The Great Wide Open

Utilizing advanced production systems for new plantings can help growers close in on untapped potential.

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During the past two years, the open hydroponics (OH) method of crop production has been intensively studied for proof of concept and adaptation as a new advanced production system (APS) for Florida citrus. The foundation of a successful OH system is based on early, high yields, made possible through 1) intensive fertigation, 2) balanced complete nutrition, and 3) high-density planting. The accelerated growth from optimal balanced nutrition and water relations achieved with precise computerized fertigation is a key component of the APS. When combined with high-density planting, the accelerated growth can potentially cut the time in half to economic production and the return on a new grove investment.

Results from replicated treatments obtained in a replanted 15-acre Hamlin orange block in a commercial grove setting demonstrated during the first year a 60% reduction in irrigation water requirement and an 83% reduction in fertilizer application was possible by using carefully regulated drip fertigation. Despite these input savings, canopy growth of the trees during the same period was 65% greater, resulting in a 9.9-fold increase in efficiency. In the APS treatments, significant reductions in nitrate-nitrogen concentrations were recorded in soil water leachates collected below the root zones of the trees. At no time in the first year did nitrate concentrations exceed the 10 mg/L maximum contaminant level in APS plots, while they frequently exceeded the limit in the conventional control plots. At the end of two years in the field, the APS trees produced their first small fruit crop in December 2010, which was 4.75 times greater than yields from the conventionally grown trees. Fruit quality was already good and passed all the required tests for juice processing (ratios of 16 to 19).

Differences in growth and fruit production of Hamlin orange trees can be seen in this experiment after 24 months with a conventional production program (left) and advanced production system (right).

On Trial

The field experiment compares fertigation delivered by microsprinklers with delivery by drip emitters and after 24 months the growth, yield, and fruit quality results of the two systems were similar, but marginally better with the drip system. The drip system is preferred for its high efficiencies, leading to significant savings of water and fertilizer, but has the distinct disadvantage of not being able to protect the crop during winter freezes. Consequently, Florida citrus growers wanting to utilize the high efficiencies of the drip fertigation system also should ensure the crop is protected from freezes — most likely by installing an additional microsprinkler irrigation system for that purpose.

An APS replant configuration currently being researched in the 15-acre experimental Hamlin orange grove near Auburndale relies on two soil sensors placed on at least one "indica-

Precise drip fertigation can lead to dense citrus root growth.

tor tree." The shallow water sensor at 0- to 4-inch depth is used to monitor the need for fertigation since it is located in the zone of greatest root proliferation. The second sensor at a depth of 18 inches is required to determine if fertigation or rainfall events cause excessive movement of water and nutrients beyond the main root zone. Thus, both sensors are used simultaneously to determine the optimal fertigation strategy for citrus tree growth and also to avoid leaching nutrient solutions to the groundwater. In this experimental APS, data from the soil sensors is automatically collected with data loggers and transmitted to the office with radio modems and the Internet. The fertigation pump control system also is remotely monitored and controlled by computer software in the office.

One Drop At A Time

From the early results of the field research, steps being taken to adapt and implement the drip fertigation APS for Florida growers can be summarized as follows:

- Keep the soil near field capacity (~zero water tension) with short duration frequent (drip) irrigations to wet the top 18 inches of soil.
- Inject fertilizer with most irrigations (100 to 150 parts per million N) to maintain a solution of readily available balanced nutrition in the root zone.
- If possible, apply the main fertilizer after sunrise and before noon, when photosynthesis and transpiration are at their peak.
- Use a complete, balanced nutrient formula (N, P, K, Ca, Mg, S, Mn, Zn, Fe, Cu, B, Mo, Cl) to maximize growth rates and improve plant fitness/disease resistance.
- Skip fertigation on rainy days, while soil is already near field capacity.
- Flush excess salts from the root zone during the dry season with plain irrigation water (three to four times normal irrigation amount every two weeks).
- Monitor nutrient concentrations in the leaf tissue and make corrections to the nutrient formula and fertilizing intensity as needed.
- Monitor and control insect pests frequently since they are attracted to the rapidly growing new leaf flushes.

Daily delivery of precise amounts of water and nutrients by drip fertigation to the efficient, modified dense root zones of citrus trees is the ultimate goal of the APS. By delivering only the water and nutrients required in a day, we eliminate the need to store fertilizer and water in soil, which is a wasteful but necessary process under conventional cultivation methods. Precise drip fertigation also continuously trains the root systems of the citrus trees to proliferate more vigorously in the small wetted region of soil around each dripper.

For more information and frequent updates on this research, visit **www.crec.ifas.ufl.edu**. FG

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