ASSESSING CITRUS CROP COEFFICIENTS FOR OPTIMIZING WATER USE AND SUSTAINING ENVIRONMENTAL QUALITY

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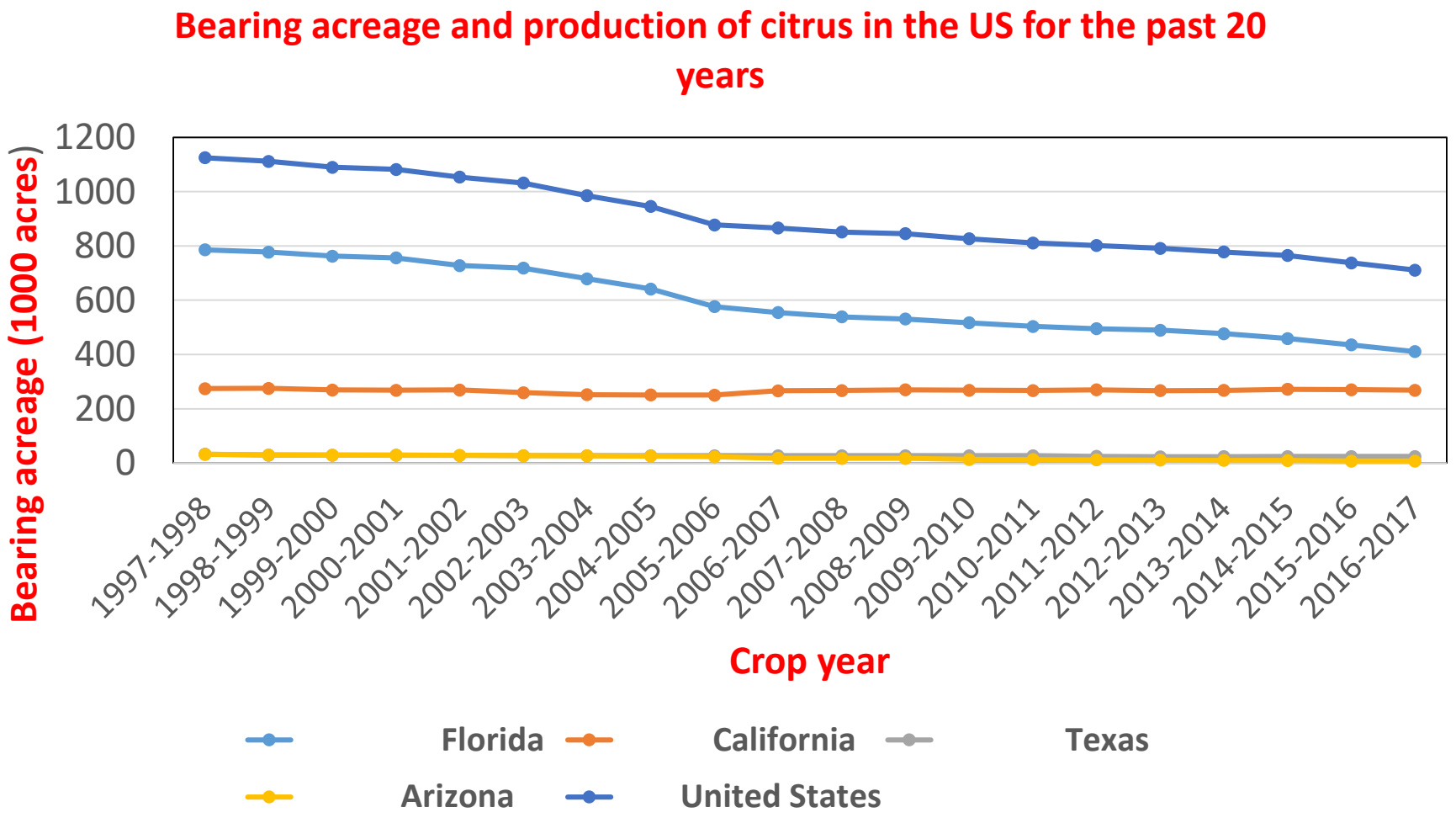
CURRENT CITRUS PRODUCTION STATUS



Florida bearing acreage has declined from **785,900 acres (70% of national production)** in 1998 to about **410,700 acres (58% of US production)** in 2017 representing about **48%** decline (USDA, 2018).

