Trunk Injection in Citrus – Compartmentalization of Wounds and the CODIT Concept

Ute Albrecht, Leigh Archer

University of Florida/IFAS

Southwest Florida Research and Education Center, Immokalee, FL

UF IFAS UNIVERSITY of FLORIDA

Funding

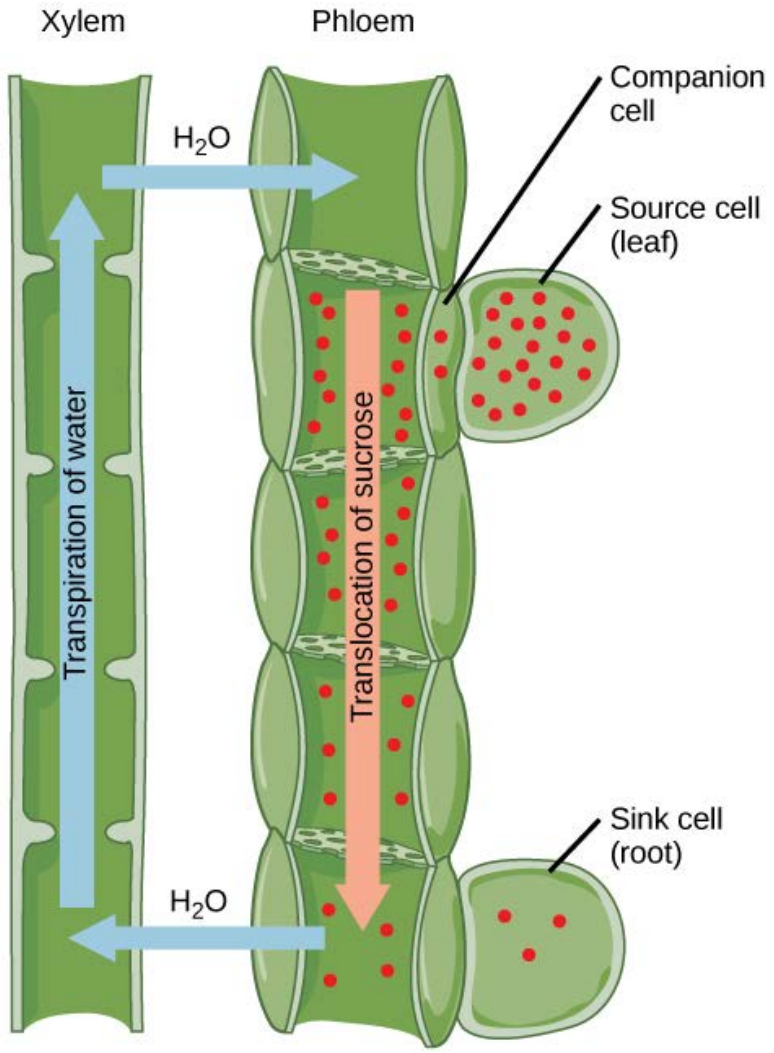
Development of an automated delivery system for therapeutic materials to treat HLB infected citrus

USDA-NIFA-SCRI #2019-70016-29096

Leigh Archer
(PhD candidate)

Trunk injection

- A targeted delivery of crop protection materials into the stem or trunk of a woody plant as an alternative to spraying or soil drenching (“endotherapy”)
- Injection occurs into the **xylem** from where the materials are then distributed throughout the plant with the transpiration stream



http://bio1520.biology.gatech.edu/nutrition-transport-and-homeostasis/plant-transport-processes-ii/

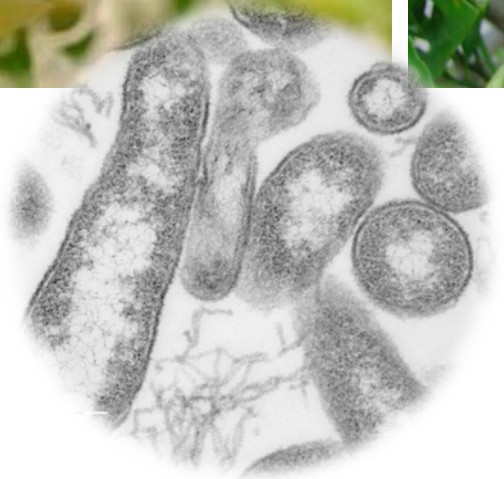
Advantages

- Precise delivery of materials
- Elimination of spray drift
- Reduced risk for worker exposure
- Reduced risk for non-target organisms
- Reduced pesticide load into the environment
- Potentially longer residual activity of materials

Mostly used on forest trees, ornamental trees, and non-bearing crops

Trunk injection – Citrus & HLB

CLas
→ phloem-limited



Martinez et al. 1970
Schwarz and Van Vuren 1970
Moll and Van Vuuren 1977
Chiu et al. 1979
Aubert and Bove 1980
Cheema et al. 1986
etc.

Hu and Wang 2016
Hu et al. 2018
Zhang et al. 2019
Li et al 2019
Li et al 2021

Field trials

Midsweet orange trees

(5-year-old)

Injections performed in Oct 2020:

1. Oxytetracycline (OTC)
2. Imidacloprid (IMI)
3. Water
4. No Injection

Injections were performed at recommended label rates using the arborjet, chemjets, and syringe (2 per tree on opposite sides).

