

Early Detection of Oak Wilt Disease in *Quercus* ssp.

A Hyperspectral Approach

Blake Weissling

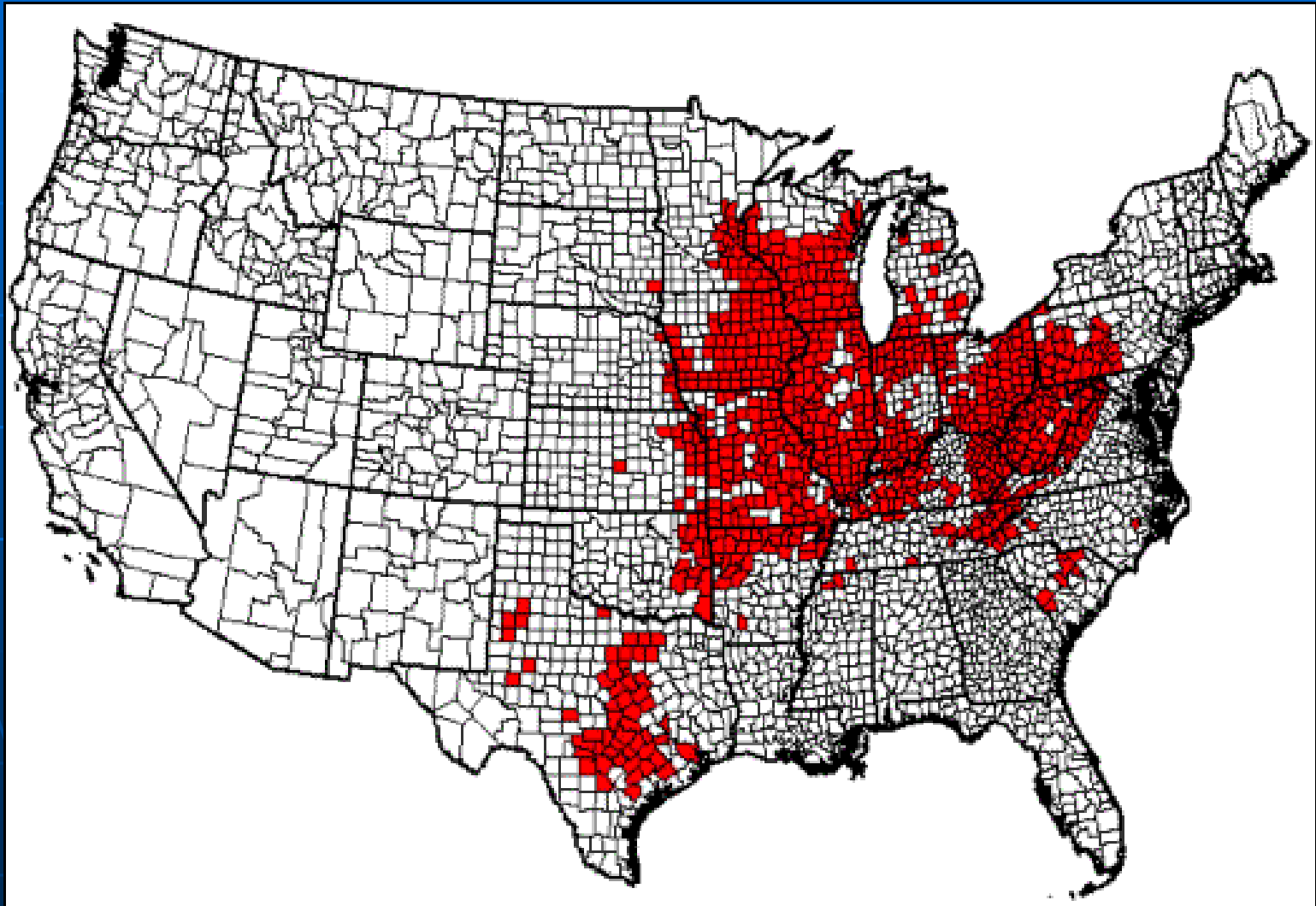
Research Objectives

- To develop and conduct an environmental investigation of the pathogenesis of oak wilt disease in the woodlands of central Texas using field-spectrometry, a controlled greenhouse experiment, and analysis of hyperspectral imagery.
- To build a species discriminatory spectral library of the common tree species of the Texas Hill Country taking into account species phenology.

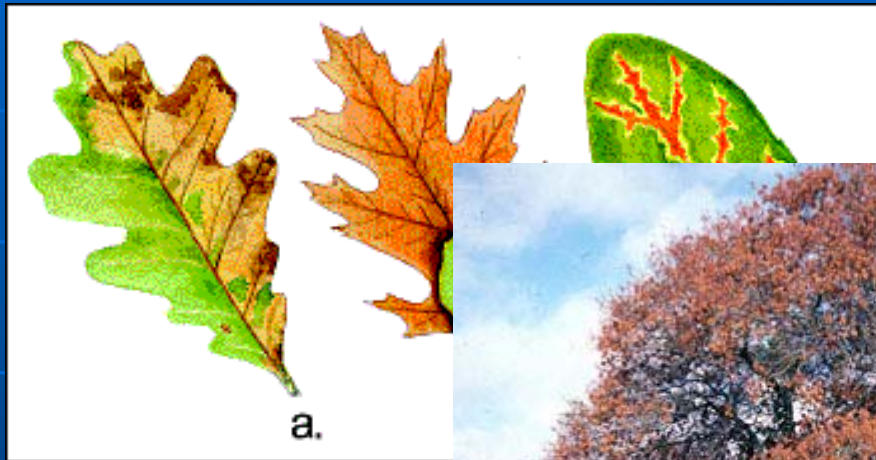
What is Oak Wilt disease?

- A vascular disease commonly afflicting oak species
- Disease agent is the fungus *Ceratocystis fagacearum*
- Oak wilt ranges from central Texas to the upper midwest
- First described in the 1930's
- Has killed millions of trees
- Texas has been hit particularly hard

