Revisiting Canker and Phytophthora Control Strategies

Jim Graham

Florida Citrus Show
January 28, 2015
Current situation with roots and Phytophthora questions about HLB expression

Situation
HLB incidence increases each year and is approaching 100% infection trees especially in young groves
January Orange crop estimate as reduced to 103 mil boxes 5% lower estimation

Question
Will drop be as high last season?
Does it depend on root health status going into the harvest season?
Statewide Phytophthora counts resurged in 2014 and trees doubled in root mass compared to 2013.

Based on 2700 soil samples and 750 root samples statewide.

Data courtesy of John Taylor, Syngenta Crop Protection.
Soil pH and well water quality affect root health and HLB disease expression

Microjet irrigation concentrates fibrous roots in the wetted zone

Some groves (e.g. fresh fruit blocks) have history of dolomite liming for control of copper toxicity

**Common condition:** pH > 6.5 in wetted zone is associated with well water high in bicarbonate (>100 ppm) and > HLB expression (i.e. fruit drop)

Bicarbonate reduces root uptake of Ca, Mg, K, Fe (e.g. [high Ca in](#) soil/moderate levels in leaves)

Groves with bicarbonate stress are experiencing > deterioration in fibrous root density, lifespan and function in root uptake

Rootstock sensitivity: **Swingle** > Carrizo > Sour orange > Cleopatra
The locations in Highlands and Desoto Co. with deep wells (pH > 6.5 and >100 ppm bicarbonates) vs. shallow wells

Data from Davis Citrus Management
Ridge: Root mass density in 4 shallow well (S) and dified groves was similar in 2014; Leaf nutrients optimum
Ridge: Soil pH in the shallow well (S) and acidified groves ranged from low 5.0 to mid 6.0
Phytophthora disease load was zero or low and decreased over the season.
Flatwoods: Root mass density in 4 acidified groves was 10X lower than in the Ridge groves; low leaf Mn and Zn
**woods**: Soil pH in acidified groves started below low 6.5 but rebounded to high 6.0’s during rainy season.
Flatwoods: Phytophthora disease load at damaging level increased until fall fungicide application.

![Graph showing disease load throughout the year in Flatwoods 2014.](image-url)
Manage soil stresses first

Balanced, lower and more frequent application of water and nutrients to the reduced root system (“spoon feeding”)
Reduce soil pH/bicarbonate stress to sustain root function in nutrient uptake and root longevity
To assess bicarbonate stress:
- check soil pH (wetted zone)
- test well water for pH, bicarbonates, salinity, cations, anions

Water conditioning: Inject N-furic acid or sulfuric acid (40%) to reduce irrigation water to 100 ppm bicarbonates

Soil conditioning: broadcast sulfur in wetted zone to reduce root zone pH
**Water Titration Report**

<table>
<thead>
<tr>
<th>ml of Solution*</th>
<th>pH</th>
<th>Bicarbonate ppm</th>
<th>Estimated Product oz/1000 gal to lower pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>7.62</td>
<td>222.04</td>
<td>0.00</td>
</tr>
<tr>
<td>0.6</td>
<td>6.68</td>
<td>192.76</td>
<td>7.68</td>
</tr>
<tr>
<td>1.4</td>
<td>6.07</td>
<td>97.6</td>
<td>17.92</td>
</tr>
<tr>
<td>2.0</td>
<td>5.19</td>
<td>42.09</td>
<td>25.60</td>
</tr>
<tr>
<td>2.2</td>
<td>4.02</td>
<td>19.52</td>
<td>28.16</td>
</tr>
<tr>
<td>2.4</td>
<td>3.51</td>
<td>0</td>
<td>30.72</td>
</tr>
</tbody>
</table>

*15% N-furic Acid
Termination of the soil and/or water reduces root zone pH and promotes release of Ca and Mg for root uptake.

