

# The Impact of Artificial Drought Conditions on Parameterization of 3-PG for *Pinus taeda*

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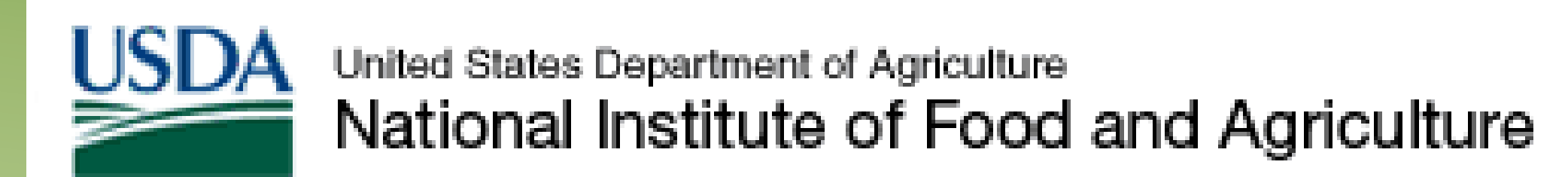


Figure 1. Throughfall exclusion in *Pinus taeda* plantation

## Introduction

The impact of climate change on temperature and precipitation patterns in the southeast U.S. are likely to have an important impact on southern pine systems. The southeast U.S. is predicted to experience an increase in average temperature of 2.5 to 5°C by the 2080s (Karl et al. 2009). Predictions for changes in precipitation for the southeast, although less certain, generally indicate a 10% to 30% reduction in summertime precipitation (Karl et al. 2009, Christensen et al. 2007). Increased average temperature and decreased precipitation will increase vapor pressure deficits (VPD).

The Physiological Principles in Predicting Growth (3-PG) model uses physiological process data, statistical growth and yield models, and easily obtained weather and site conditions to simulate the growth of forest stands (Landsberg and Waring, 1997). The ability of this model to predict forest productivity under a variety of management and environmental conditions makes it an especially useful tool for predicting the impact of climate change scenarios on forest stands. The sensitivity of stomatal conductance to VPD and the impact of soil moisture on growth are important components of 3-PG. The objective of this research project is to parameterize the 3-PG model for both fertilized and unfertilized loblolly stands under conditions of extended artificial drought.

## Study Design

The study design is a randomized complete block containing two levels of fertilization and throughfall exclusion in a 2x2 factorial arrangement. Treatments include: fertilization with 224N, 28P, 56K (kg/ha) and micronutrient blend as to eliminate any nutrient deficiencies, and an exclusion of 33% of incoming throughfall. The factorial design will result in four individual treatment types. Each individual treatment type will be replicated four times for a total of 16 plots. Treatment types include:

- 1) **Control (C)**: ambient throughfall, no fertilizer
- 2) **Fertilization (F)**: ambient throughfall, fertilization
- 3) **Throughfall Exclusion (E)**: 33% throughfall exclusion, no fertilizer
- 4) **Fertilization and Throughfall Exclusion (FE)**: 33% throughfall exclusion, fertilization.

