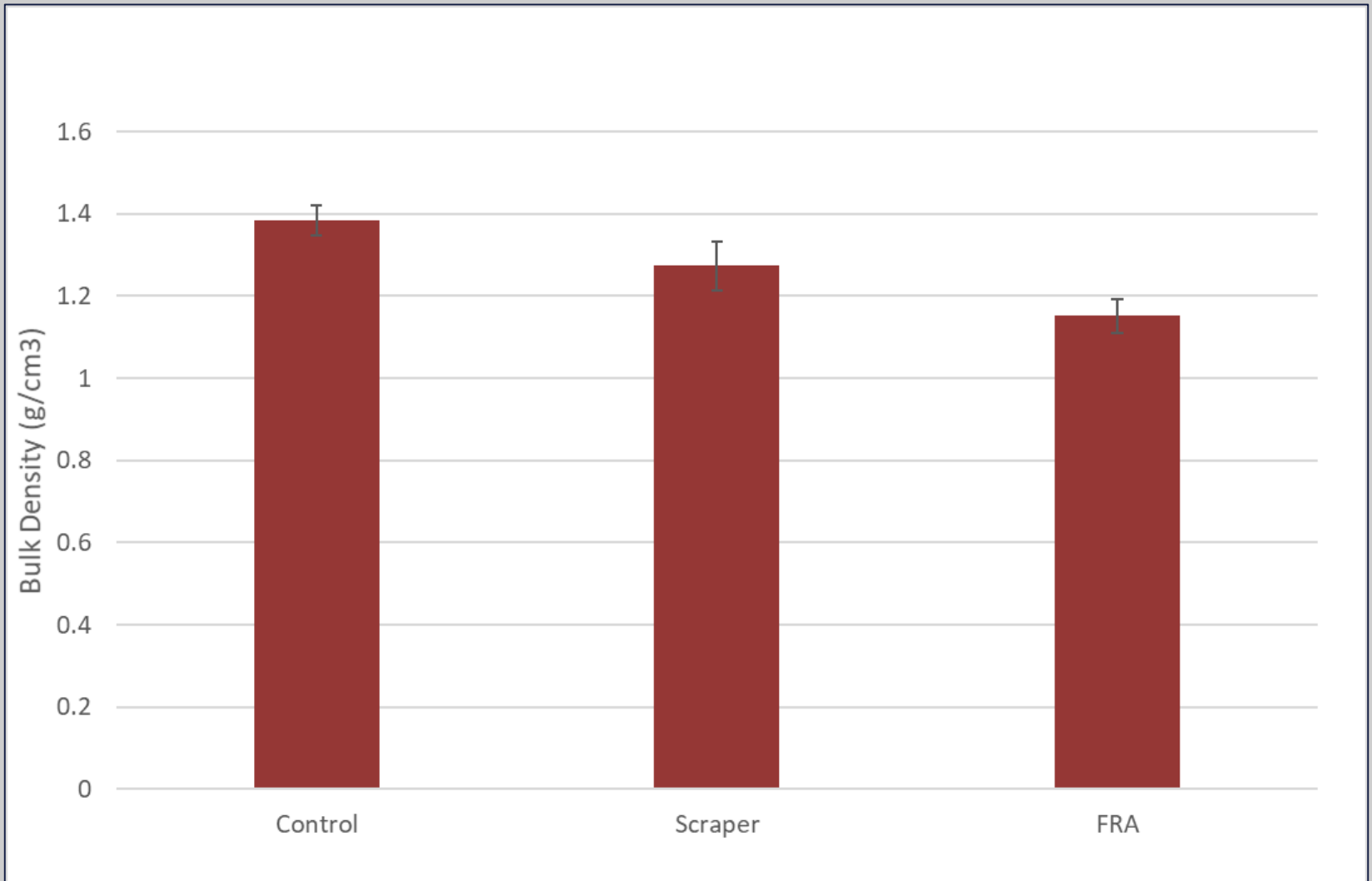
# Cone Penetrometer
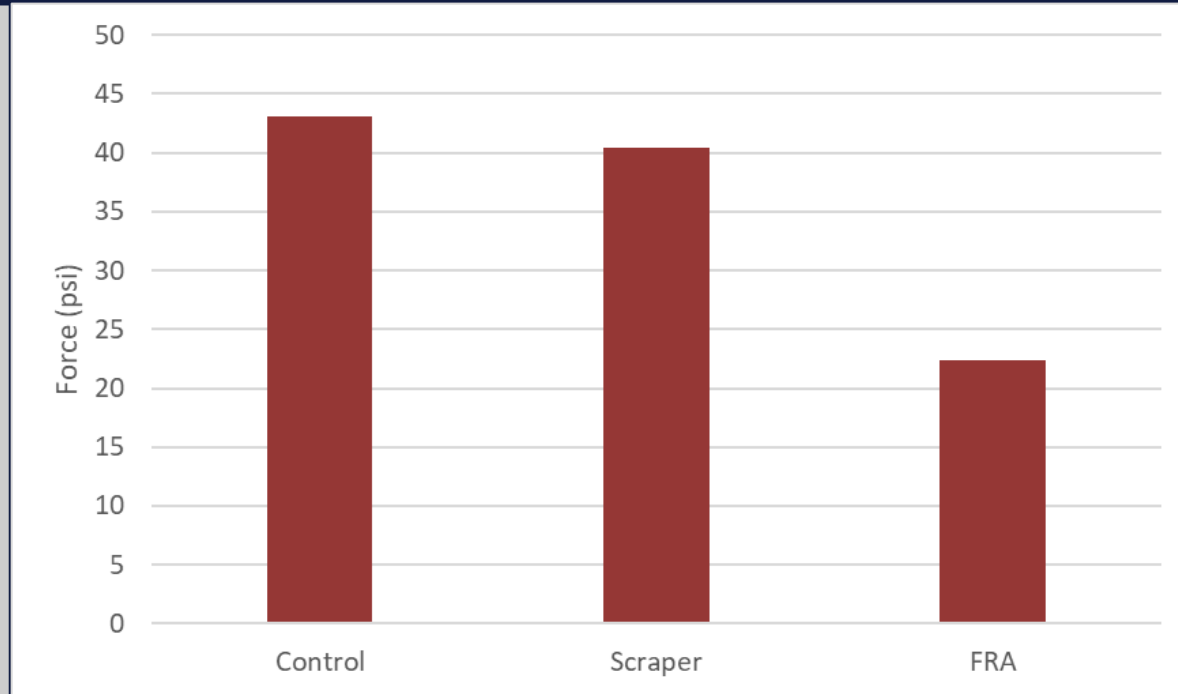
# Year 2 Survival Rates
