Frequent irrigation benefits HLB-infected sweet orange trees

By Tripti Vashisth and Mary Sutton

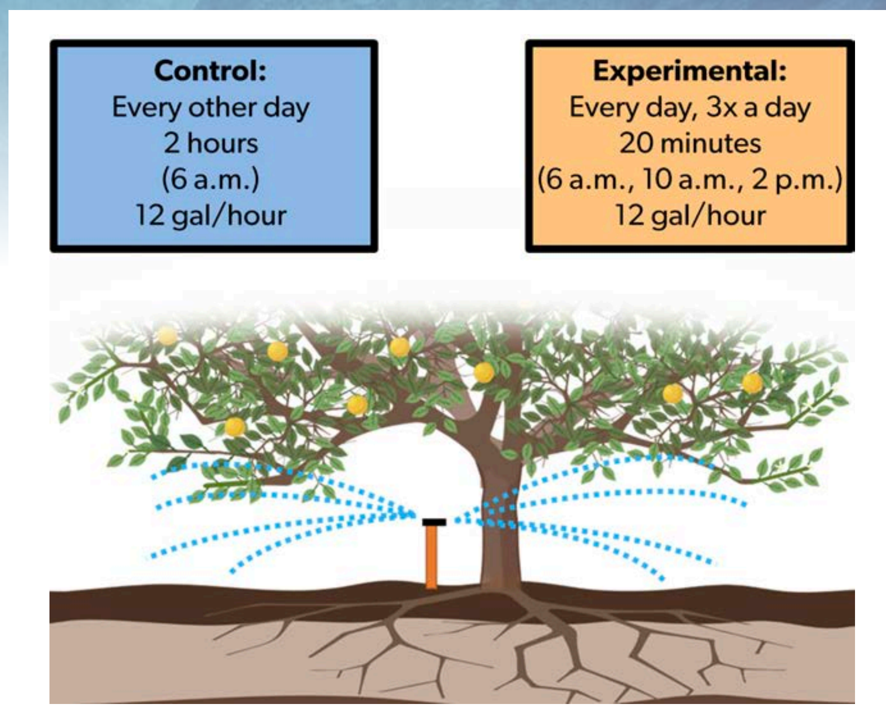

Figure 1. Control and experimental irrigation regimes

Citrus trees affected by huanglongbing (HLB) show significant root dieback. This dieback results in smaller root systems than would be seen in healthy citrus trees. These small root systems are limited in their uptake capacity. In other words, if an HLB-affected tree is given the same amount of water as a healthy tree, the HLB-affected tree would not be able to take up as much water as the healthy tree.

As a result, HLB-affected trees are more susceptible to drought stress when water availability is limited. This is a concern during the dry season (October through May) when trees are largely reliant on supplemental irrigation for their water. For sweet oranges, the dry season overlaps with flowering, fruit set and fruit maturation. This means any drought stress occurring during the dry season could negatively affect multiple fruit developmental stages. For this reason, a University of Florida Institute of Food and Agricultural Sciences (UF/IFAS) study was conducted to evaluate an alternative irrigation schedule that would better meet the water needs of HLB-affected trees.

Fifteen-year-old Valencia on Swingle rootstock trees were used for this study in Lake Alfred, Florida. The control trees received the standard practice of irrigating every other day, for two hours, at a rate of ~12 gallons per hour. The experimental trees received the experimental schedule of irrigating every day, three times a day, for 20 minutes at a time, at a rate of ~12 gallons per hour. The two treatments received the same amount of water over time, but differed in how often they received water and how much water they received at a time (Figure 1). Trees were monitored over the course of two years (January 2022–March 2024).

WATER AVAILABILITY

Upon implementation of the treatments, the mid-afternoon volumetric water content of the soil was significantly higher in the experimental treatment compared to the control (10% vs. 5.6%, respectively). This suggests the experimental treatment was ensuring water was available for uptake throughout the day.

Similarly, mid-afternoon leaf water potentials were higher in the experimental trees than in the control in both years (Figure 2). This suggests the control trees were experiencing more of a water deficit. The more frequent irrigation was able to ensure water availability throughout the day and result in a more well-watered tree status during the dry season.

