MANAGING NUTRIENT ACCUMULATION AND UPTAKE USING ADVANCED CITRUS PRODUCTION SYSTEMS

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Outline

- Overview
- Biomass accumulation studies
- Nutrient accumulation studies
- BMP considerations for water and nutrient management
- Take home message
Overview

- Florida citrus production ranked #1 in the US
- FL citrus valued at $1.29 billion per year
- Citrus production ~ 480,121 acres (USDA, 2016)
- Nutrient management critical for successful & profitable production due to sandy soils
- Good irrigation management is crucial for retaining the nutrients in the soil
Advanced citrus production system (ACPS) uses high density plantings coupled with intensive fertigation practices for improved tree nutrition and yield.

Merits of ACPS include rapid tree growth & high yield within the first 5 yrs of establishment.

ACPS tested using the open hydroponic system (OHS) with drip and microsprinklers
Biomass accumulation

Destructive tree sampling for nutrient accumulation and biomass analyses
Biomass accumulation (2)

Typical citrus biomass distribution patterns: branches > roots > leaves ~ fruits

- Leaves (%)
- Branches, twigs and trunk (%)
- Fruits (%)
- Roots (%)

Barnette et al., 1931; Mattos et al. 2003a,b; Morgan et al., 2006; Quinones et al. 2003a,b, 2005; Feigenbaum et al., 1987; Cameron and Appleman, 1935; 1945
Biomass accumulation with ACPS (3)

- DOHS – Drip open hydroponic system
- MOHS – Microsprinkler open hydroponic system
- CMP – Conventional microsprinkler practice

Biomass accumulation: Canopy development

Canopy volumes: DOHS-Swingle > DOHS-C35 > MOHS > CMP

DOHS – Drip open hydroponic system
MOHS – Microsprinkler open hydroponic system
CMP – conventional microsprinkler practice

N concentration follows the pattern: leaves > branches > roots > fruits

Cameron and Appleman (1935); Cameron and Compton (1945); Feigenbaum et al. (1987); Quiñones et al. (2005); Legaz et al. (1982); Legaz et al. (1995) Quiñones et al. (2003)
Nutrient accumulation (N)

- Greater N accumulation with DOHS and MOHS
- More N in leaves than other plant parts
- Comparable N distribution in fruits, branches and roots

**Nitrogen accumulation in citrus**

- CMP
- DOHS
- MOHS

DOHS–Drip open hydroponic system; MOHS–Microsprinkler open hydroponic system; CMP–Conventional microsprinkler practice
Nutrient accumulation (P)

- Higher P accumulation in CMP and MOHS than DOHS
- Greatest P accumulation in branches, twigs and trunk across all methods

DOHS—Drip open hydroponic system; MOHS—Microsprinkler open hydroponic system; CMP—conventional microsprinkler practice
Nutrient accumulation (K)

- Greatest K accumulation in branches, twigs and trunk than other parts
- K accumulation in CMP > DOHS > MOHS

DOHS–Drip open hydroponic system; MOHS–Microsprinkler open hydroponic system; CMP–conventional microsprinkler practice
Best water and nutrient management practices
BMP considerations for nutrient and water management

- Use of UF/IFAS recommendations:
  Nitrogen rate & timing for the growth of young non-bearing trees depending on soil type, fertilizer source and placement, crop load, citrus variety, tree age and irrigation method

- Use of soil analyses information for fertilizer application:
  Growers can make informed decisions about the fertilization requirements of citrus trees.
BMP considerations for water and nutrient management (2)

- Use of tissue analyses for fertilizer application decisions:
  This helps in assessing nutrition status of trees for macronutrients (e.g. N and K) and micronutrients (e.g. Cu, Mn, Zn, Fe, B)

- Training of fertilizer applicators:
  Adequate training of the field operators in the handling, loading and operating of fertilizer spreaders and accurate calibration of equipment.
BMP considerations for water and nutrient management (3)

- **Fertilizer placement near or over the root zone:** Accurate placement of fertilizer facilitates uptake and reduces nutrient losses through runoff and leaching.

- **Avoiding fertilization during high water table or flooded conditions:** Applying nutrients during wet conditions leads to leaching and lateral flow of nutrients, thus increasing costs of production and posing environmental concerns to surface and groundwater.
BMP considerations for water and nutrient management (4)

- **Use of CRF for mature trees:**
  CRF, @ 90lbs/ac found to be effective with one time application

- **Use of organic amendments:**
  Adding organic amendments to the soil facilitates slow release of nutrients and improves water and nutrient retention.

- **Avoiding fertilizer application between mid–June and mid–September:**
  Applying fertilizer before or during intense rainfall is not advisable on highly erodible soils.
BMP considerations for water and nutrient management (5)

- **Split fertilizer applications:**
  Split fertilizer applications >4 times per year can reduce leaching losses particularly for N and K during excessive rainfall events.

- **Use of fertigation practices:**
  Helps in precise control of nutrient placement in concert with irrigation for optimal water and nutrient uptake.
BMP considerations for water and nutrient management (6)

- **Soil moisture based irrigation scheduling:**
  Use of TDR, tensiometers and other soil moisture measurement devices. This can reduce nutrient leaching beyond the root zone.

- **ET-based irrigation scheduling:**
  Use of weather data to decide when and how much to irrigate. FAWN and other weather data help in using the soil water budget for irrigation.
Good nutrient and water management through ACPS improve biomass accumulation and canopy development

N accumulation greater with ACPS than grower practice

BMPs critical for reducing nutrient loads, irrigation water volumes and production costs.
THANK YOU FOR THE ATTENTION!