Methods of injection

Arborjet

High pressure injection

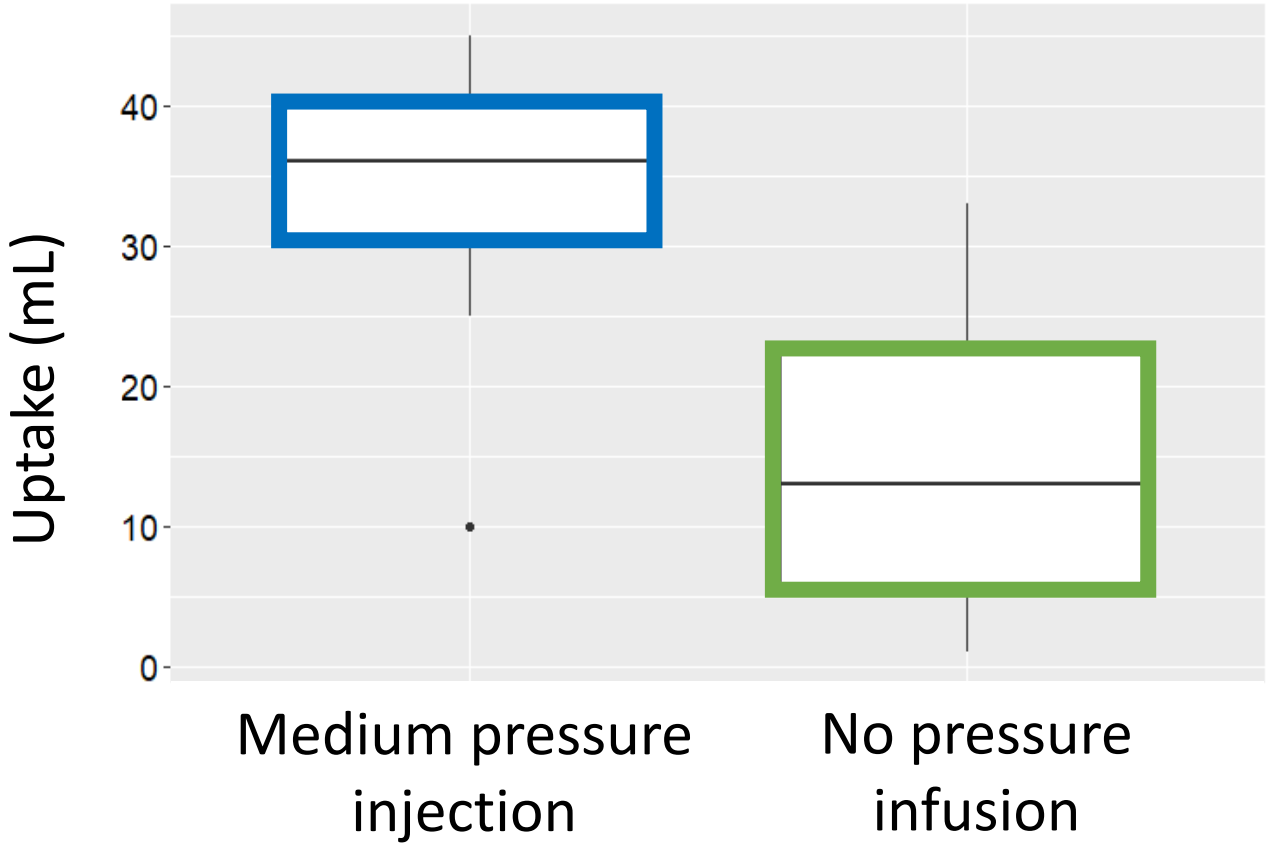
Chemjet

Medium pressure injection

Syringe

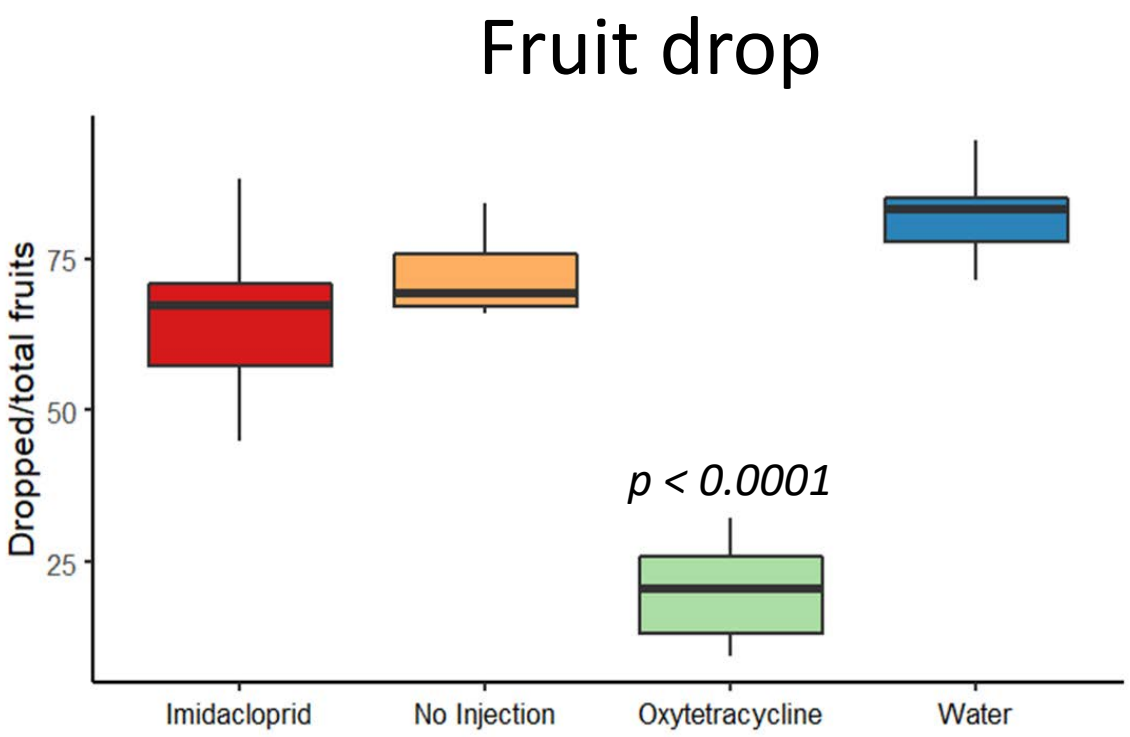
Low pressure infusion

Efficacy of injections



Low or no pressure infusion is not effective for efficient delivery of large volumes of liquid materials

