Citrus Canker and Phytophthora Management

March 7, 2018; Workshop- Scouting and managing citrus diseases

SWFREC, Immokalee FL

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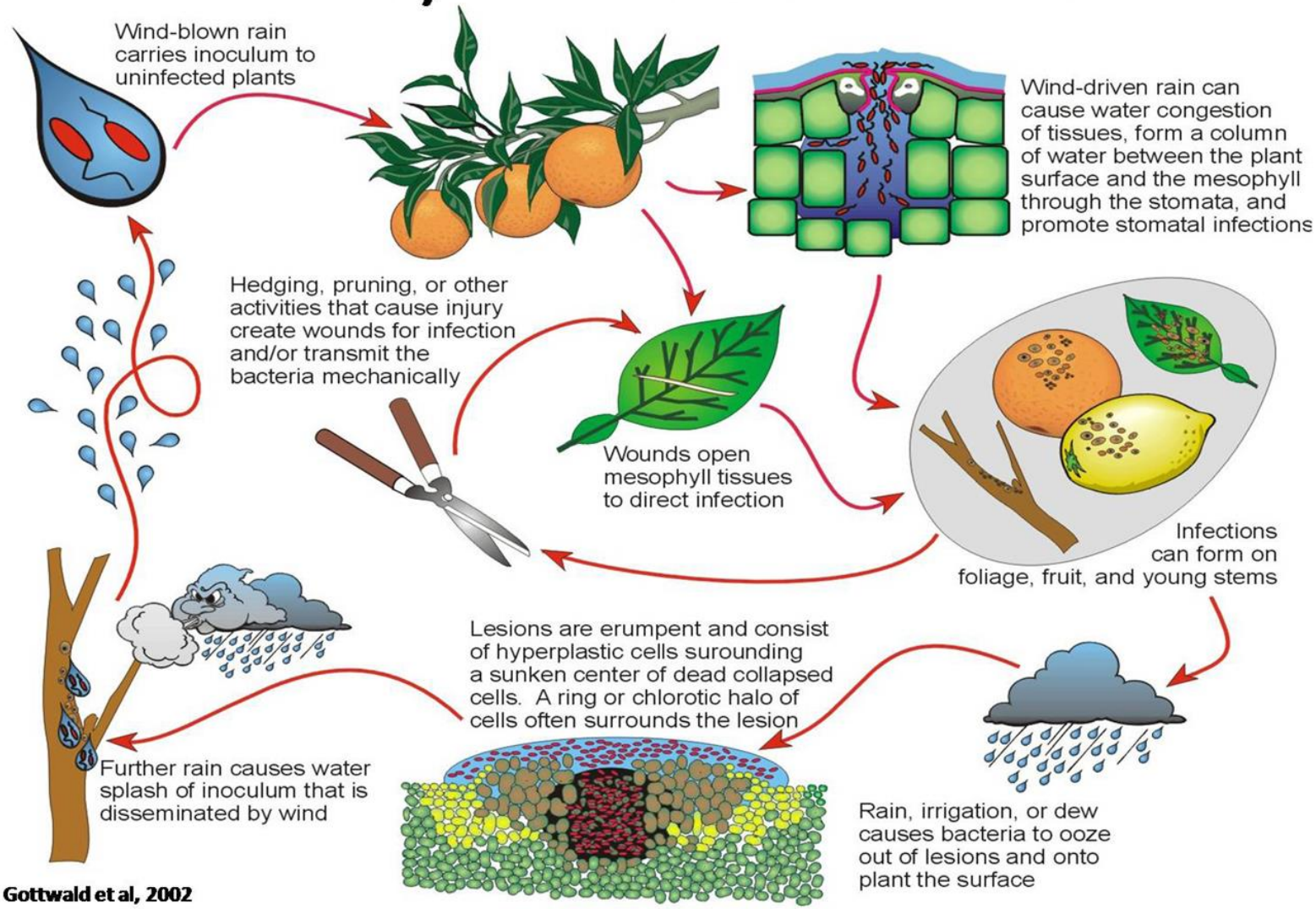
Outline

- Citrus Canker
  - Canker and early season fruit drop
  - Field trial results (Drs. Graham and Johnson)
  - How sprays of Streptomycin and Oxytetracycline for HLB affect canker management
- Canker treatment and timing
  - Copper model
  - Development of new management tools
- Phytophthora Management
  - Citrus diseases caused by Phytophthora
  - Cultural control and management
  - Interaction with HLB

Citrus Canker

- Caused by Gram-negative bacterium *Xanthomonas citri subsp. citri*
- The disease spreads by rain splash combined with wind and worsens by tropical storms and hurricanes
- Infects young leaves, fruit and stems
- Symptoms begin as small water-soaked lesions that develop over 2 weeks
- Large yellow halos develop on leaves and fruit
- Lesions are corky and erumpent
- Fruit most susceptible between 1 cm and ~4 cm diameter
- Disease results in premature fruit drop reducing yield

Life Cycle of Citrus Canker



Gottwald et al, 2002

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Fruit susceptibility to canker

- Early bloom may affect timing of susceptible fruit size
- Fruit most susceptible from 1 cm diameter until fruit reach ~4 cm diameter
- Rains in April, May or June promote early season infection
- The rind is susceptible throughout the entire period of fruit growth
- Rind becomes much more resistant when fruit > 4 cm diameter

Cu sprays at 21 day interval protect fruit beginning at 1 cm:

Spray volume and tractor speed important for fruit coverage

Why 21 day interval?

- Copper residue is significantly reduced by rain washing
- Copper does not move once dried
- Copper residue is cracked by fruit growth



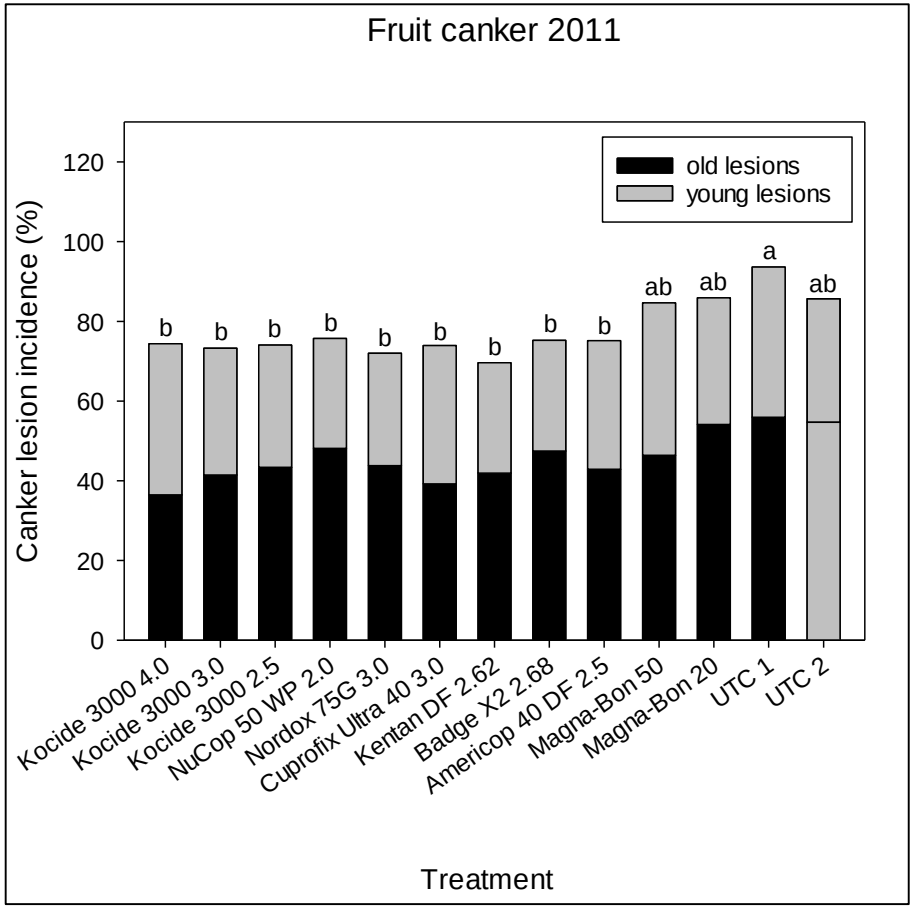


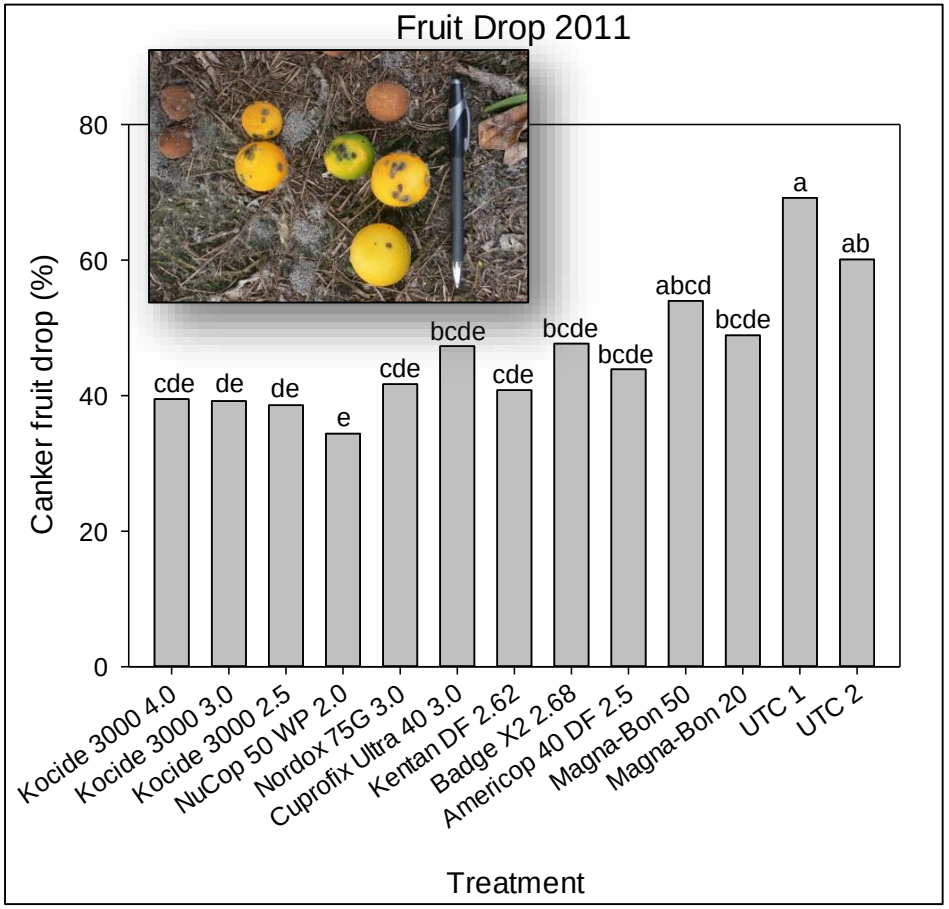
As the fruit grows, copper must be reapplied to continually cover the fruit as it becomes larger