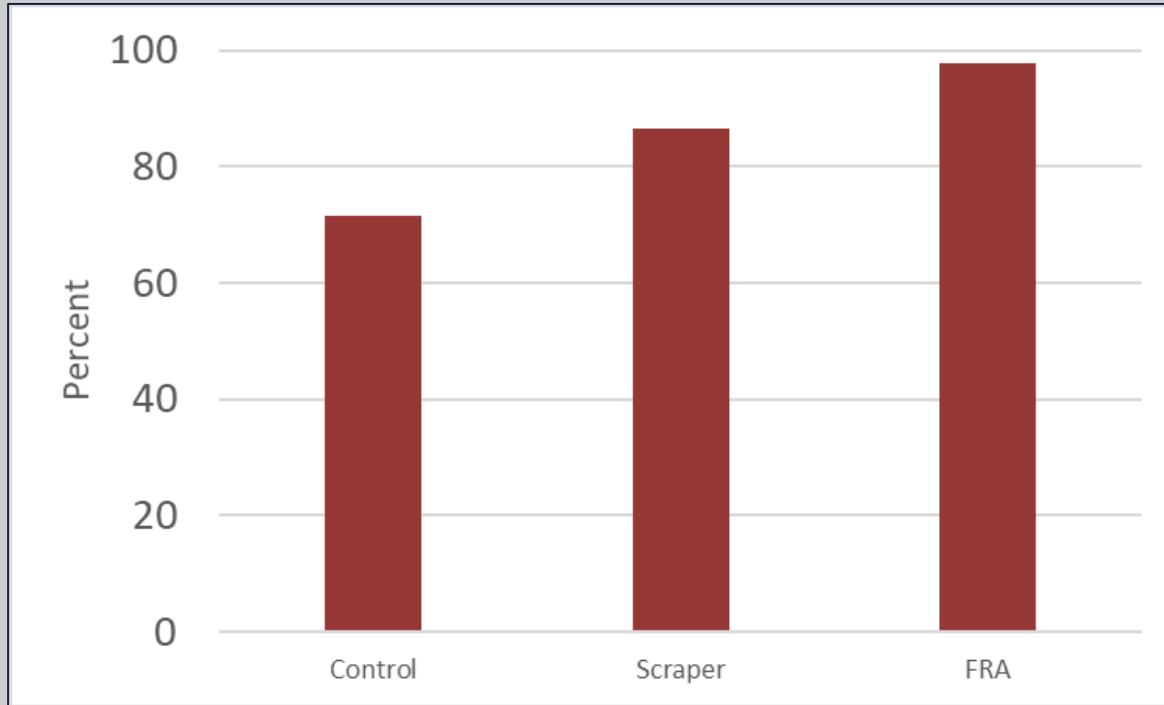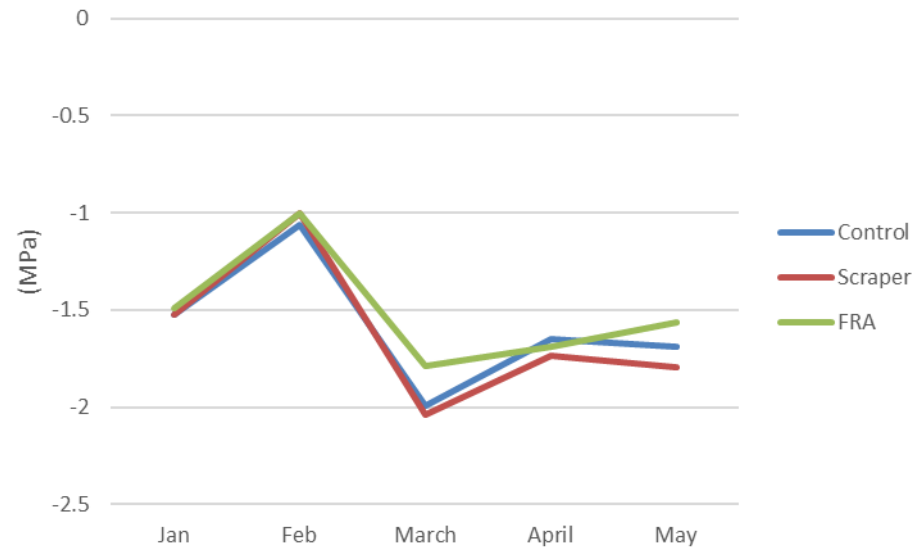
# Tree Volumes Year 1 & 2
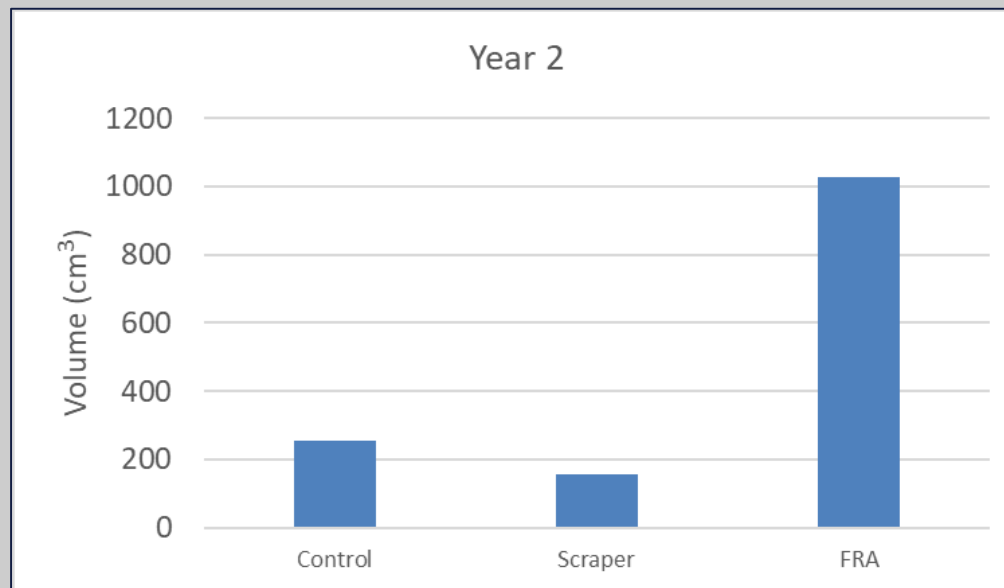