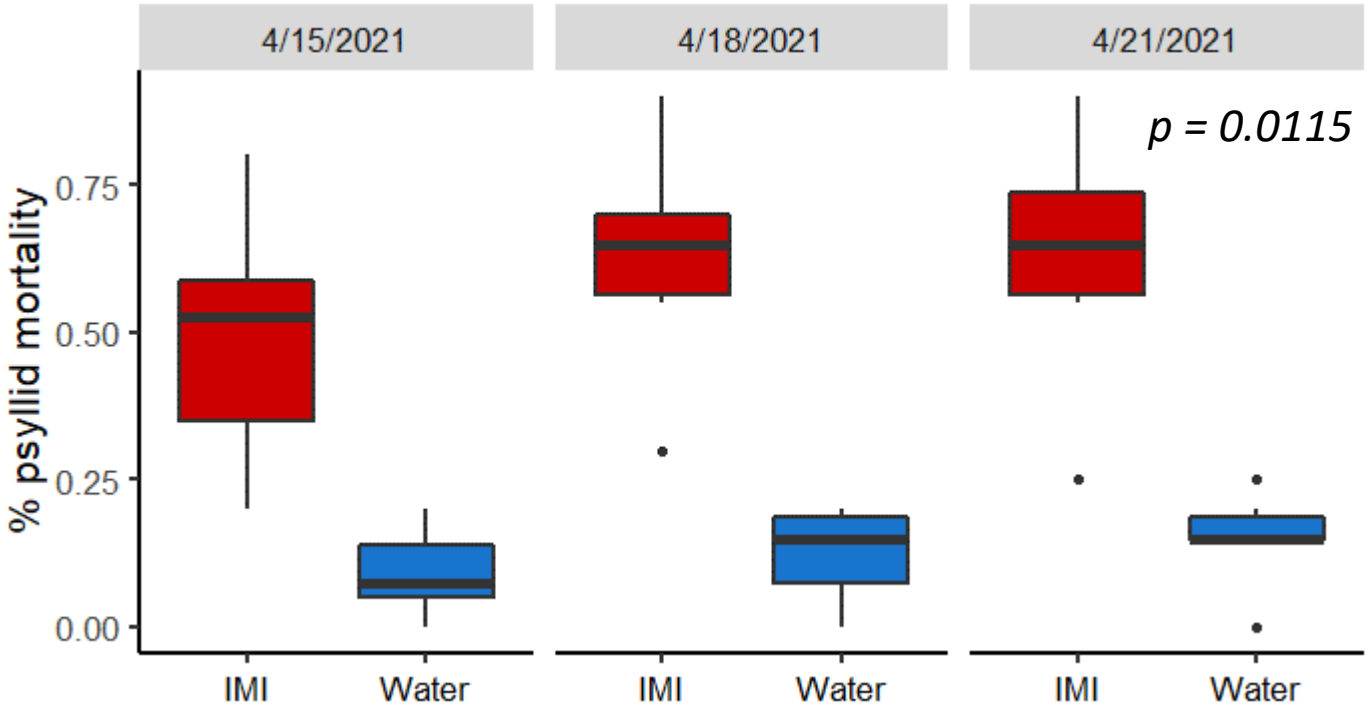
Efficacy of injections (OTC)



OTC injections improved tree health, reduced fruit drop dramatically and improved internal and external fruit quality

Efficacy of injections (IMI)

Psyllid mortality



IMI significantly increased psyllid mortality 10 days after injection, but effects did not persist after 30 days

Tree injury

Closed

Open

Mostly closed, but bark cracking

Open, bark cracking

Necrosis

Drill-induced wounding (no compounds injected)