Field Trials

- Drs. Graham and Johnson conducted these trails
- Evaluate copper sprays in relation to early season rains for control of fruit infection and drop in young fruiting Hamlin trees
  - Trial in a south central Florida citrus grove
- Compare soluble and fixed copper formulations for efficacy
- 2011 through 2015

In 2011, 9 sprays began 15 April (too late) ended 27 Sept in an attempt to reduce impact of the early epidemic





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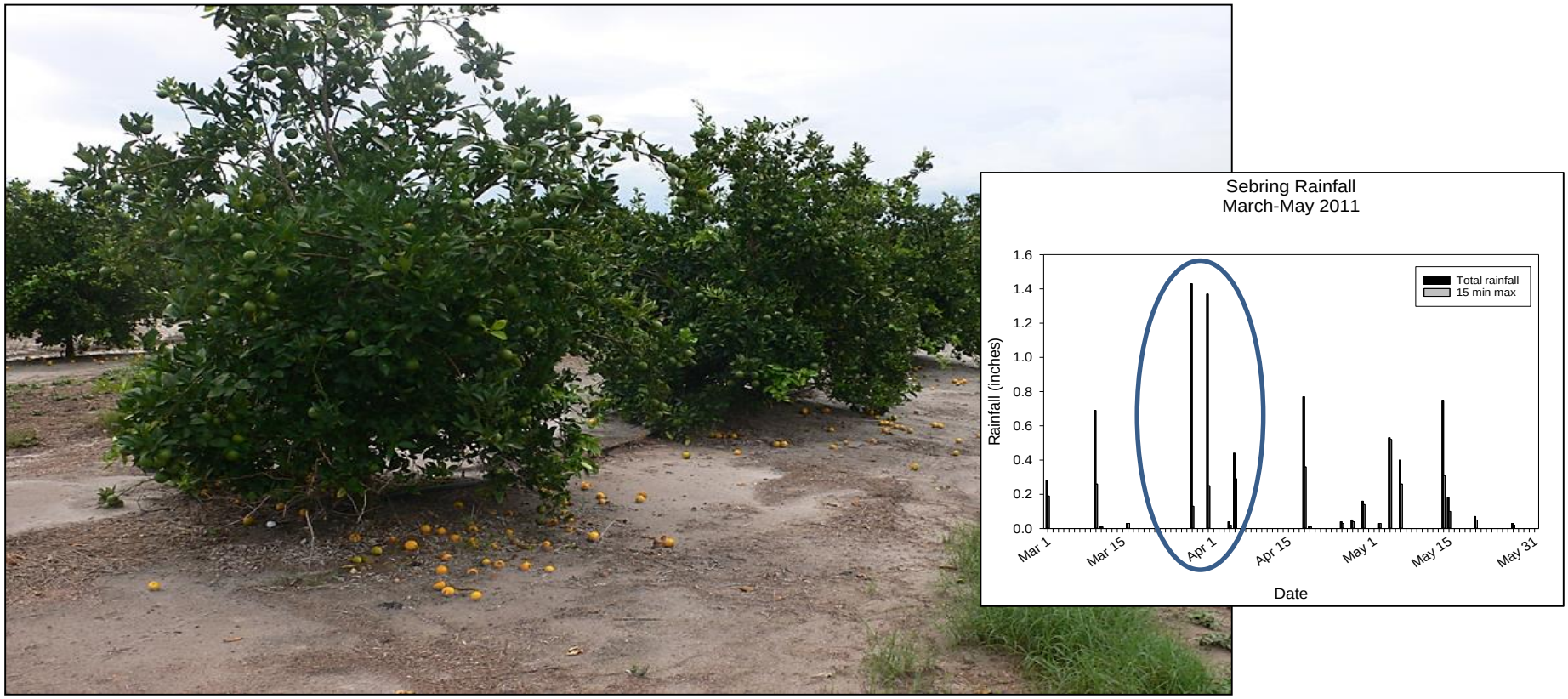
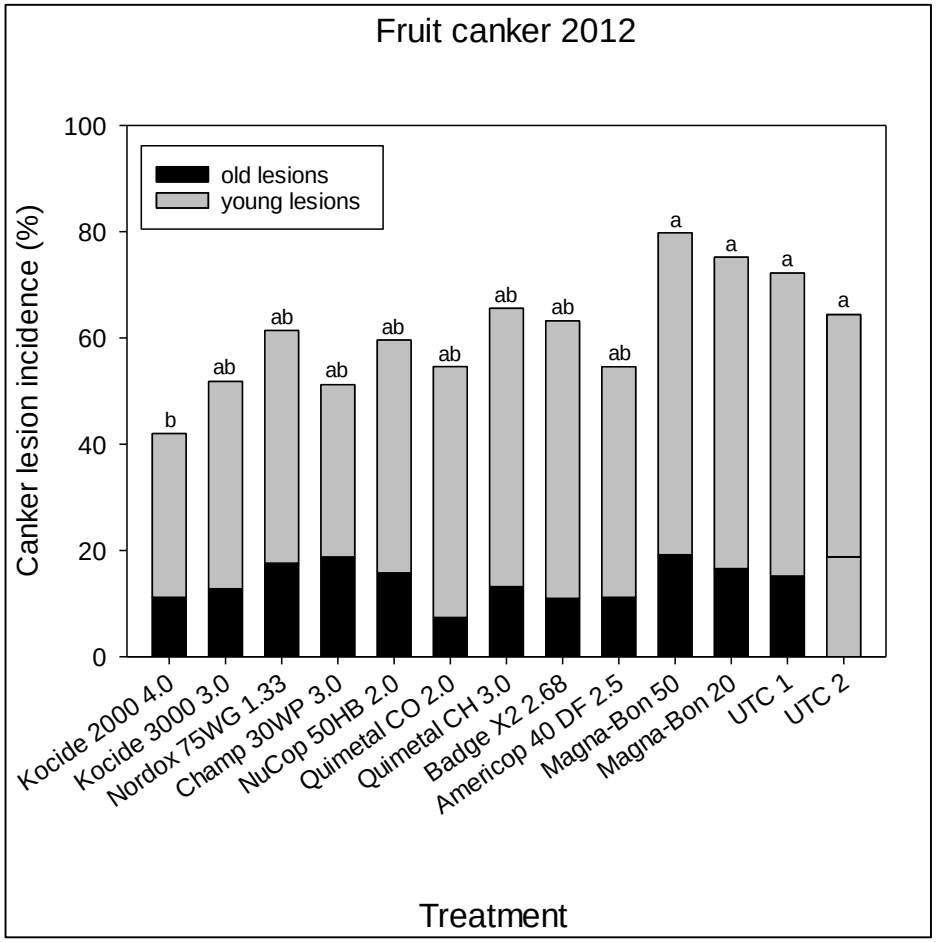
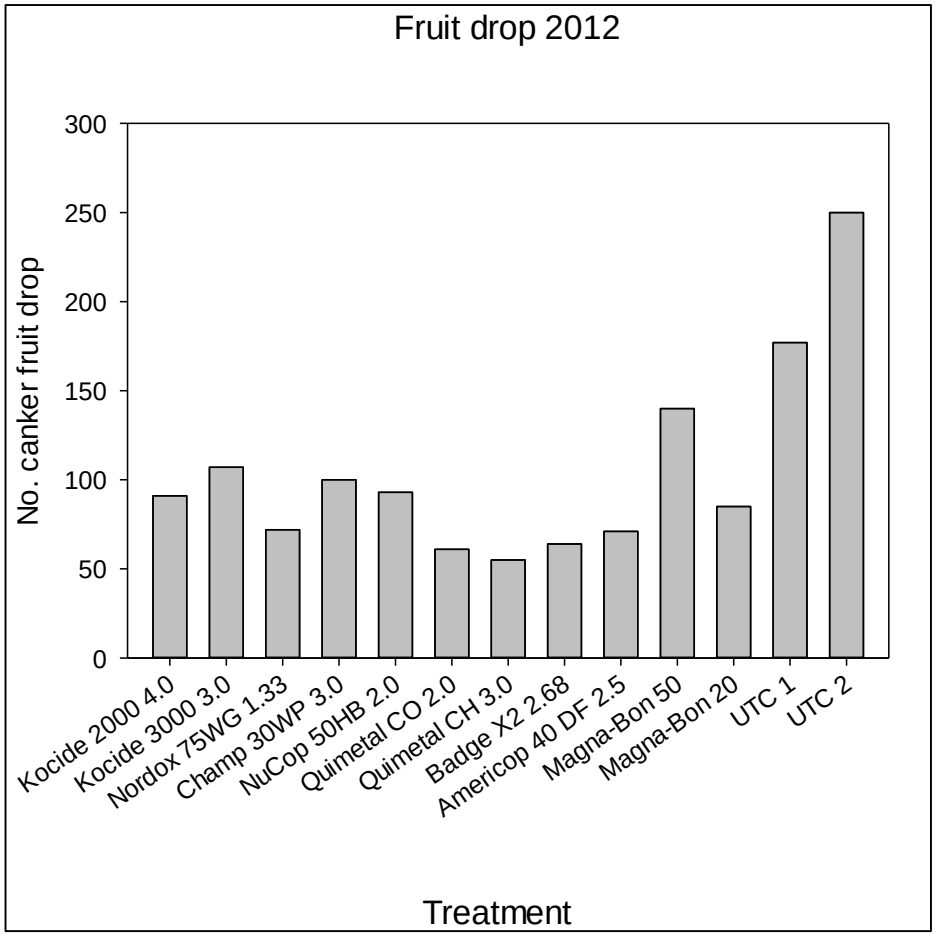
Early Season Fruit Drop