National distribution of oak wilt



An oak wilt photo gallery



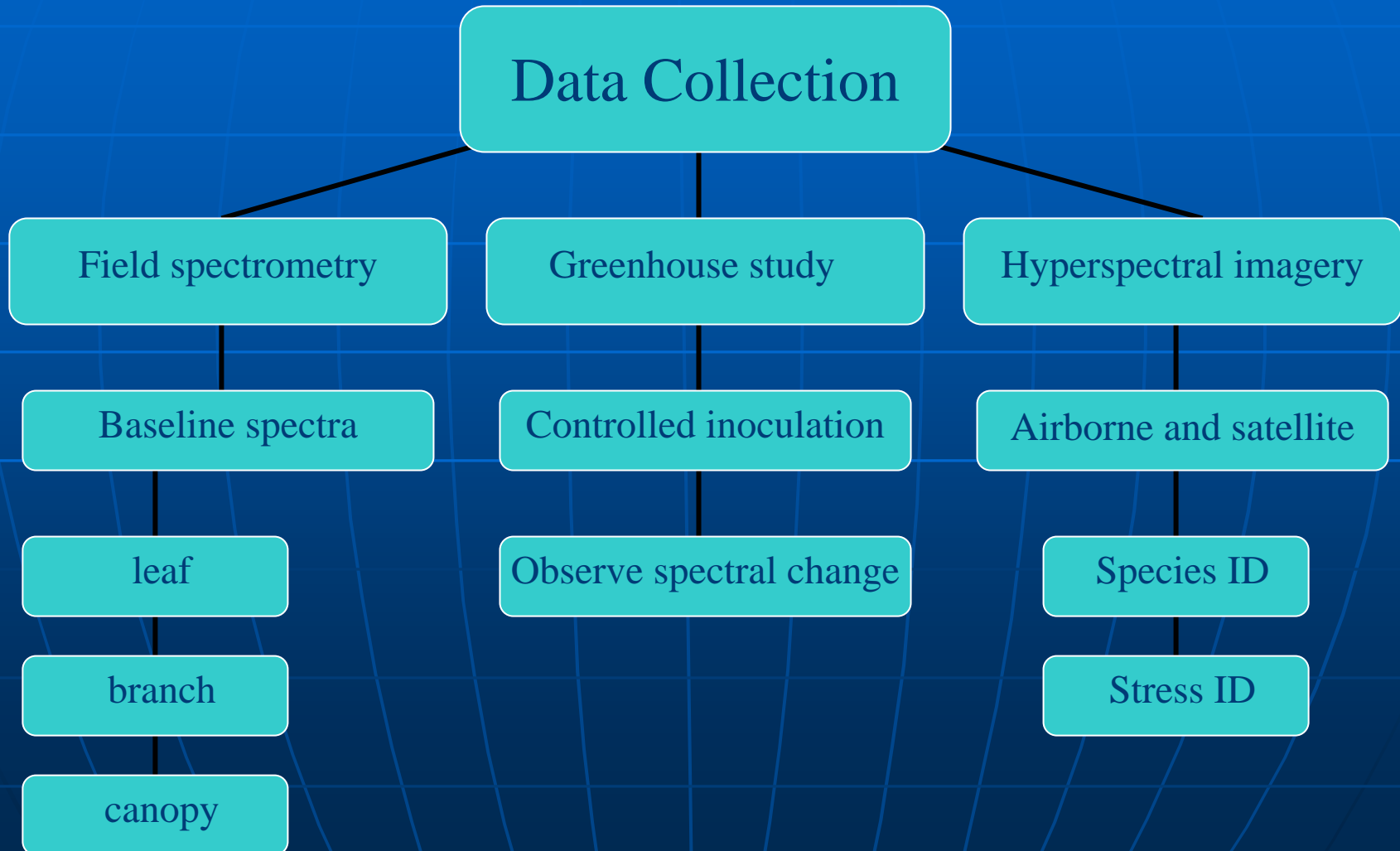
Commonly affected species in Texas

- *Quercus fusiformis* (Plateau live oak)
- *Quercus virginiana* (Coastal live oak)
- *Quercus texana* (Spanish red oak)
- *Quercus stellata* (Post oak)
- *Quercus marilandica* (Blackjack oak)

The Challenge

- To spectrally discriminate a disease-induced stress signal from a multitude of other stress signals as well as inherent spectral variability within and across species and variability across time

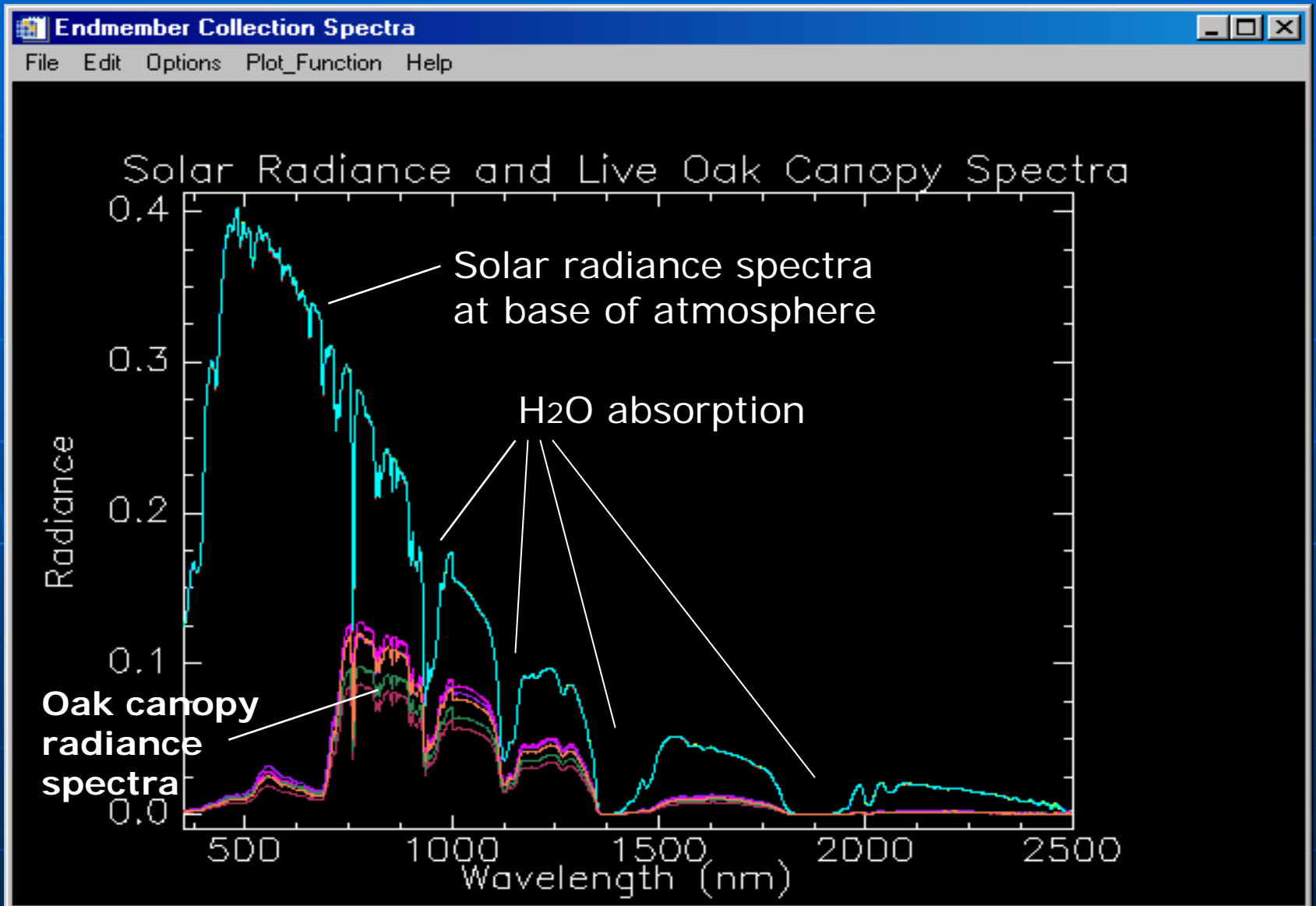
Research Considerations and Experimental Design



