Pruning and controlled-release fertilizer to rehabilitate HLB trees

By Tripti Vashisth and Troy Gainey

Pruning is one of the oldest horticultural practices that changes the form and growth of a tree. The pruning process 1) adjusts tree shape and the ratio of framework to fruit-bearing shell of the canopy, 2) alters the shoot/root ratio and 3) changes the carbohydrate (food storage) status of the tree.

Under Florida weather conditions, citrus trees often produce vigorous vegetative growth that can result in overcrowding and shading. Shading reduces yield and foliage on the lower parts of the trees. Sunlight not only influences flowering and fruit set, but also enhances fruit quality and color development. Increased sunlight penetration within the tree canopy might also allow foliage to dry quicker after a rain shower and could help reduce establishment of fungal pathogens. Therefore, adjustments must be made to the tree canopy to maximize sunlight interception.

TYPES OF CUTS

Thinning out and heading back are the main types of pruning cuts (Figure 1). Thinning out is a selective pruning method — often done with handheld equipment — that involves the removal of complete branches down to the main trunk. Thinning out is a common pruning method in peaches and plums to maximize light penetration in the canopy for better fruit set and growth.

Heading back removes the terminal portion of a shoot or branch, removing apical dominance and stimulating lateral bud breaks (Figure 1). As a result, trees are more branched and compact. Mechanical hedging and topping are the main forms of mass heading back used to prune mature trees in Florida.

HLB-AFFECTED TREES

Previous research has shown that HLB-affected trees have a reduced root system and a higher rate of root turnover. In a greenhouse experiment, a significant imbalance in root-to-shoot

Figure 1. Basic pruning cuts are thinning and heading back. Florida citrus groves are mostly pruned by heading back.

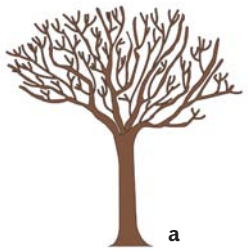

Figure 1a: Tree before pruning

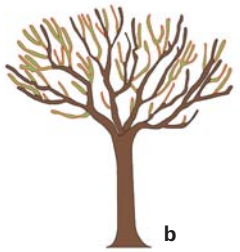

Figure 1b: Thinning Selective removal of branches (green and red)

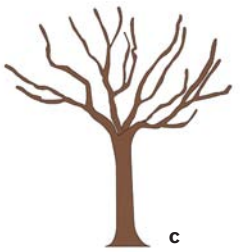

Figure 1c: Thinning Open canopy

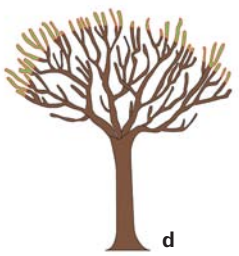

Figure 1d: Heading Back Non-selective removal of terminal portion of branches (green and red)

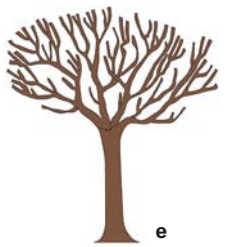

Figure 1e: Heading Back Terminal portion of branches is removed

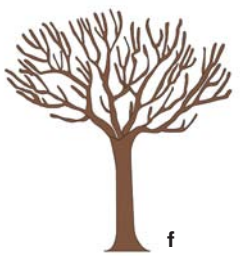

Figure 1f: Heading Back After heading back, new lateral growth

ratio was observed in HLB-affected trees as compared to same-age, healthy trees (Figure 2). The diminished root system cannot support the existing above-ground canopy and fruit

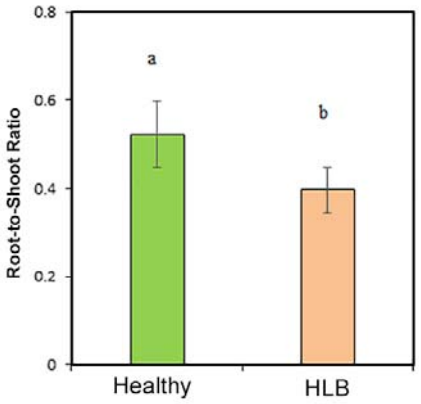

Figure 2. Root-to-shoot ratio in greenhouse HLB-affected and healthy plants. A low root-to-shoot ratio suggests that root systems might not be sufficient to meet shoot-system requirements.