- **In 2011 Hamlin: early rain events and miss-timed Cu sprays resulted in 50% fruit drop**

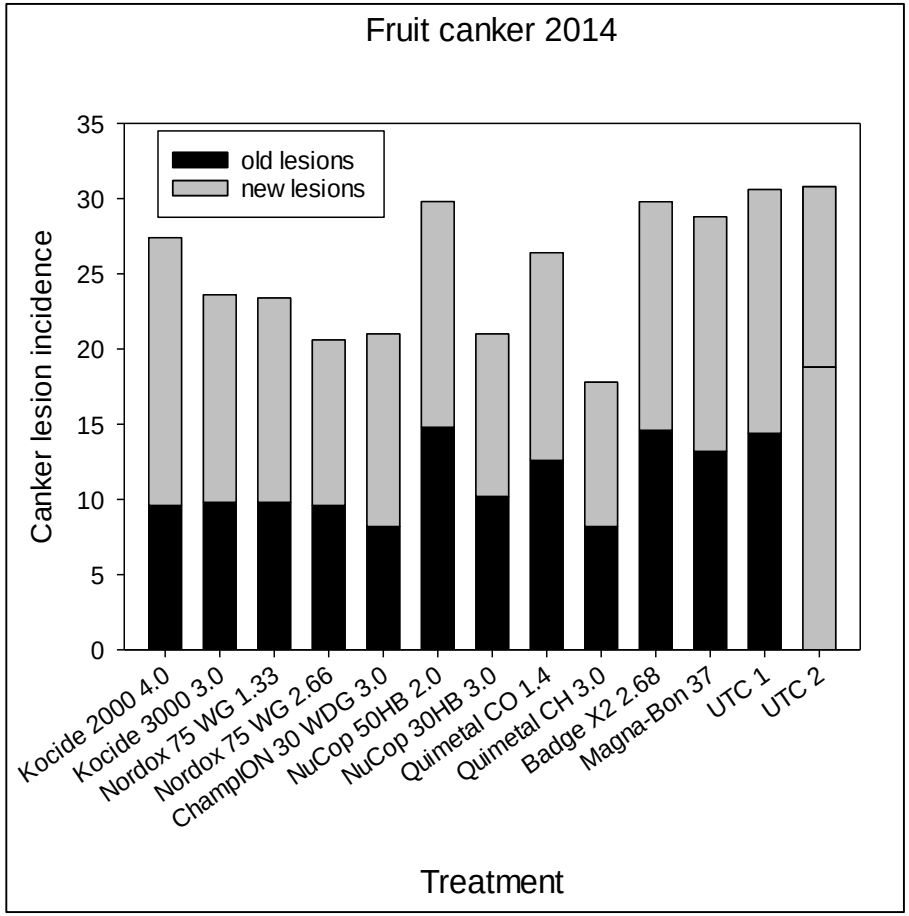


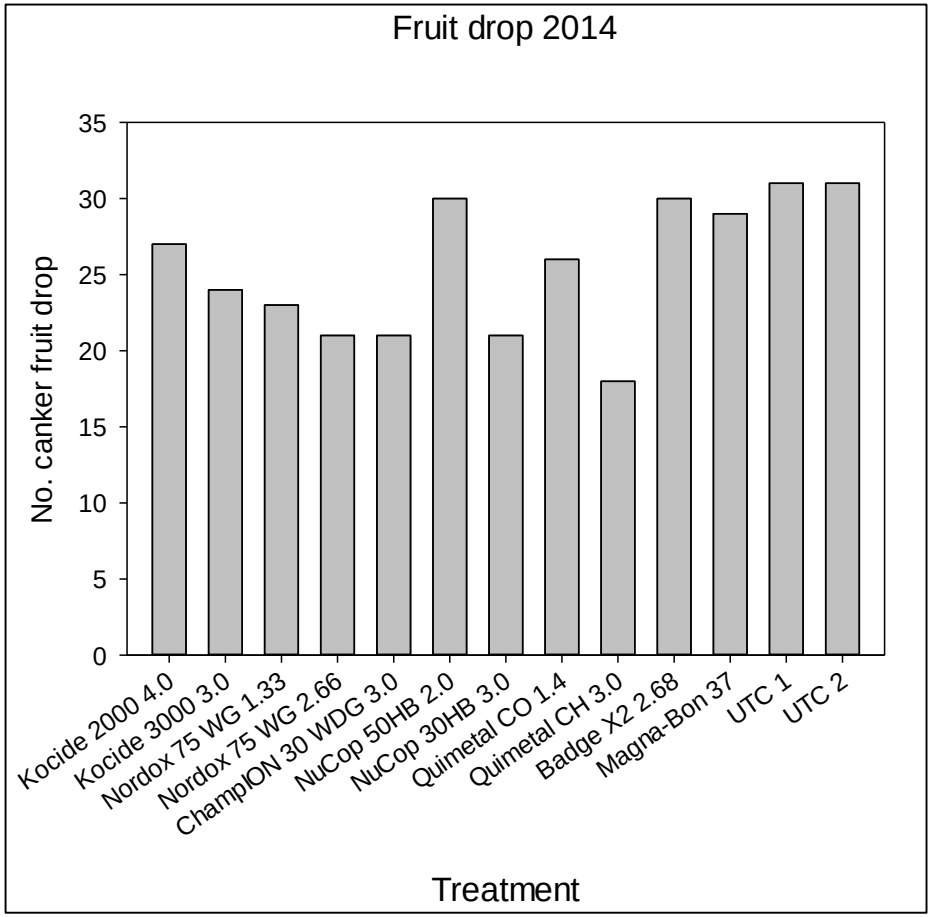
2012: First rain event in late-April after sprays begun



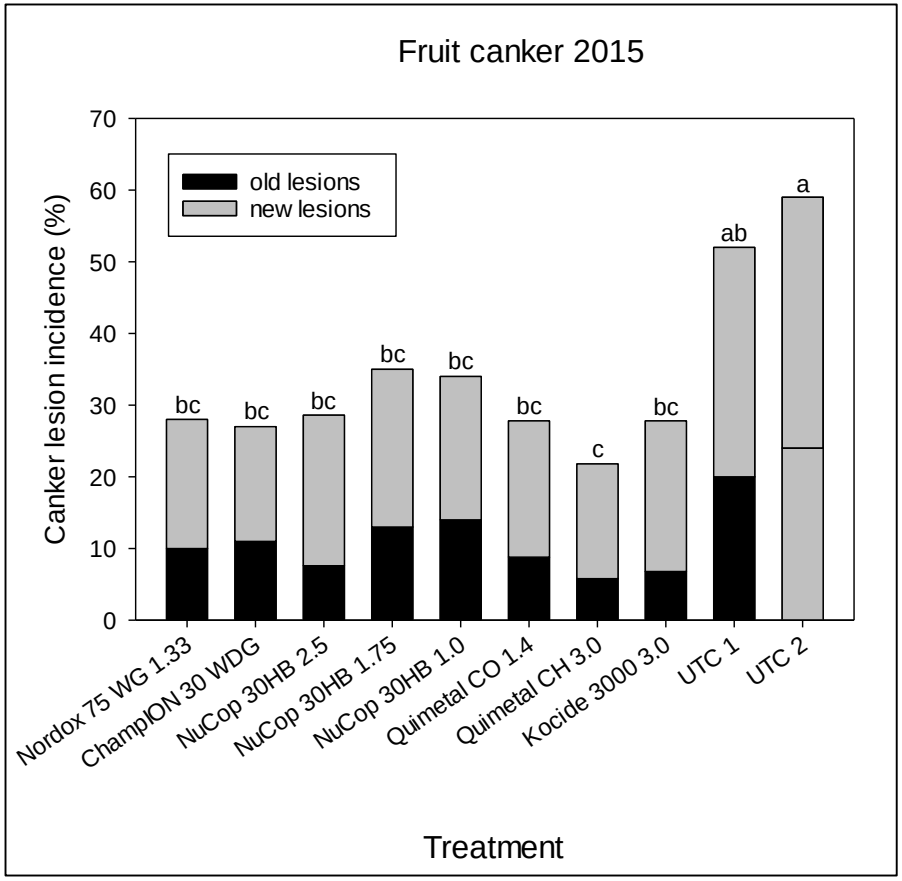


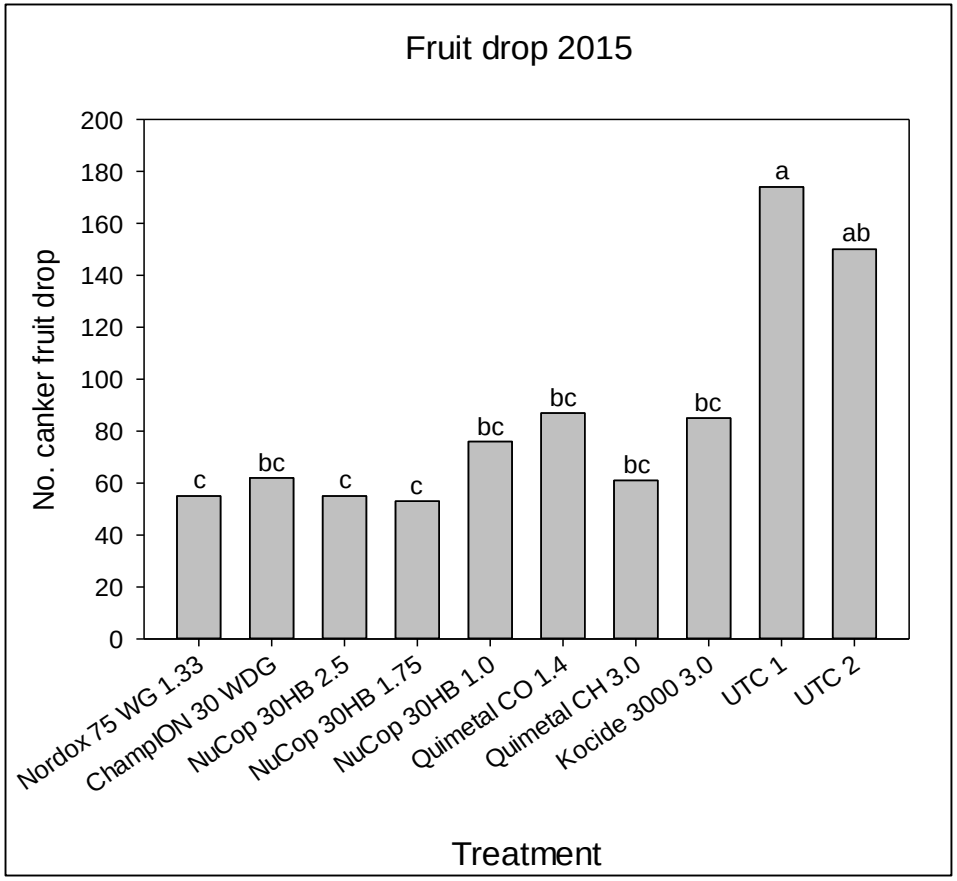
2014: Rain was below average when fruit was at the most susceptible size



