Photos by Eduart Murcia

Comparison of young lemon trees under the fabric mulch (left) and bare ground (right).

Fabric mulch groundcovers save water

By Sandra M. Guzmán

New challenges require new solutions. This is especially true with water and nutrient management in Florida citrus.

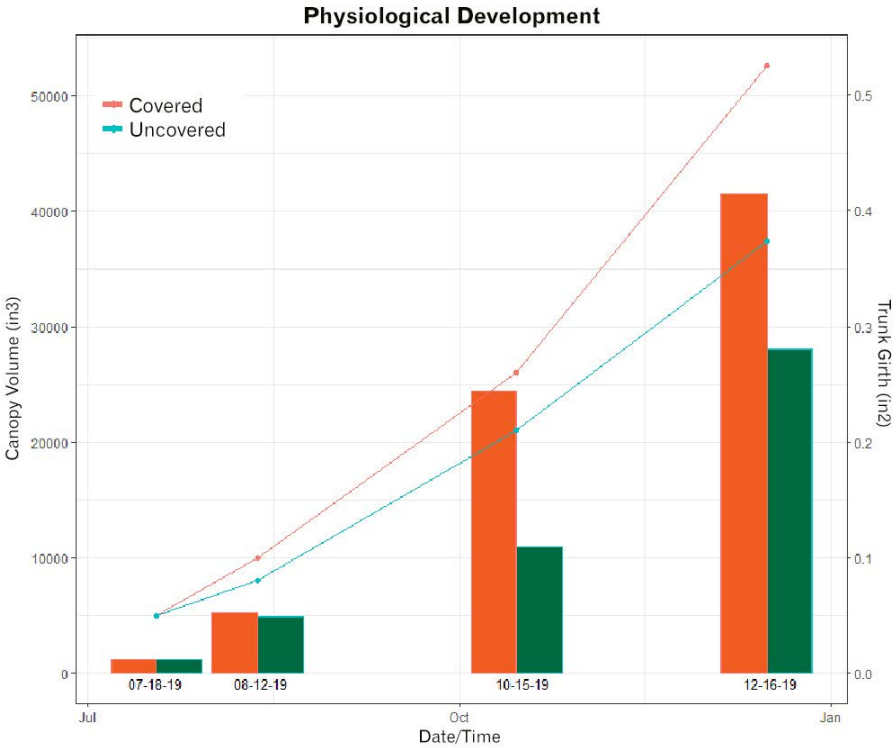
Currently, a University of Florida Institute of Food and Agricultural Sciences (UF/IFAS) team is analyzing fabric mulch groundcovers for young lemon trees on a commercial scale. During the last year, the use of groundcovers has shown water savings of 50 percent when combined with soil moisture sensor irrigation scheduling. During rainy periods, the groundcover allows excess water to move faster into drainage canals. During the fall season, a decrease in soil temperature during the day and an increase at night has been seen with the use of fabric mulch. This could be beneficial for crop management in both summer and winter periods.

The UF/IFAS study is looking at the effects of fabric mulch groundcovers in the water, nutrient dynamics and plant root growth of young lemon trees. A lab is collecting and analyzing real-time soil moisture sensor data and environmental variables including rain, soil temperature, solar radiation and wind velocity to provide daily irrigation recommendations for covered and uncovered beds.

The amount of water applied to young lemon trees planted in a Fort Pierce commercial grove is quantified and evaluated using the real-time data collected. The irrigation system, which is fully automated, provides real-time soil moisture sensor information that is examined to provide daily analysis on irrigation management. When the soil moisture sensor hits a "dry" threshold, irrigation is triggered until the soil moisture sensor hits the upper limit of water in the soil or field capacity.

During the first year of this study, for ground-covered beds, there have been significant increases in canopy volume with almost half of the water applied. The fabric mulch allows water to hold longer in the soil and reduce evaporation losses. Results show there is a significant reduction of the volume of water used (close to 50 percent) and the frequency of irrigation when using the fabric mulch.

In summer, when the demand for irrigation is usually higher, water is held in the covered bed for longer, which reduces runoff and nutrient losses. However, more data needs to be collected to increase the certainty of the groundcover's potential. Holding irrigation water in the beds for longer is good for the young trees because it reduces water stress. It's good for field management because it reduces irrigation energy usage. It's also good for the environment because it helps to keep nutrients where they are supposed to be, near the root zone. During



Significantly higher canopy volume (bars) and trunk girth (lines) were achieved with fabric mulch groundcovers (orange) compared with uncovered beds (green).

hurricane season, when high volume and high intensity rains occur, the beds allow water to move faster into drainage canals.

MULTIPLE BENEFITS

One of the main effects of HLB in citrus is the reduced capacity for the roots to take up water and nutrients. Thus, it is imperative to promote citrus management strategies that help slow down the movement of water in Florida sandy soils and make irrigation more efficient. Currently, fabric mulch groundcovers are being analyzed as a best management practice (BMP) to optimize the uptake of water in young lemon trees on a commercial scale. However, groundcovers are used for multiple reasons.