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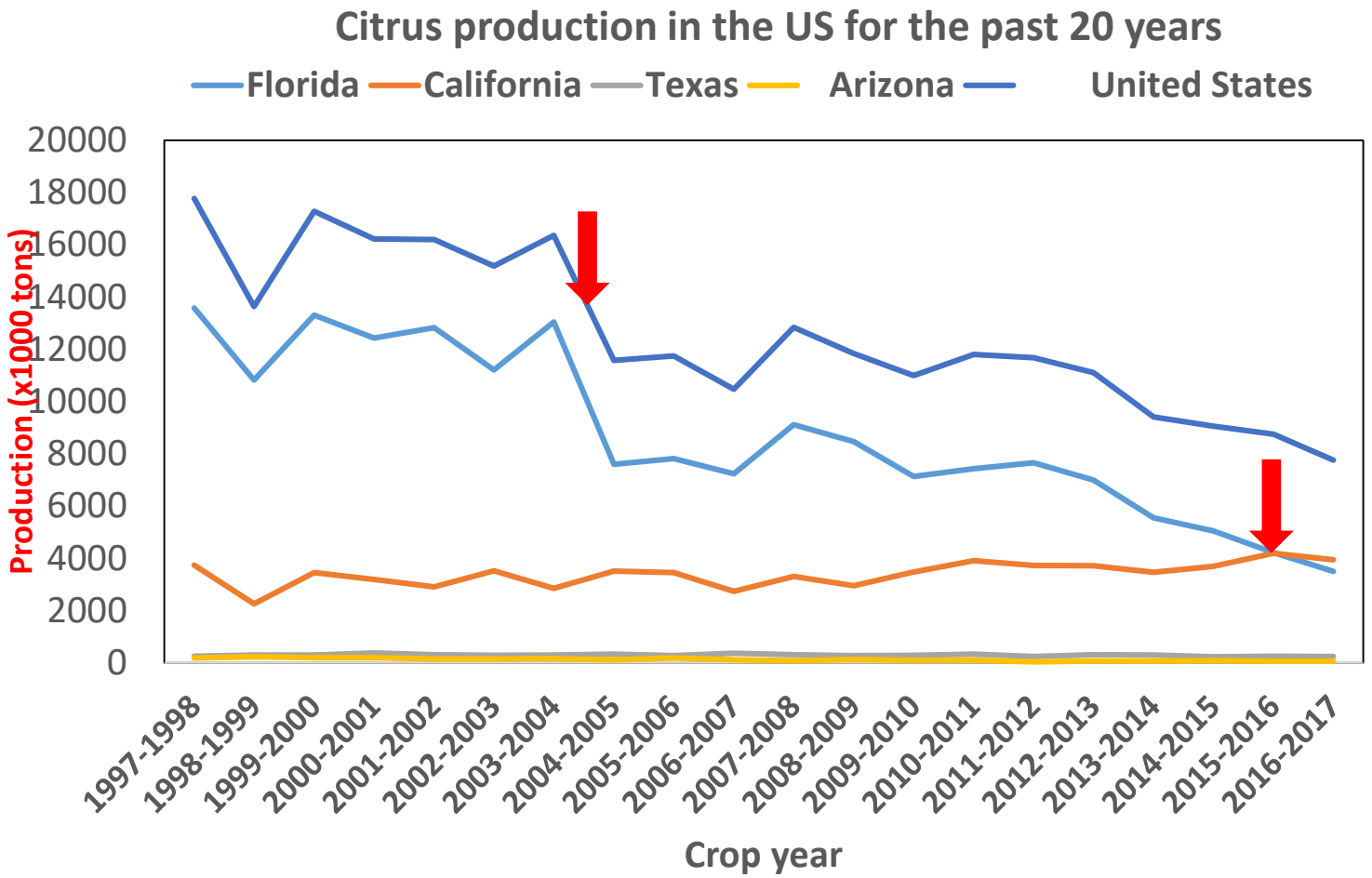
CURRENT CITRUS PRODUCTION STATUS (2)



