

# Foliar diseases: Citrus Canker and Citrus Black Spot



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# CITRUS CANKER



Some slides adapted from E. Johnson

# Fruit susceptibility to canker

- Orange fruit are most susceptible from 3/8 in. diameter until fruit reach ~1.5 in. dia.
- Rains in April, May, and June promote early season infection
- Rind becomes much more resistant for fruit > 1.5 in. dia.
- Rind susceptible throughout entire fruit growth period
- Early bloom may affect timing of susceptible fruit size



# Copper sprays at 21 day intervals protect fruit beginning at 3/8 in.: Spray volume and tractor speed important for fruit coverage



# Why a 21-day interval?

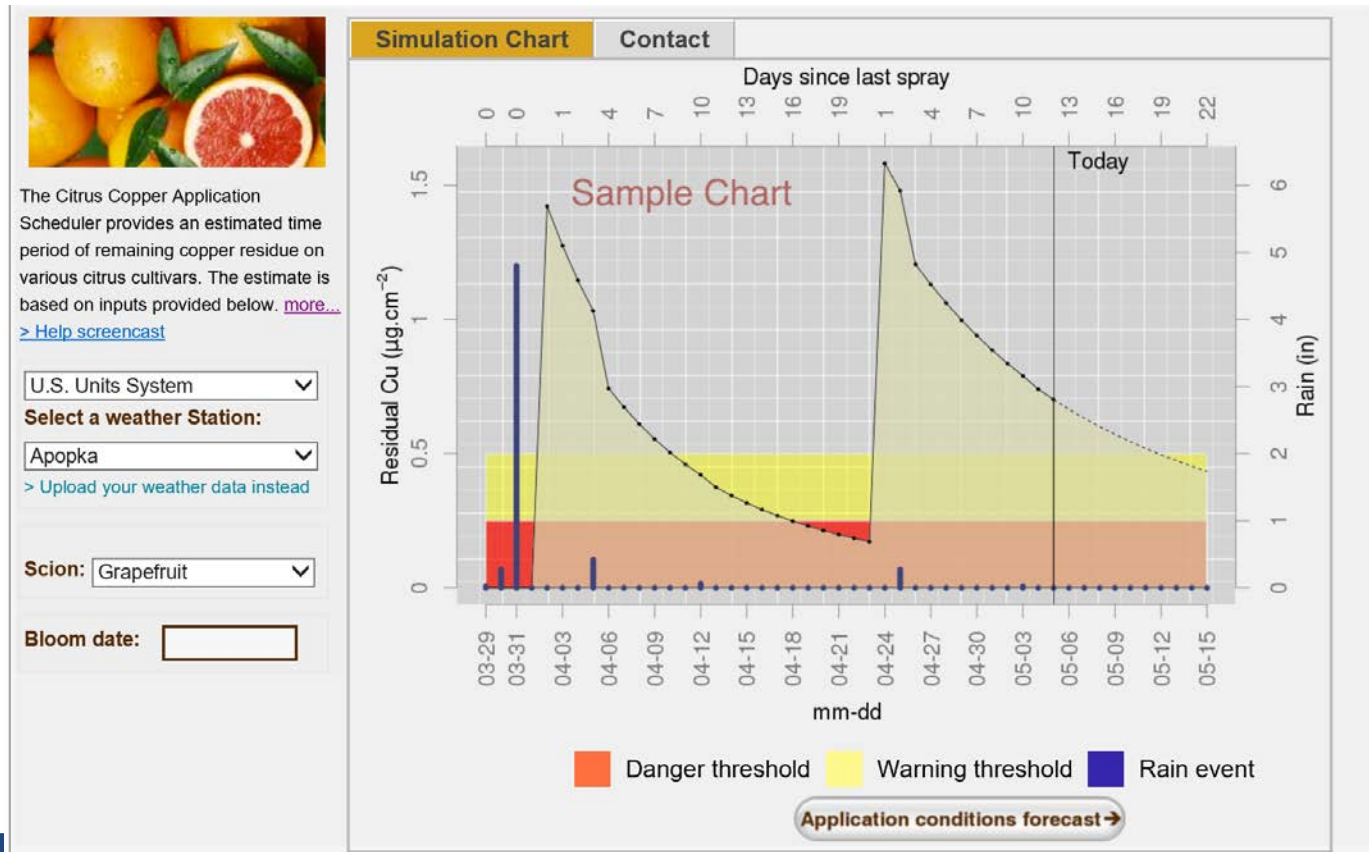
- Copper residue is significantly reduced by rain washing
- Copper does not move once dried
- Copper residue is cracked by fruit growth



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

# Alternative way for application timing

- Time application based on residue levels
  - Citrus copper application scheduler
  - Available on Agroclimate or through FAWN



# Proper Application of Copper

- Use label rate recommended for a disease
- Be cautious in hot weather ( $> 94^{\circ}\text{F}$ ;  $34^{\circ}\text{C}$ )
  - Phytotoxicity occurs more easily in hot weather
- Potential for phytotoxicity can be reduced with greater water volume per acre
  - Complex tank mixes, oil applications, and nutritional materials contribute to phytotoxicity
- With aerial applications get inadequate penetration of canopy for control, best method is with an air blast sprayer