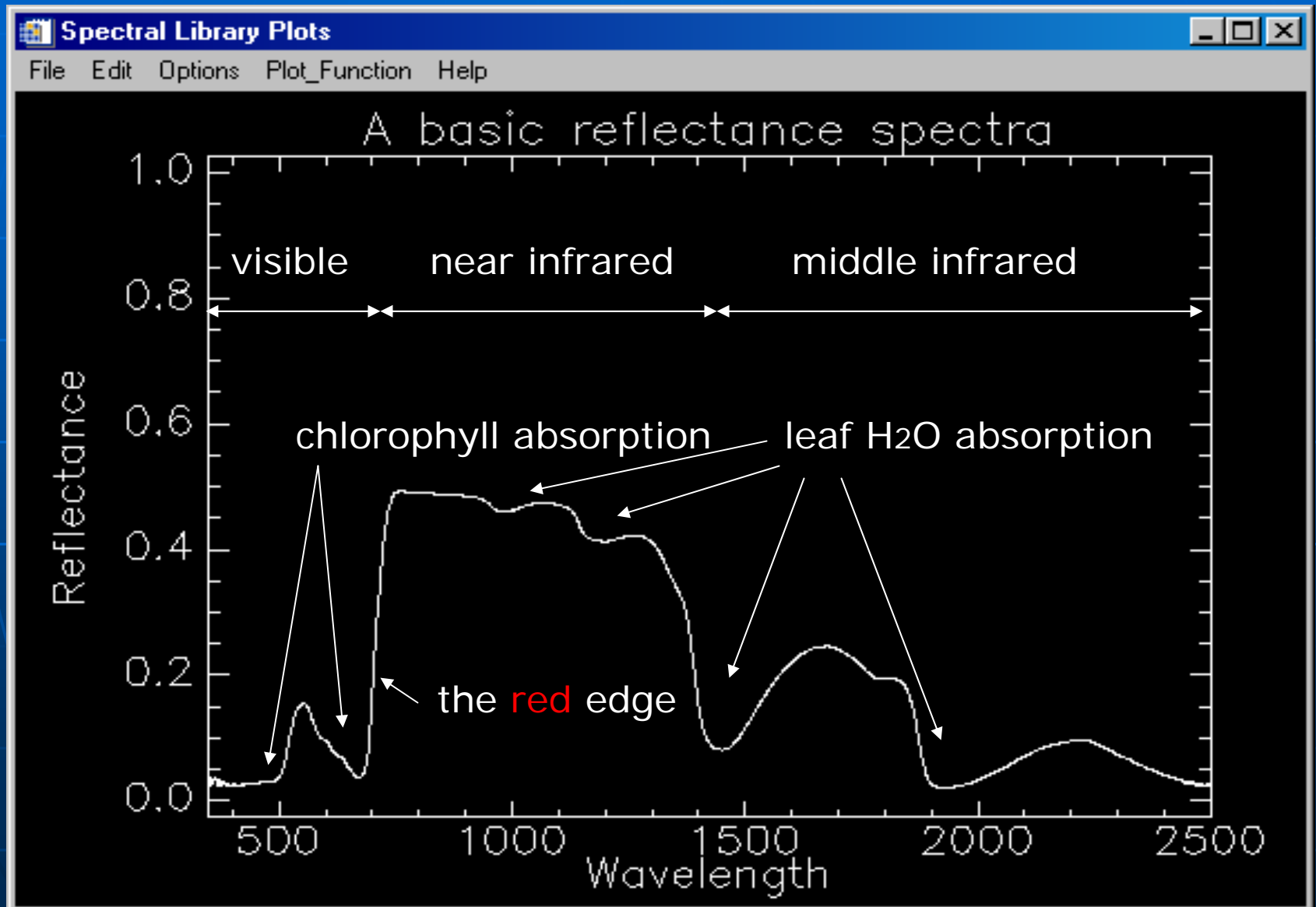
Preliminary Research

- Collection and analysis of leaf spectra for:
 - Variance within species
 - Variance across species
 - Variance with time (phenology)
 - Effects of water loss (stress)
 - Effects of additive reflectance
 - Continuum removal analysis
 - Effects of on-branch analysis vs. in-lab analysis