production. As a result, the tree enters into a continuous carbohydrate stress cycle and declines in overall health. To intervene in this vicious cycle of imbalance and carbohydrate stress, pruning is needed to correct the root-to-shoot ratio to benefit the tree. In addition to pruning, it is important to promote rejuvenation of the tree, for which plant nutrition plays a critical role in regrowth and development. HLB-affected trees have a smaller root system and thinner canopy; therefore nutrient uptake is often limited at any given time. Thus, it seems reasonable that a small and constant supply of nutrients throughout the growing season should provide the stressed root system a better chance to effectively take up nutrients.

PRUNING AND CRF EXPERIMENT

In January 2015, a 3-year trial was initiated to evaluate pruning as well as source of fertilizer in combination. A grove of 15-year-old Hamlin on Swingle rootstock trees was expressing significant HLB symptoms and produced about 160 to 180 pounds of fruit per tree in 2014. The initial tree canopy size was estimated at 12

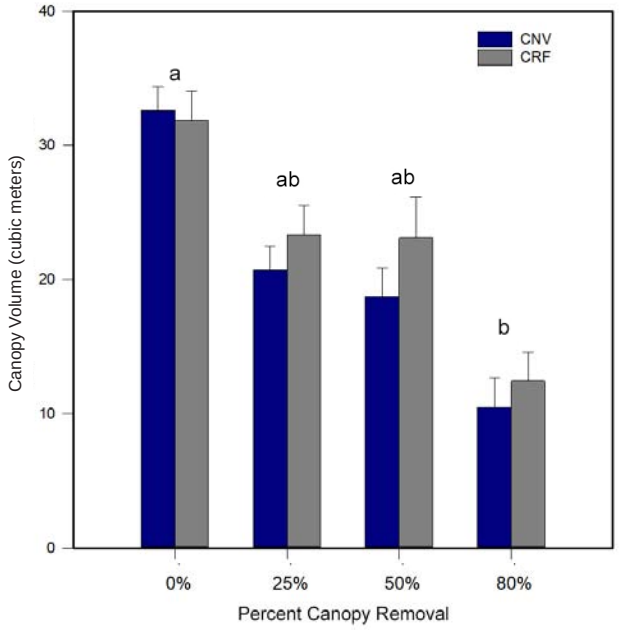

Figure 3. Canopy volume for each of four pruning treatments.

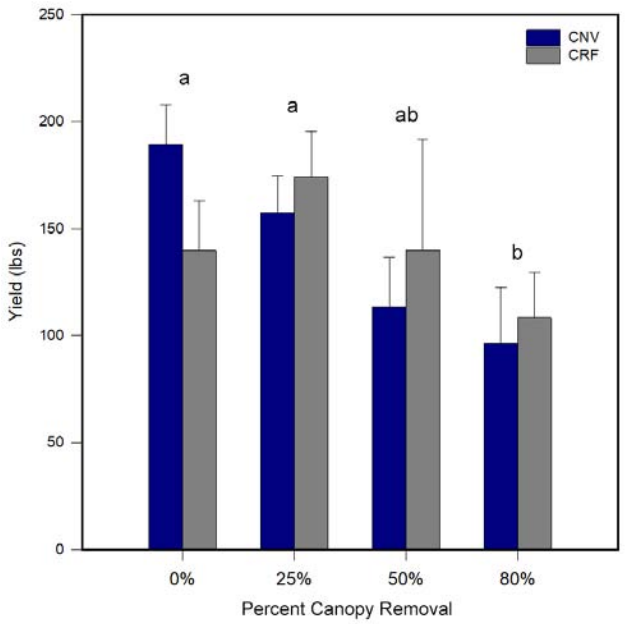

Figure 4. Mean yield for each of four pruning treatments.