# Field Trials

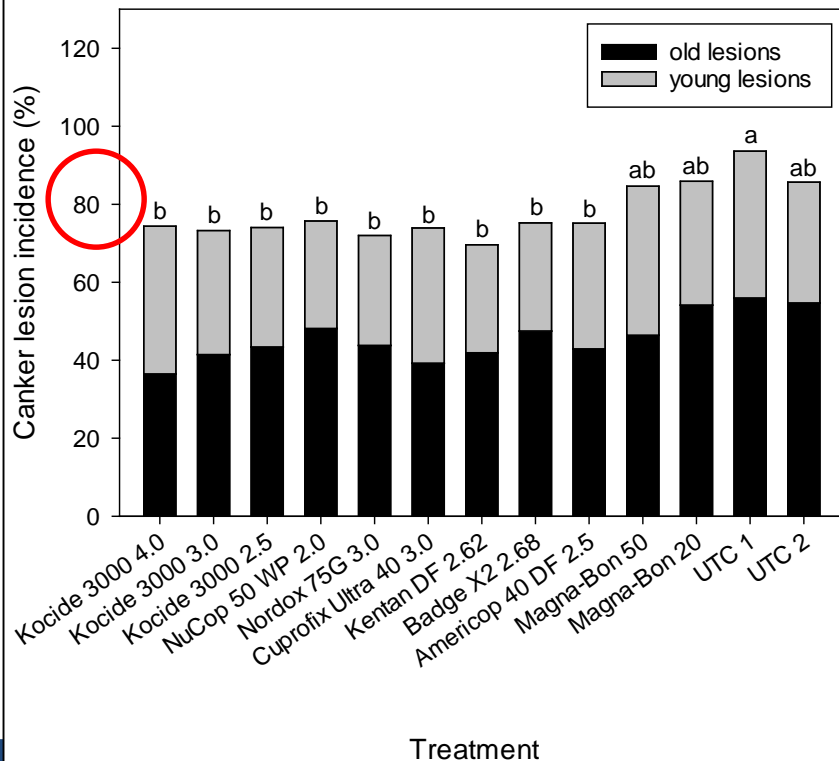
- Evaluate copper sprays in relation to early season rains for control of fruit infection and drop in young fruiting Hamlins
  - In a south central Florida citrus grove
- Compare soluble and fixed copper formulations for efficacy
  - 2011, 2014, and 2015



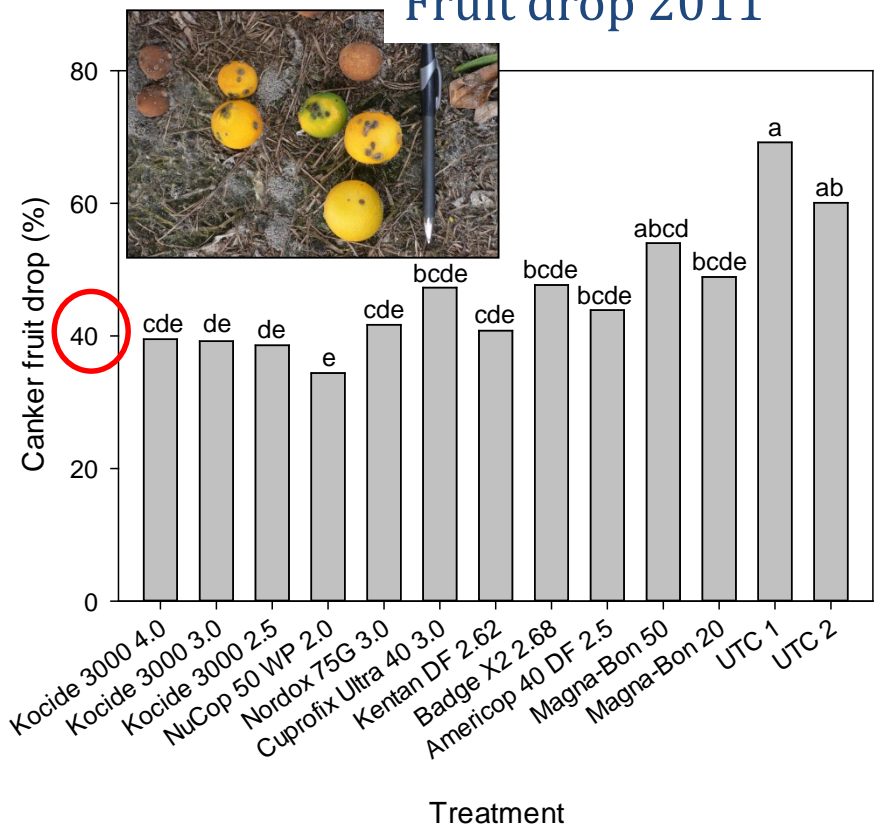
# Timing and weather matters

- Need to watch early season weather forecasts for rain
- Effects of being too late
  - In 2011, 9 sprays began 15 April (too late) to 27 Sept attempting to reduce impact of early epidemic