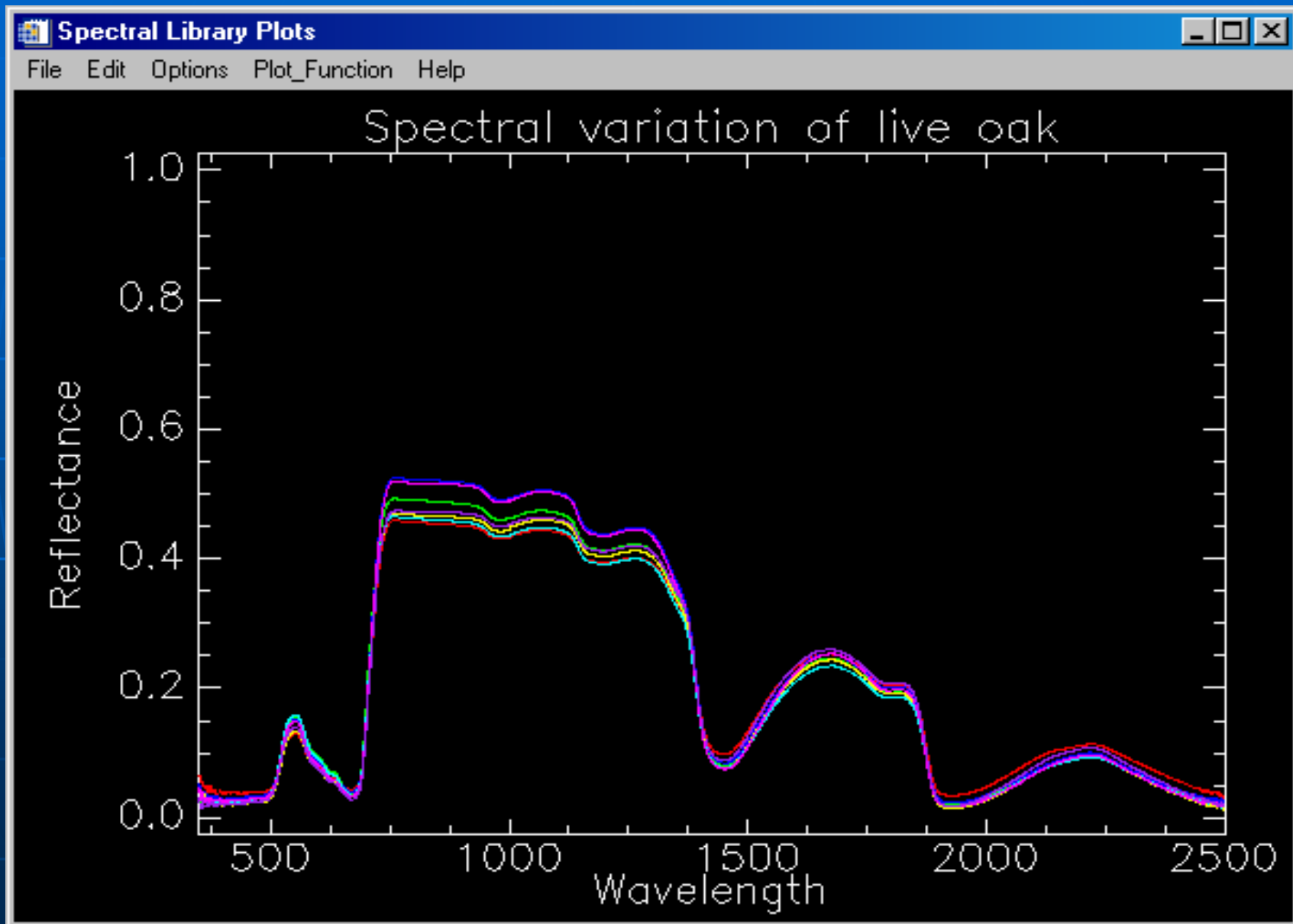
Collected radiance data



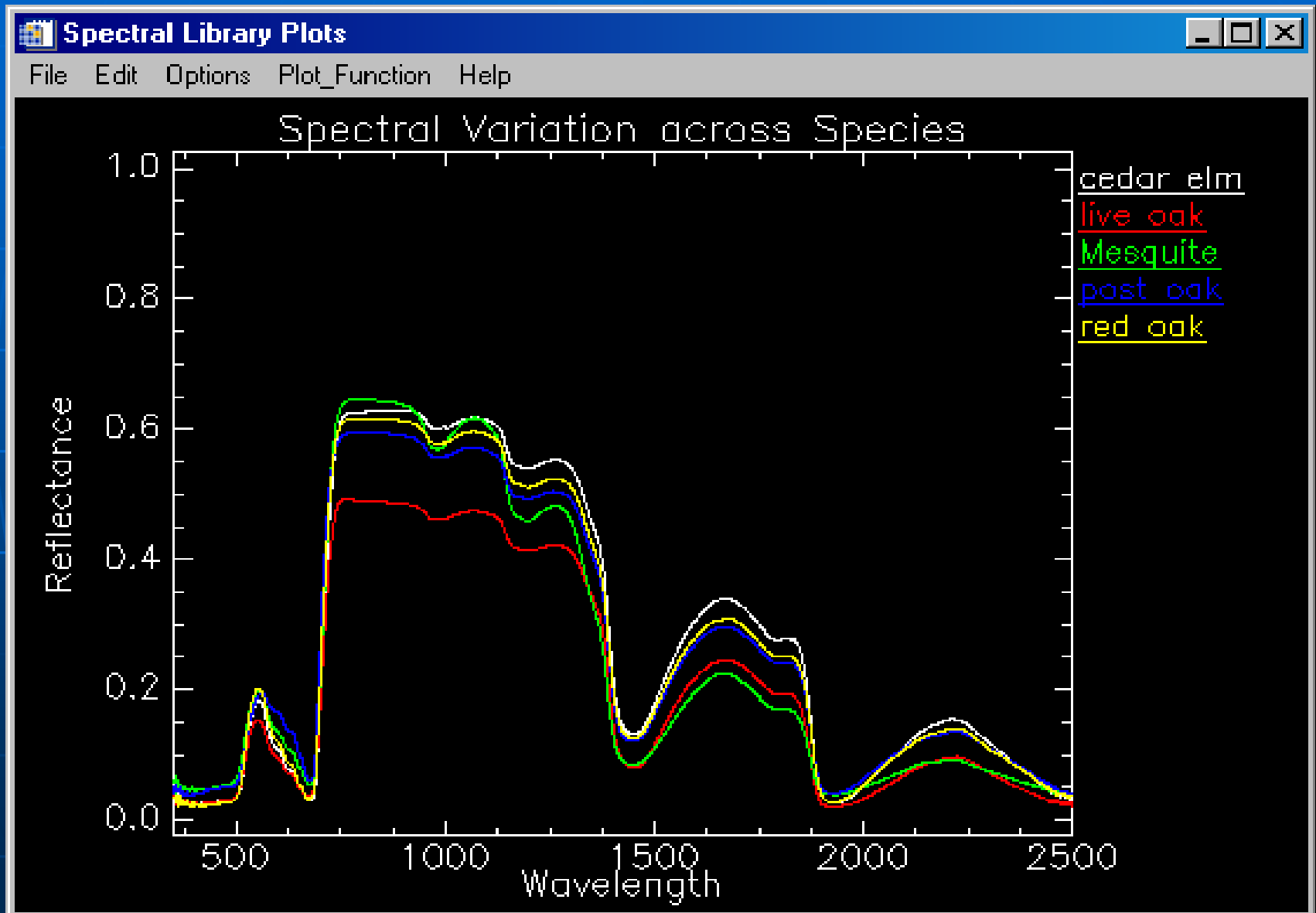
Reflectance spectra



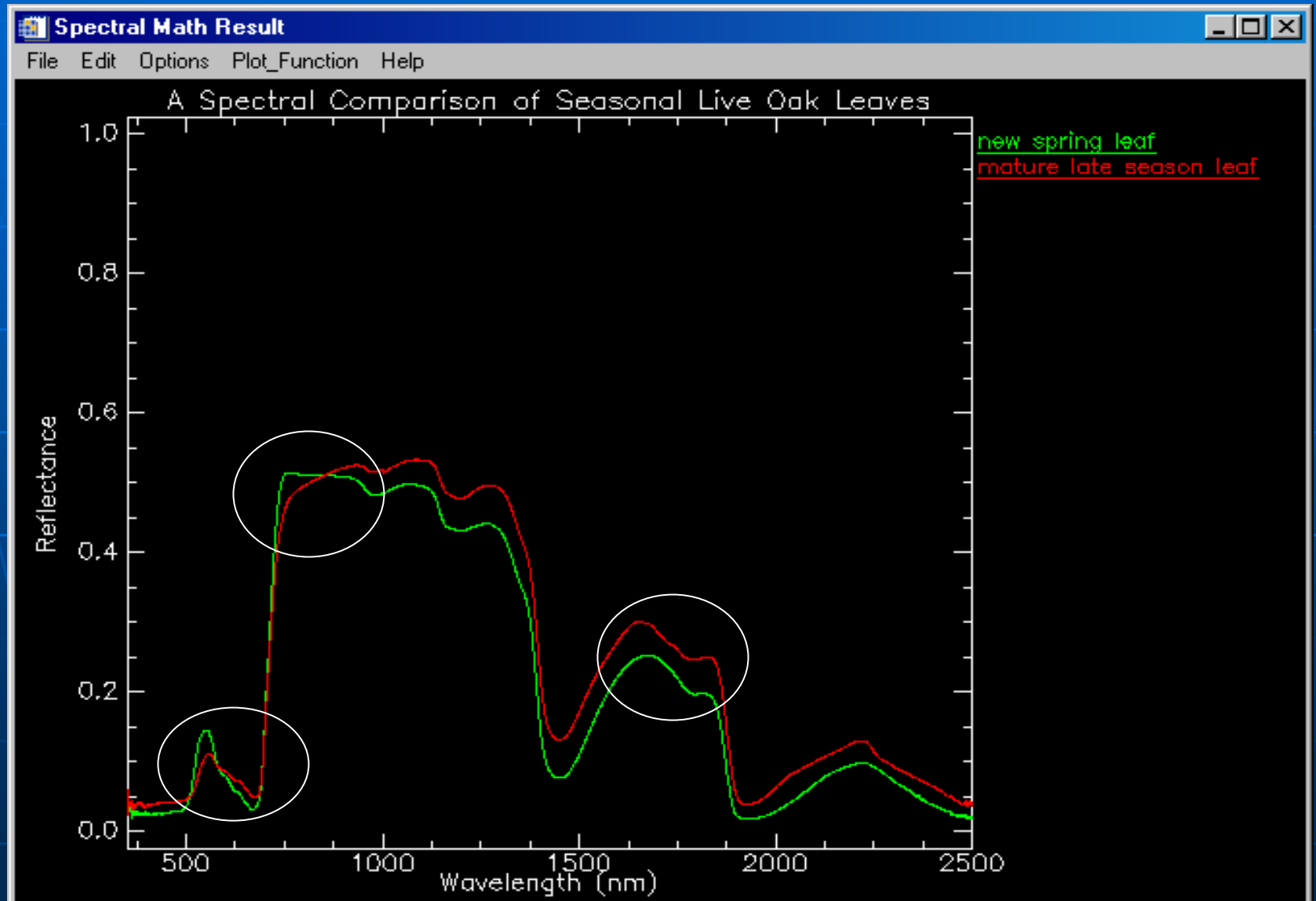