Florida production has declined from **13.6 million tons (76% of national production)** in 1998 to about **3.5 million tons (45% of US production)** in 2017 representing about **74%** decline in production (USDA, 2018).

Bearing acreage and production losses have been ascribed largely to **Huanglongbing (HLB) or citrus greening**. Other reasons include **hurricanes** and **urbanization**.

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WATER MANAGEMENT STRATEGIES FOR HLB-AFFECTED CITRUS TREES

- Preventative measures: HLB negative (healthy trees) (Ferrarezi et al. 2017a, 2017b, Schumann et al. 2017)
  - Frequent irrigation (daily or multiple times a day) e.g. Citrus Under Cover Production System
  - Regulated deficit irrigation
  - Ensure Asian citrus psyllid (ACP) exclusion
- Curative management of HLB positive trees (asymptomatic trees) (Kadyampakeni et al., 2014a,b,c)
  - Daily irrigation plus ACP control
  - Managing pH to optimum levels for nutrient availability
  - Improved nutrition programs via fertigation or use of controlled-release fertilizer (CRF) sources
- Remediation/Management of HLB affected trees (symptomatic trees) (Hamido et al., 2017a,b; Kadyampakeni and Morgan, 2017)
  - Daily irrigation plus ACP control
  - Managing pH to optimum levels for nutrient availability
  - Fertigation practices and CRF

OBJECTIVES OF THE VARIOUS FIELD AND GREENHOUSE STUDIES

- **Determining water use patterns of HLB-affected trees at field scale and in greenhouse conditions.**

- **Estimating crop coefficients for HLB-affected and healthy trees under greenhouse conditions.**

- **Evaluating soil moisture thresholds for HLB-affected trees in the greenhouse and field conditions.**

HYPOTHESES FOR VARIOUS WATER MANAGEMENT STUDIES

- **Frequent irrigation management practices would enhance growth, water use and crop resilience to HLB.**

- **Soil moisture availability would be optimal with frequent, but reduced irrigation level, and maintain and/or increase root growth, root water uptake and tree water use.**

MATERIALS AND METHODS

Water use measurements in field studies and greenhouse studies.

Use of sapflow sensors supported by a datalogger, solar panel, and 12-V battery (right and top)

Weighing lysimetry for measuring water use (left)

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MATERIALS AND METHODS (2)

Water monitoring at grove scale and soil moisture measurement at 15, 30 and 60 cm soil depth

Water volume measurements at field scale

Evapotranspiration and root growth measurements between HLB affected and healthy trees under greenhouse conditions