## Fruit with lesions 2011



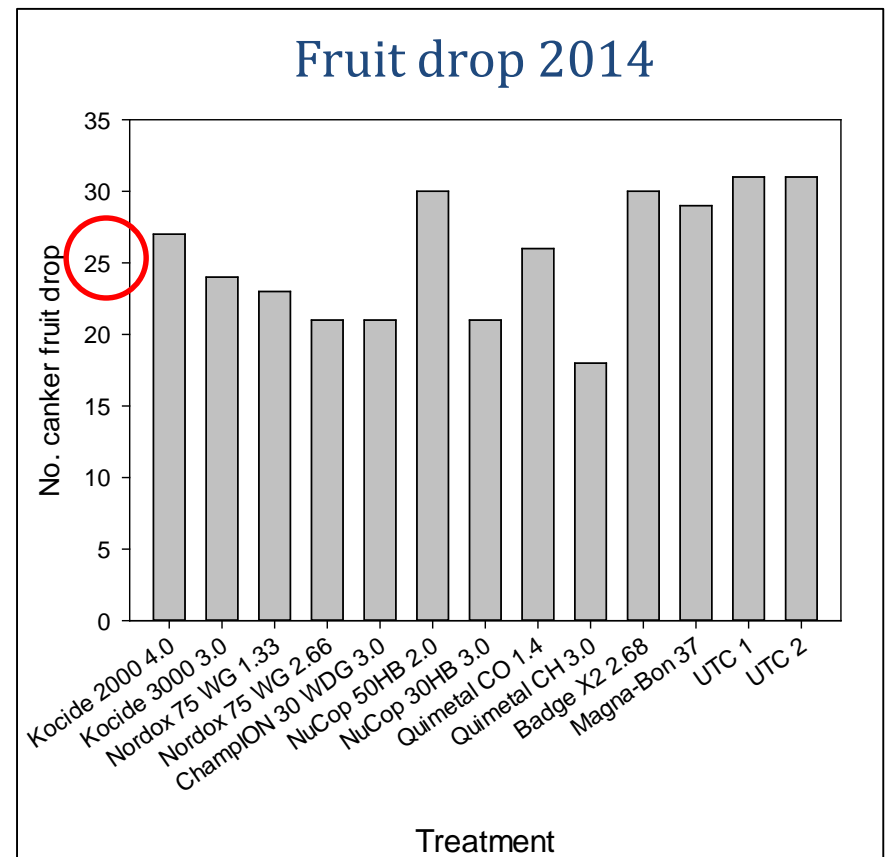
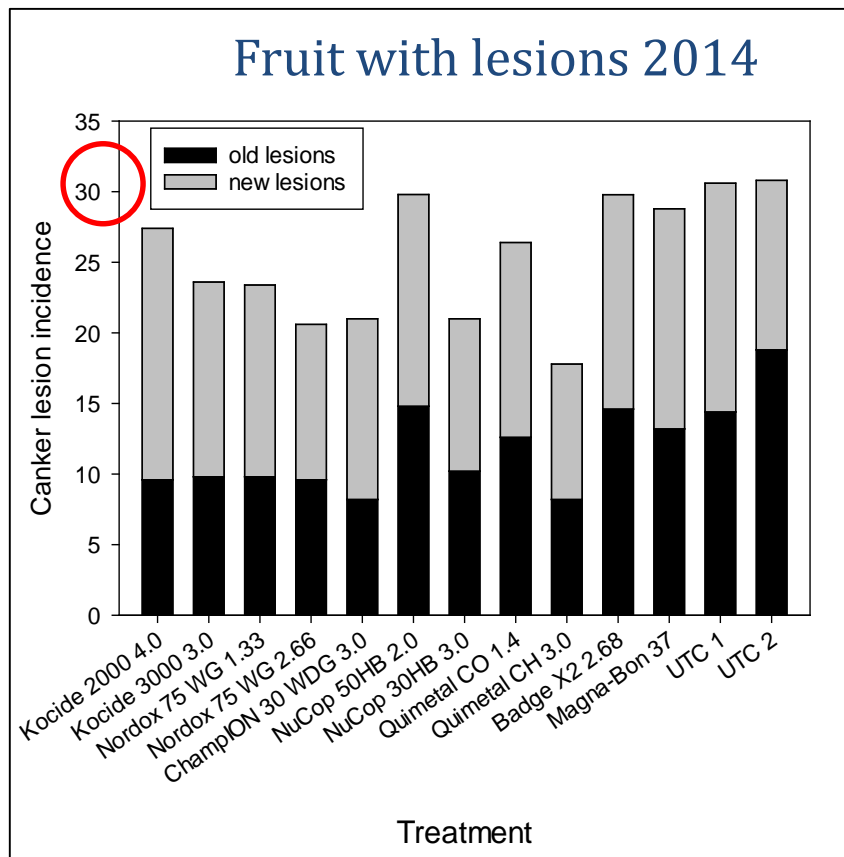
## Fruit drop 2011