Variation within species



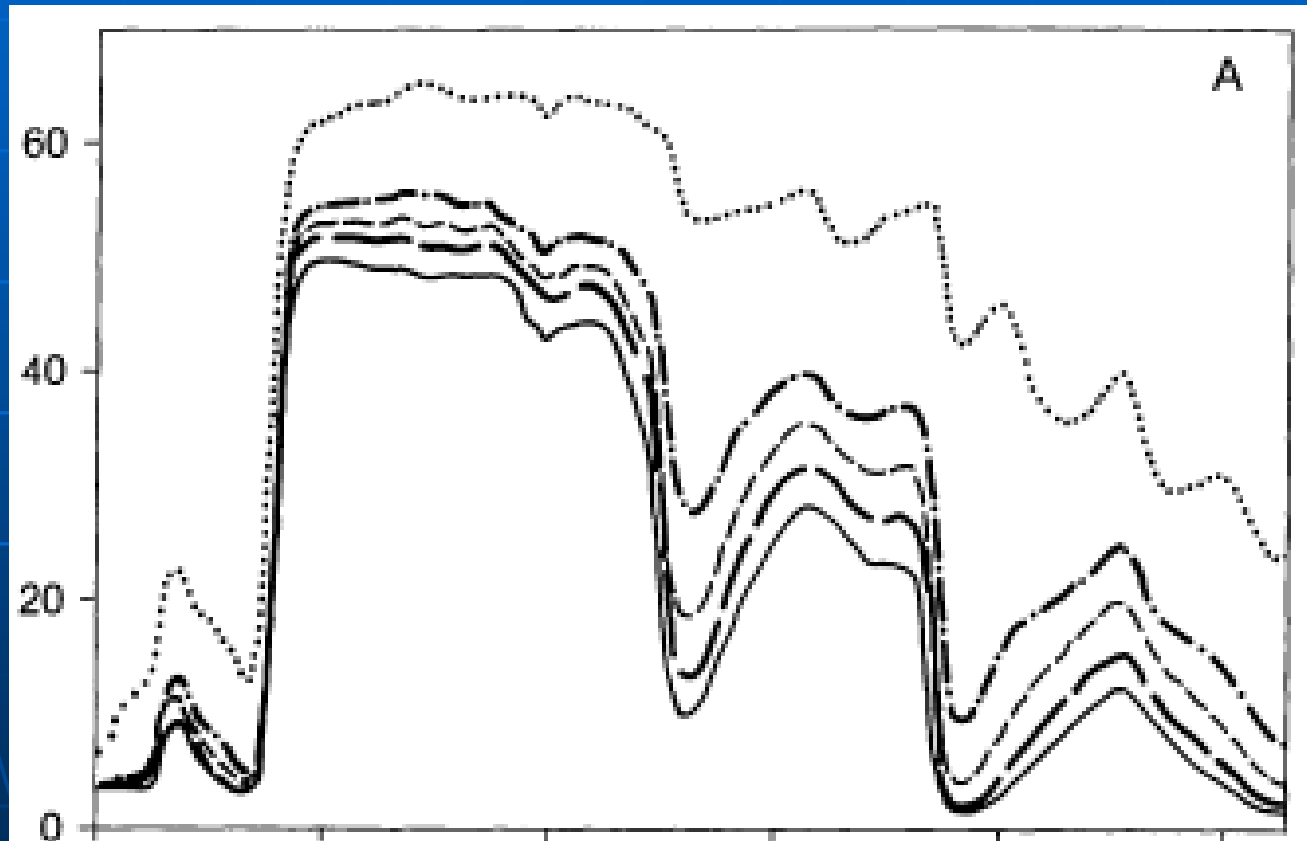
Variation across species



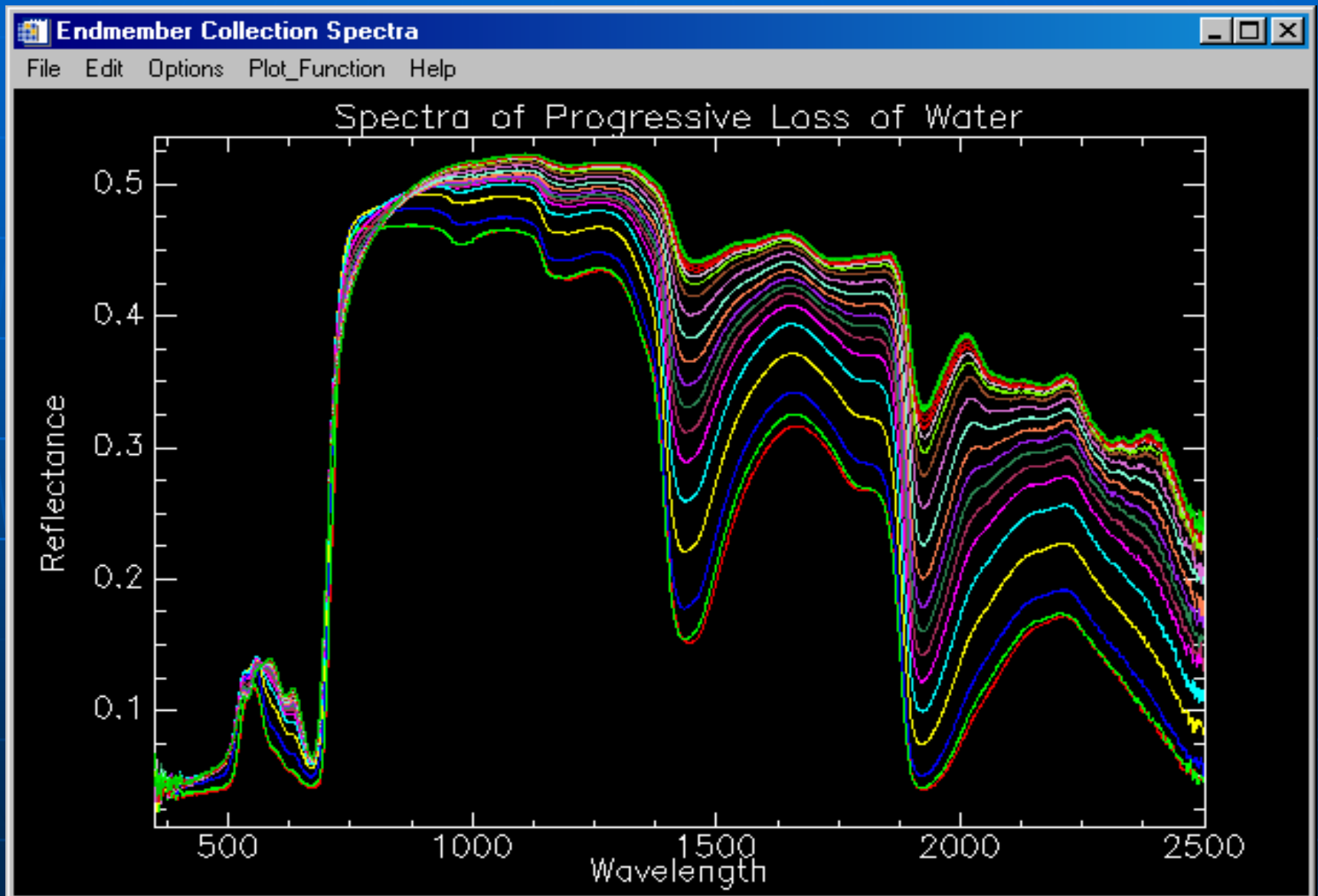
Phenologic influences



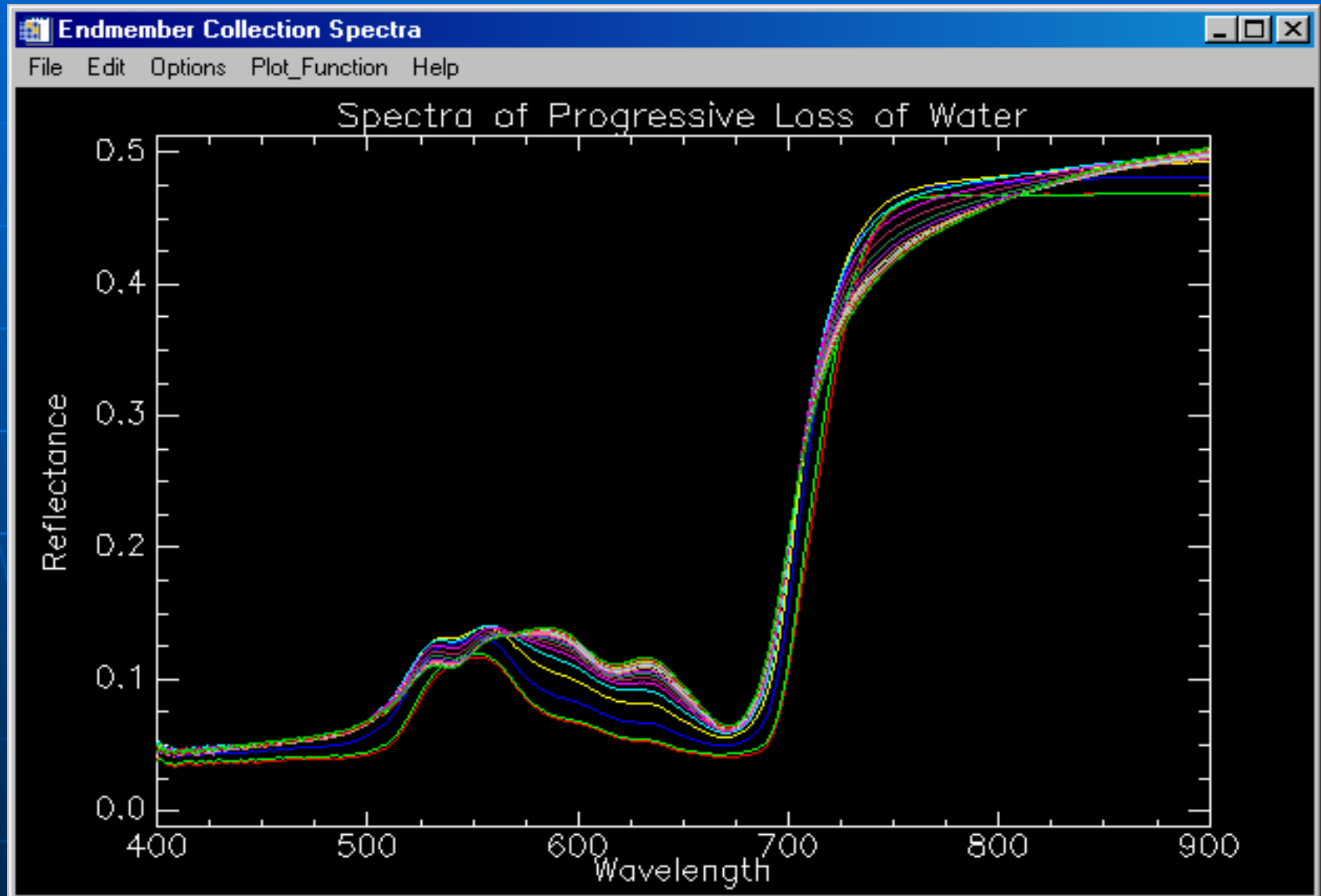
Response of leaf reflectance to decreased water content for the adaxial surface of *Magnolia grandiflora*



Effects of water loss



Effects of water loss cont.



