Dual treatment tested for HLB trees

Severe pruning combined with enhanced foliar nutrition did not prove cost-effective.

Figure 1 (left). Pruning, also known as buckhorning, was applied to HLB-affected citrus trees at the Southwest Florida Research and Education Center in Immokalee.

Figure 2 (right). Overview of pruned and non-pruned trees as well as foliar nutrient treatments applied to HLB-affected citrus trees at the Southwest Florida Research and Education Center in Immokalee.

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Citrus trees affected by huanglongbing (HLB) become diminished, weak and develop dieback resulting in reduced production. Decline in fruit yield ultimately prevents economically acceptable commercial citrus production. Pruning and spraying foliar nutritionals are two practices being considered to restore some level of productivity to HLB-infected trees.

Pruning, also known as buckhorning (Figure 1), is a cultural practice that stimulates strong tree regrowth. While shown to be effective to regrow freeze-damaged trees, buckhorning has never been tested in HLB trees. Citrus growers, however, have implemented foliar treatments of micronutrients and macronutrients as a method to satisfy a tree's nutrient requirements after HLB has blocked nutrient flow via the phloem, reduced root systems or limited uptake capacity.

The enhanced foliar nutritional treatments do not have bactericidal effects on the bacterial pathogen *Candidatus* Liberibacter asiaticus (*C*Las). They may be employed, however, to maintain the nutritional health and productivity of HLB-affected trees.

STUDY SETUP

A study was conducted between 2010 and 2015 to evaluate the horticultural impact, juice quality and economic returns from pruning in combination with an enhanced foliar nutritional treatment on HLB-affected orange trees. The study was located at the University of Florida/Institute of Food and Agricultural Sciences Southwest Florida Research and Education Center in Immokalee within a 5-acre block of 16-year-old Valencia orange trees on Swingle citrumelo rootstock. Trees were planted 15 feet in-row by 22 feet between rows (132 trees/acre) on two-row raised beds with micro-sprinkler irrigation and soil classified as Immokalee fine sand.

A total of 14 rows on the east side of each bed were buckhorned (Figure 2). The rows on the west side of each bed were not pruned. Each row was split in half, and four foliar nutritional treatments were applied as Boyd, Fortress with KNO_3 or urea (four times per year), and a control [(commercial standard), Table 1, page 30]. Each nutritional treatment was replicated seven times across the area.

Pruning was done in February 2010 using a commercial hedger and topping machine. Pruned trees were cut back to their scaffold branches, leaving only 10 to 15 percent of the original canopy (Figure 1). The products and amounts of the foliar-applied nutrient treatments are shown in Table 1. In accordance with the UF/IFAS recommendations for citrus, all treatment plots received ground-applied fertilizer twice per year using a slow-release 14-0-18 + magnesium, sulfur and boron, and calcium nitrate 9-1-14 + magnesium, manganese, zinc, iron, copper and boron. The annual total amount of nitrogen was 160 pounds per acre and 205 pounds per acre of potassium oxide.

Data collection consisted of

Table 1. Foliar nutrient treatment amounts applied and estimated costs for pruned and non-pruned trees. Products were applied in 125 gallons of water per acre with a citrus speed sprayer.

Boyd Mixture		Fortress[1]/KNO_3		Fortress[1]/Urea		Control[2]	
Product	Amount	Product	Amount	Product	Amount	Product	Amount (%)
3-18-20	8.0 gal.	K	7.7 lbs.	N	0.93 gal	Mg	1.5
K-phite	1.0 gal.	P	58.4 %	P	58.4 %	S	4.0
Saver	1.0 qt.	Ca	4.0 %	Ca	4.0 %	Mo	0.003
Mg	1.5 lbs.	Mg	3.0 %	Mg	3.0 %	Fe	3.5
Mn	3.6 lbs.	B	0.6 %	B	0.6 %	B	0.16
Zn	1.0 lbs.	Co	0.1 %	Co	0.1 %	Zn	0.75
Mo	0.35 oz.	Cu	0.6 %	Cu	0.6 %	Mn	0.75
K	3.9 lbs.	Mn	3.5 %	Mn	3.5 %	Cu	0.06
435 oil	5.0 gal.	Zn	6.0 %	Zn	6.0 %		
		Ni	0.1 %	Ni	0.1 %		
Application times	4		4		4		1
Cost/acre (material and application)	$550		$295		$305		$40

N = nitrogen, P = phosphorus, K = potassium, Ca = calcium, Mg = magnesium, S = sulfur, Fe = iron, B = boron, Zn = zinc, Mn = manganese, Cu = copper, Mo = molybdenum, Ni = nickel, Co = cobalt and KNO_3 = potassium nitrate.