# Dry spring

- Limited early season infection

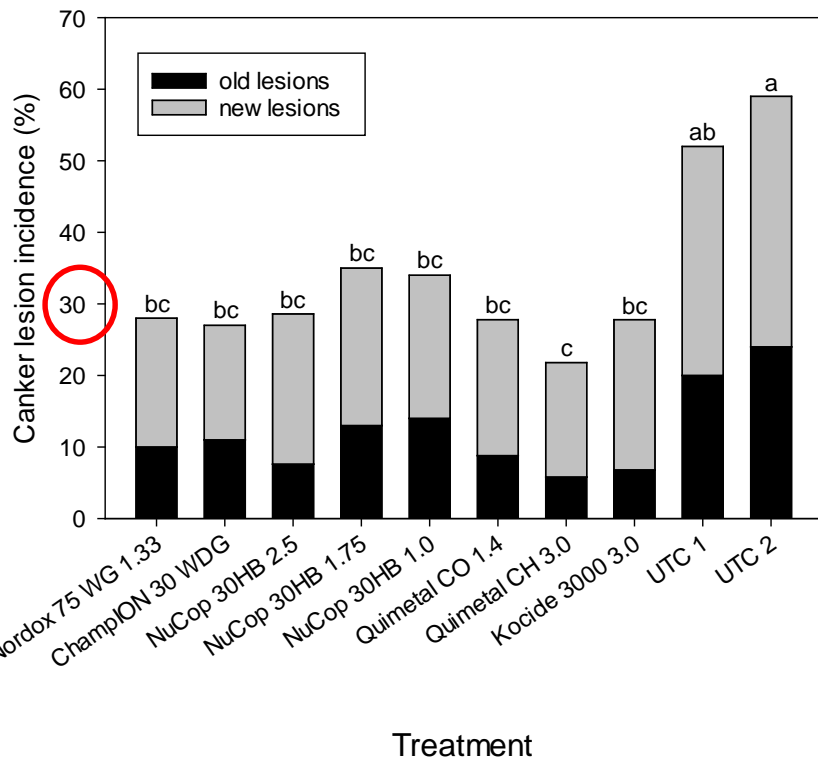
- In 2014, rain below average when fruit most susceptible size



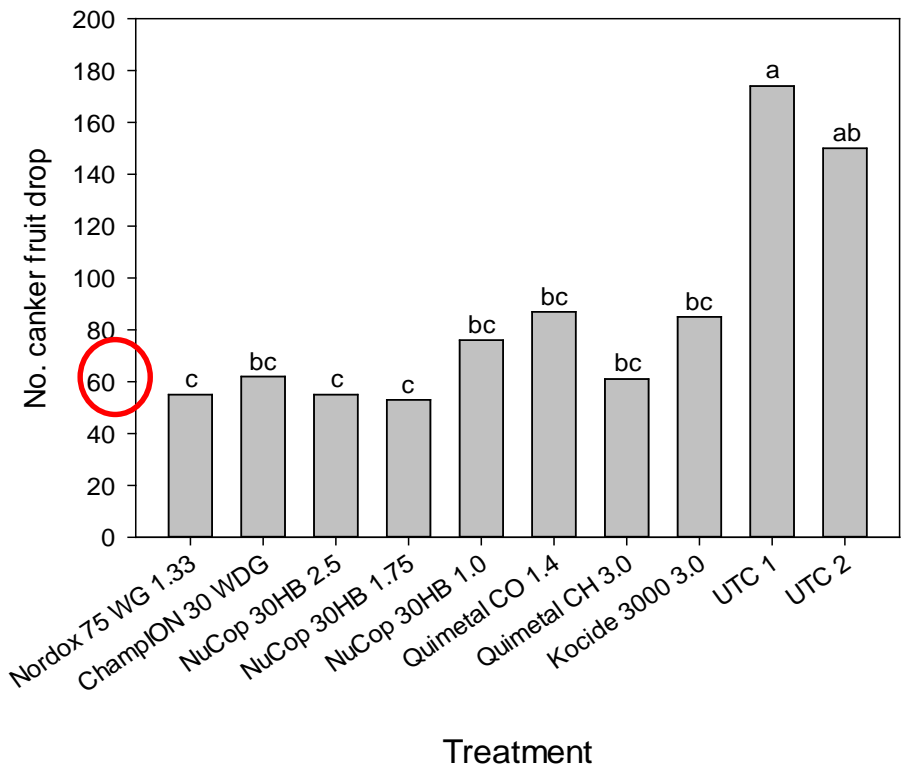
# Well timed application

- Well timed applications can mitigate unfavorable rainfall patterns
  - 2015, April rain greater than average when fruit at most susceptible stage