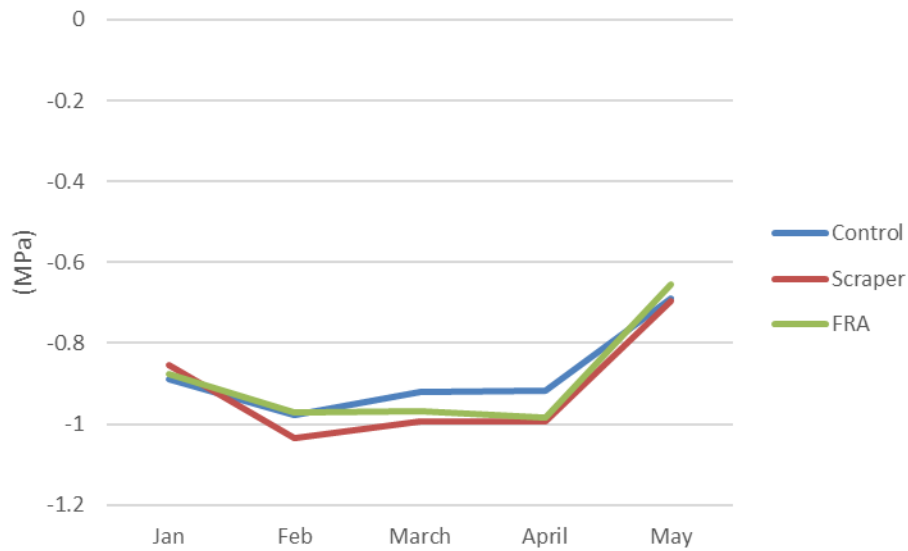
# Tree Seedling Comparison
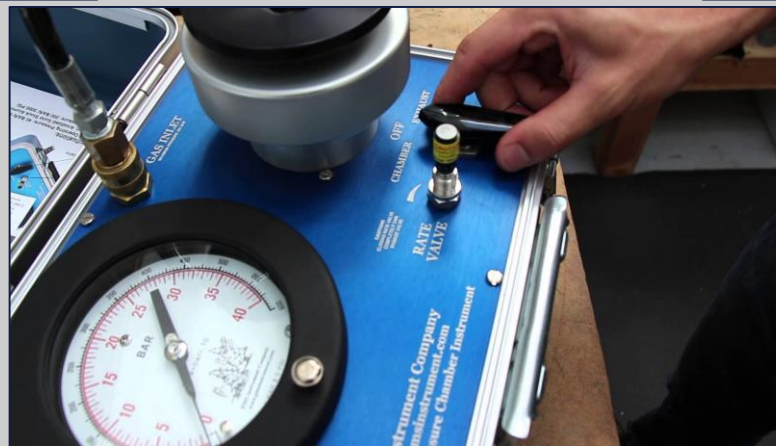