Additive reflectance phenomena

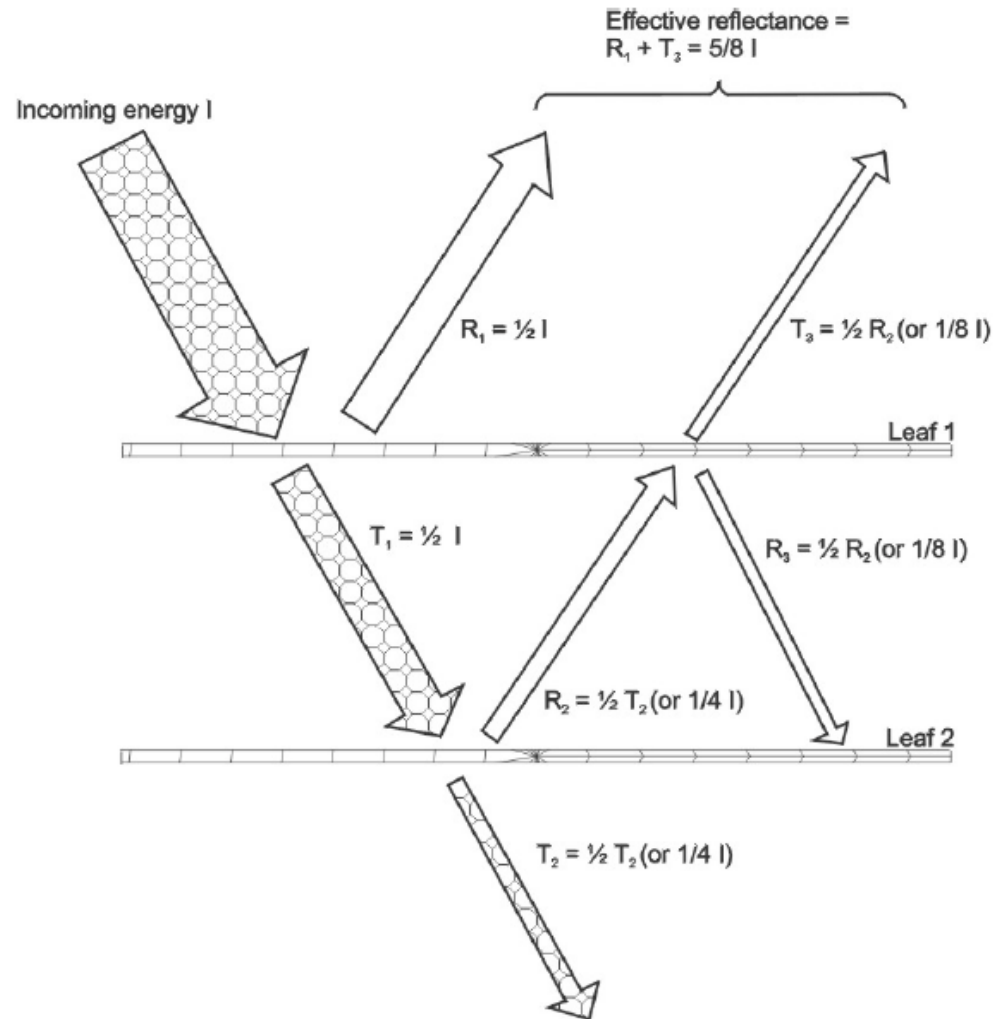
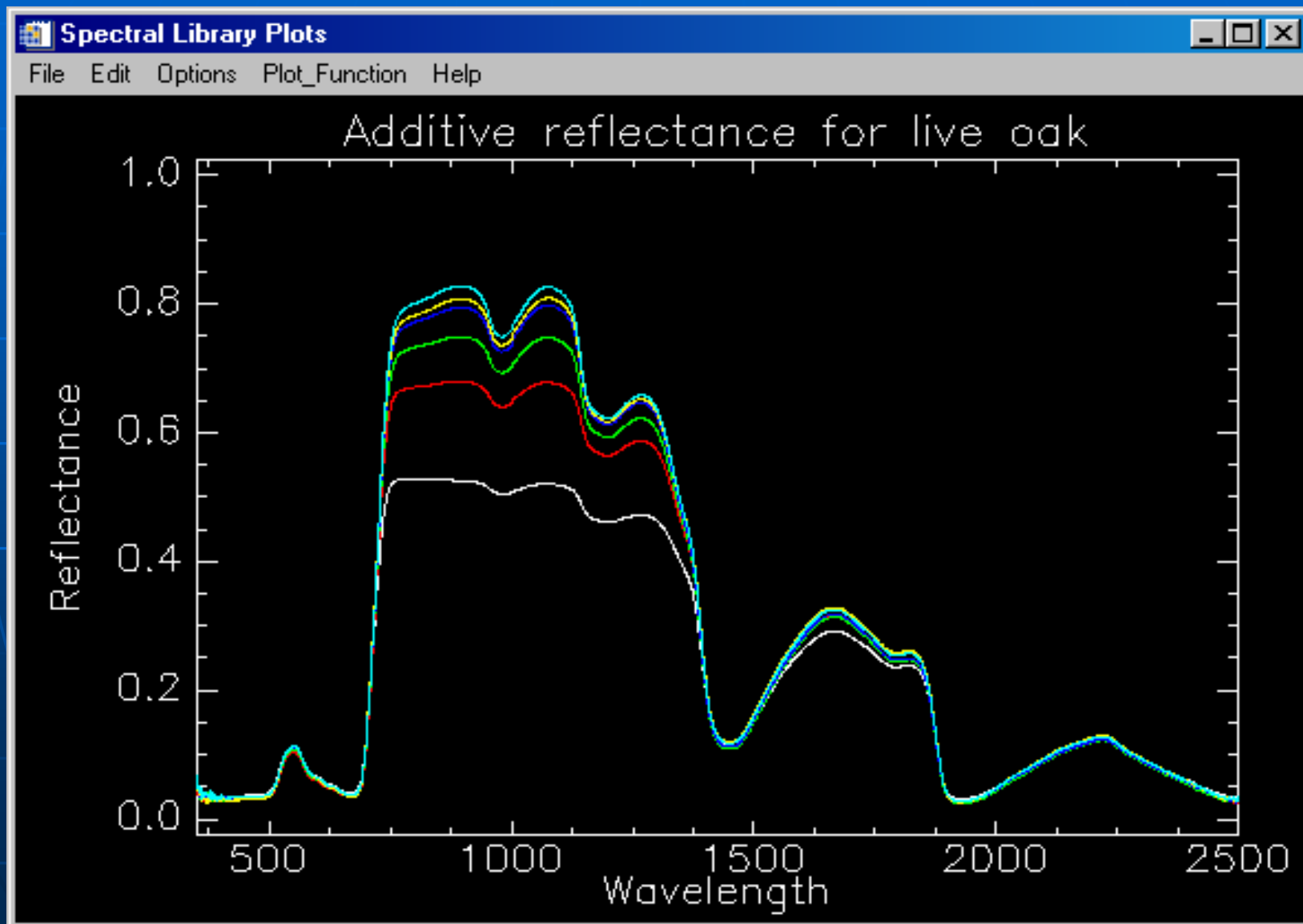
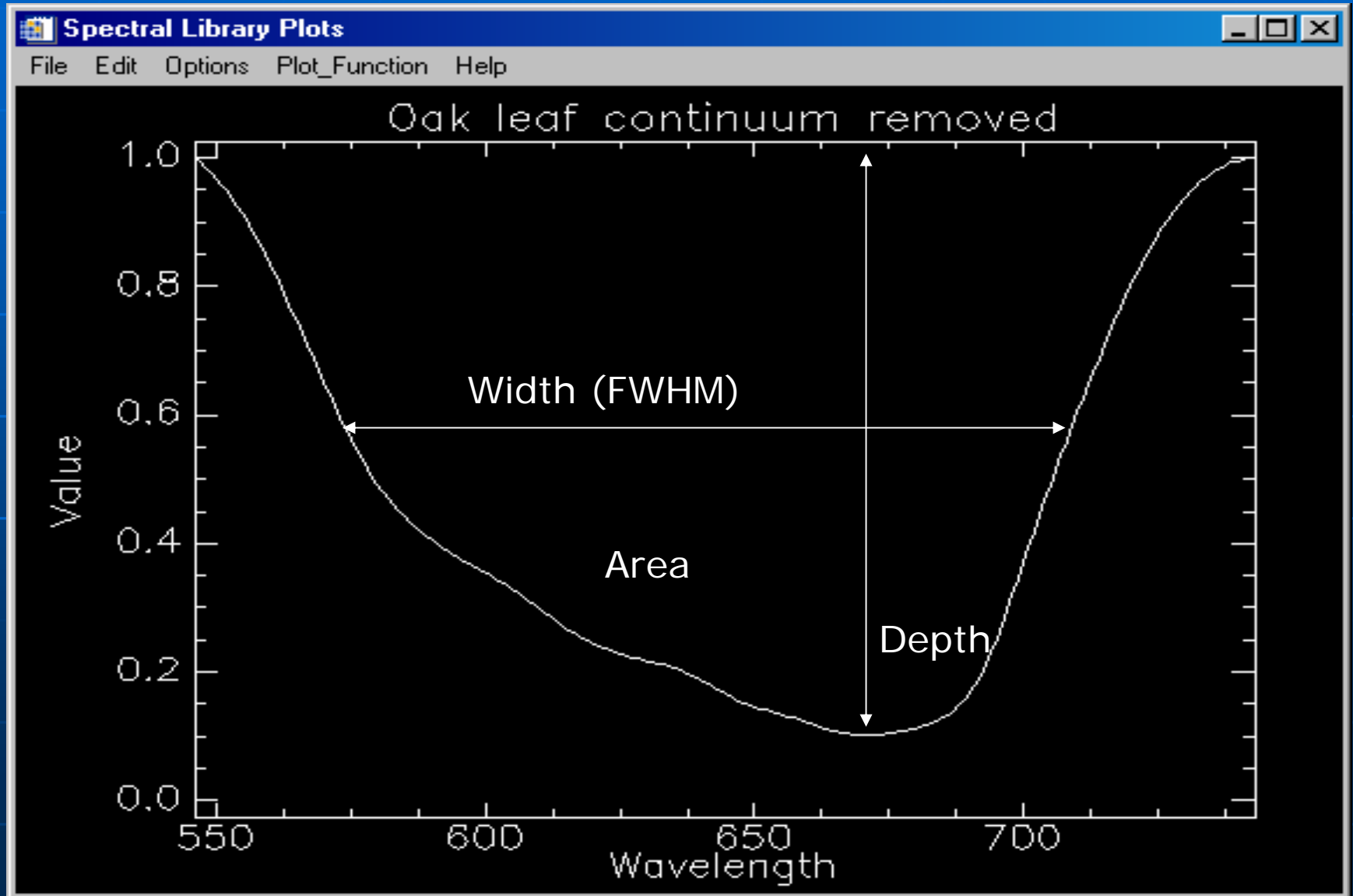


Figure 2. The effect of multiple leaf layers on the effective reflectance from vegetation. I = Incoming energy, T = Transmitted energy, R = Reflected energy (Adapted from Hoffer, 1978).