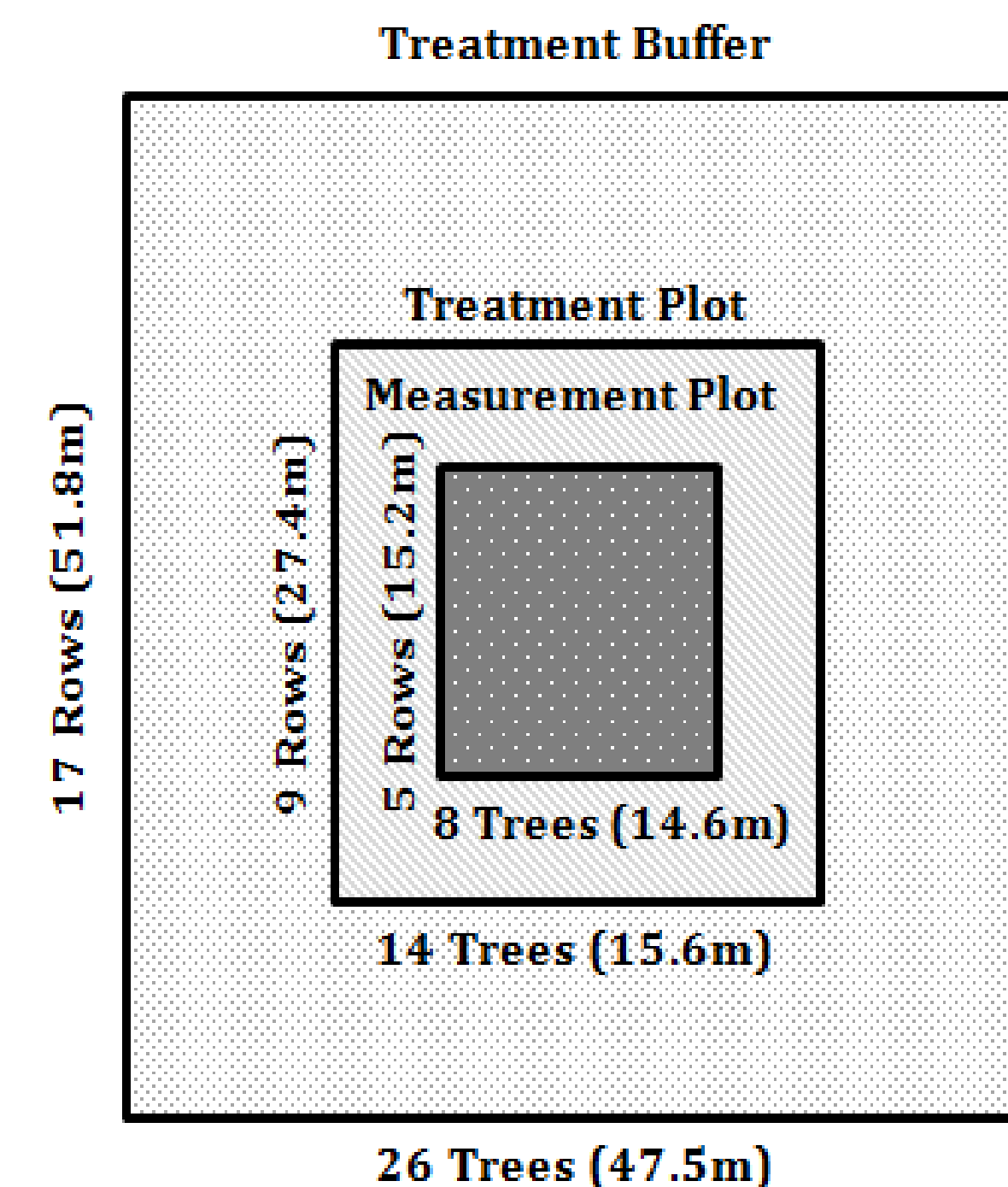


Figure 2. Design of treatment plots

## Methods

An inventory of all trees in measurement plots will be conducted before treatments are applied to assess baseline conditions. Inventories will include measurements of diameter at breast height (DBH ~1.4m) and total tree height. Once treatments have been applied inventories will be conducted monthly in order to assess the impact of treatments on stand growth.

Whole-crown transpiration will be estimated using heat dissipation sap flow probes described in Granier (1987). Leaf water potential will be measured for the entire diurnal period (predawn to sundown) monthly using a Scholander pressure chamber. Soil moisture will also be measured at multiple points in each plot using automated soil moisture probes.

A weather station will be installed at the site to measure photosynthetically active photon flux density, net radiation, wind speed and direction, temperature, relative humidity and precipitation. All sensors will be measured every minute and used to develop 30-min averages which will be collected on dataloggers.