FRUIT SET, FLOWERING AND FLUSH

In both years, peak fruit set was higher in the experimental treatment than in the control treatment. In year two, the control trees saw a second, late peak in bud (Figure 3A, page 20), flower and fruit production. Prior to this second peak, an extended period of no rainfall was followed by a rain event (Figure 3C, page 20).

When drought conditions are alleviated, it can result in a flowering event in citrus. Therefore, this late peak in flowering seen in the control trees may suggest that the control trees were experiencing drought conditions that the experimental trees were not. Unfortunately, most of the fruit set from this late-flowering event was not retained to harvest (~1% retained).

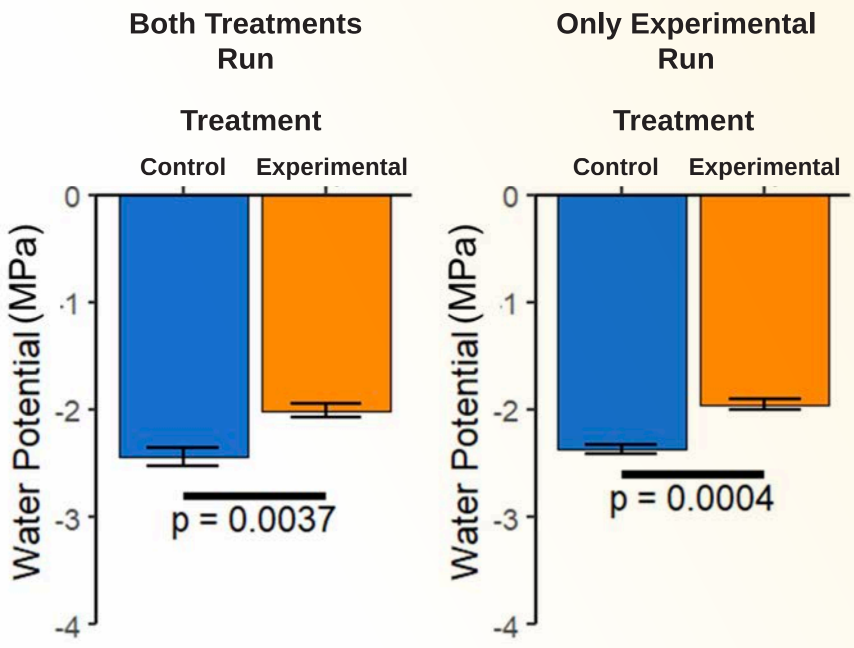

Figure 2. Mid-afternoon leaf water potential in year two. Average mid-afternoon leaf water potentials for a day when both treatments ran is on the left. On the right are average mid-afternoon leaf water potential for a day when only the experimental treatment ran. Lower leaf water potentials indicate high water deficit.

Lastly, leaf production during the spring flush was significantly higher in the experimental treatment compared to the control treatment (Figure 3B, page 20). Together, spring reproductive and vegetative growth was higher with more frequent irrigation compared to