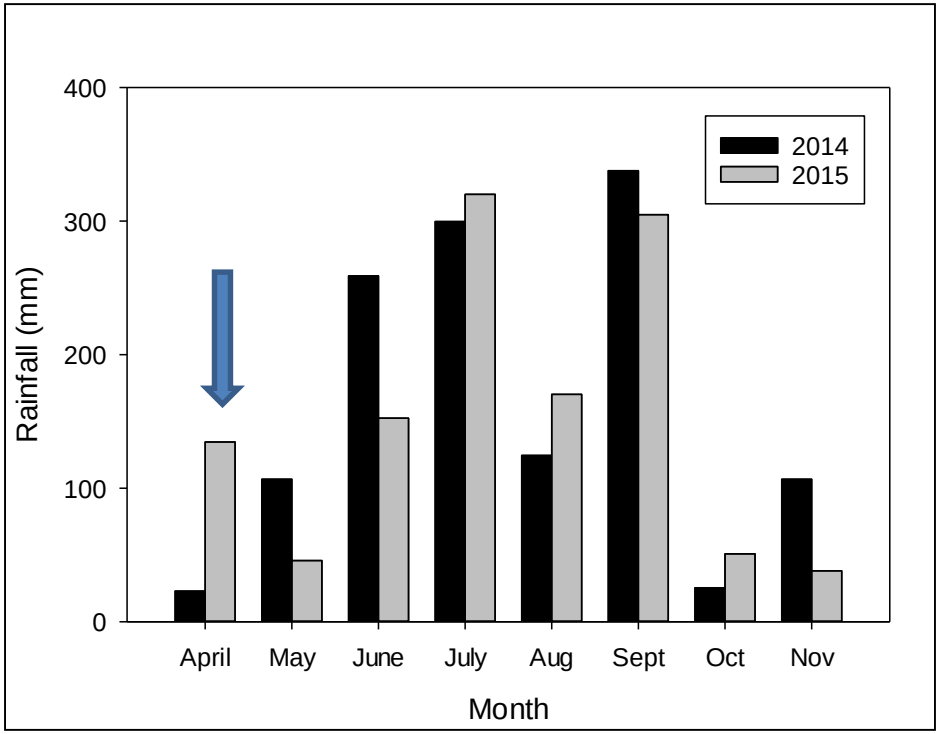


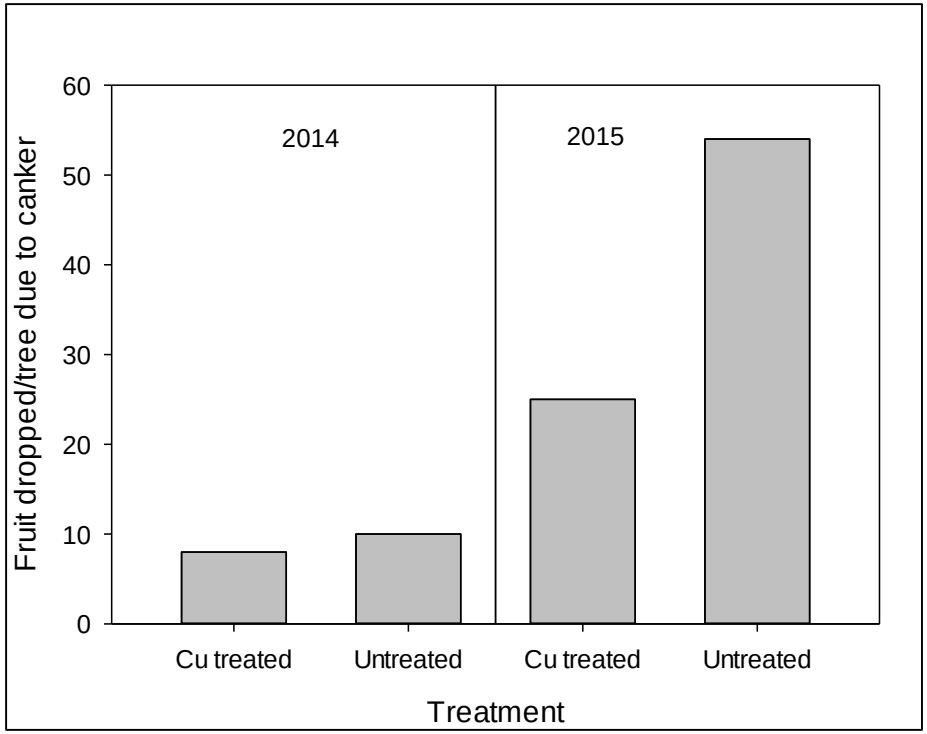
2015: Rain higher than normal in April when fruit were at the most susceptible stage





Early season canker induced fruit drop due to April rains, <u>not</u> due to inoculum carry over from previous season





Conclusions

- Timing of sprays before rains in late March and early April is critical for protecting fruit from 1 cm diameter (3/8 in.)
- Inoculum in form of infected leaves and stems from the previous season is always present in the spring
- Early fruit infection resulting in fruit drop depends on coincidence of late March-April rains with the most susceptible fruit stage (inoculum buildup on spring flush)
- In June-July, infections of fruit > 4 cm (1.5 in.) result in smaller lesions that do not induce premature drop

Streptomycin and Oxytetracycline Considerations

- Currently used only for HLB
  - No current label or declaration for citrus canker
- Have very short residual activity
  - Compounds need to be present when rain occurs
- Resistance development is likely
  - Rapid development in other foliar bacterial diseases
- Unlikely to provide the control you might hope for
  - Can’t spray with necessary frequency
  - Timing for HLB (leaf flush) does not match timing to protect fruit, but might lower leaf inoculum

How did Irma change canker incidence?

- Hurricane winds forced bacteria to past all barriers
  - Widespread mature leaf infection and stem lesions (even Valencia) occurred
  - Incidences were particularly bad in young blocks, especially if high canker inoculum was present in surrounding blocks
- Stem lesions are found on twigs with green bark
  - Quite visible still and advisable to prune out in young blocks while still dry
  - Will contribute years of inoculum; leaves only supply significant inoculum for a few months
- For non-bearing and young blocks, Actigard recommended
  - Copper does not control stem or leaf lesions
  - Will help to suppress inoculum

Citrus Canker Control

- Start with clean seedlings from well maintained nurseries
- Don't move plant material from site to site, and decontaminate personnel and equipment
- Plant windbreaks around the grove
- Spray copper-based bactericides (or Actigard) on time during the new flush and before early season rains
- Aerial applications are not recommended due to poor penetration of canopy

Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
	Valencia, tangerines &H						
	Early Oranges						
	Grapefruit						

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Copper Facts

- High copper concentrations in the soil are toxic for citrus
- Applied as a **PROTECTANT** on citrus for foliar diseases
  - Must be present on plant before the pathogen!
    - Broad spectrum protectant and non-specific
- Copper residue is substantially reduced by rain washing
- Once dried, copper does not 'expand' with leaf or fruit tissue
- Copper can cause phytotoxicity when applied in hot weather (>94°F or >34°C) or in complex tank mixes
  - Phytotoxicity reduced when made into water insoluble salts

Timely Application of Copper

- **Modern Web-based scheduler [vs Calendar-based (every 21 days)]**
  - **Incorporates rainfall data from Florida Automated Weather Network (FAWN)**
  - **Incorporates data on copper residue degradation**
  - **Incorporates fruit growth size**

  - **Improves timing of copper sprays**
  - **Reduces the environmental impact of copper**
  - **Reduces management costs**
  - **Warns when residue levels are lower than expected**