## Fruit with lesions 2015

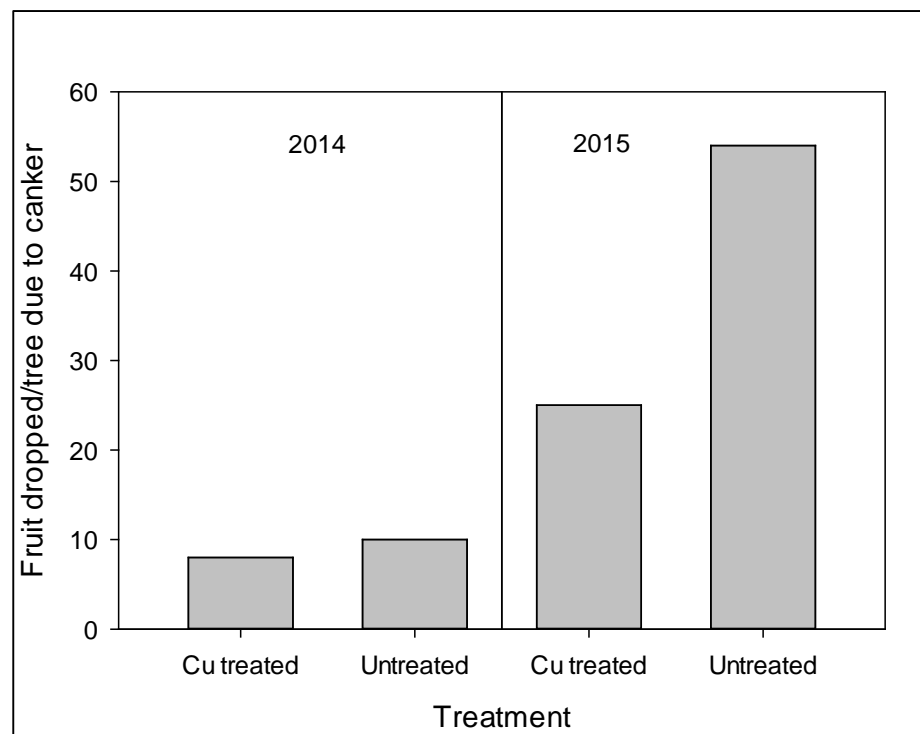
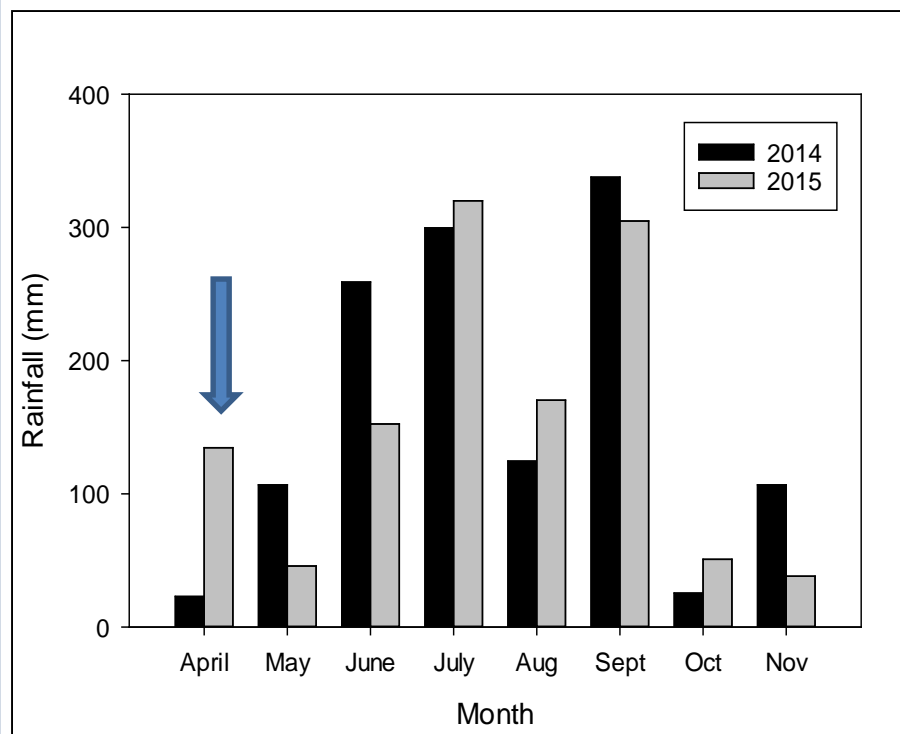


## Fruit drop 2015



# Effect of inoculum carry over

- April rains induced early season fruit drop
  - Not canker inoculum carry over from previous season
- Early bloom this season
  - Initiate program once fruit reach 3/8 in. dia.
  - May be in mid- to late-March



# How does Irma change things?

- On all trees, hurricane force winds force bacteria past any barriers
  - Considerable mature leaf infection (even Valencia) and stem lesions
  - Particularly bad in young blocks, especially if high canker in surrounding blocks
- Stem lesions found on twigs with green bark
  - Quite visible still and advisable to prune out in young blocks while still dry

# How does Irma change things? Cont.

- 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

# Conclusions on Application Timing

- Spray timing before rains in late-March to early-April critical for fruit protection once 3/8 in. dia.
- Inoculum from infected leaves and stems from previous season always present in spring
  - Stem lesions more problematic
  - Irma has amplified inoculum this spring and in future

# Conclusions on Application Timing

- Early fruit infection leading to fruit drop depends on late March-April rains coinciding with most susceptible fruit stage
- In June-July, infections of fruit > 1.5 in. result in smaller lesions that do not induce premature drop
  - If for juice production, these are less of a concern