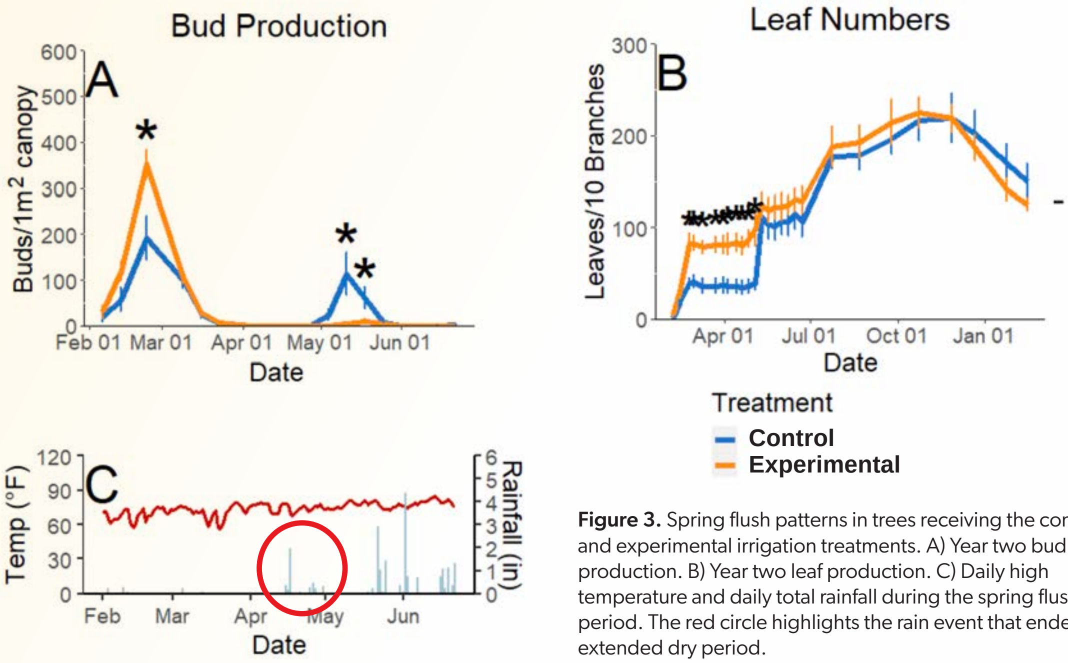

Figure 3. Spring flush patterns in trees receiving the control and experimental irrigation treatments. A) Year two bud production. B) Year two leaf production. C) Daily high temperature and daily total rainfall during the spring flush period. The red circle highlights the rain event that ended an extended dry period.

the standard practice.

Following the onset of the rainy season in year two, the control trees produced a large vegetative flush. From that point on, the two treatments were similar in their leaf production patterns. Similarly, fruit size did not differ throughout the fruit growth period. As the trees are not solely reliant on supplemental irrigation during the rainy season, it is unsurprising that no differences were observed in reproductive and vegetative growth during this time.

	Year 1		Year 2	
	% Fruit Drop	Yield (lbs/tree)	% Fruit Drop	Yield (kg)
Control	77.2	13.2 **b**	25.5	19.6 **b**
Experimental	72.6	23 **a**	25.1	60 **a**
p-value	***0.4624***	***0.0908***	***0.9299***	***0.0408***

Table 1. Harvest data for year one and year two. Percent fruit drop is the percent of the crop load dropped during the preharvest fruit drop period. Yield is the total amount of fruit remaining on the tree at harvest.

FRUIT DROP AND YIELDS

Throughout the season, the control and experimental trees dropped a similar proportion of their crop load during immature fruitlet drop, June drop and preharvest fruit drop. As the experimental trees set more fruit at the start of the season, this ultimately resulted in more fruit at harvest in the experimental treatment.

In year one, trees were harvested in early May so that any effect the experimental treatment had on preharvest fruit drop could be fully studied. As mentioned, preharvest fruit drop rates did not differ between the control and experimental treatment. Despite the high rates of fruit drop, the experimental trees had significantly higher yields than the control trees (Table 1).

In year two, trees were harvested in late February. Preharvest drop rates again did not differ between the control and experimental treatments. The experimental trees also had significantly higher yields than the control trees.

CANOPY MEASUREMENTS

The trees in both treatments had similar canopy volumes and densities before treatments were implemented. At the conclusion of the study, the experimental trees had significantly larger canopies than the control (27 m^3 vs. 22 m^3). Similarly, the experimental trees had significantly denser canopies than the control (83% vs. 75% light interception, respectively).

In citrus, canopy density and health is often determined by measuring the amount of light that is intercepted by the canopy. The more light that is intercepted, the denser the canopy.

SUMMARY FINDINGS

More frequent irrigation, but in smaller amounts, improved soil water availability throughout the day and resulted in higher leaf water potentials. The more well-watered status of the trees receiving more frequent irrigation likely prevented the late drought-stress induced flowering event seen in the control trees.

The more well-watered status of the frequent irrigation trees likely contributed to the higher reproductive and vegetative growth seen during the spring flush compared to the control. The more frequent irrigation trees dropped a similar proportion of their crop load as the control trees, resulting in more fruit at harvest. Ultimately, the more frequent irrigation resulted in significantly higher yields in both years of the study.

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