Sap flow will be converted to crown conductance using the approach described in Martin et al. (1997). Responses of crown conductance to VPD, soil moisture, and their interaction will be analyzed. Field data will be used to parameterize the 3-PG crown conductance functions to refine the response of these functions to variable atmospheric and soil drought.

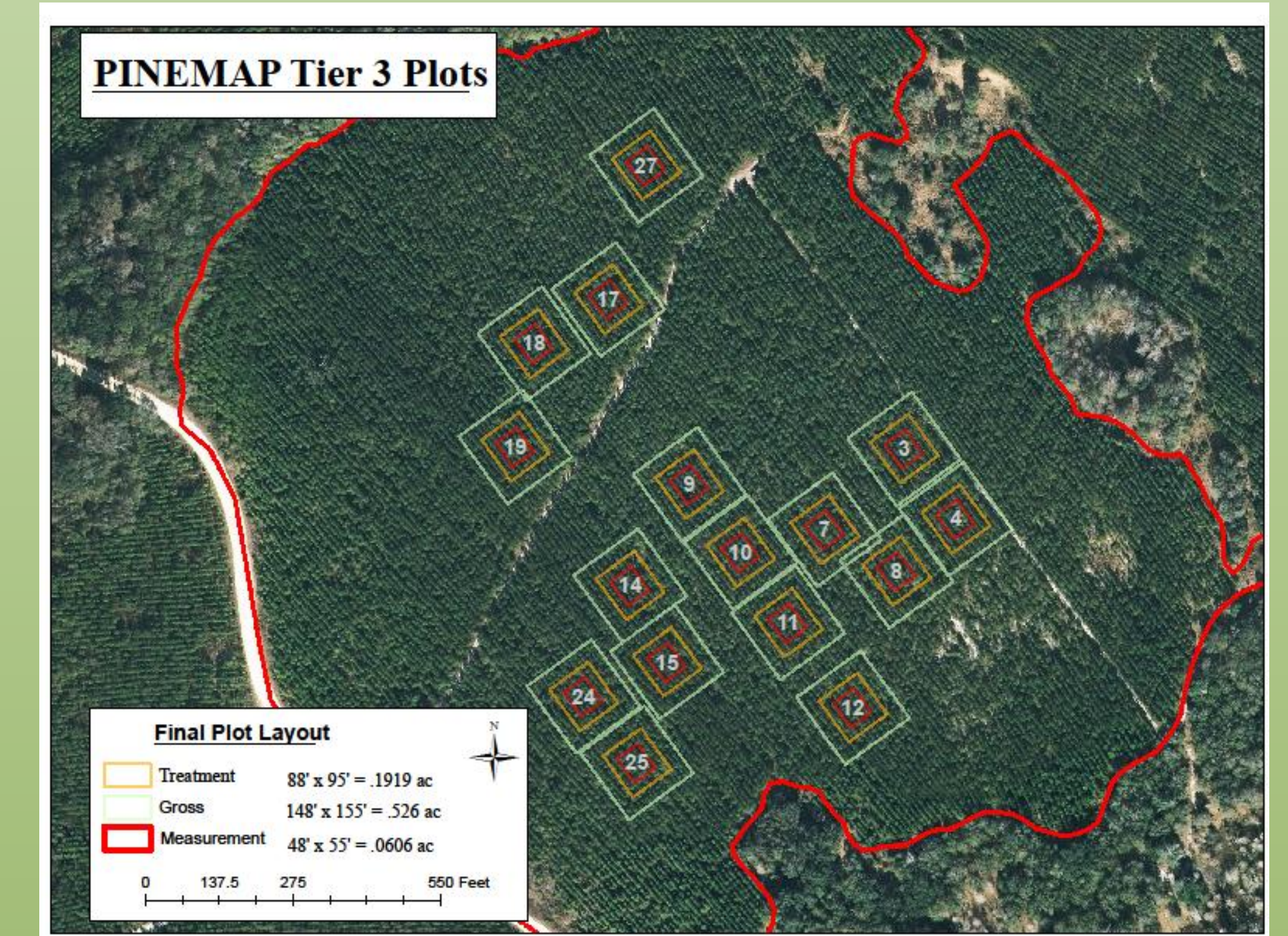


Figure 4. Plot layout within study site

## Site Description

This study will be conducted in a genetically diverse 8 year old loblolly pine plantation located in Taylor County, Florida (30.206, -83.870). The site was machine planted with 2<sup>nd</sup> generation open pollinated "seed orchard