# **NEW MATERIALS UNDER DEVELOPMENT**

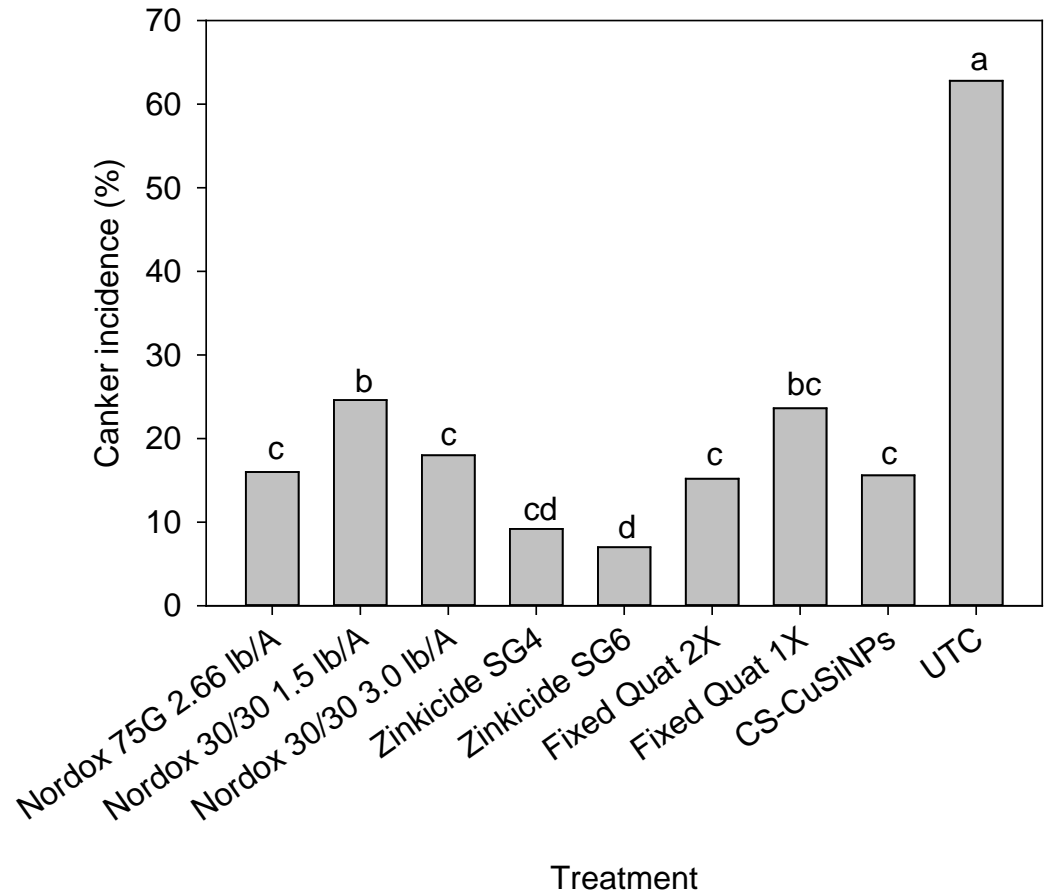
In collaboration with: Evan Johnson and  
Swadesh Santra, UCF

# Multiple new products under development

- 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

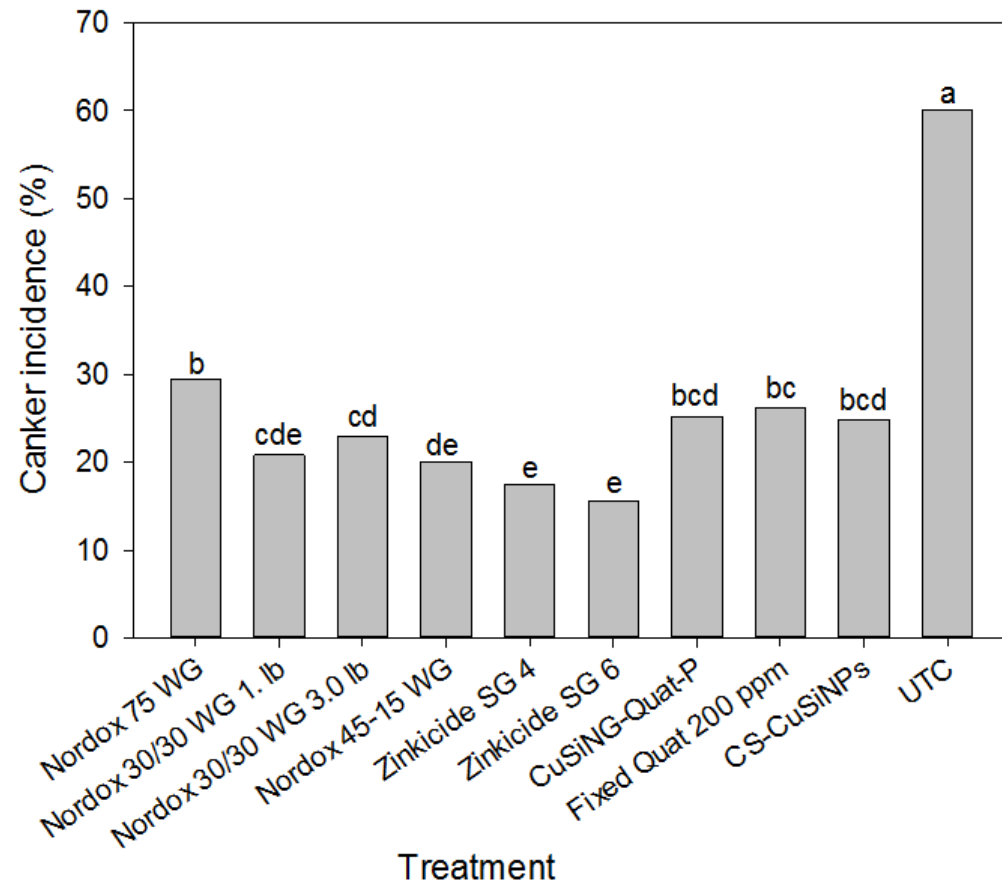
# 2014 Grapefruit canker trial

- Equivalent efficacy to copper
  - Core-shell copper
  - Fixed-Quat
- Zinkicide control exceeded Cu and Cu/Zn