Tree injury

HIGH PRESSURE INJECTION

Water

OTC

IMI

MEDIUM PRESSURE INJECTION

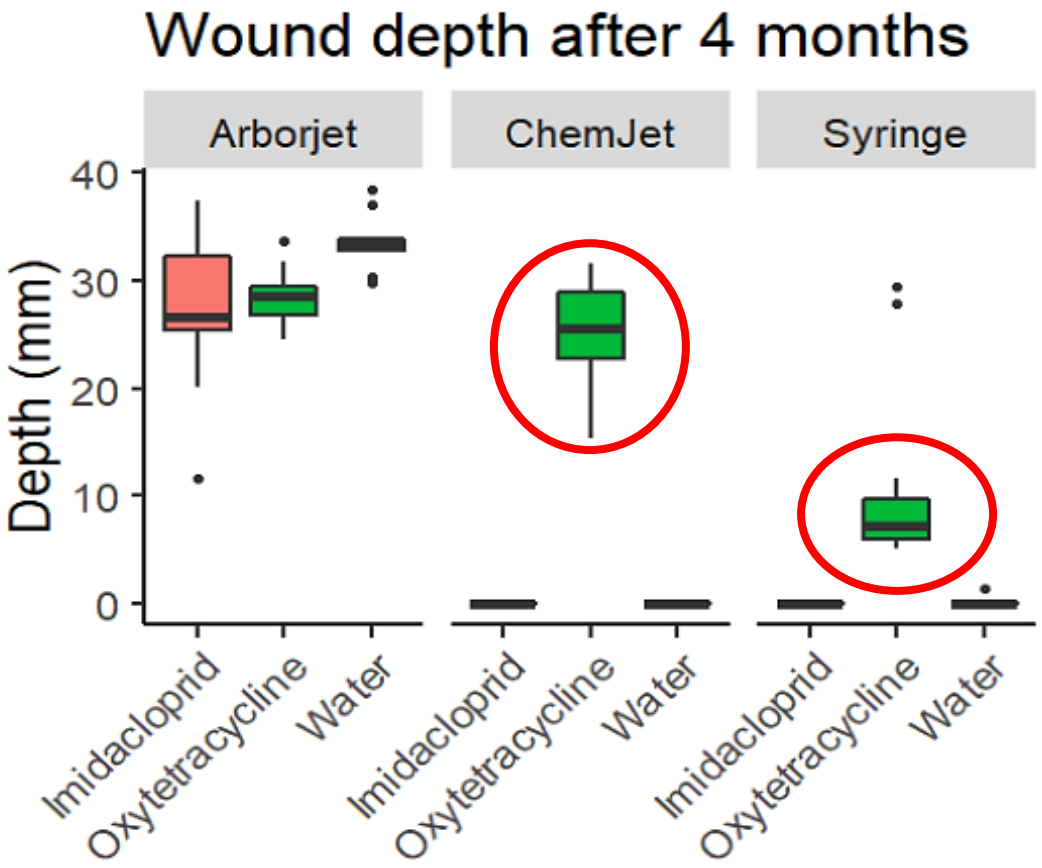
Water

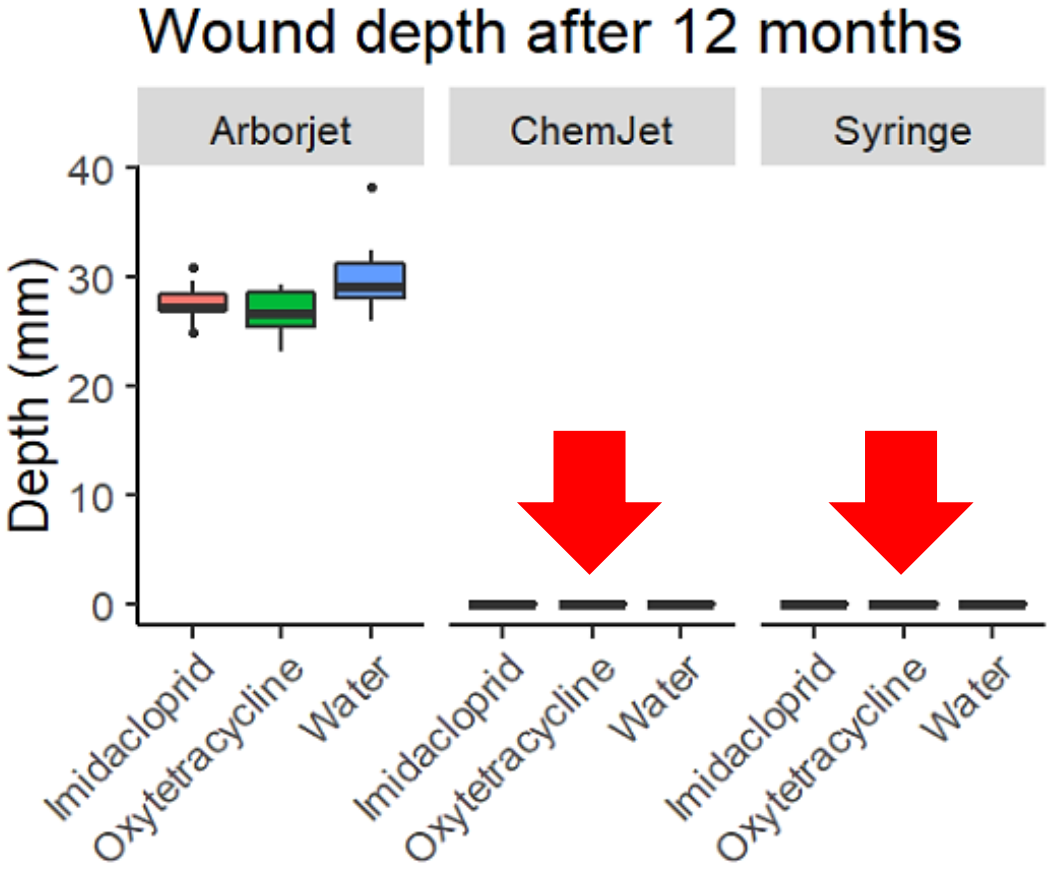
OTC

IMI

- Most tree injury with high pressure injection in combination with plugs
- Wound closure can be inhibited by the injected materials