  - **Available from *AgroClimate* and FAWN websites**

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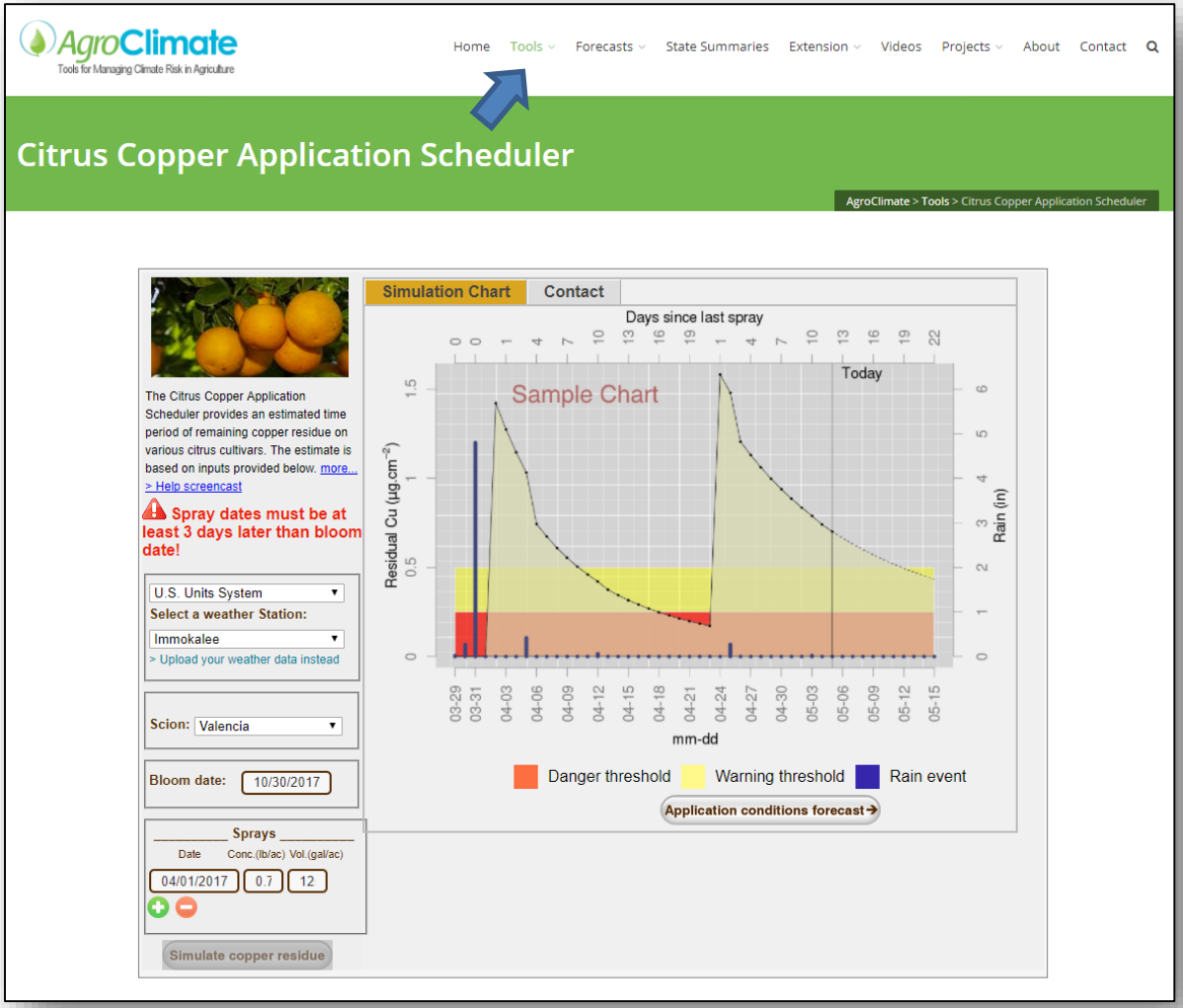
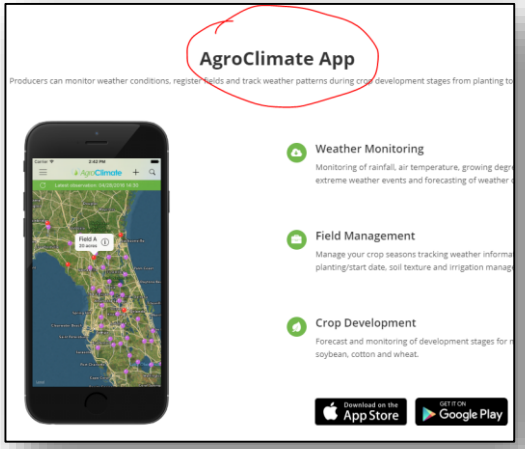
Resources



http://agroclimate.org/tools/citrus-copper-application-scheduler/

- Web-based
- User friendly
- Easier data input
- Mobile Version



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Resources

Select:

Tools

Climate Tools

Citrus Copper Application Scheduler

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Florida Automated Weather Network

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Tools

Cold Protection
- Cold Protection Toolkit
- Citrus Leaf Freezing
- FAWN Desktop Widgets
- FAWN Freeze Alert System

Irrigation
- Your Virtual Lawn Tool
- Vegetable Irrigation Scheduler
- Citrus Irrigation
- Strawberry Irrigation
- Urban Irrigation Scheduler
- Row Crop Irrigation
- Evapotranspiration (ET)
- Fact Sheets
- Home Irrigation Presentation
- Application Rate Worksheet

Tools
- Citrus Pesticide Tool
- Hay Cutting Tool Beta
- Air Temperature Threshold
- Video Presentations
- The FAWN Overview Video

Climate Tools
- Degree-Days Calculator »
- Chill Hours calculator »
- Strawberry Advisory System »
- Citrus Copper Application Scheduler »

Latest Observations
Graphic Weather Data
NWS Forecast
RADAR
My Florida Farm Weather
New! My Florida Farm Weath

FAWN Freeze Alert System
Receive weather alerts on your phone and/or by email

Tweets by @UF_FAWN

FAWN @UF_FAWN
October 30 Almanac: The high was 70 at DeFuniak Springs, the low was 34 at Quincy. Max rainfall was 0.05 inches at Indian River.
11h

FAWN @UF_FAWN

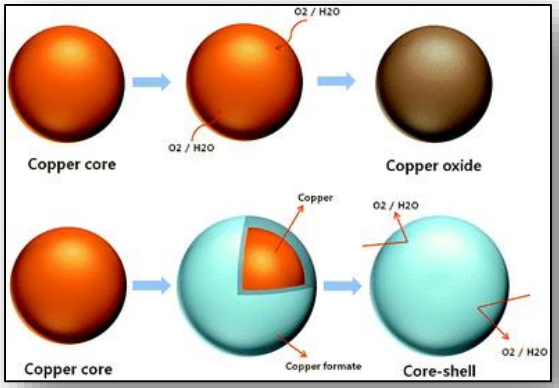
FCST Min Temp

Click measurement for additional data and tools

https://fawn.ifas.ufl.edu/

Multiple new products under development

- Dr. Evan Johnson, UF CREC
- Dr. Swadesh Santra, UCF



Kim et al. 2013, RSC Adv., 3, 15169-15177

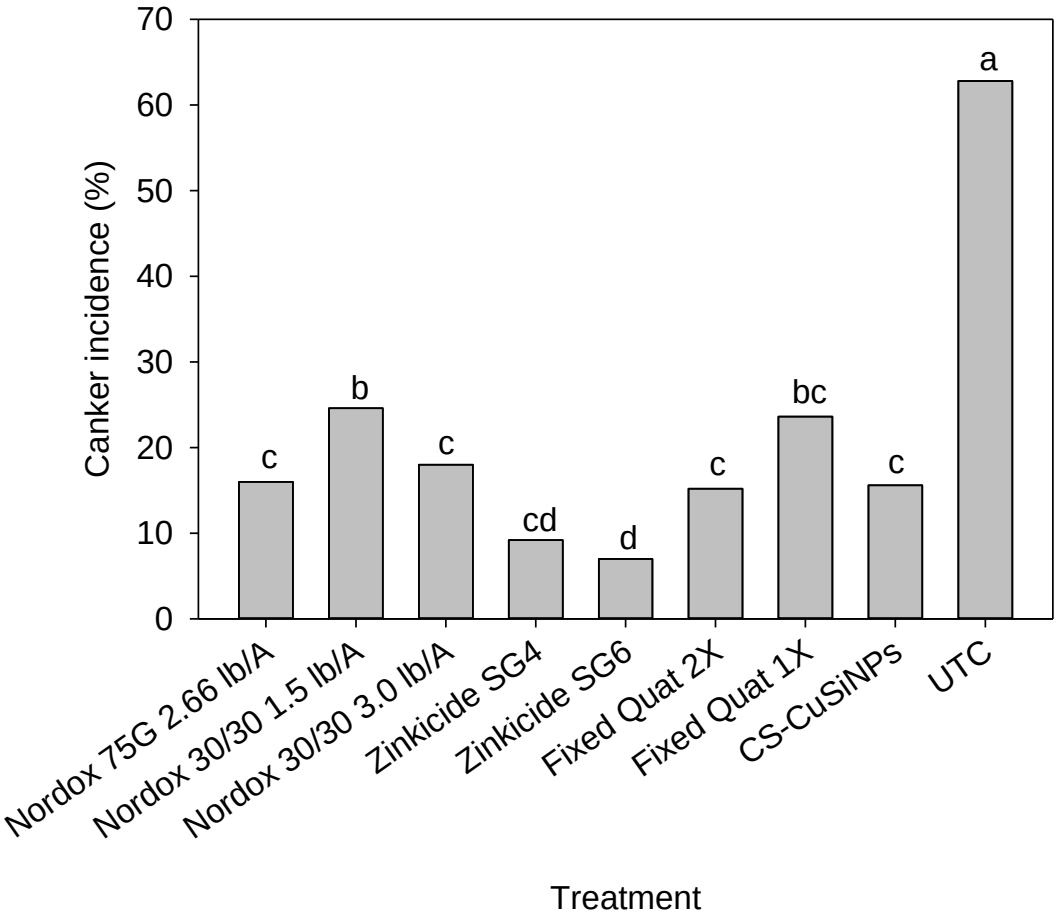
- **Core-shell Copper**
  - **Reduced copper, based on surface area**
- **Fixed-Quat**
  - **Quaternary ammonia immobilized to keep bactericidal activity and prevent phytotoxicity**
- **Zinkicide**
  - **Zinc-based nanomaterial using plant metabolizable ingredients**

- **Tested in Grapefruit trial (because of susceptibility)**

2014 Grapefruit Canker Trial

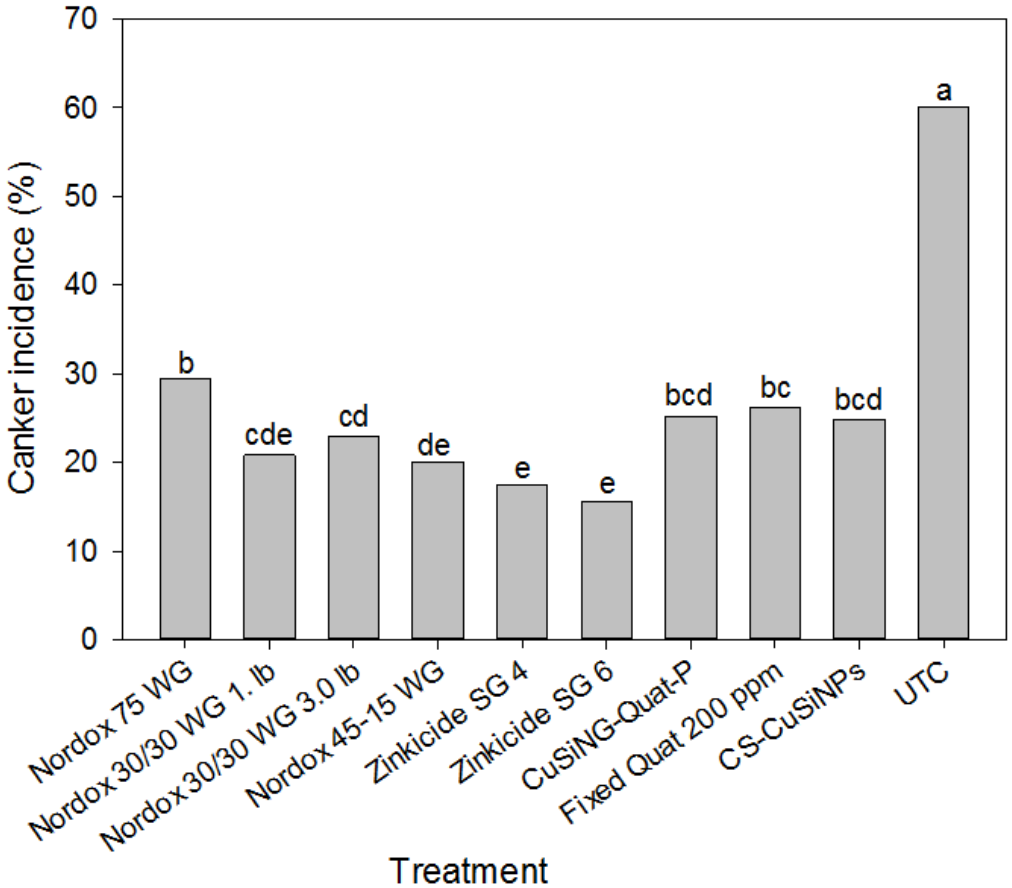
- **Equivalent efficacy to copper**
  - **Core-shell copper**
  - **Fixed-Quat**