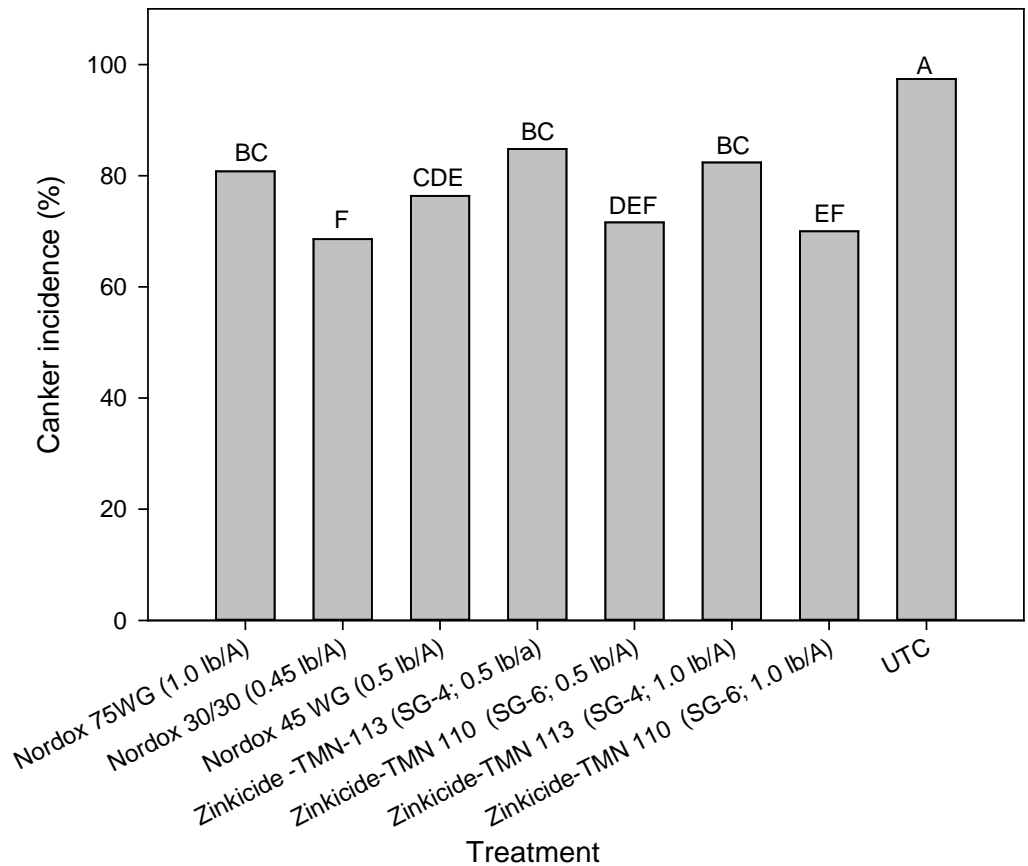
# 2015 Grapefruit canker trial

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



# 2017 Grapefruit canker trial

- Oh Irma!
  - Nearly 100% incidence in UTC
- All treatments significantly better than UTC
  - Nothing gave satisfactory control



# 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
- Hurricane force winds break any form of control



# CITRUS BLACK SPOT



# Spores of importance

- Only one spore type present in Florida
  - Only splash dispersed conidia present
  - Every other location with disease has two: ascospores and conidia
- Known to be abundant in the leaf litter
  - Present in high numbers all year
  - When in canopy, tend to move down more than splash up
  - Rain splash likely moves spores into lower canopy from leaf litter



# Large Scale Field Trial

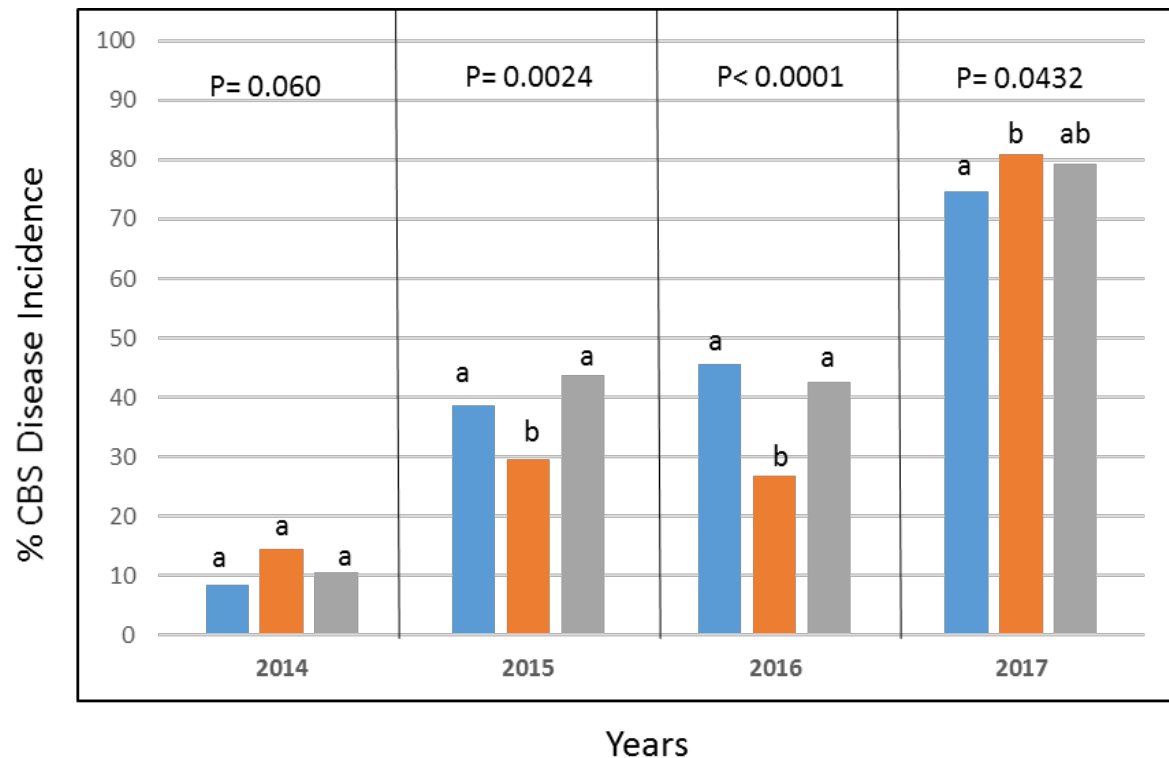
- 20 year-old Valencia
- 3 treatments
  - Urea (40 lb/acre)
  - Soil-set (1.3 fl oz/acre)
    - a compost accelerator
  - Untreated control
- Applied with herbicide booms at 50 gal/acre in a 10 ft strip
- Three rows treated per rep, middle row evaluated for disease