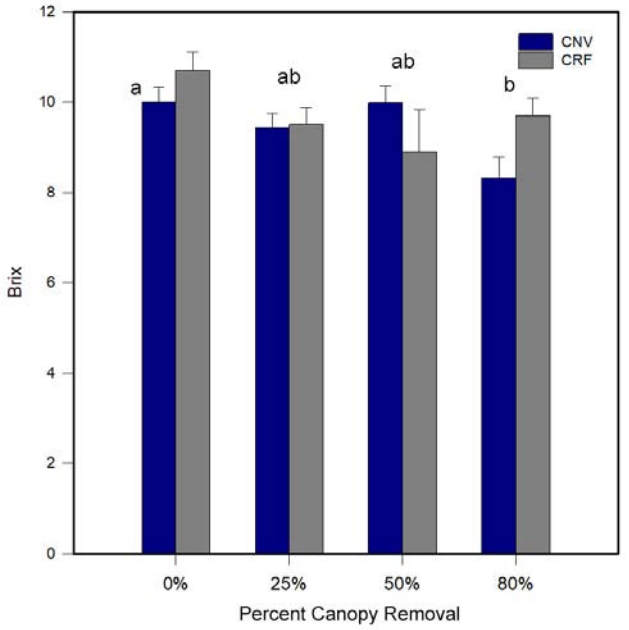

Figure 5. Mean Brix of juice in fruit from each of four pruning treatments. Brix was measured in 10 fruits per tree at the time of harvest.

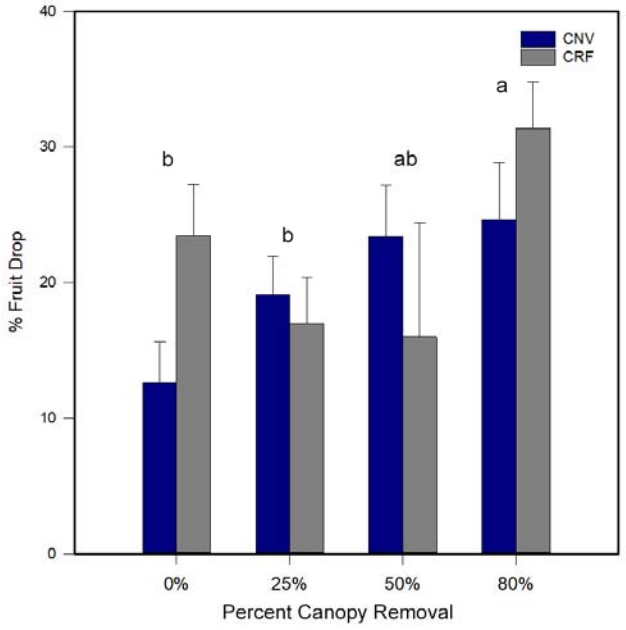

Figure 6. Mean percent fruit drop for each of four pruning treatments. Pre-harvest fruit drop was monitored from September through the harvest in December.

Additional information for figures 3-6: Blue bars represent trees that received only conventional fertilizer (CNV). Gray bars represent trees that received only controlled-release fertilizer (CRF). The treatments include 0 percent, no canopy removal (control treatment); 25 percent reduction, canopy topped at 9 feet; 50 percent reduction, canopy topped at 6 feet; and 80 percent reduction, canopy topped and all the major branches severely pruned (buckhorned). Different forms of fertilizer were found to be not significantly different. Therefore, the data within each pruning treatment was pooled for both the fertilizers. Sets of bars with the same letter are not significantly different.

feet in height and 11 to 12 feet in width. Four pruning treatments were imposed on replicate trees to achieve specific reductions in canopy volume at specific heights. The four pruning treatments were:

1) 0 percent, no canopy removal (control treatment)
2) 25 percent reduction, canopy topped at 9 feet
3) 50 percent reduction, canopy topped at 6 feet
4) 80 percent reduction, canopy topped and all the major branches severely pruned (buckhorned)

The two sources of fertilizer used were:

1) Conventional fertilizer (CNV, dry granular) applied at 200 pounds per acre nitrogen in five split applications
2) Controlled-release fertilizer (CRF) applied at 150 pounds per acre nitrogen, split in three applications

Within each pruning treatment, half of the trees received CNV and the other half received CRF. Throughout this report, the treatments are referred to as 0 percent, 25 percent, 50 percent and 80 percent. For this 3-year trial, the data being collected includes percent change in tree canopy volume, percent pre-harvest fruit drop, fruit quality and total yield in pounds.

2016 HARVEST RESULTS

All the trees that were pruned produced new flush that looked healthy with no HLB symptoms (initially). The 80 percent pruned trees grew vigorously over the course of two years, but are still significantly smaller than the canopy of control trees (0 percent pruning) for both CRF and CNV (Figure 3, page 24). The 25-percent and 50-percent pruned tree canopies grew back and now are not significantly different from the 0 percent control pruning treatment.

In the first year, the yield for 25 percent, 50 percent and 80 percent were significantly lower than the control trees as canopy removal included fruiting wood. Conversely, in the second year, the yields of all pruned trees were significantly improved. Both 25 percent and 50 percent pruning yields were comparable to 0 percent pruning following the canopy volume pattern, and 80 percent pruned trees showed the lowest fruit yield (Figure 4, page 24).

The 25 percent pruning had the highest fruit set among all the treatments and the control during year two. A significant correlation was observed between canopy volume and yield, reinforcing the plant model or correlation that higher canopy volume can support higher numbers of fruit.

The Brix value of juice from the fruit was observed to decrease with a decrease in canopy volume. Fruit in the 0 percent pruning treatment had the highest Brix followed by the 50 percent, 25 percent and 80 percent pruning treatments (Figure 5, page 24).

In the first year after pruning, a significant increase in pre-harvest fruit drop occurred in both the 25 percent and 50 percent treatments (60 to 80 percent fruit drop). This did not occur in the 80 percent pruning treatment, as the fruit set was lower and, therefore, resulted in less fruit drop. In the second year after pruning, overall fruit drop was lower in all the treatments, and significantly higher fruit drop was observed in the 80 percent pruning treatment (Figure 6, page 24). A clear inverse relationship between canopy

volume and fruit drop was observed.

No significant differences were observed between the two forms of fertilizer for any of the measured parameters. This was surprising since the CRF was applied only three times a year and at a 25 percent lower rate of nitrogen than that of the CNV. Therefore, it is suggested that with the use of CRF, the amount of nitrogen applied and resources associated with multiple applications of fertilizer can be reduced. Generally, when applying CRF, rate of N can be reduced by 25 percent as compared to CNV.

SUMMARY

This trial will be continued for third-year data collection. However, based on two years of study, it's apparent that severely pruned trees cannot catch up with control trees in yield and fruit quality, probably due to the resource allocation required to restore vegetative growth rather than reproductive growth. The 25 percent pruning treatment seems to be promising in rejuvenating tree health, correcting root-to-shoot ratio imbalance, and as a general grove management strategy. During this regrowth period, attention should be paid to leafminer and psyllid control as pruning results in simultaneous emergence of new flush in all of the trees, making them more attractive to foliar pests.

Use of CRF is a good alternative to CNV to ensure nutrients are available to trees throughout the year, as well as to reduce production costs by reducing the fertilizer application rate and mandating fewer applications.

Acknowledgment: The authors acknowledge ICL Specialty Fertilizers (formerly Everiss) for donating CRF for this study.

Tripti Vashisth is an assistant professor and Troy Gainey is a senior biological scientist, both at the University of Florida Institute of Food and Agricultural Sciences Citrus Research and Education Center in Lake Alfred.