- **Zinkicide control exceeded Cu and Cu/Zn**



2015 Grapefruit Canker Trial

- Equivalent efficacy to copper
  - Core-shell copper
  - Fixed-Quat
- Zinkicide control matched commercial Cu/Zn at same rate Zn



Products under development - Conclusions

- **Provide Copper equivalent or better efficacy**
- **Reduce metal or Cu applied to the field**
- **Provide rotation alternatives to Cu**
  - **Resistance management**
- **Licensing and Registration for commercial availability underway**
  - **Time to available product is difficult to predict**

Summary

- Proper Copper applications on young fruit (3/8 to 1.5 inch) can reduce fruit drop from early season canker infections
- Copper must be applied before rain to be effective
- The copper application scheduler can help reduce unnecessary sprays and prevent gaps in coverage
- Materials with new modes of action are under development to allow for future resistance management

Phytophthora Management

Topics:

- **Citrus diseases caused by Phytophthora**
- **Cultural control and management**
- **Interaction with HLB**

Phytophthora Diseases

- Foot rot of trunk and limbs
- Root Rot
- Brown Rot
- Yield reduction estimate: 3-6% per year or approx. $20M in crop loss *(pre HLB)*

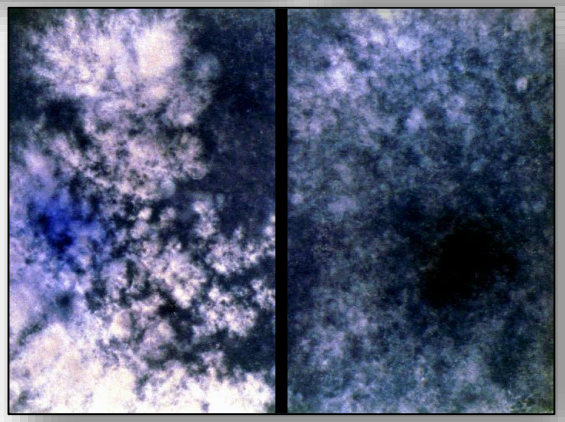
The Phytophthora species causing diseases in Florida citrus

- ***Phytophthora nicotianae*** **(*parasitica*) common cause of foot rot and root rot**

- ***Phytophthora palmivora*** **causes brown rot of fruit, root rot in poorly drained soils with high water tables**

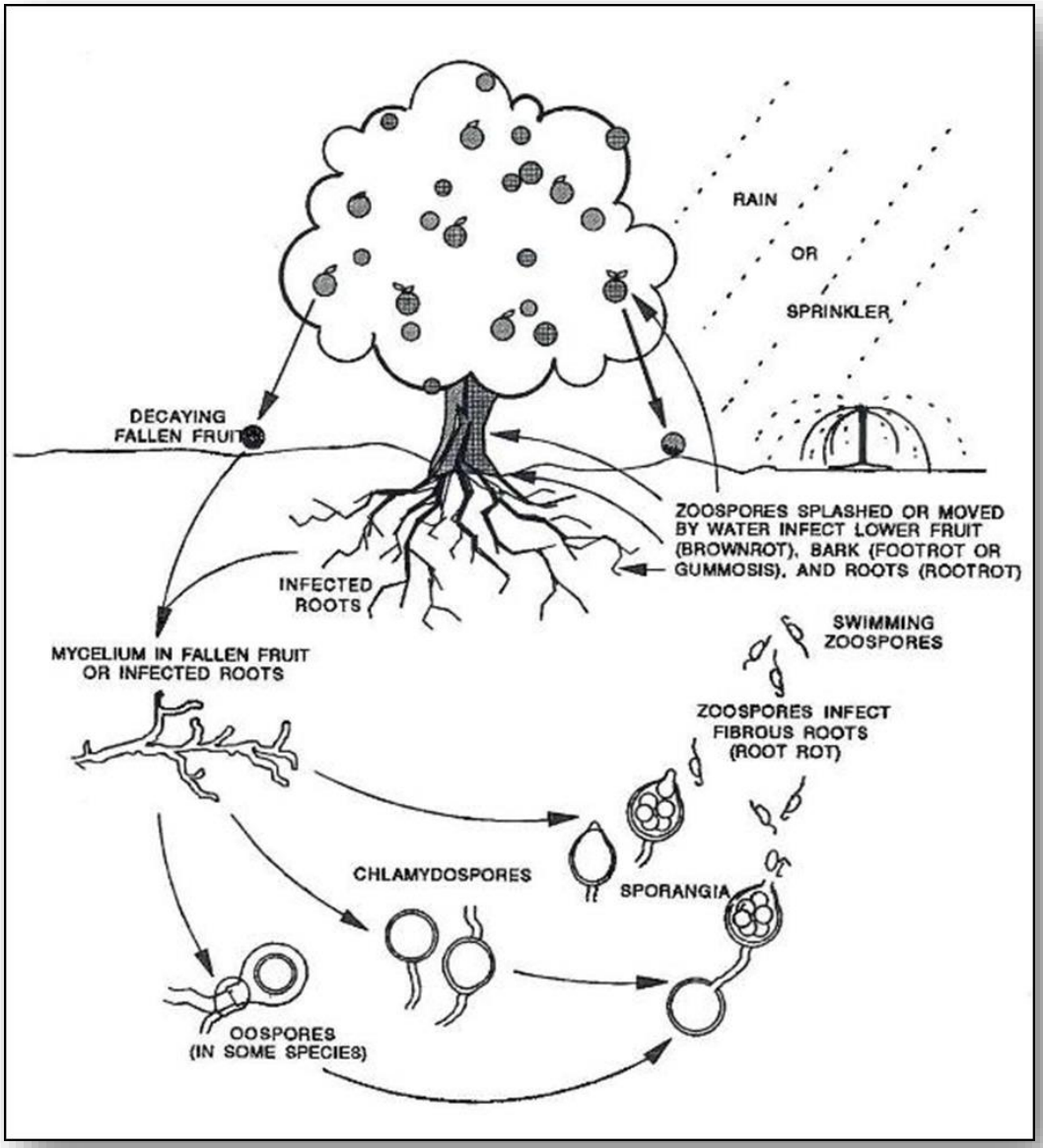
P. palmivora
Sporangia elongated

P. nicotianae
Sporangia round



Wet conditions favor root infection cycles

- Susceptibility of roots highest during very wet to very dry cycles
- Wetting and drying increases root exudation attracts zoospores
- HLB infected roots also produce more exudates that promotes infection



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Phytophthora Foot Rot

- Kills bark
  - Blocks water and carbohydrate transport
- Can girdle tree
- Controlled with rootstock
  - see rootstock guide
- Avoid wounding and soil exposure of scion
- Graft union >6 inches above soil

Phytophthora Root Rot

- **Impairs water and nutrient uptake**
- **Reduces CHOs allocated for next crop season**
- **If severe at planting, stunts tree**

Phytophthora Root Rot Control

- **Good drainage and irrigation**
- **Clean nursery material**
- **Monitor disease pressure (propagule count; Syngenta?)**

