Advanced Water and Crop Nutrition Systems – 3.5 Years of Citrus Results

Arnold Schumann, Kevin Hostler, Laura Waldo (UF/IFAS, CREC)

Fluid Fertilizer Technology Workshop
December 4, 2012
Orlando, FL
Greetings & Introduction
Outline

- Introduction to the Advanced Citrus Production Systems (ACPS) using open hydroponics (OH)

- Huanglongbing (HLB) in the Auburndale ACPS trial

- Summary & take home messages
Main components of an ACPS

- Intensive fertigation (controller, sensors)
- Balanced complete nutrition (N-P-K-Ca...Mo)
- Higher planting density
- Adapted rootstocks (‘dwarfing’)

(AWS, 2012)
Intensive fertigation (controller, sensors)

ACPS could fail without effective management of psyllids and HLB

Effective psyllid & HLB control

Balanced complete nutrition (N-P-K-Ca...Mo)

Adapted rootstocks (‘dwarfing’)

High planting density

(AWS, 2012)
Replant configuration – drip OH

Water / EC sensor

Sensors:
- 04” depth
- 18” depth

Wetted soil and roots

Drip emitters
- 15” apart

Sandy soil

Profile moisture sensor
Soil moisture (% by volume)

- **Wilting point** ("empty")
- **Field capacity** ("full")
- **uptake period**
  - 8-9 am. nutrient solution in 1 large pulse
  - 12 pm to 5 pm: water only every hour
  - "small irrigation "pulses""

Date and Time:
- 5/15/10 0:00
- 5/15/10 0:30
- 5/15/10 5:00
- 5/15/10 7:30
- 5/15/10 10:00
- 5/15/10 12:30
- 5/15/10 15:00
- 5/15/10 17:30
- 5/15/10 20:00
Selected research results spanning 3.5 years

‘Hamlin’ orange trees, Ridge - 16 December 2008 (0 weeks)
First fruit harvested in December 2010 – drip ACPS at 2 years
OH: Early fruit production, early ripening, high quality after 24 months

Conventional methods Advanced drip fertigation methods (OH)
Gapway experiment: Drip OH, C-35 rootstock, 3 years
222 boxes/acre with 363 trees/acre
Fruit yields (boxes/ac) at 3 years

- Year 3
- Year 2

* trees/acre
Designing ACPS: Horticultural synergies and interactions

Soluble solids (lb/acre)
Normalized % gains

- 22% Drip-OH
- 57% Rootstock (C35)
- 21% High density (363 trees/acre)

This component is highly flexible but tree planting costs increase with density
The importance of planting density, potential yield, and early break-even time (not HLB infected)

Early cycle risk management (more predictable)

Early return on investment (preferable)

Late cycle risk management (less predictable)
Gapway experiment: Conventional, 36 months
Gapway experiment: Drip OH, C-35 rootstock, 36 months
Gapway grove experiment, 36 months
The unique ACPS root system for efficient nutrient uptake

Drip emitters

Root pad = “nutrient filter”
ACPS develops healthy dense feeder roots
1st HLB infection found at 20 months (0.1% in year 2)

(8.5% in September, year 3)
View SW from last row on W side: 10/01/11

Row of highest HLB incidence
Situation analysis: 10/01/11

Zone of highest HLB incidence

.95 feet from yard trees

0.33 miles from abandoned grove

ACPS experiment
View NNW from SW corner: 10/01/11

HLB-infected yard trees
Tree removal is no longer a viable option for this block due to uncontrolled external inoculum. Therefore management options for mitigating HLB are being developed through ongoing research: All infected trees are periodically mapped & rated for HLB symptom severity (0-5), and photographed to track progression of the disease / mitigation effects.
May 25, 2012

H Bae = 0
May 25, 2012

HLScore = 2
n=345 trees

Less severe HLB symptoms

More severe HLB symptoms

HLB severity class score (0-5)
Severity score = 0
Severity score = 1
Severity score = 2
Severity score = 3

=88% mild to moderate
Severity score = 4

Severity score = 5

=12% severe to very severe (1.2% of block)
HLB incidence and severity: Statistical analysis

- HLB incidence was significantly lower in ACPS-grown plots than in standard-grown plots.
- HLB symptom severity was significantly lower on the ACPS-grown trees using C35 rootstock than on the standard-grown trees using Swingle rootstock.
Subsequently HLB-affected trees improved during the summer.
June, 2012: asymptomatic trees
June, 2012: symptomatic tree
June, 2012: symptomatic tree
June, 2012: symptomatic tree
Tolerance of HLB by 3.5-year old trees

- HLB symptoms identified September 2011 (11 months before)

- ‘Hamlin’ orange, C35 & Swingle rootstocks

- Scout and spray to manage psyllid and other pests

- Daily complete nutrient fertigation (open hydroponics)

- Drip or microsprinkler delivery of nutrients to trees

- Sensor- and computer-based precision irrigation

- K-Phite + DKP spray every 8 weeks (Plant Food Systems)

- 3 nutrient sprays on major leaf flushes/year (Chemical Dynamics)
Interactions of citrus nutrition with HLB

- Nutrients from foliar and soil fertilizer affect HLB through the “Environment” component of the tetrahedral disease schematic.
Rootstock genotypes affect HLB through the "Citrus host" component of the tetrahedral disease schematic.
Conclusions after 3.5 years

- HLB appeared at 1.5 yrs; 10%+ at 3 yrs (exponential)
- Standard methods of inoculum reduction impossible
- Host tolerance to HLB improved by ACPS
- Continued fruit production possible despite HLB?
PROBLEMS: Fruit drop caused by HLB is severe
Long-term tree survival?
Acknowledgements

Gapway Grove Corp.

Griffin Fertilizer, Plant Food Systems, Tiger Sul, Growers Fertilizer, Harrell’s

IFAS Research
Florida Agricultural Experiment Station

YARA

CRDF
Citrus Research and Development Foundation, Inc.

Southwest Florida Water Management District
WATERMATTERS.ORG • 1-800-423-1476

Fluid Fertilizer Foundation

Our Business Is To Help You Grow

CHEMICAL DYNAMICS, INC.

florikan
controlled release fertilizers