# Disease Incidence

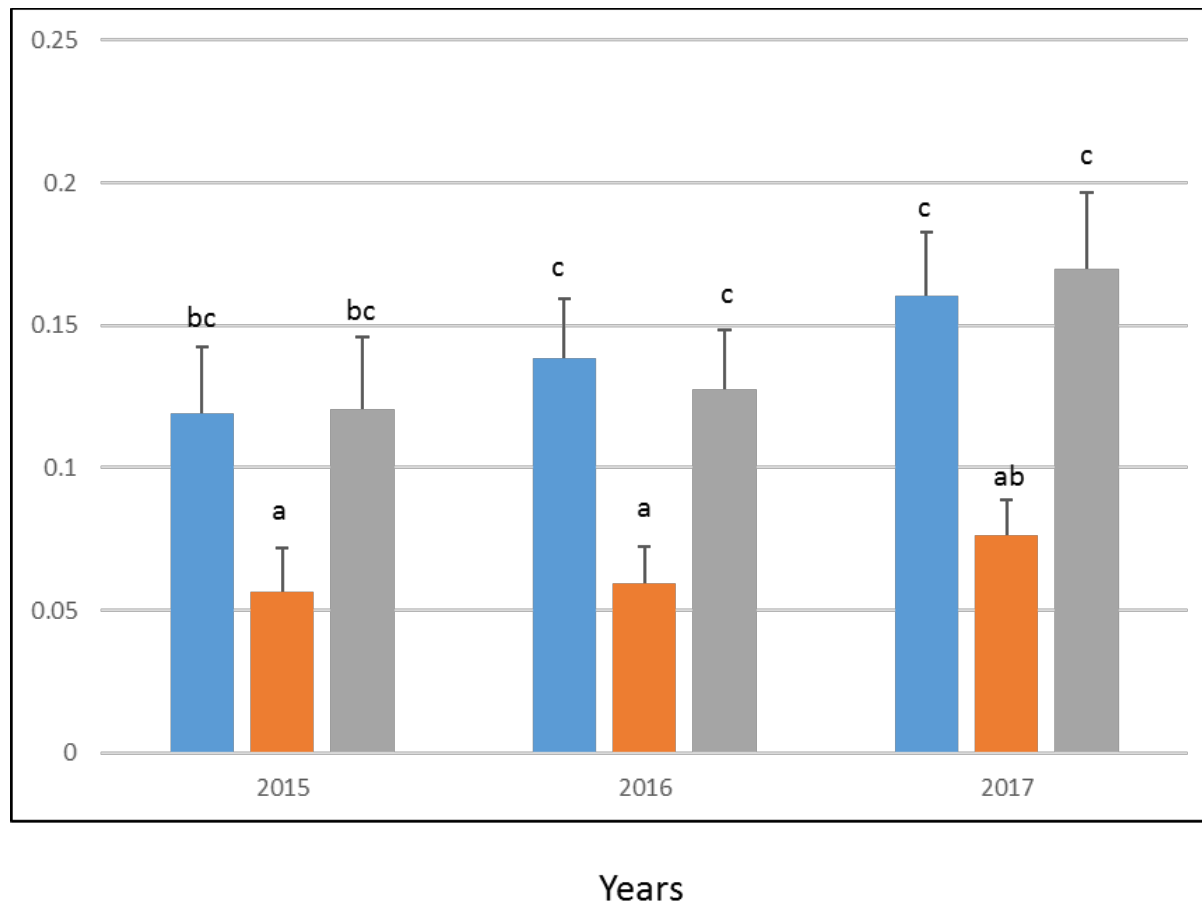
- Data taken spring following treatment
- Disease incidence lower in 2015, 2016 post-trt for Soil-set but not 2017

Blue = urea  
Orange = Soil-set  
Gray = UTC



# Disease Severity

- Soil-set consistently had the lowest disease severity



# Summary

- Disease incidence consistently increased over the four years of the trial
- Despite conidia being only spore type present, enhanced leaf litter management improved disease management
- Soilset had the greatest reduction in disease incidence and severity
  - Urea did not have the same effect

# Black spot program

- Fungicide applications should start mid-April to early-May
  - Dependent on April rainfall
- Monthly applications until September of fungicide
- Alternate copper (full rate of chosen product) with a strobilurin, a premix, or Enable

# Black spot program cont.

- Preferable to alternate among modes of action
- Strobs are Abound, Gem, Headline
- Premixes are Pristine (SDHI), Amistar Top (DMI), and Priaxor (SDHI) and contain a strobilurin
- Coverage is key so at least 125 gal/acre and slow!

# Acknowledgments

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**Any Questions?**



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