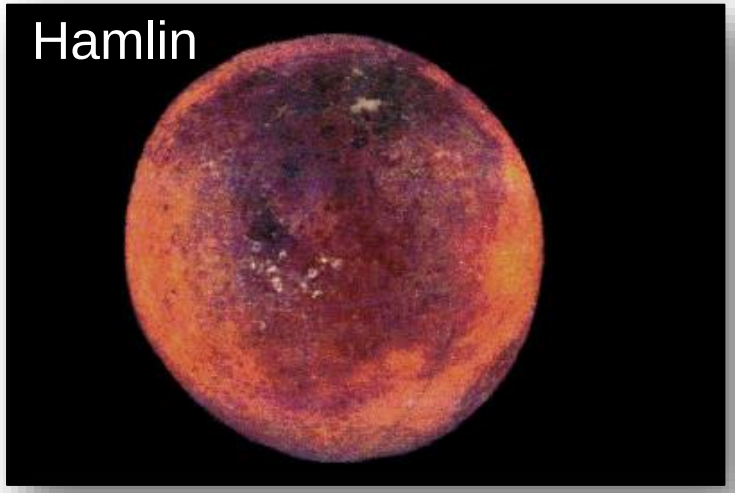
Chemical Management of Phytophthora

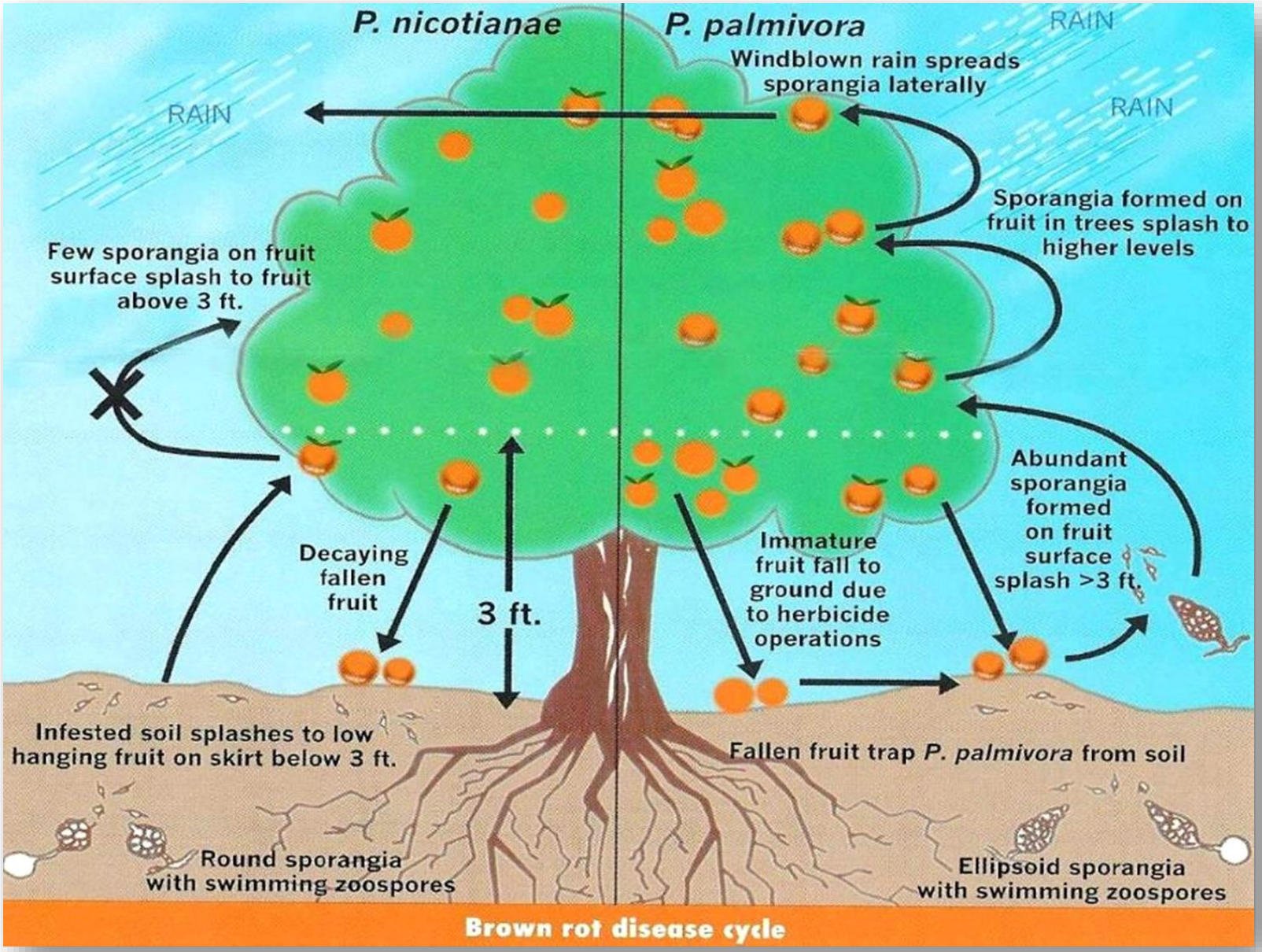
- **Based on history of Phytophthora in the grove; protect growing roots**
  - **details in FCPMG http://www.crec.ifas.ufl.edu/extension/pest/**
- **Phytophthora count >10-20 propagules/cm^3 recommend rotation of fungicides:**
  - **Fosetyl-Al /phosphite after spring shoot flush**
- **If severe problem -Mefenoxam after spring-early summer rains begin**
- **Fosetyl-Al /phosphite after midsummer shoot flush**
- **Mefenoxam after fall shoot flushes**

Remember root flushes follow shoot flushes!

Phytophthora Brown Rot

- **Mainly damages early varieties**
- **Light brown leathery decay**
- **White fungal growth on surface under humid conditions**
- **Infected fruit have sharp, pungent odor**
- **Infection spreads in post harvest**





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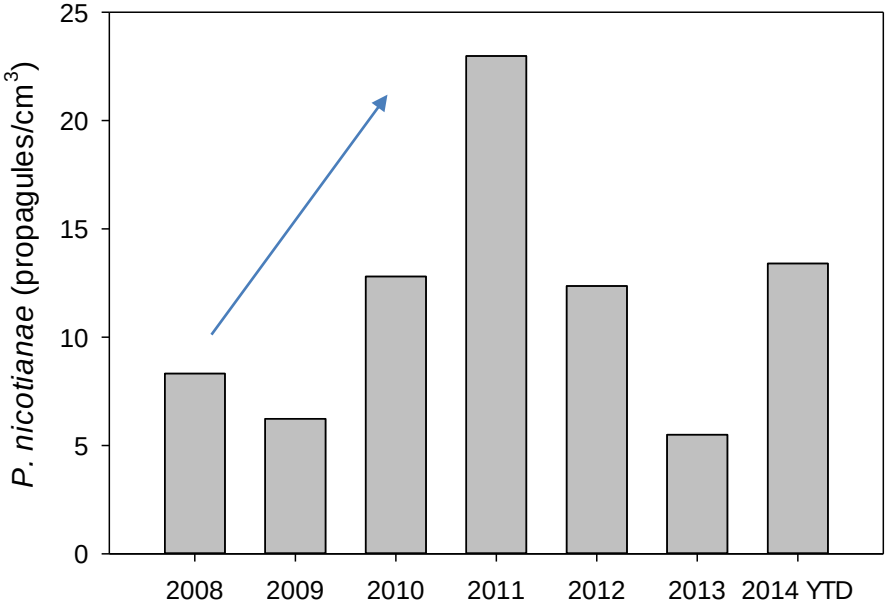
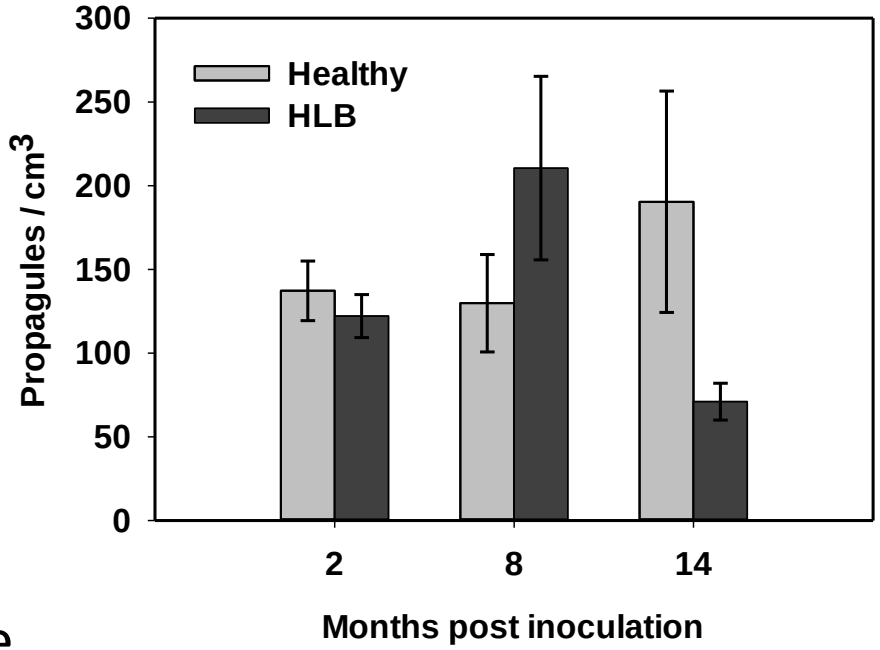
Brown Rot Management

- Avoid fruit under tree to reduce inoculum (may not feasible with HLB)
- Raise tree skirts to increase air movement and promote drying of foliage
- Apply preventative sprays of phosphites or copper
- Time phosphite sprays in July (and October if fall rainy season is prolonged)

HLB-Phytophthora interaction





Based on 600+ samples statewide

Data courtesy of John Taylor, Syngenta Crop Protection

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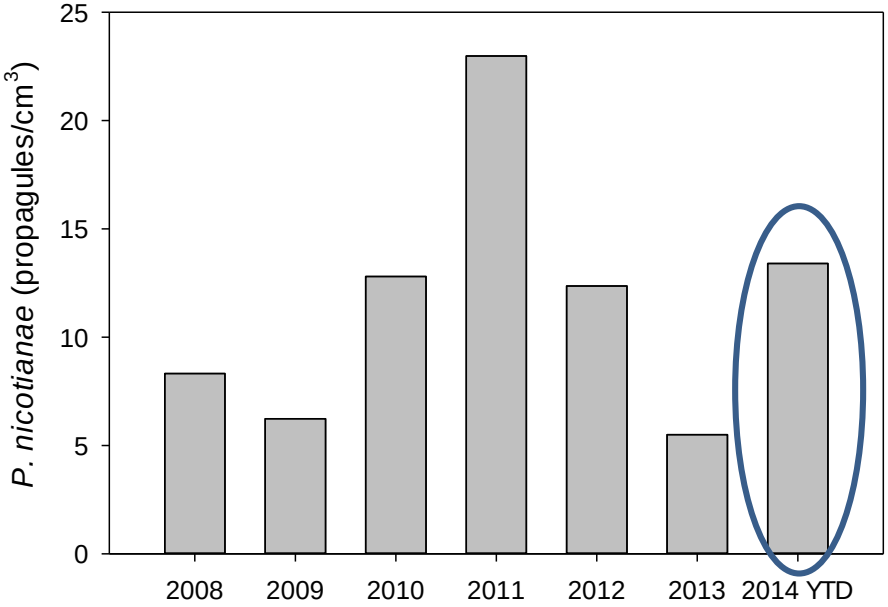
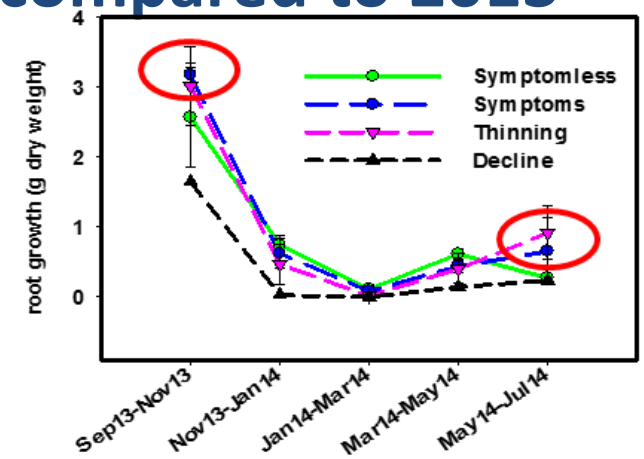
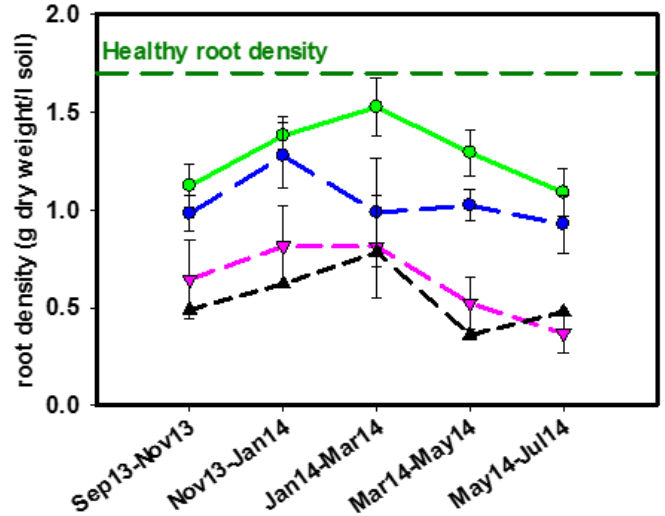
Statewide propagule counts have resurged in 2014 in response to increased root mass compared to 2013