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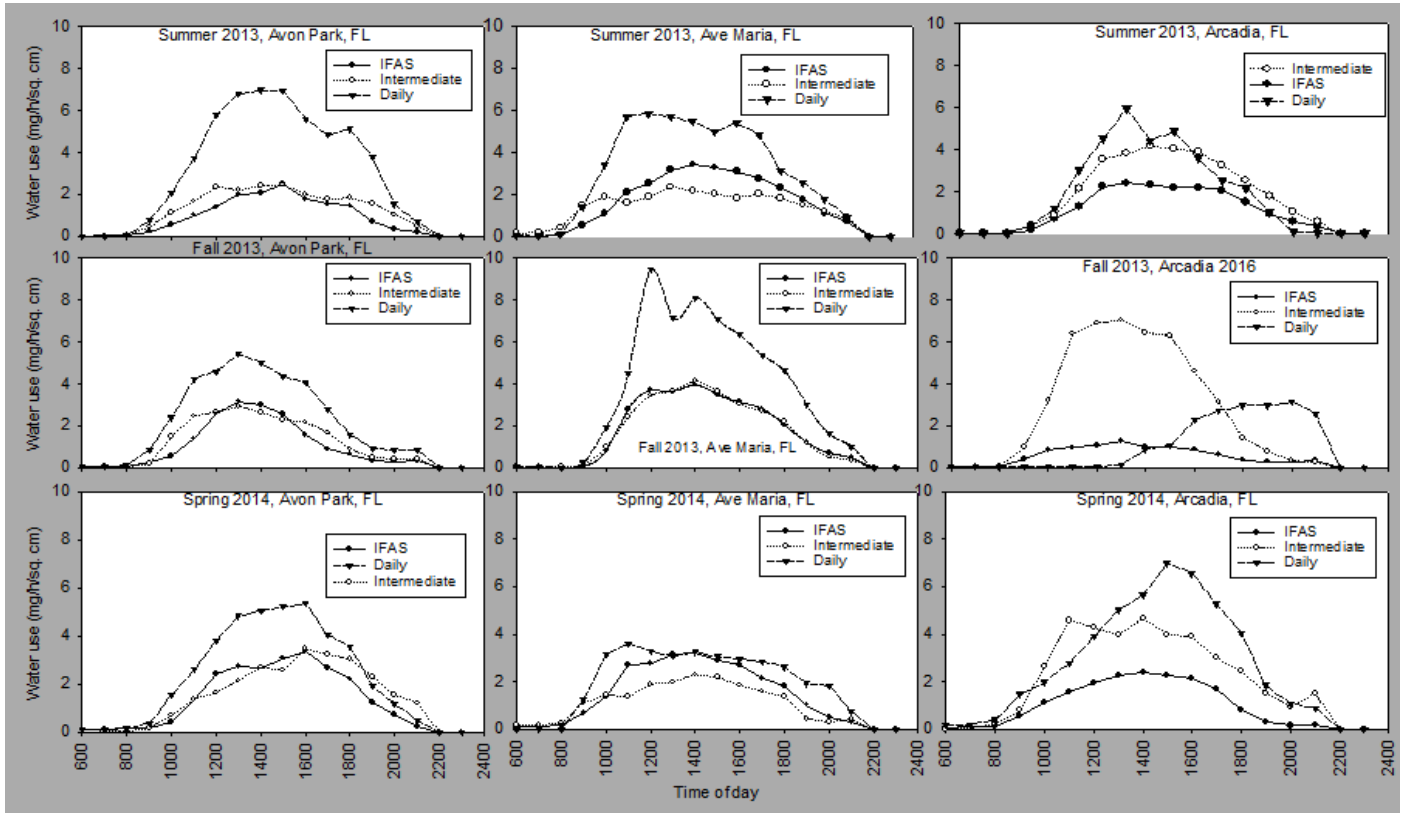
TREE RESPONSE TO IRRIGATION SCHEDULES



Water use of HLB affected trees in south west and central Florida

- Daily irrigation > Intermediate (irrigating every 1.5 days) > IFAS irrigation (irrigating every two days) scheduling
- Daily irrigation could help in managing HLB affected trees and reduce tree water stress
- More details: Kadyampakeni and Morgan, 2017. Scientia Horticulturae 224:272-279