Internal injury





Seasonal effects

JUNE

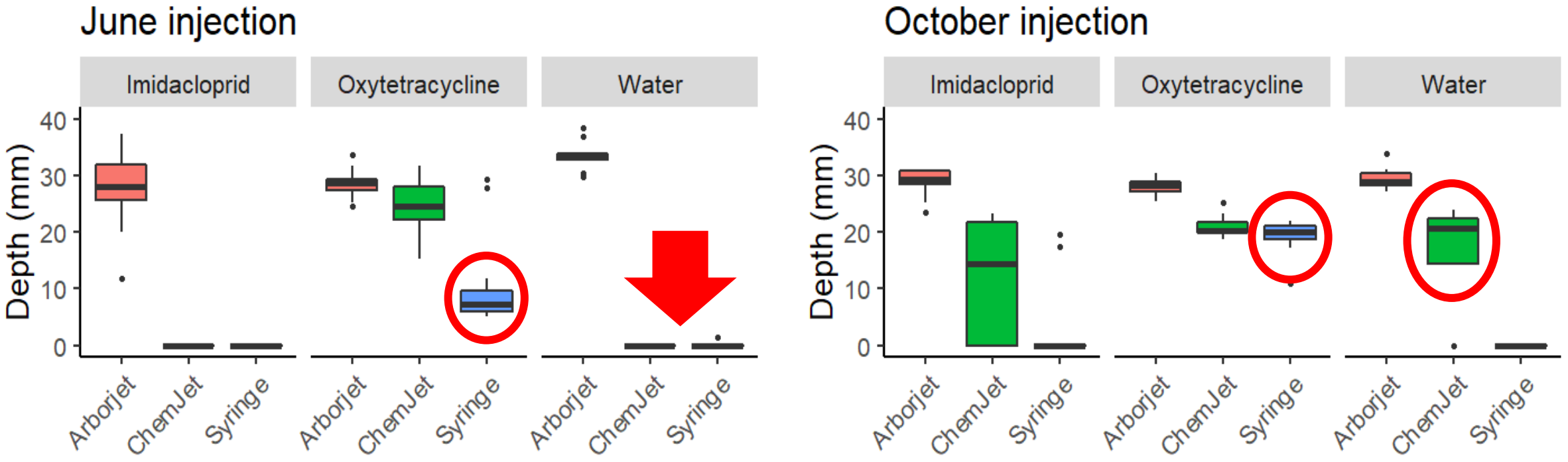
OCTOBER

Water Imidacloprid

Water Imidacloprid

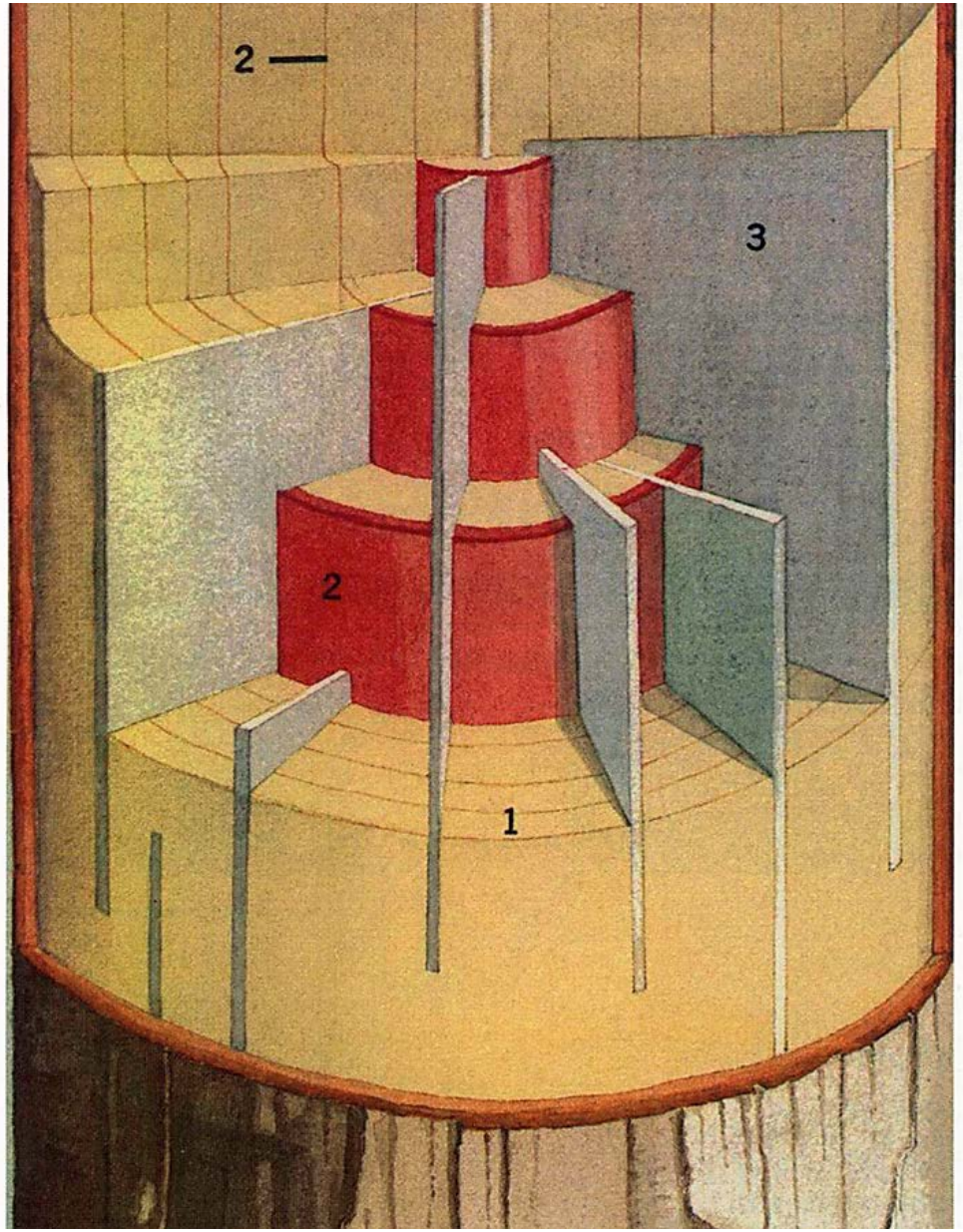
Syringe-induced wounding - wounds heal better in June

Seasonal effects



Wound depth was measured 4 months after injection

CODIT



Compartmentalization of Decay in Trees (CODIT)

Shigo and Marx (1977)

Part I

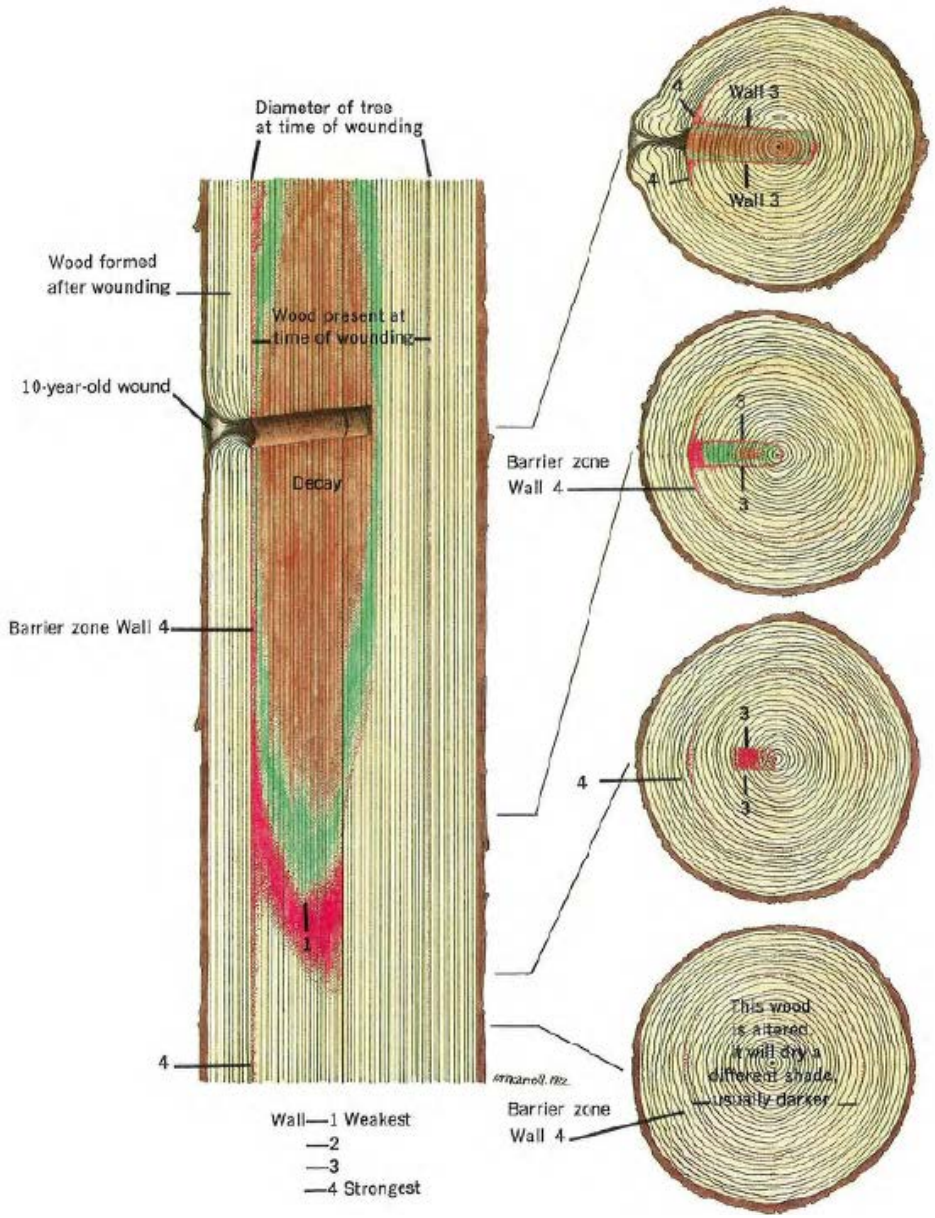
- o at wounding
- o reaction zones (walls 1-3)

Weak (wall 1)

Strong (wall 3)

Fig. 64: The CODIT Model depicts the tree as a chambered organism in which there are structural walls that can react to decay by compartmentalization. Wall 1 occurs in the axial direction. Wall 2 provides barriers in the radial direction (toward the center of the trunk) and wall 3 in the tangential direction (to the sides). In the model, wall 1 represents the weakest compartment and wall 3 is the strongest (Shigo & Marx 1977).