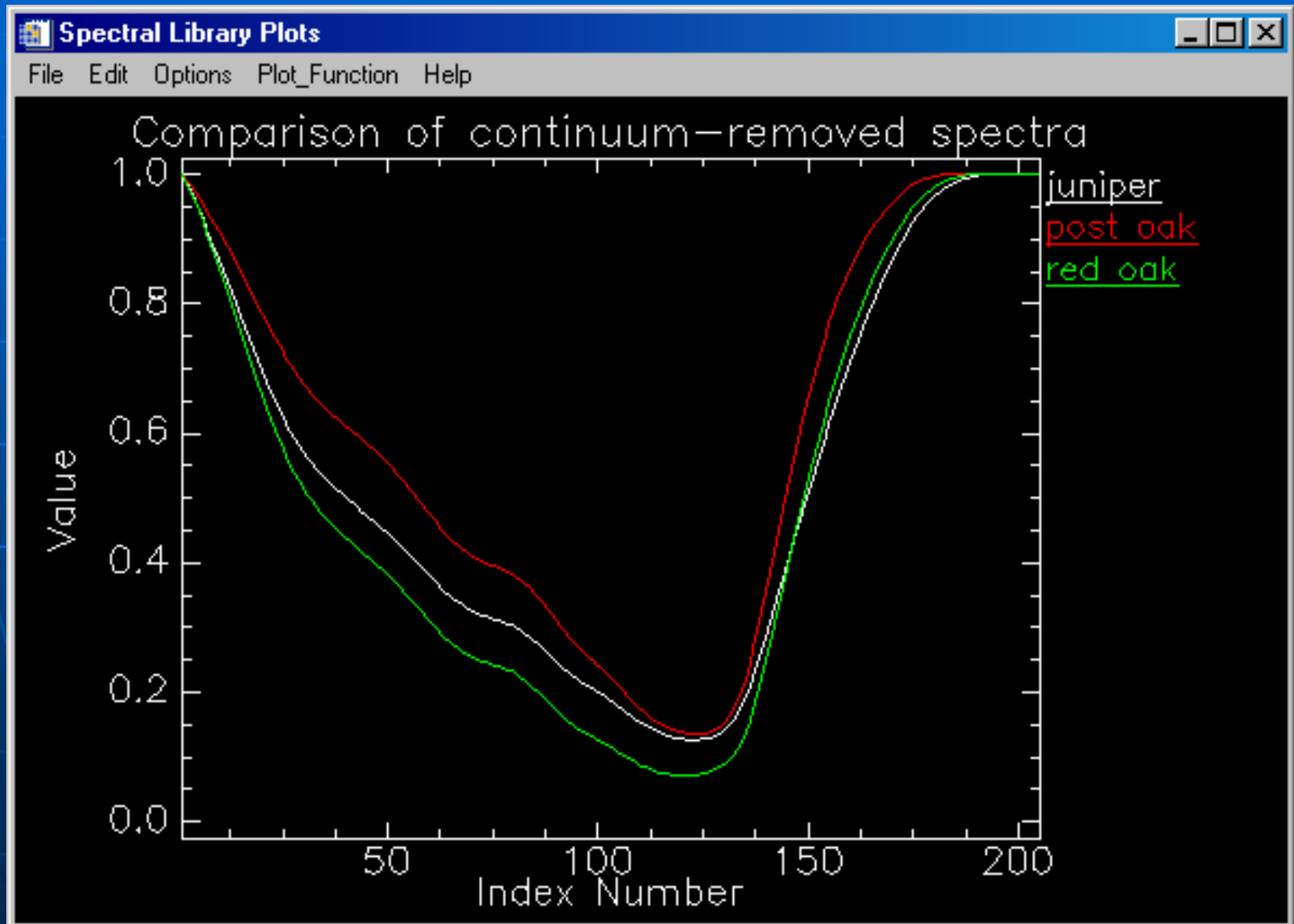
Effects of additive reflectance



Chlorophyll absorption trough continuum removal



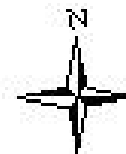
Continuum-removed comparison



Future work

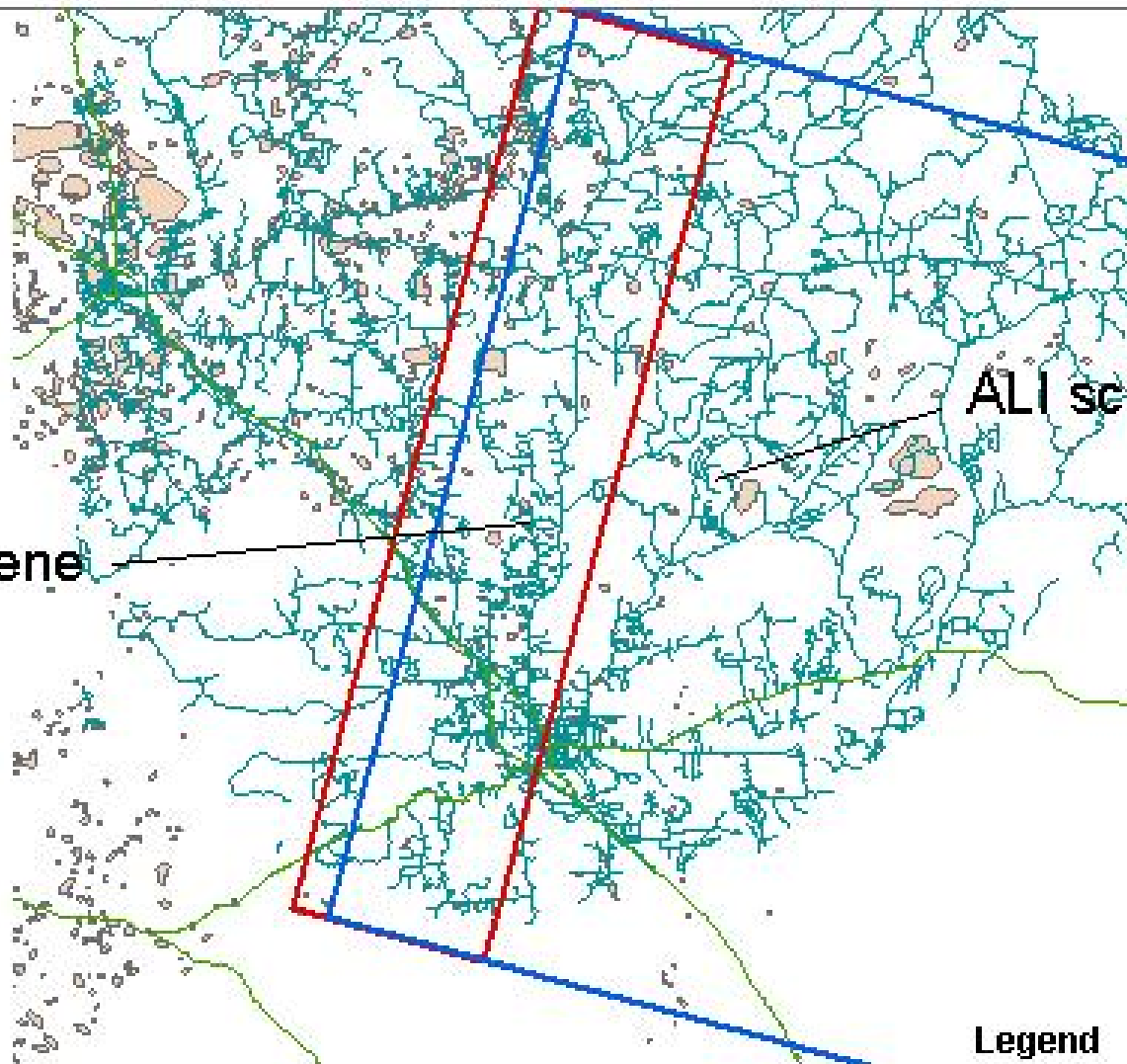
- Start controlled inoculation experiment with 20 live oak saplings
 - Analysis of spectral leaf reflectance
 - Detection of an infection stress signal
 - Crossed design with inoculant and water regimen treatments
- Acquire hyperspectral (Hyperion) data in June
- Begin spectral field sampling of an oak wilt disease center (summer)

Current Oak Wilt Mortality Centers and Planned Hyperion/ALI Image Acquisitions



Hyperion scene

scene center
-98.744195
29.894957



ALI scene

Legend

- Texas_rd
- mortality

Questions?