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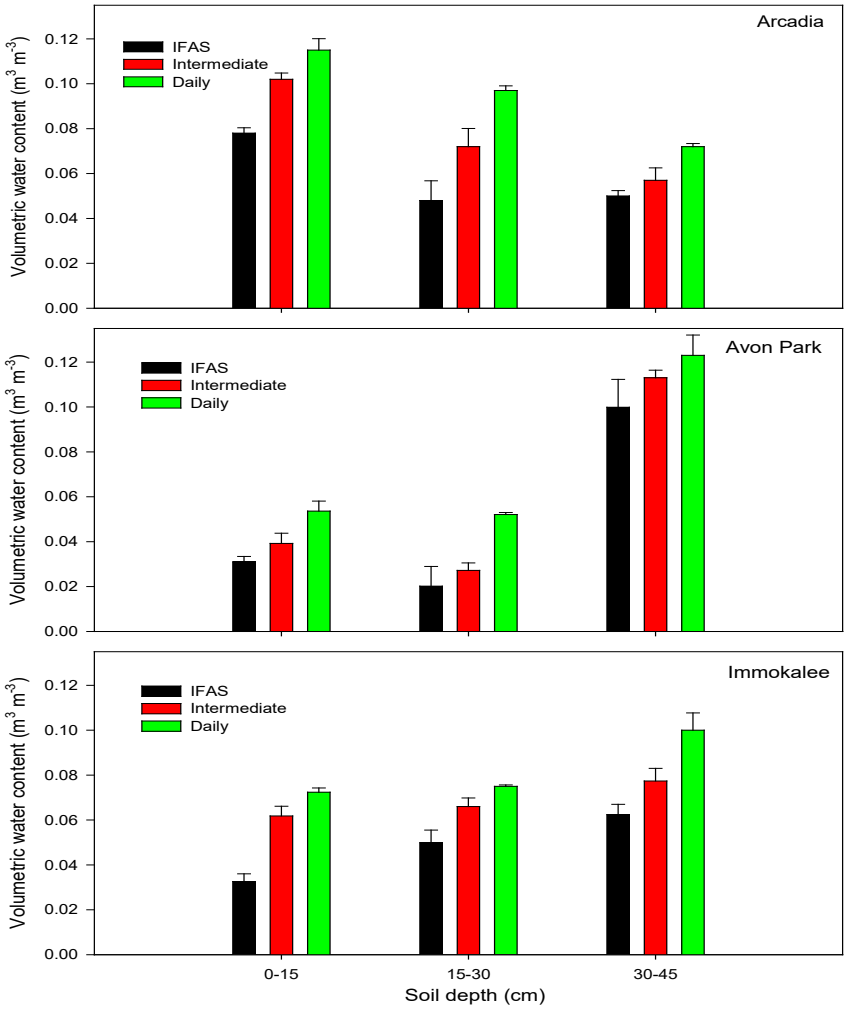
SOIL MOISTURE DISTRIBUTION AT 3 DEPTHS



Keeping water in the top 0-30 cm improved water use for HLB affected trees. Greater moisture content beyond the root zone (at 45 cm) in Immokalee (bottom) could be due to capillary rise since the soils have a high water table and in Avon Park (middle) could be due to deep percolation because those soils are well drained.

More details: Hamido et al. 2017a. HortScience 52(6):916-921.

