Care and feeding of HLB-infected roots

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Topics

- Things you might not know about roots
  - Roots do more than you think!

- Importance of carbohydrates (CHO) to compensate for root losses
  - HLB roots are lacking the CHO they need to thrive physiologically

- How to support root growth without reducing fruit production?
  - Roots are expensive so “stimulating” more is not necessarily good

- Close relationship between roots and fruit
  - Will more roots this past season support more fruit at harvest?

- How do you grow and support roots this coming and next season?
  - Can (new) rootstocks help?
Presymptomatic root loss is due to Las root infection

Johnson et al 2014
HLB drastically reduces root lifespan and increases root turnover

- Reduces water and nutrient uptake

- Damage stimulates CHO movement to the roots for repair and replacement

- Root tips produce cytokinins (CK) and abscisic acid (ABA)
  - CK regulate plant growth
  - ABA regulates plant responses to stress and pathogens

- Disruption of hormonal balance leads to “out of cycle” flushes of roots, shoots and bloom
A closer look at thinning and erratic flushing

- Woody branches visible
- Symptomatic new flush
- Leaf drop and dieback
Evidence for sustaining root growth with a fuller canopy

Root Density

Healthy root density

root density (g dry weight/l soil)


Symptomless
Symptoms
Thinning
Decline

Johnson, 2014
Measuring root growth with root cages

Install Root Cages Under Tree

Collect Root Cages After 2 months

Take to lab for processing

Soil Cores at time of cage harvest
Aboveground evidence for lack of regular growth easy to see but belowground takes time and lots of effort!

“Out of cycle” growth occurs any time of the season on actively declining trees

Problem with timing pest and pathogen control applications!

Johnson et al 2014
Producing more CHOs compensates for HLB damage by restoring regular growth cycles of roots and shoots

- Growers: Dieback branches and dragons do not support fruit production, so why keep them on the tree?
- Rejuvenation by heavy pruning (30%) stimulates vigorous vegetative flushes at the expense of roots (<30%) and CHOs (<20%) Eisenstat & Duncan 1992
Removal of the unproductive branches by hedging and topping with a floating bar ("haircut")
Renewal of canopy produces maximum CHOs to support root growth (year 1) and fruit production (year 2)
Out of cycle stimulation of root growth by HLB may be at the cost of fruit production/retention!

Root Growth

Johnson 2014
How to minimize “out of cycle” root flushes? Manage soil stresses!

- Balanced, lower duration 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 lower bicarbonates below 100 ppm
- Soil conditioning: broadcast sulfur in wetted zone to reduce soil pH
<table>
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*15% N-furic Acid
How do you grow and support more roots in future seasons?

Right rootstock in right soil with right management

St. Helena rootstock trial

Fibrous root density (g dry weight/soil)

- Swingle
- Orange 4 / UFR-2
- Changsha + 50-7
- Cleo + Carrizo

Root density on a healthy tree

Does this difference in root growth define HLB tolerance?

Johnson et al 2013-14
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