mix" planting stock at a spacing of 1.83m x 3m (6'x10') in the winter of 2003/2004. Although the site did not receive mechanical site preparation, a broadcast herbicide was used to control competing vegetation. The site is located on the Melvina-Moriah-Lutterloh soil complex. This soil complex consists mainly of fine sand and is classified as somewhat poorly drained. The mean annual precipitation is 1210 mm. The region normally experiences wet summers and winters and drier springs and falls. The mean annual temperature is 67°F.

## Literature Cited

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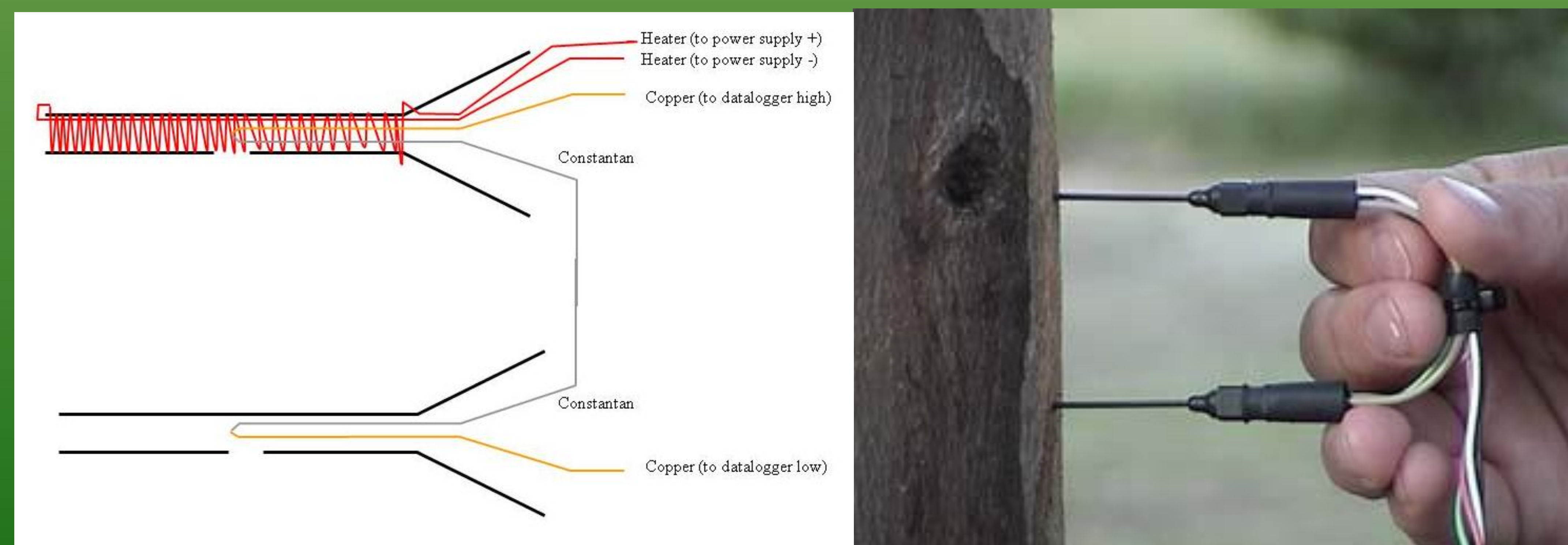


Figure 3. Design of Granier sapflow probe