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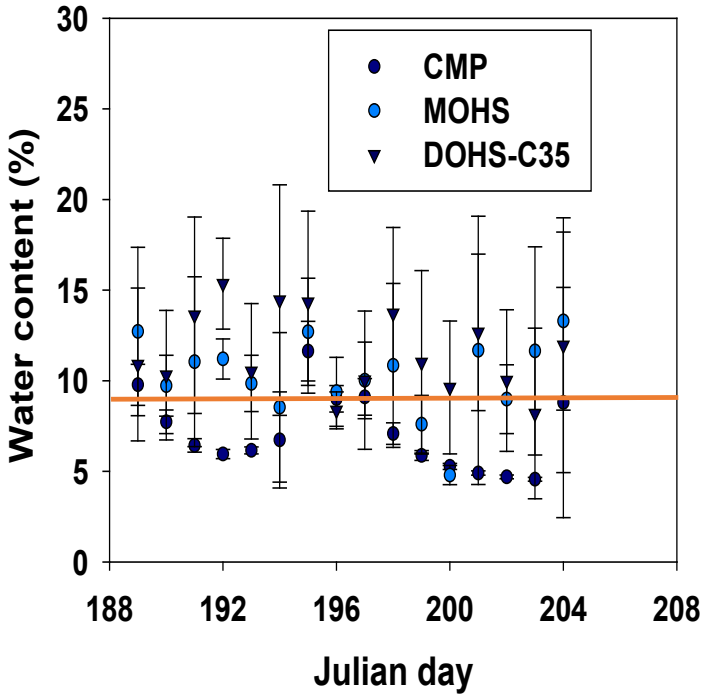
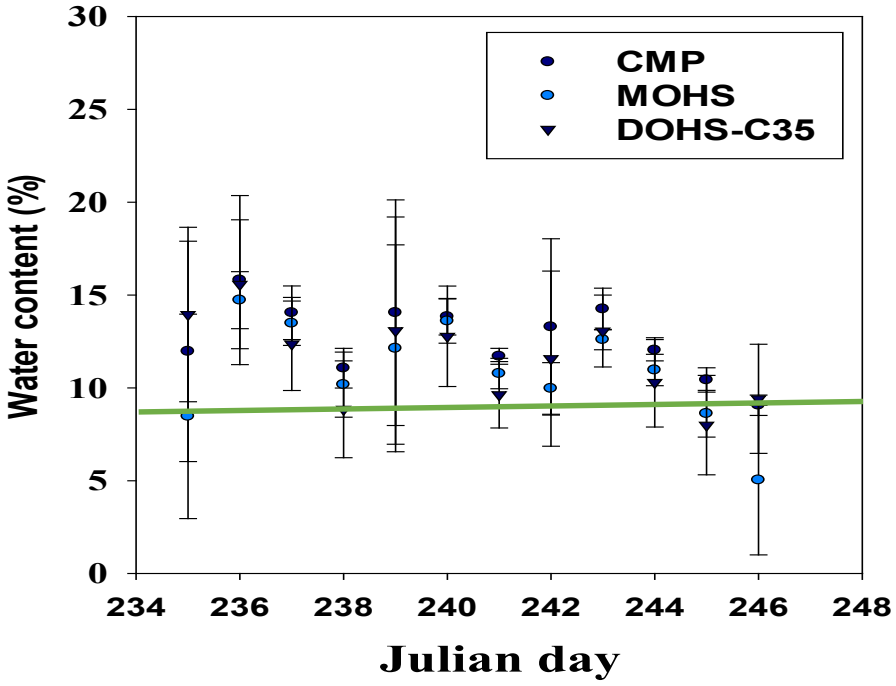
SOIL MOISTURE DISTRIBUTION USING DRIP AND MICROSPRINKLER IRRIGATION SYSTEMS



July 2010



Aug-Sept 2011

CMP-Conventional microsprinkler irrigation
MOHS-Microprinkler open hydroponic system with daily irrigation and weekly fertigaton.
DOHS-C35-Drip open hydroponic system with daily irrigation and fertigation

Soil moisture at 10 cm depth was close to or slightly above field capacity in the range of 7 and 15%.

Kadyampakeni et al. 2014a, b. Soil Science Society of America Journal 78:645–654; 78:1351–1361