Soil conditioning
- High soil bicarbonate, slower, working all season long
- 300 lbs/treated acre of Tiger 90 sulfur lowered soil pH in 9 months

Valencia/Swingle - 10 yr old

<table>
<thead>
<tr>
<th>Sulfur</th>
<th>pH</th>
<th>Root density (mg/cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>6.4</td>
<td>1.1</td>
</tr>
<tr>
<td>Yes</td>
<td>5.9*</td>
<td>1.4*</td>
</tr>
</tbody>
</table>

* Significant difference P < 0.05
Manage root pest and pathogens after correcting water/soil stresses

tophthora, nematodes, weevils should be managed more aggressively to sustain root health details in FCPMG www.crec.ifas.ufl.edu/extension/pest/
tophthora count >10-20 propagules/cm³ recommend rotation of fungicides: te/phosphite after spring shoot flush fenoxam after spring-early summer rains begin te/phosphite after midsummer shoot flush fenoxam after fall shoot flushes memer rootflushes follow shoot flushes
Target fungicide applications to protect root flushes
Effect of windbreaks on wind speed and canker severity in grapefruit - collaboration with Clive Bock USDA-ARS

Foliage assessment scale:

0 = 0% leaves with any canker
1 = 1-15 % leaves with any canker
2 = 16-30 % leaves with any canker
3 = 31-50 % leaves with any canker
4 = 51-75 % leaves with any canker
5 = 76-100 % leaves with any canker

On fruit percent area cankered estimated and number of lesions counted
Effect of distance from the windbreak on severity of canker on grapefruit

Linear relationship between canker severity (no. of lesions/fruit) and distance from the windbreak.

Results confirm that the closer citrus trees are to windbreaks, the lower the incidence and severity of canker on fruit.

Estes grove

Scott grove

Disease assessed October 2014
Alternative to copper for canker control has been the search objective for last 8 years of canker control trials

Formulations and rates in the grapefruit trial 2014 (Ten 21day interval sprays between April and October)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Manufacturer/supplier</th>
<th>CuO (%)</th>
<th>ZnO (%)</th>
<th>Rate CuO or ZnO (lb/acre)</th>
<th>Metallic Cu or Zn (lb/ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ordox 75G</td>
<td>Brandt</td>
<td>75</td>
<td>--</td>
<td>1.33 Cu</td>
<td>1.0 Cu</td>
</tr>
<tr>
<td>Ordox 30/30 WG</td>
<td>Brandt</td>
<td>30</td>
<td>30</td>
<td>1.5 CuO/1.5 ZnO</td>
<td>0.45 Cu/Zn</td>
</tr>
<tr>
<td>Nkicide SG4</td>
<td>UCF</td>
<td>--</td>
<td>--</td>
<td>1.66 Zn</td>
<td>0.50 Zn</td>
</tr>
<tr>
<td>Nkicide SG6</td>
<td>UCF</td>
<td>--</td>
<td>--</td>
<td>1.66 Zn</td>
<td>0.50 Zn</td>
</tr>
<tr>
<td>Untreated check</td>
<td>---</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>
Copper oxide, copper oxide/zinc oxide or two Zinkicide formulations on control of canker, scab and melanose on ‘Ray Ruby’ fruit

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Metallic Cu (lb/ac)</th>
<th>Metallic Zn (lb/ac)</th>
<th>Canker incidence (%)</th>
<th>Scab incidence (%)</th>
<th>Melanose Incidence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nordox 75WG</td>
<td>1.0</td>
<td>--</td>
<td>21.2 b z</td>
<td>3.0 b z</td>
<td>1.8 b z</td>
</tr>
<tr>
<td>Nordox 30/30 WG</td>
<td>0.45</td>
<td>0.45</td>
<td>24.6 b</td>
<td>4.0 b</td>
<td>1.6 b</td>
</tr>
<tr>
<td>Zinkicide SG4</td>
<td>--</td>
<td>0.50</td>
<td>9.2 c</td>
<td>2.2 b</td>
<td>0.6 b</td>
</tr>
<tr>
<td>Zinkicide SG6</td>
<td>--</td>
<td>0.50</td>
<td>7.0 c</td>
<td>1.2 b</td>
<td>0.4 b</td>
</tr>
<tr>
<td>Untreated check</td>
<td>--</td>
<td>--</td>
<td>62.8 a</td>
<td>18.4 a</td>
<td>9.0 a</td>
</tr>
</tbody>
</table>

* Treatments followed by unlike letters are significantly different at $P \leq 0.05$ according to Student-Newman-Keuls multiple range test
What is Zinkicide™?

Zinkicide is an antimicrobial containing oxides of Zinc metal particles (active ingredients)
High surface area of these particles is maintained using proprietary chemical stabilizers
Chemical stabilizers control growth of particles during chemical synthesis process and determine particle size and shape
Zinkicide particles have a core-shell structure where the shell protects the metal oxide core and controls the release of active ingredient in Zinkicide liquid formulation, particles (coated with chemical stabilizer) form water-dispersible gel
Zinkicide gel particles are sub-micron to micron in size
Zinkicide™ Antimicrobial

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