CODIT



Part I

- o at wounding
- o reaction zones (walls 1-3)

Part II

- o after wounding
- o barrier zone (wall 4)

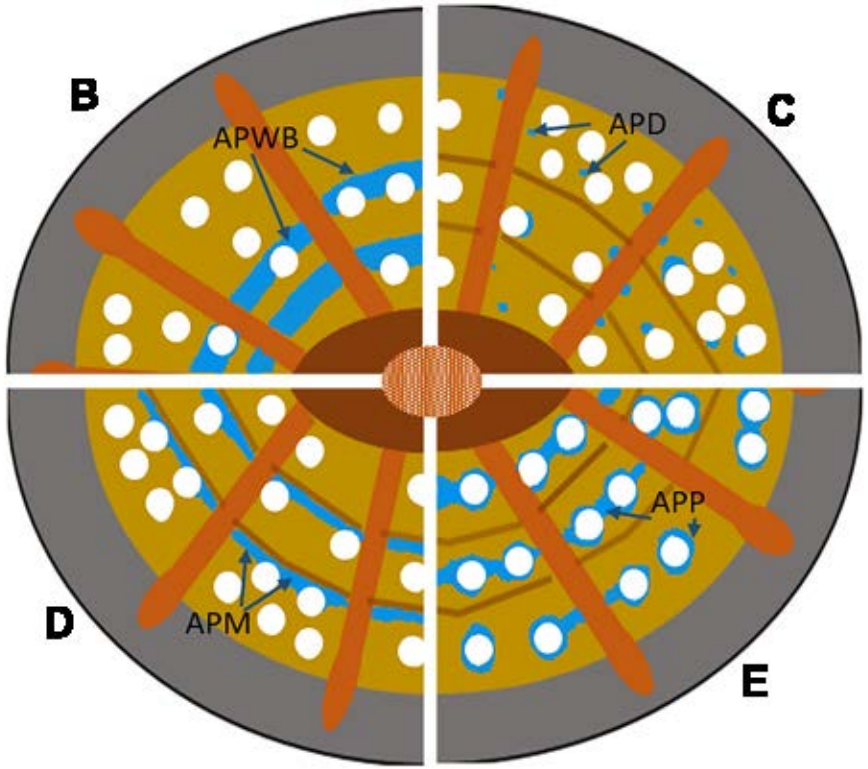
Weak (wall 1)

Strong (wall 3)

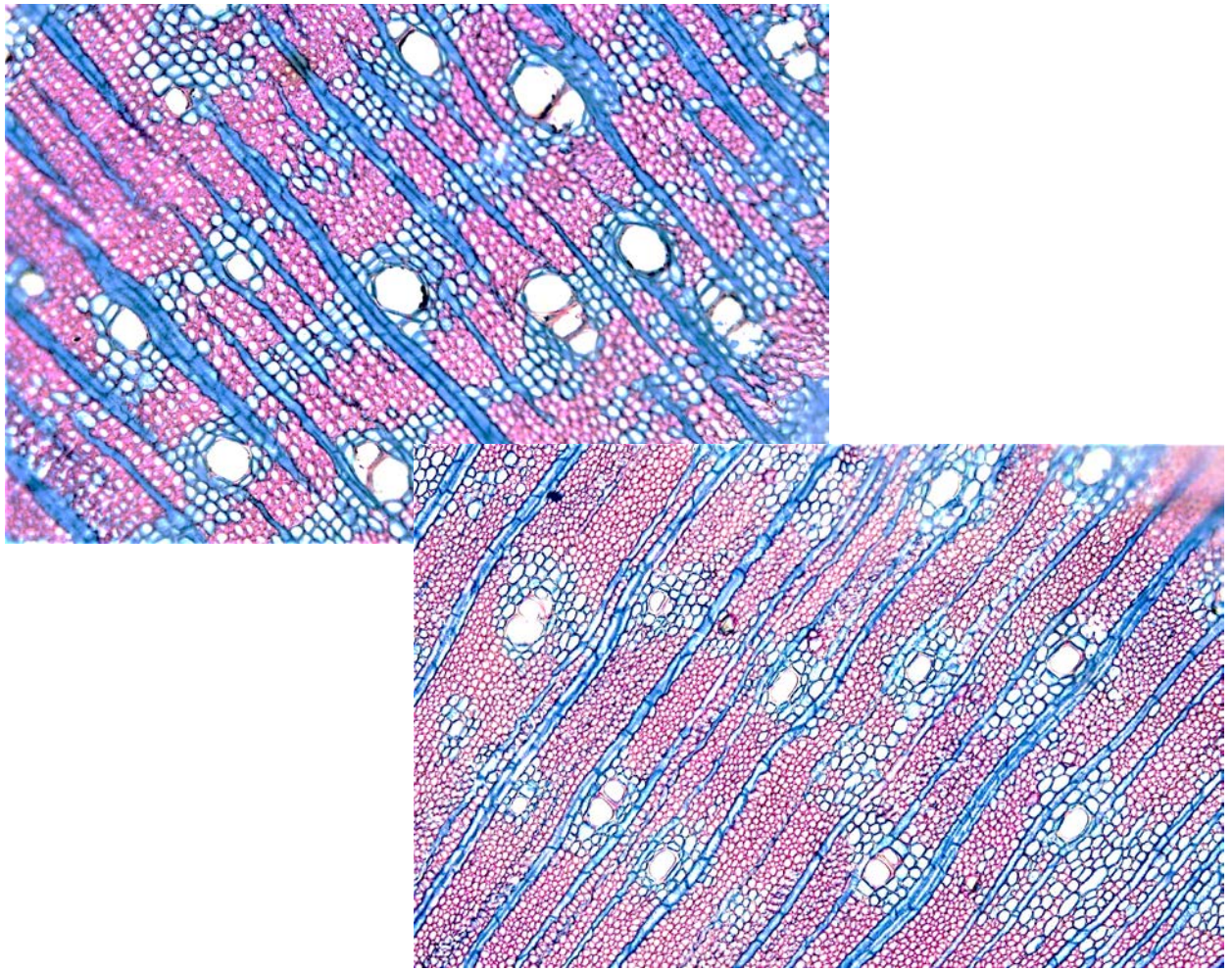
Strongest (wall 4)