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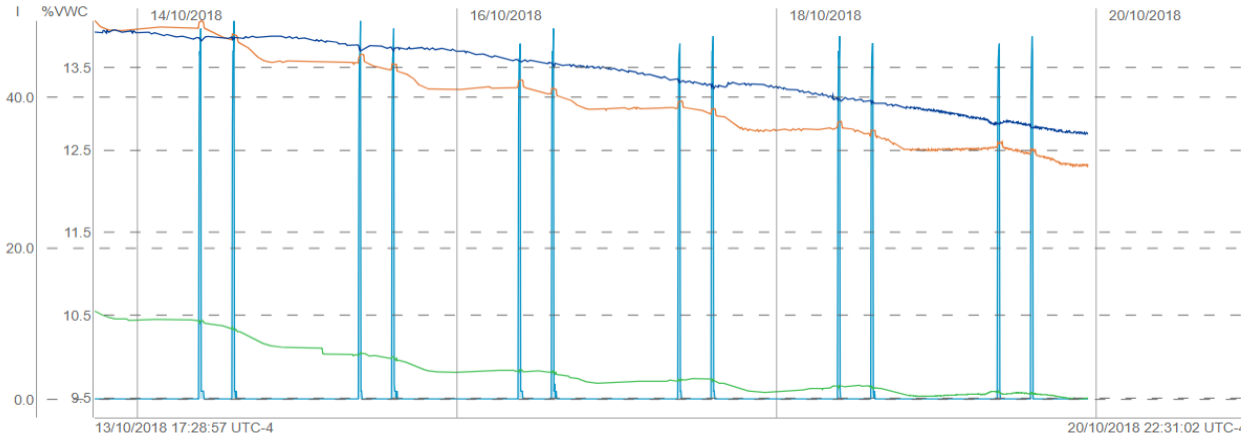
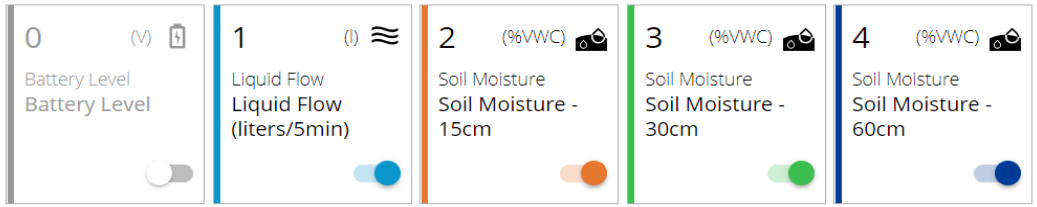
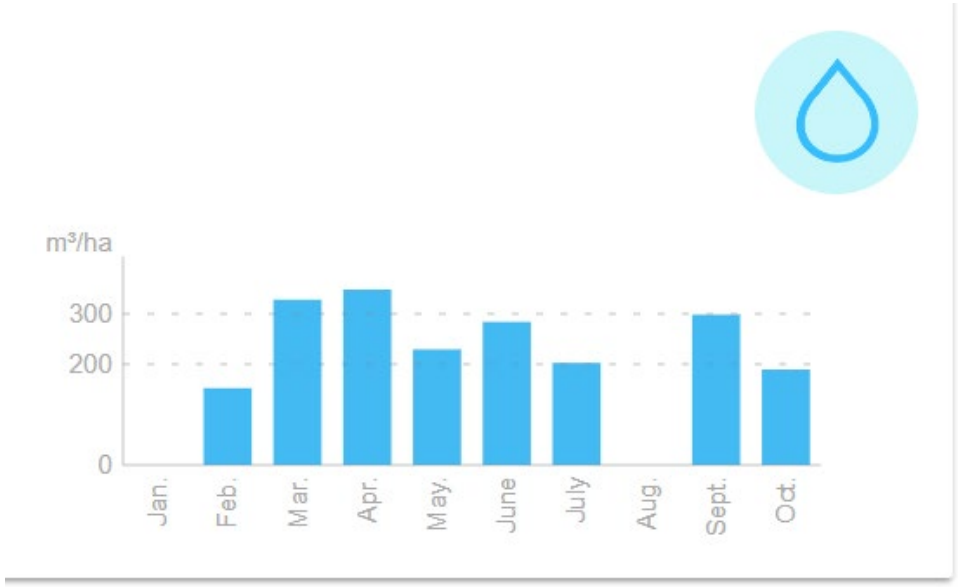
MEASURING WATER CONTENT IN THE SOIL AND APPLIED WATER VOLUMES





Water monitoring at grove scale and soil moisture distribution at 15, 30 and 60 cm soil depth