Control
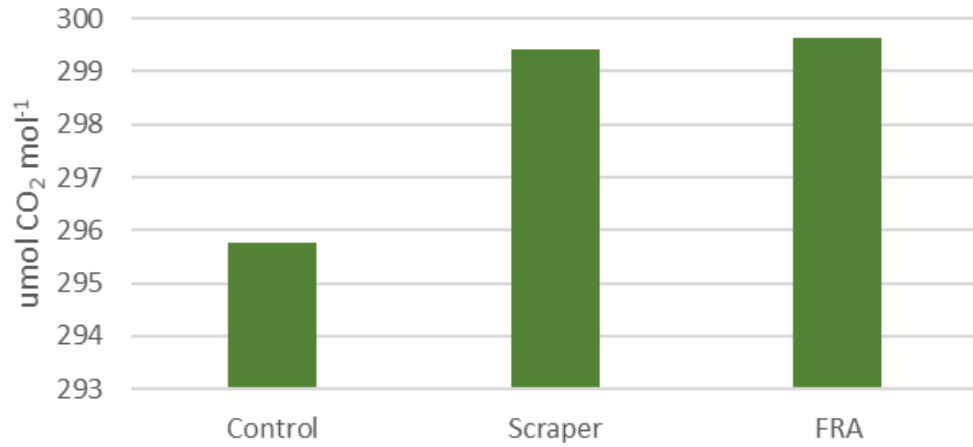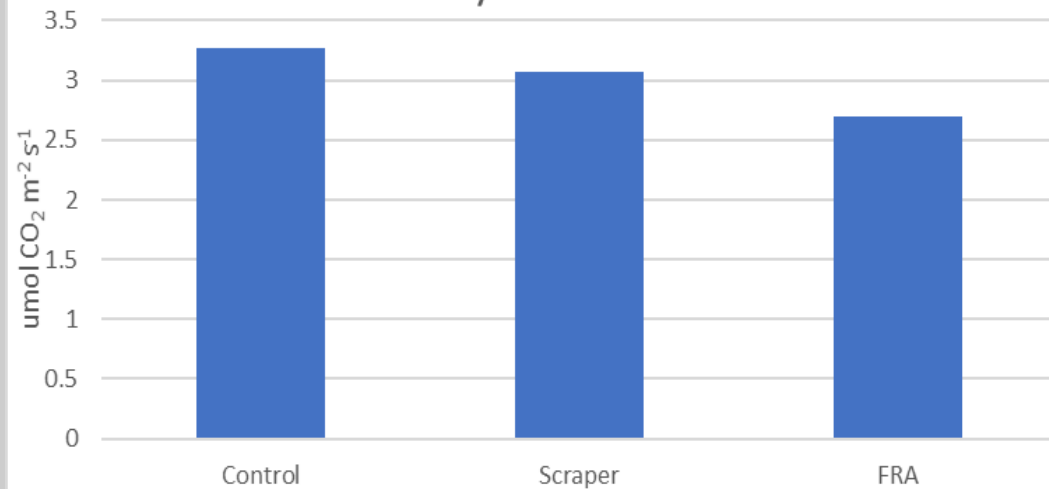
Pan Scraper