Shigo and Marx (1977)

CODIT

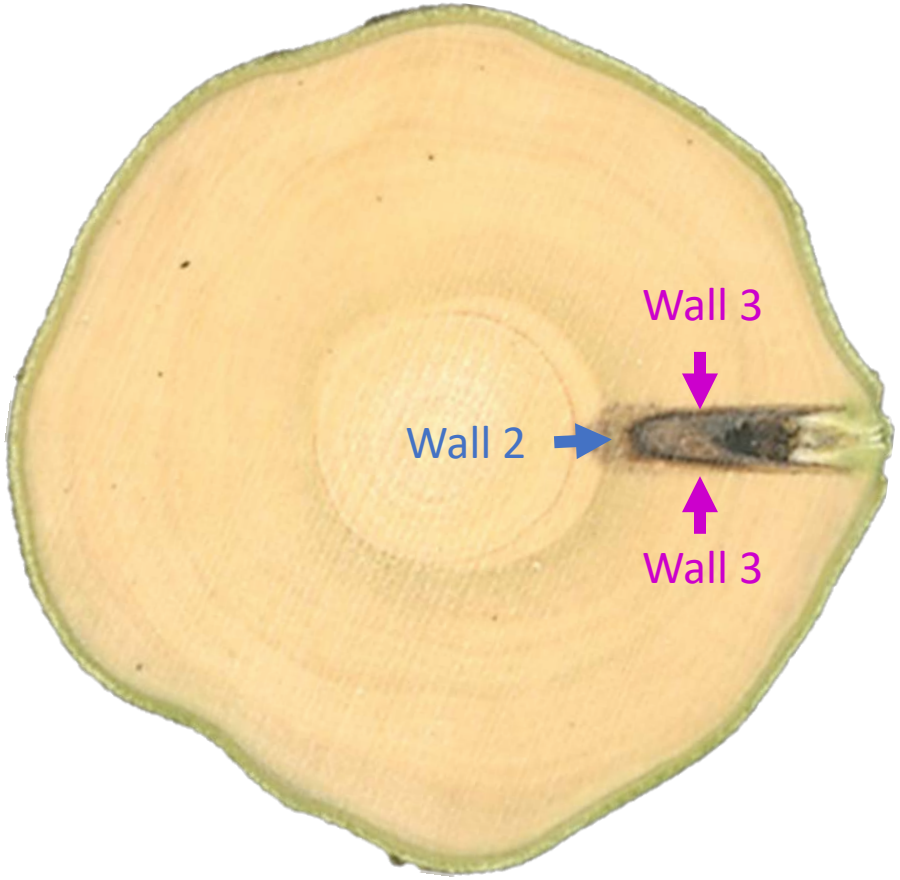


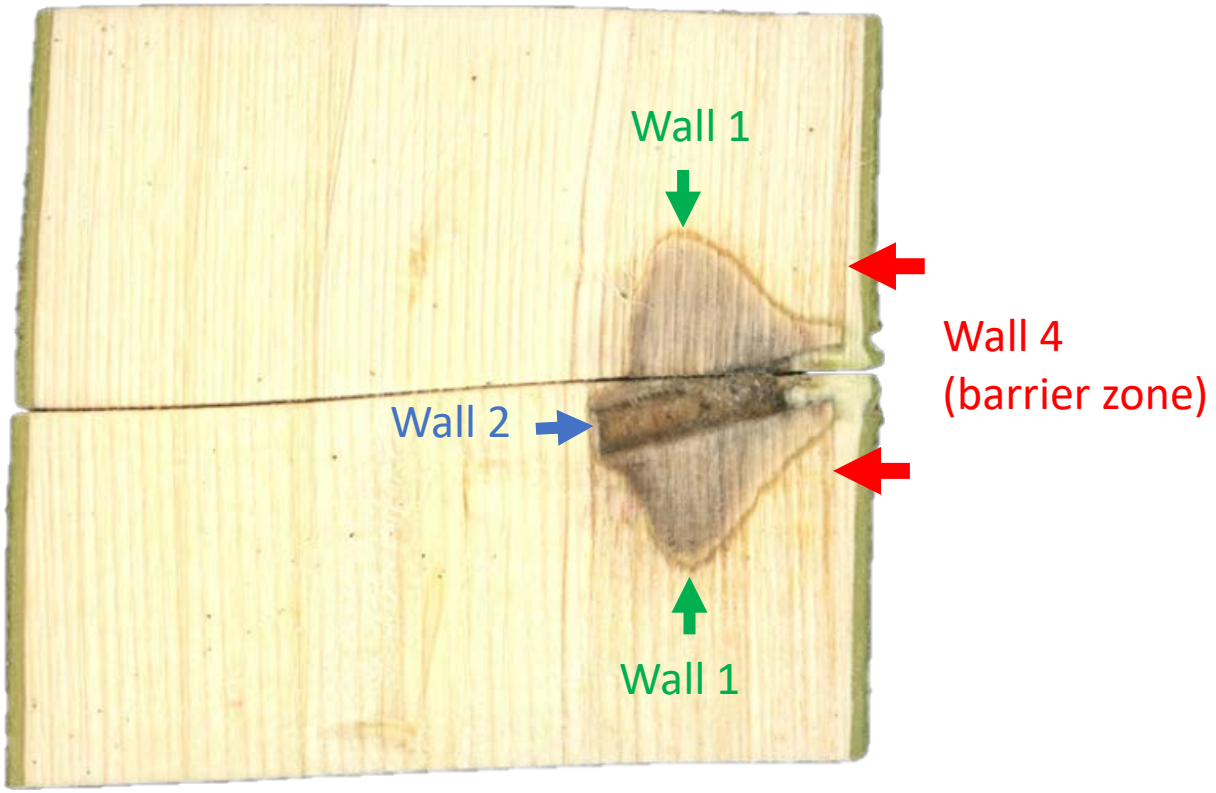
Morris et al. 2016
Front. Plant Science 7:1665



