Vascular physiology and anatomy of different avocado genotypes relative to laurel wilt susceptibility

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Background

• Avocado trees appear to be less susceptible to laurel wilt than native forest tree species in the laurel plant family

• Differential susceptibility exists among Mexican (M), Guatemalan (G) and West Indian (WI) avocado races

• Susceptibility to laurel wilt appears to be related to the rate of xylem sap flow

• Xylem sap flow is influenced by tree vigor and xylem anatomy
Xylem Sap Flow and Disease Severity of Different Avocado Cultivars
Relative differences in xylem vessel size among avocado races

From: Robert Blanchette & Garret Beier, U. Minn.
https://drive.google.com/file/d/0B5KhAyErEeAZaFo2T0NSR3VRcVU/view

Samples collected by Randy Ploetz

\begin{figure}
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\begin{subfigure}{0.3\textwidth}
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\includegraphics[width=\textwidth]{image1}
\caption{\textit{Simmonds''(WI)}
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\begin{subfigure}{0.3\textwidth}
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\includegraphics[width=\textwidth]{image2}
\caption{\textit{Nabal''(G)}
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\begin{subfigure}{0.3\textwidth}
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\includegraphics[width=\textwidth]{image3}
\caption{\textit{Egas''(M)}
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Anatomical responses

SEM showing tyloses in xylem vessels of inoculated ‘Waldin’ avocado tree
Leaf gas exchange Analyzer

- Net photosynthesis
  Net CO$_2$ assimilation (A)
- Stomatal conductance (gs)
- Transpiration (E)
- Water use efficiency (WUE)

Indicates of plant stress prior to any visible symptoms
Net photosynthesis and disease severity of different avocado cultivars
Chlorophyll fluorescence meter

Chlorophyll fluorescence (Fv/Fm): measure of plant stress (damage to photosynthetic apparatus)
Objectives

1. To Investigate the relative susceptibility to laurel wilt between susceptible forest trees species and avocado trees in relation to plant physiology and anatomy

2. To Investigate the relative susceptibility to laurel wilt among different avocado races (rootstocks and scions) and rootstock/scion combinations in relation to plant physiology and anatomy
Materials and Methods

Compare physiology, anatomy, and susceptibility to laurel wilt among different species in the laurel family, avocado rootstocks, and rootstock/scion combinations

Expt. 1: Native forest species
- Red Bay
- Swamp Bay

Avocado
- Waldin Seedling

Expt. 2: Clonal avocado rootstocks
- West Indian (WI)
- Guatemalan (G)
- Mexican (M)

Expt. 3: Rootstock/scion combos
- WI/WI, G, M
- G/WI, G, M
- M/WI, G, M

Expt. 4: Clonal rootstocks
- Duke-7
- Dusa
- Toro Canyon

with WI, G and M scions
Inoculation

Six Replicates of each species will be inoculated with *Raffaelea lauricola*
Disease assessment

• External (daily)

• Internal sapwood discoloration (end of experiment)
Plant physiological measurements

- Xylem sap flow
- Chlorophyll fluorescence
- Leaf gas exchange
Root and Stem Hydraulic Conductivity

High pressure flow meter

![Image of high pressure flow meter]

![Graph showing stem hydraulic conductivity for inoculated and control conditions]
Xylem anatomy

1. Compare tyloses formation among species, races and cultivars
2. Compare xylem vessel size and potential hydraulic conductivity
3. Compare anatomical measurement of relative hydraulic conductivity with physiological measurements of hydraulic conductivity

Calculations from xylem vessel anatomy
- Vessel frequency and diameter
- Relative hydraulic conductivity, $RC = \frac{r^4}{VF}$
- Vulnerability index, $V = \frac{VD}{VF}$
- % Vessel occlusion = ($\#$ vessel tyloses / Total $\#$ vessels) $\times$ 100
Goals

• **Short Range:** Confirm the relationship between xylem sap flow, xylem anatomy and disease susceptibility

• **Medium Range:** Determine physiological and anatomical differences among avocado races that are associated with laurel wilt susceptibility

• **Long-Range:** Identify laurel wilt-tolerant avocado rootstocks and rootstock scion combinations
Thank you!

Questions?