FRA

# Leaf Level Water Potential
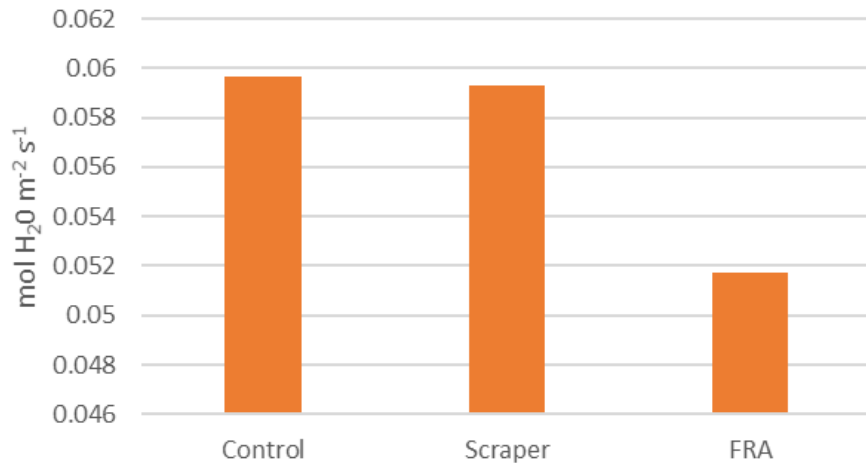


Pre-Dawn

Mid-Day

# LiCOR 6400-XT



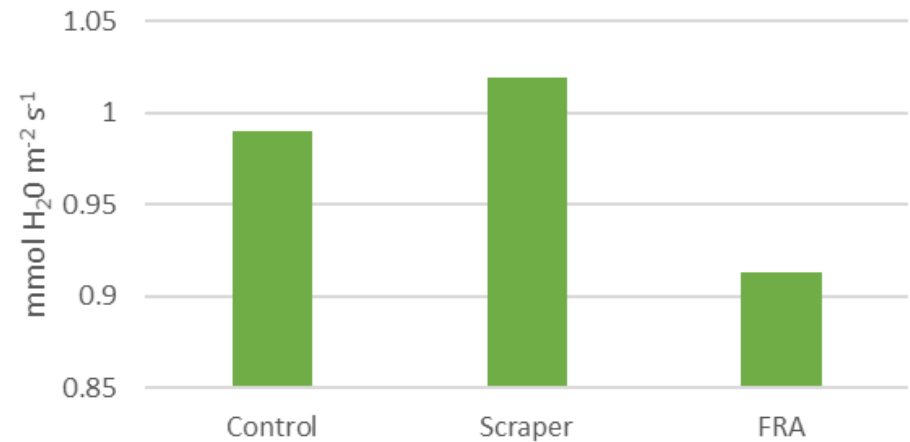$C_i$= intercellular $CO_2$ concentration