In citrus, groundcovers are used for the control of fields affected by an invasive insect, *Diaprepes abbreviatus* (root weevil). Daniel Scott, from Scott Citrus Management, was using the fabric mulch groundcovers as a method to break the cycle of the root weevil by preventing the larvae from entering or leaving the mulch and establishing in the root system.

"In the beginning, we used the groundcovers to manage diaprepres and weeds, but after some time we realized the groundcovers were also an option to reduce the use of water," Scott said. "We have been studying the groundcover with some young plantings under field conditions at two different locations for about a year now. With the installation of soil moisture sensors, soil temperature probes and a weather station, we have been recording the differences between covered and uncovered beds. Dr. Guzman's irrigation lab at University of Florida has been helping us collect tree growth measurements and give recommendations on when to irrigate the covered and uncovered areas. Though it is early in the trial, it looks like the trees on the covered beds are outperforming the uncovered beds and using substantially less water."

Beds with the fabric mulch contribute to the reduction of weeds, stimulate faster plant growth and develop better roots. Now, the beneficial effects of the mulch are seen in reducing the use of water for irrigation. The fabric much allows a better distribution of water across the bed and slows down the vertical movement of water. All the above-mentioned effects are in accordance to related experiments using covers for small fruits and vegetables. Some aspects

that are currently under study include:

- **Nutrient management.** Because the water is holding longer in the soil, nutrient leaching is reduced. Preliminary results showed a reduction in nutrient leaching to drainage canals, but additional data is required to be more certain.
- **Soil temperature**. Preliminary results showed that the fabric mulch helped to slightly cool the soil during the day and warm it during the night.
- **Water management in hurricane season.** Usually during hurricane season, the rain intensity is higher than other months of the year and the soil is not able to hold all the rain. Fabric mulch covers allow most of the water to move through the soil during those seasons without any restrictions. In fact, the cover allows water to move faster through drainage canals.

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NEXT STEPS

This ongoing study will continue evaluating the effects of fabric mulch groundcovers on tree growth and water use for both dry and rainy seasons. Based on the results for year one, significant tree growth was observed with the covered beds, in addition to the water savings. The fabric mulch could be used as a BMP to reduce the use of irrigation water without affecting tree growth. Future analysis on root architecture and water quality will provide better insights on other physiological and management effects of fabric mulch groundcovers.

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Small Plays Have Big Impact

By Rick Dantzler, CRDF chief operating officer

It has taken a while for me to get a sense of why research takes so long, but I'm beginning to understand. A baseball analogy comes to mind. Most runs are scored with a series of base hits and smaller plays. Homeruns make a bigger splash, but base hits, steals and sacrifice flies score more runs.

And so it is with research. Occasionally something truly huge happens, but usually it is a series of smaller discoveries that leads to something growers can use. Take, for example, the relationship between root loss and bicarbonate as a factor that limits nutrient uptake.

In 2011, researchers knew that Liberibacter infected structural and fibrous roots, but how quickly the bacterium moved to the roots after initial infection in the leaf shoots was unknown. Greenhouse studies indicated that the bacterium moved to the roots before infecting the shoots. Researchers suspected that this infection caused rapid decline of fibrous root integrity, but weren't sure. They noted that even if aboveground symptoms appeared to be reduced by enhanced nutrition, damage to fibrous roots was still occurring. Hence, it was concluded that root health must be an integral part of any HLB management program.

In 2012, surveys determined that Liberibacter in roots was capable of multiplying and moving to other root tissue, causing significant root density loss *before* any indication of aboveground HLB symptoms or disruption of phloem in the shoots.

In 2013, researchers discovered that greater stress in HLB-affected trees was occurring in groves planted in poorly drained soils and/or soils high in calcareous materials (high levels of calcium and magnesium bicarbonate, which increase alkalinity). Even soils low in calcareous materials were stressing fibrous roots if irrigated with water high in bicarbonates. Bicarbonates were building up in the root zone and reducing root mass density, resulting in less tolerance of HLB.

In 2014, researchers confirmed a relationship between fibrous root density and reduction in fruit yields when irrigation water was in excess of 100 parts per million bicarbonates and soil pH greater than 6.5. This was determined to be because high bicarbonate in the irrigation water was causing lower root density than irrigation water low in bicarbonate. At the same time, it was discovered that acidification of soil or water reduced root zone pH and promoted release of calcium (Ca), magnesium (Mg), zinc (Zn), manganese (Mn) and iron for root uptake, improving leaf color and reducing twig dieback.

In 2015, it was determined that soil and leaf Ca and Mg were declining because of enhanced acidification. Mining of these nutrients from the soil was occurring, making them less available for uptake by the tree, so annual soil and tissue samples are now recommended to determine Ca and Mg requirements.

In 2016, researchers confirmed that acidification to reduce pH below 6.0 increased leaf levels of Ca, Mg, Mn and Zn, and increased yield. Better nutrient management practices followed. Today, fertigation mixes or slow-release fertilizers containing supplemental micronutrients, along with soil applications of Ca sulfate (gypsum) and Mg sulfate (Epsom salts), are recommended. And it was a number of small discoveries along the way that taught us this.

CRDF Grower Dollars at work for you

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