



# Effects of Scraper Pans on Mine Soil Compaction and Tree Growth at an East Texas Lignite Surface Mine



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## Introduction

Luminant has planted over 38.7 million trees on its reclaimed lignite surface mine operations in East Texas since 1974. The Luminant Oak Hill Mine has shifted its reclamation method of operation with the use of tractor pulled scraper pans for the transport and placement of the oxidized growth medium used in reforestation. However, there is a lack of information regarding the effects of scraper pans on mine soil compaction and tree establishment. This study assesses the impacts of the scraper pan reclamation method by evaluating soil and vegetative response with and without the use of soil tillage techniques.



Luminant's reforested mined land in East Texas

## Objectives

Development of new reclamation methodologies offers opportunities to improve tree seedling growth and long-term productivity at Luminant's Oak Hill Mine (Fig. 1). Objectives include:

- Evaluate and compare soil physical and chemical properties between four tillage treatments at three soil depths (0-30, 30-60, 60-90 cm).
- Investigate the influence of tillage treatments on:
  - herbaceous biomass and percent cover; and,
  - tree seedling survival, growth, and above + below ground biomass.



Tractor pulled scraper pan equipment method



Fig. 1. Luminant Oak Hill Mine, Rusk Co., Texas

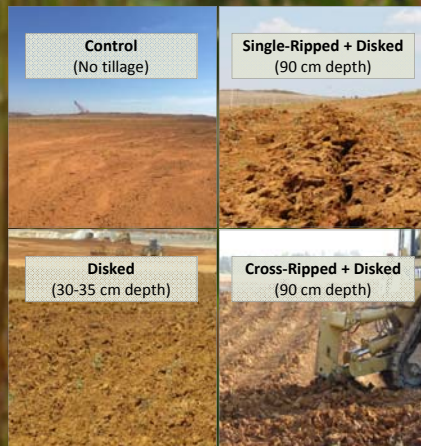


Fig. 2. One replicate block with four tillage treatments (n=5)

## Methods

Four soil tillage techniques (Fig. 2) were installed and planted with loblolly pine (*Pinus taeda*) tree seedlings. Analysis of variance was used to assess:

- Tree seedling volume index, survival, and above-below ground biomass after one growing season
- Soil pH, texture, nutrient & volumetric water content
- Above ground herbaceous biomass (1 m<sup>2</sup> quadrant) and percent cover (Daubenmire method)
- Soil bulk density (slide hammer method)
- Soil strength (cone penetrometer)
- Saturated hydraulic conductivity (surface only)



Loblolly pine seedlings in ripped soil, April 2016

Table 1. First year survival ( $P < 0.1$ )

Treatment	Survival (%)
Control	85a
Disk (D)	91b
Rip/D	95bc
Cross-Rip/D	97c

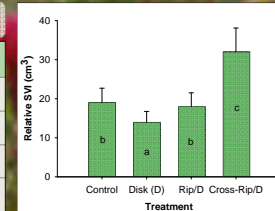


Fig. 3. Seedling volume index ( $P < 0.1$ )

Table 2. First year seedling biomass production (g) ( $P < 0.1$ )

Treatment	Needles	Stem	Roots	Above-ground	Total
Control	8.9a	5.1a	6.0a	14.1a	22.3a
Disk (D)	5.5b	3.5b	7.2a	9.3b	21.5a
Rip/D	5.7b	4.8a	6.7a	10.3b	19.5a
Cross-Rip/D	8.7a	6.8c	12.4b	15.5c	27.9b

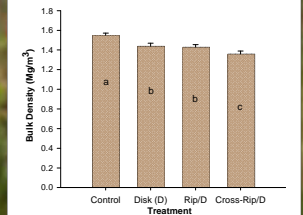


Fig. 4. Soil bulk density for treatment ( $P < .0001$ ) and depth ( $P = 0.0833$ ) effects.

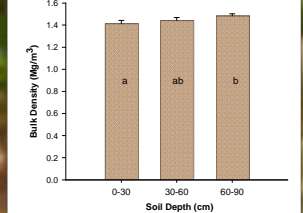


Fig. 4. Soil bulk density for treatment ( $P < .0001$ ) and depth ( $P = 0.0833$ ) effects.

## Results

- Cross-ripping + disking was superior at lowering soil bulk density while increasing relative tree seedling growth and total biomass production (Fig. 4, 3, & Table 2, respectively).
- Survival was lowest for the control treatment, likely due to hard soil conditions at the time of machine planting (Table 1).
- Volumetric water content increased with depth and for the control and disk plots (28 and 27 m<sup>3</sup> m<sup>-3</sup>, respectively).

Depth (cm)	Sand	Silt	Clay	Texture Class
	%-----			
0-30	60 <sub>a</sub>	11 <sub>b</sub>	28 <sub>a</sub>	scl
30-60	56 <sub>ab</sub>	11 <sub>a</sub>	33 <sub>b</sub>	scl
60-90	53 <sub>b</sub>	14 <sub>a</sub>	33 <sub>b</sub>	scl

Table 3. Soil texture by depth

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