[1] Fortress (Florida Phosphorus LLC, Key Largo, FL). Sources: calcium phosphite, magnesium phosphite, boric acid, cobalt phosphite, copper phosphite, manganese phosphite, sodium molybdate, nickel EDTA and zinc phosphite.

[2] Control is a commercial, liquid, micronutrient product containing chelates.

Table 2. Effects of the foliar nutrient treatments applied to pruned and non-pruned HLB-affected citrus trees on crop yield at the Southwest Florida Research and Education Center in Immokalee.

Treatment	2011–2015 Total (90-pound boxes per acre)
Management System	
Pruned	757
Non-pruned	812
(a statistically significant difference)	
Nutritional Treatment	
Control	741
Boyd	793
Fortress/KNO_3[1]	794
Fortress/Urea	810
(no statistically significant differences)	

[1] KNO_3 = potassium nitrate

Table 3. Summary of changes to revenue, cost and net returns from using an enhanced foliar nutritional treatment versus the control foliar treatment over the 5-year trial period at the Southwest Florida Research and Education Center in Immokalee. Note that the figures represent negative numbers.

Season	Unit	Boyd	Fortress/ KNO_3[1]	Fortress/Urea
Cumulative change in net income, 2011–2015	$/acre	(1,930)	(1,062)	(1,022)

[1] KNO_3 = potassium nitrate

real-time polymerase chain reaction (PCR) for detection of *C*Las, tree growth (shoot length, tree volume and total shoot leaf area), leaf chlorophyll concentration, fruit yield and juice quality [percent juice, titratable acid (TA), total soluble solids (TSS) as Brix and TSS/TA ratio]. Prices of materials were collected from fertilizer and chemical product vendors to estimate the costs of each foliar treatment.

RESEARCH RESULTS

PCR testing confirmed that all trees were infected with *C*Las at the beginning of the study. Canopy volume of pruned trees increased throughout the trial, but never grew to equal the canopy volume of non-pruned trees. However, leaf area of pruned trees was consistently greater than the leaf area of non-pruned trees, beginning with the second year of the trial.

As expected, fruit yields from pruned trees were significantly lower than yields from non-pruned trees in the year after buckhorning. While the pruned trees recovered and set a fruit crop close to the non-pruned trees, the 5-year cumulative yield from the pruned trees remained significantly less than the cumulative yield from the non-pruned trees (Table 2). Pruned trees did not produce a higher yield than non-pruned trees in any year. There were no statistically significant differences among juice-quality parameters between pruned and non-pruned trees or nutritional treatments.

The total cost of pruning was estimated to be $160/acre. When the estimated value of first-year fruit loss was considered, the total cost of buckhorning rose to $560/acre. Since the yields from pruned trees never surpassed the fruit yields from unpruned trees, there were no offsetting gains.

The annual cost of the control foliar nutritional treatments was $40/acre. Fortress treatments were between $295 and $305/acre, depending on whether KNO_3 or urea was applied. The Boyd foliar nutritional treatment was $550/acre (Table 1, page 30). All treatment costs included materials and application.

Enhanced foliar nutrition treatments provided slight yield benefits, especially in the early years of the trial (Table 2, page 30), but the yield differences were not statistically significant. Even if a value were to be put to the numerical yield differences, the added value of the higher yields did not offset the cost of any foliar nutritional treatment beyond the control (Table 3, page 30). It should be noted, however, that the control foliar nutritional treatment did contain some micronutrients (Table 1, page 30). Given the lack of statistical differences among the nutritional treatments, the amount of micronutrients in the control treatment may have more than satisfied the trees' requirements.

The results from this trial confirmed that HLB-infected trees can regrow after pruning and produce fruit. The pruning, as used in this trial, was not cost-effective through the first five years after buckhorning. However, the rapid regrowth of pruned trees suggests that a more moderate pruning approach may be more cost-effective at rejuvenating HLB-affected trees and may be an alternative to tree removal and replanting.

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