→ Importance of parenchyma cells in defense of decay

Tree injury

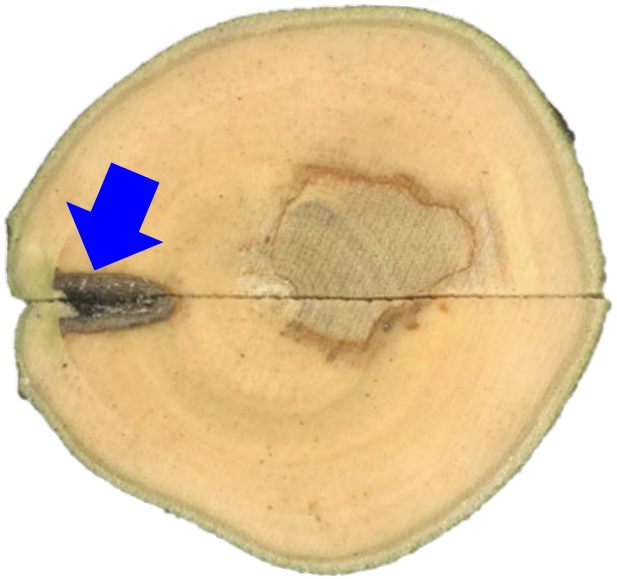


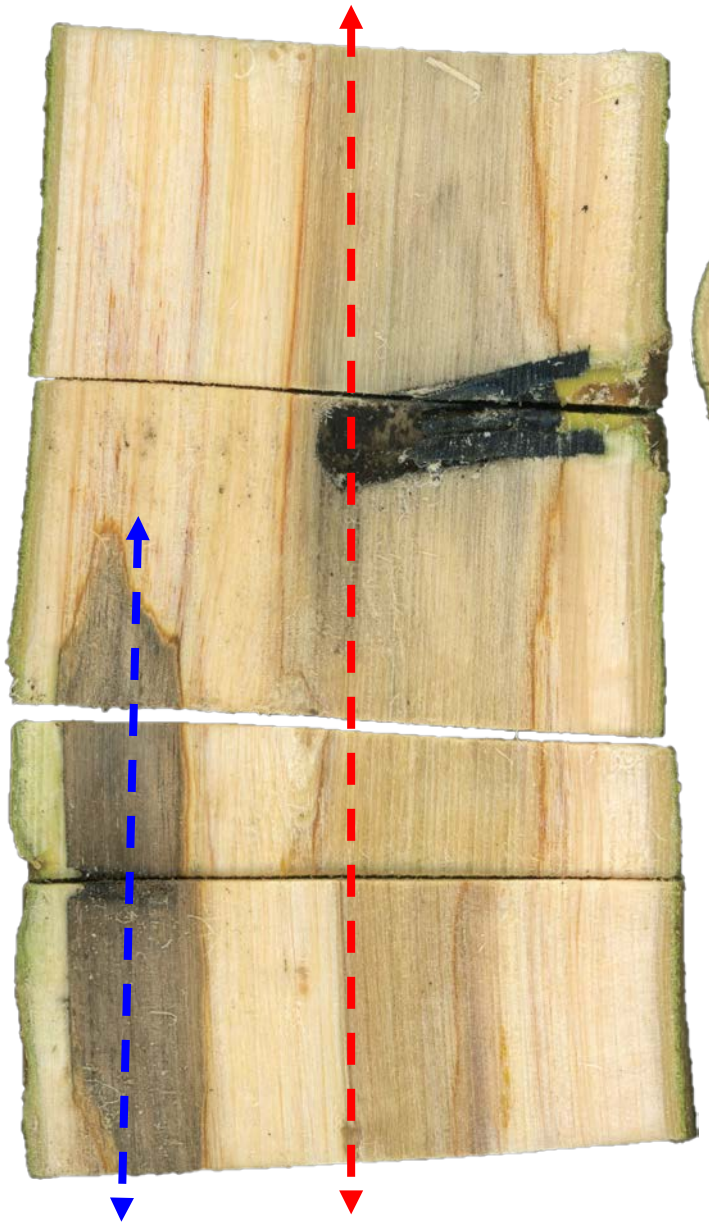


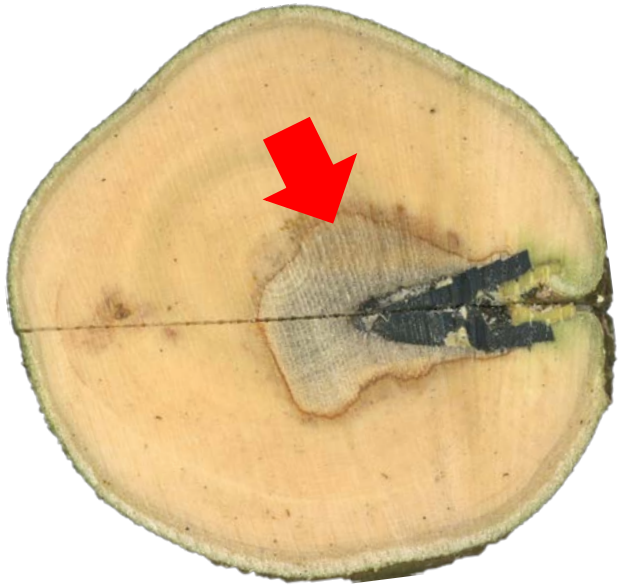
Citrus trees effectively compartmentalize wounds generated by medium/low pressure injection of water

Tree injury

Medium pressure
injection of
oxytetracycline
(no plug)







High pressure
injection of
oxytetracycline
(with plug)

Summary

- Trunk injection can effectively and systemically deliver crop protection materials to target pests and diseases of citrus
- Citrus trees can effectively compartmentalize wounds
- Injected compounds can be phytotoxic and inhibit effective compartmentalization of wounds
- Wound healing is better in the spring
- Long-term effects on tree health need to be established

Questions

Ute Albrecht

UF/IFAS, Southwest Florida Research and Education Center

ualbrecht@ufl.edu

UF IFAS
UNIVERSITY of FLORIDA