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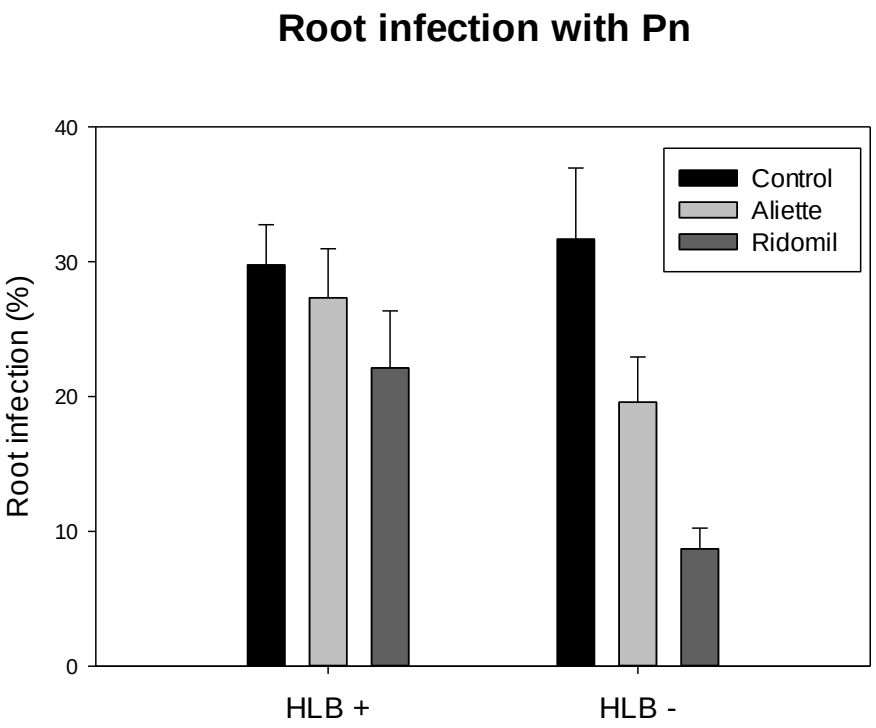
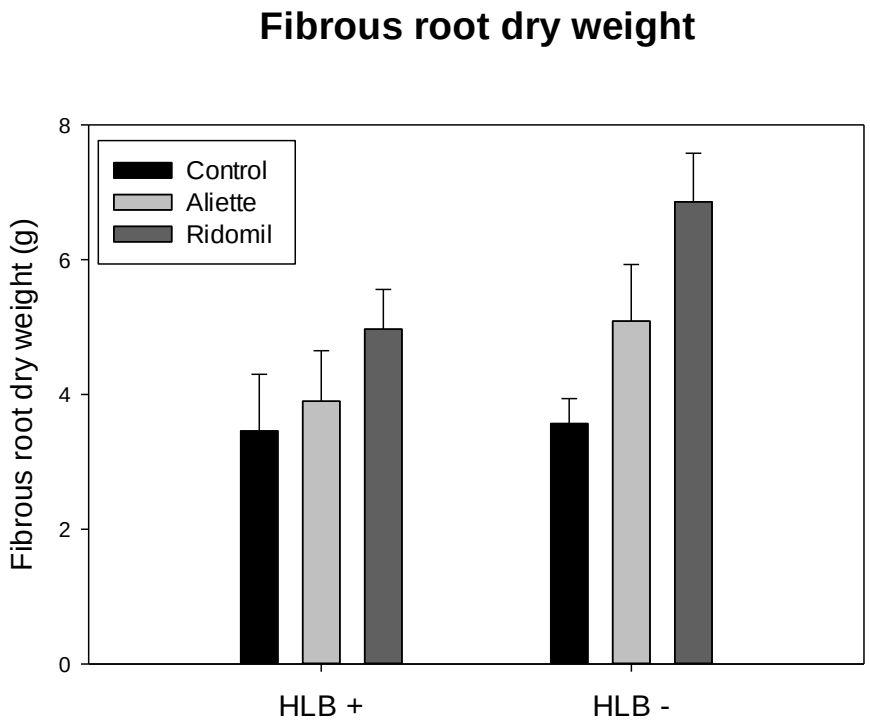
HLB reduces efficacy of Phytophthora management





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Phytophthora control with HLB

- **Start with root stresses that give the best return**
- **Monitor groves to look for a developing problem**
- **Decide which root flushes to protect**

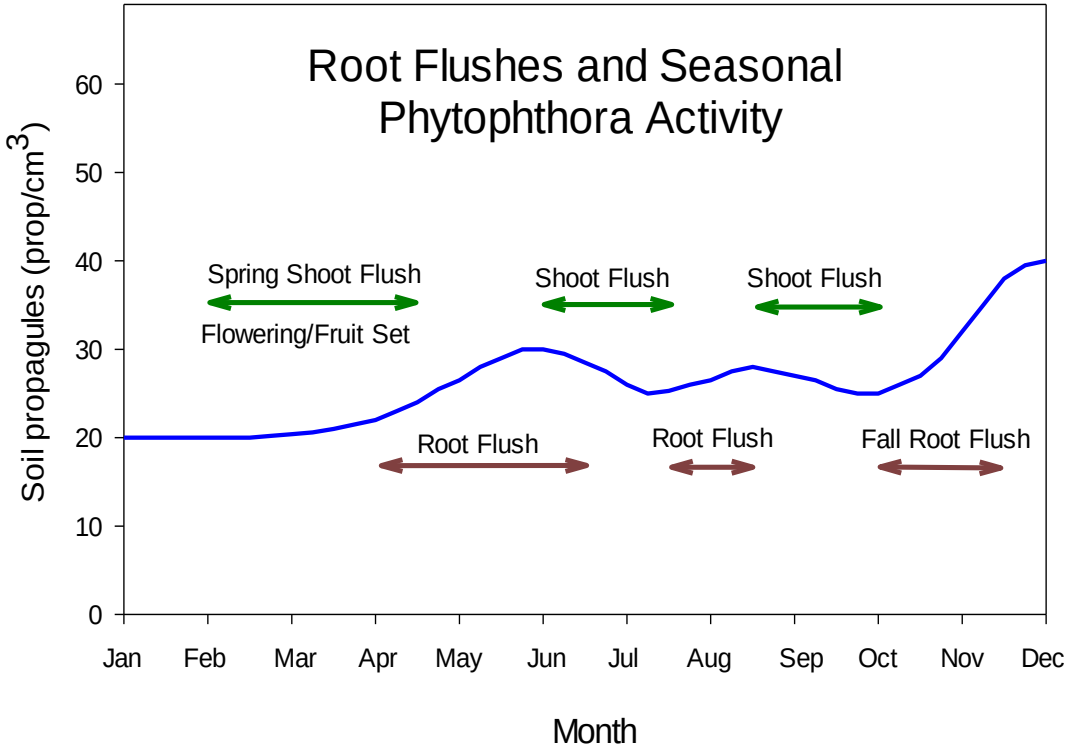
Phytophthora control with HLB

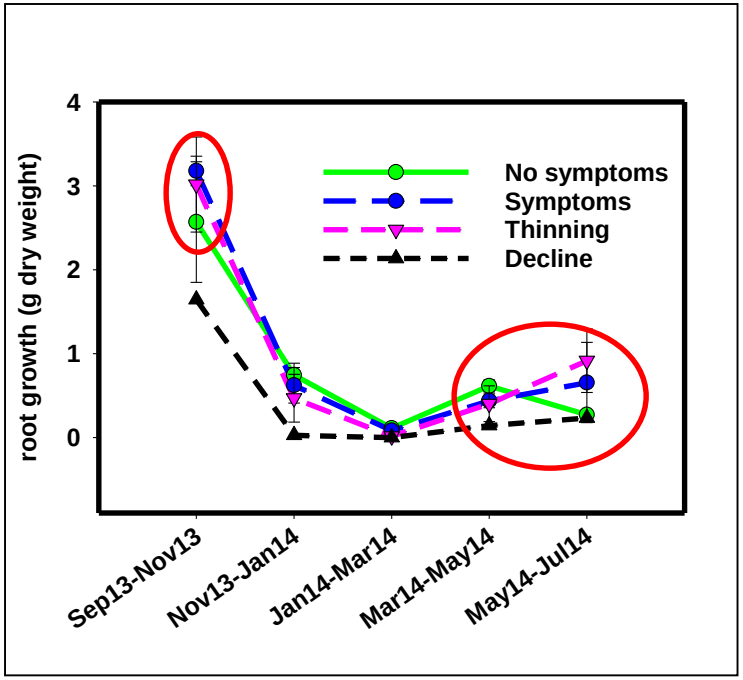
- Treat based on propagule count

  >20 propagules per cm^3 of soil

- Time application for maximum effect
  - Management tools are less effective
  - Phytophthora damages root flushes
  - Treatments are protective – apply at/just before root flush

Target soil applications of fungicides to root flushes





Thank You!
Any question?

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