

# Interaction between fertilizer and drought on leaf area dynamics and tree water use and their relationship to stand growth of loblolly pine (*Pinus taeda* L.)

Adam O. Maggard

Graduate Research Associate, Department of Natural Resource Ecology and Management, Oklahoma State University, Stillwater, OK 74078



## Introduction

Nutrient deficiency, nitrogen in particular, limits growth of most southern pine plantations. Fertilizing loblolly pine plantations increases leaf area and subsequent growth. Predicted changes in climate will affect southern pine plantations. Increasing temperature and decreasing or more variable growing season precipitation are projected.

## Objective

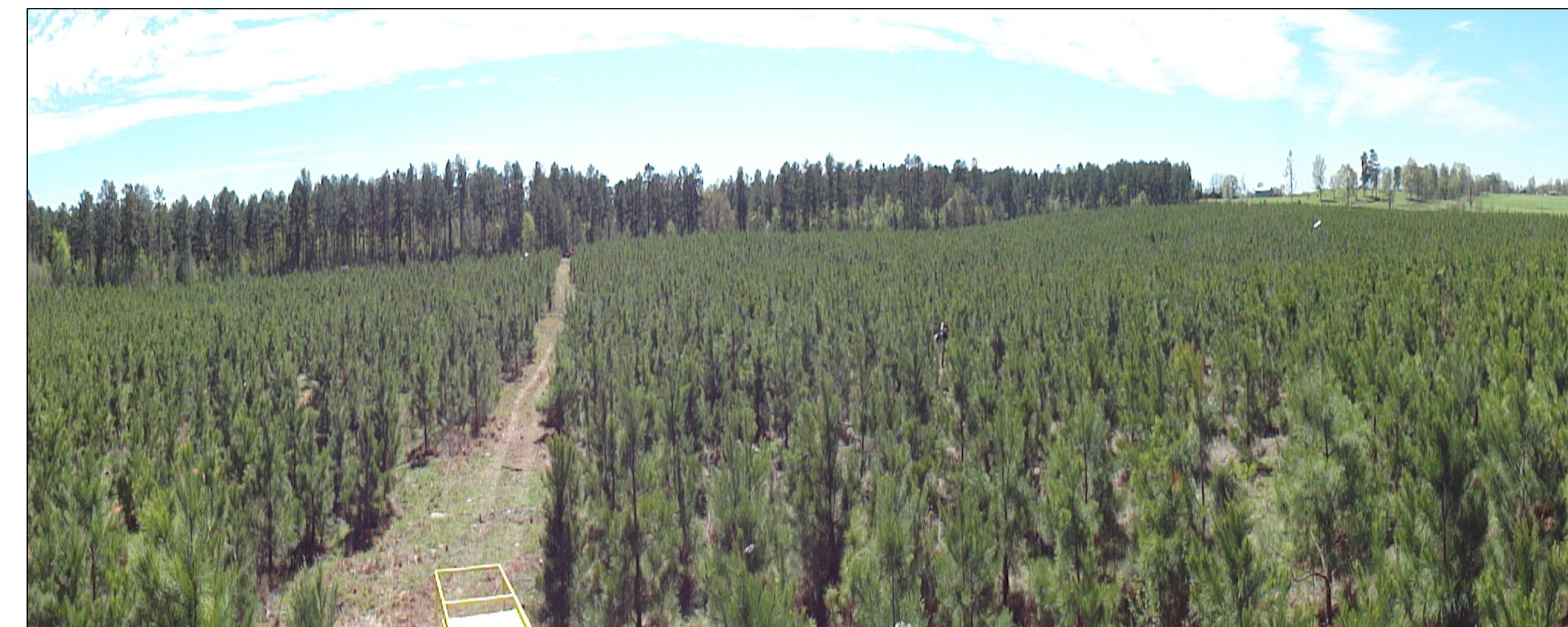
The objective of this study is to determine if the positive effects of fertilizer on the growth of loblolly pine plantations can compensate for decreased water availability or whether fertilization increases susceptibility to water stress.

These data will help determine the implications of potential climate change scenarios on loblolly pine management and the interaction between fertilization and drought.

## Hypothesis

*The central hypothesis is that fertilizer added to a loblolly pine plantation experiencing reduced water availability will increase its susceptibility to drought such that the effects of nitrogen fertilizer are largely negated.*

- Increased leaf area due to fertilization causes a greater reduction in leaf-level and whole-tree water use when water availability is limited.
- Increased leaf area due to fertilization causes greater water stress and earlier leaf abscission.
- The combined effects of reduced leaf gas exchange and earlier leaf abscission of fertilized stands during drought will result in growth rates more similar between fertilized and non-fertilized stands than when under well watered conditions.



Tier III site, Broken Bow, Oklahoma (McCurtain County).

## Rationale and Significance

*Understanding the interaction between fertilizer and drought is essential to understand the effects climate change will have on loblolly pine management throughout the southern United States.*

The benefits of nitrogen and combined benefits of irrigation and nitrogen on physiology and growth of loblolly pine have been extensively studied. However, few studies have monitored the interaction between decreased water availability and fertilization (Tang et al. 2004) and none to our knowledge have monitored the effects of decreased water availability on nitrogen benefits in young loblolly pine plantations.

*The outcome of this proposed study will increase our understanding of how the benefits of nitrogen fertilizer are affected by water stressed conditions and how decreased water availability may alter nitrogen use in future forest management.*



Rainfall exclusion treatment. Tier III site, Broken Bow, Oklahoma (McCurtain County)



Soldering, part of the sap flow probe installation



Soldering, part of the sap flow probe installation

## Methods

- Loblolly pine growth characteristics will be compared under different treatments of nitrogen and water availability in a six-year old loblolly pine stand (Tier III) located in McCurtain county near Broken Bow, OK.
- Fertilization and precipitation reduction treatments will be conducted according to PINEMAP protocols.
- Leaf area dynamics will be measured by a combination of frequently collected litter trap samples and measurement of leaf growth phenology.
- Whole-tree water use will be measured with thermal dissipation probes.
- Leaf-level water use will be estimated with periodic measurements using a LI-6400 portable photosynthesis system.
- Water use efficiency will be estimated by a combination of leaf-level gas exchange measurements and carbon isotope discrimination.

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