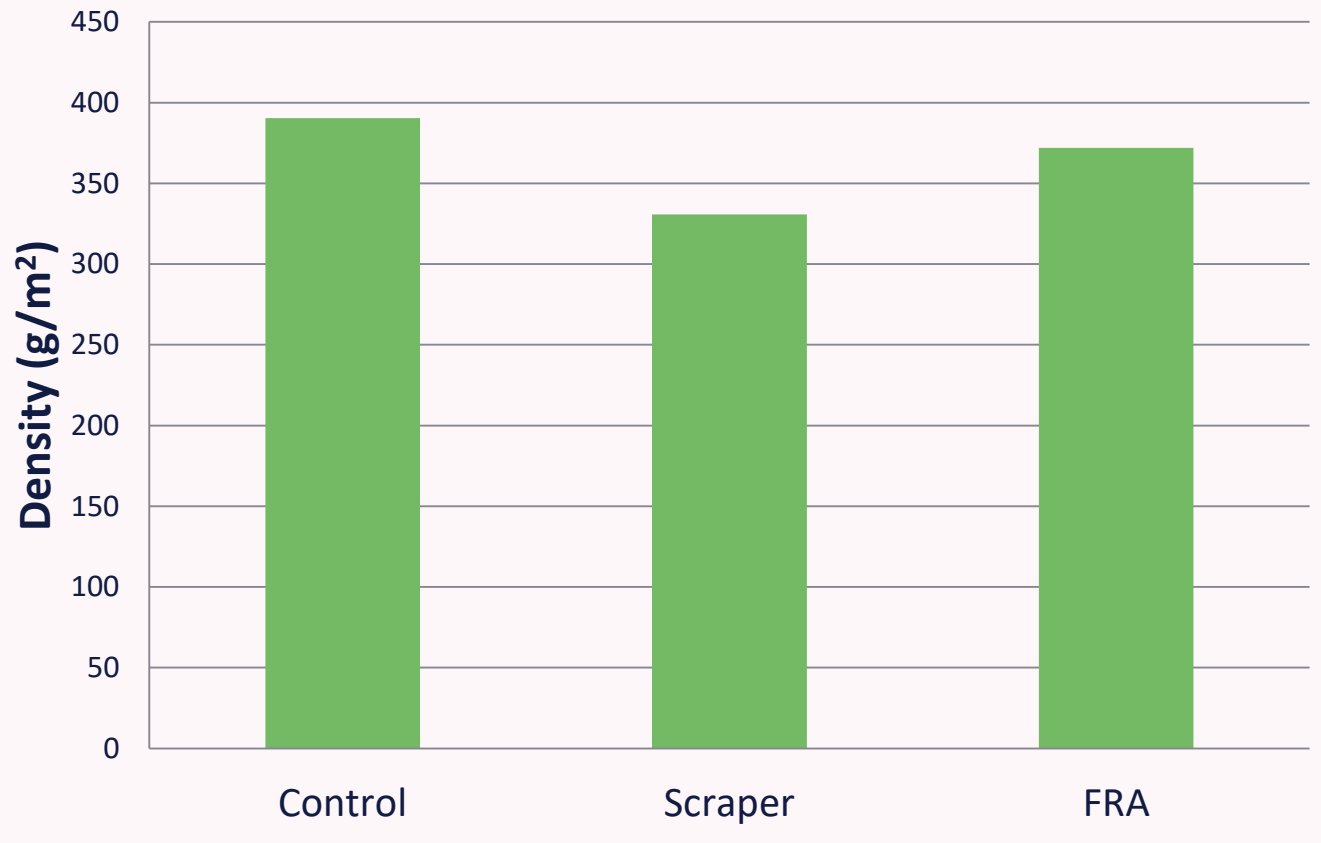# LiCOR 6400-XT

$g_s$

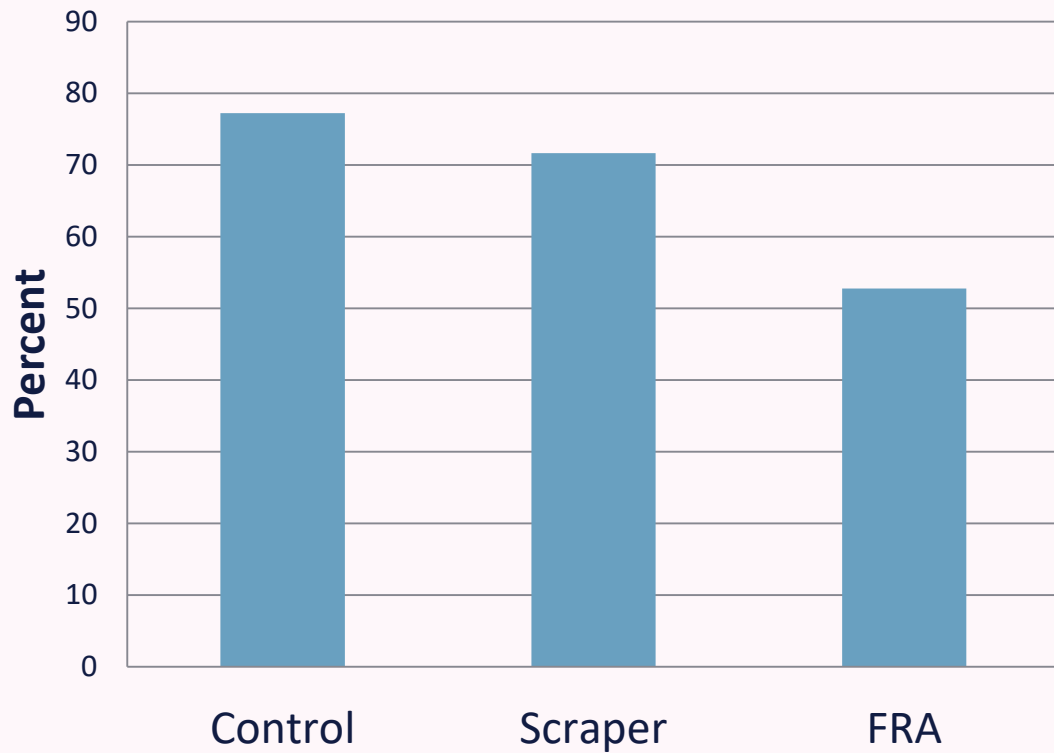

$g_s$ = stomatal conductance

$E$ = leaf transpiration

$E$

# Competing Vegetation after 1 year

# Percent Cover after 1 growing season

# Ground Cover



FRA



Pan Scraper



Control

# Conclusions

- Higher soil bulk densities were observed in the control plots

- Competing vegetation could potentially explain lower survival on the control plots