~217,238 gal/acre since Feb 2018

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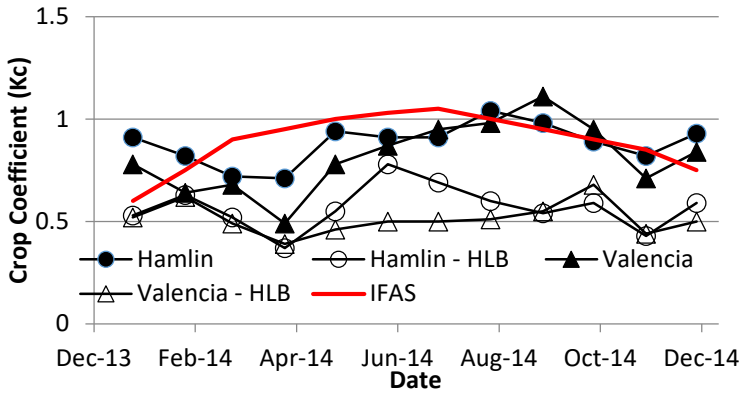
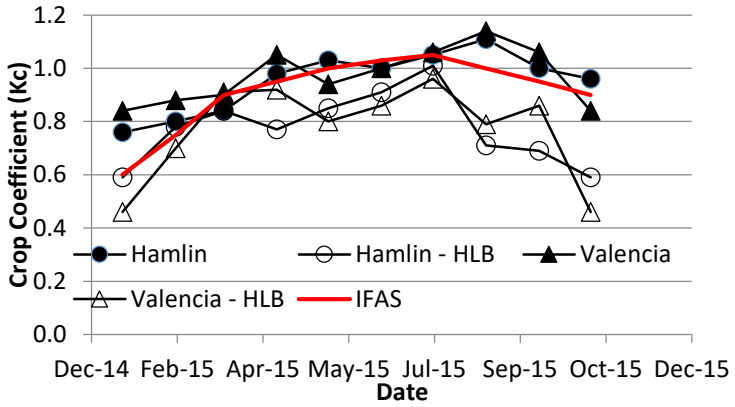
CROP COEFFIENTS FOR HLB VS NON-HLB AFFECTED TREES

- Patterns of crop coefficients (K_c) similar for HLB affected and non-affected trees
- Non-affected tree K_c similar to those found to field trees prior to greening
- Infected trees consistently with lower K_c
- K_c 35.2% and 20.8% lower for HLB-affected trees in 2014 and 2015, respectively.





Crop coefficient (Kc) for HLB affected trees in southwest Florida under greenhouse conditions

More details: Hamido et al. 2017b. HortTechnology 27(5):659-665

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CROP EVAPOTRANSPRIRATION FOR HLB VS NON-HLB AFFECTED CITRUS

Month -year	ET_o (mm d^{-1})	ET_c (mm d^{-1})		ET_c diff. (%)[‡]
		Hamlin-Non HLB	Hamlin-HLB	
Jan-Jun-14	3.57	2.97	2.23	23.73
Jul-Dec-14	4.42	4.16	2.63	34.82
Jan-Jun-2015	3.38	4.08	2.83	29.82
Jun-Oct-15	3.73	4.94	3.18	35.20
Overall Average	3.79	4.00a**	2.69b**	30.75
		Valencia-Non HLB	Valencia-HLB	
Jan-Jun-14	3.57	2.83	2.22	22.28
Jul-Dec-14	4.42	3.97	2.83	28.85
Jan-Jun-2015	3.38	3.85	2.69	30.98
Jun-Oct-15	3.73	4.79	3.56	26.42
Overall Average	3.79	3.82a**	2.80b**	26.99**

- 22 to 35% greater water use for Non-HLB affected trees
- Inter-season and annual variability in water use
- Comparable water use between varieties

SUMMARY

- **Daily irrigation is critical for maintaining tree production and performance.**
- **Optimal irrigation scheduling along with monitoring water use is important for high irrigation efficiency, greater water use efficiency and minimizing leaching losses.**
- **Soil moisture content at or close to field capacity is possible with modified water application methods on Florida's sandy soils**
- **Trees affected by HLB appear to use about 22 to 35% less water than healthy trees. These results, if confirmed at field scale, will result in modified crop coefficients for HLB-affected citrus leading to water savings.**

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QUESTIONS/COMMENTS?

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