- FRA plots appear to have greater tree volumes and better survival rates
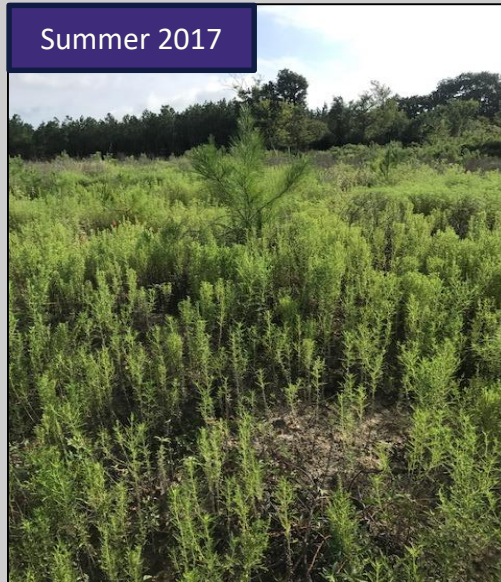
# Next Steps

- Ground cover composition
- (ongoing) LiCOR and plant moisture stress data
- Soil nutrients
- Foliar N


Winter 2017


Summer 2017


Spring 2018

# Acknowledgements



Field Techs

     Thomas Briggs

     Megan McCombs

     Casity King

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