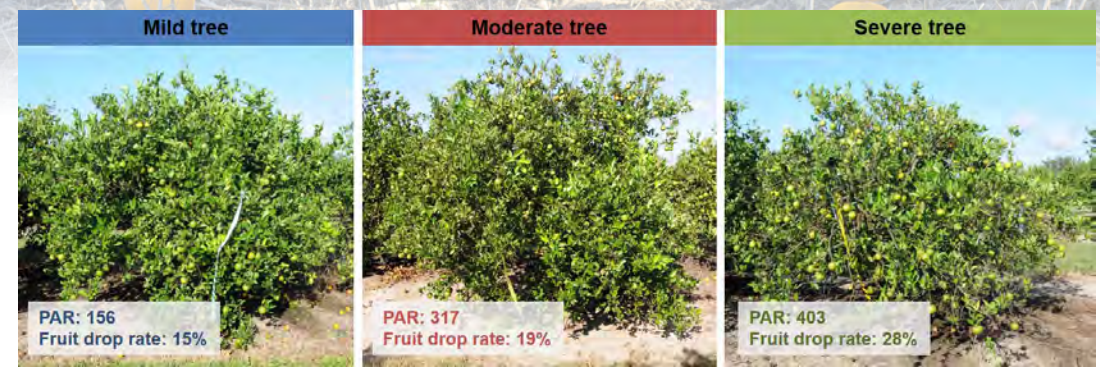

Figure 1. Hamlin trees at three HLB symptom levels with photosynthetically active radiation (PAR); high PAR = thin canopy

The facts on preharvest fruit drop

By Tripti Vashisth, Lisa Tang and Sukhdeep Singh

In citrus, huanglongbing (HLB) causes an increase in the mature fruit drop rate up to three months prior to commercial harvest. This preharvest fruit drop results in a great reduction in yield and overall grove productivity.

Since the plant growth regulators that improve fruit retention on healthy trees do not have consistent effects for HLB-affected trees, their use is not recommended for controlling HLB-associated fruit drop in Florida. Currently, how HLB escalates preharvest fruit drop in citrus remains unclear. Therefore, a study with trees exhibiting three HLB symptom levels (mild, moderate and severe) of early-season Hamlin (Figure 1) and late-season Valencia sweet oranges was carried out to gain more understanding of mature fruit drop and to determine the potential causes of fruit drop in the presence of HLB.

HLB SEVERITY

Starting from mid-October through harvest in late-December, Hamlin trees with severe HLB symptoms had a greater drop rate of fruit compared to moderate or mild HLB trees (Figure 1). Total fruit drop rate was correlated with HLB severity and canopy density.

The severity of HLB for trees in this study was based on visual symptoms and canopy density, which is represented using photosynthetically active radiation (PAR) that indicates the amount of sunlight passing through the canopy to the orchard floor (i.e., a high PAR value suggests a thin canopy). Results demonstrate that trees with a thin canopy, mainly due to HLB-caused twig dieback, have a high rate of preharvest fruit drop.

Fruit drop over time was also related to HLB severity for Valencia trees (Figure 2, page 10). In late January (approximately 4 months before anticipated harvest time), the drop rate of mature fruit for trees at different HLB symptom levels was similar. Interestingly, starting in mid-February, severe trees had more fruit drop than less symptomatic trees, and the increase in fruit drop became more noticeable as time progressed.

Small fruit are more prone to drop from trees compared to large fruit.

FRUIT SIZE

Consistent with the previous reports on HLB and fruit size, Hamlin and Valencia fruit of severe trees were smaller than those of mild or moderate trees (Figure 3, page 10). Attached fruit (those that did not drop and were still attached to trees at the time of harvest) were overall larger than dropped fruit (those that dropped naturally without external force) for both cultivars.

To determine the characteristics of fruit that tend to drop, a set of attached fruit with 6 to 8 inches of branches was clipped from trees. Fruit was further separated into tight fruit and loose fruit based on the value of fruit detachment force (FDF), which determines how much force is required for individual fruit to be pulled or detached from the tree/branch. Whereas tight fruit [FDF > 6 kilogram-force (kgf)] were not physiologically ready to drop, loose fruit (FDF < 6 kgf) represented the fruit with a high tendency to drop at the time of collection. For both Hamlin and Valencia, there is a significant and positive correlation between fruit size and FDF, indicating that small fruit require less force to be detached from trees (Figure 4, page 10). In other words, small fruit are more prone to drop from trees compared to large fruit.

The growth of fruit can be attributed to cell division and enlargement, which increases the number

DSO Status Under Review

By Rick Dantzler, CRDF chief operating officer

In 2009, when CRDF was founded, growers decided to become a Direct Support Organization (DSO) of the University of Florida (UF). Key to their decision was a meeting with state Senator J.D. Alexander and UF President Bernie Machen. They persuaded the growers that, by being a DSO, the university could assist with administrative costs and it would be easier for CRDF to receive research monies from governments.

There was one downside, however. By statute, DSOs are "organized and operated exclusively to receive, hold, invest, and administer property and to make expenditures to or for the benefit of a state university in Florida…" Nevertheless, Machen, aware of the existential threat posed by HLB, assured growers this would be interpreted broadly and that CRDF would be free to go wherever it must to find a cure.

Based on this assurance, growers agreed to proceed with becoming a DSO, and it has worked well. The CRDF board has been free to fund the best proposals, including projects with universities from across the country and even the private sector, all to bring relief to growers struggling with HLB.

This determination of the board to fund projects believed to offer the best hope for the industry was the only position it could take, regardless of its status as a DSO. Bubbling beneath the surface, though, was potential conflict with the statute.

This conflict has come to a head. Increased legislative scrutiny of DSOs has caused UF to take a more literal interpretation of the statute, resulting in two potential changes to CRDF's bylaws that the board has been told to expect. The first would require all research monies to be spent with the UF. While the UF Institute of Food and Agricultural Sciences has the most talented group of agricultural scientists in the world, there are great scientists in other places, too, and the board has no choice but to engage them in the struggle against HLB. The second change would require UF approval of all research projects the CRDF board decides to fund, making the board, essentially, advisory. The board will not accept either of these changes.

The desire of UF to bring DSOs in line with its interpretation of the statute is understandable. Nevertheless, it has forced CRDF to begin thinking of what happens next if it is told it must adopt the two changes referenced above. Departments of state government may have a DSO, so there are places to land. Still, CRDF has benefitted greatly by being associated with UF, so leaving should not be done lightly or impulsively.

We are in touch with UF officials to resolve this in a way that serves the interests of both institutions. My hope is that rational thinking will prevail. One thing is certain, though: CRDF will do whatever is best for citrus growers because they have taxed themselves to provide CRDF with research funding and are facing a struggle with a disease that threatens the commercial viability of the industry. Frankly, how could we do anything else?

CRDF Grower Dollars at work for you

Column sponsored by the Citrus Research and Development Foundation

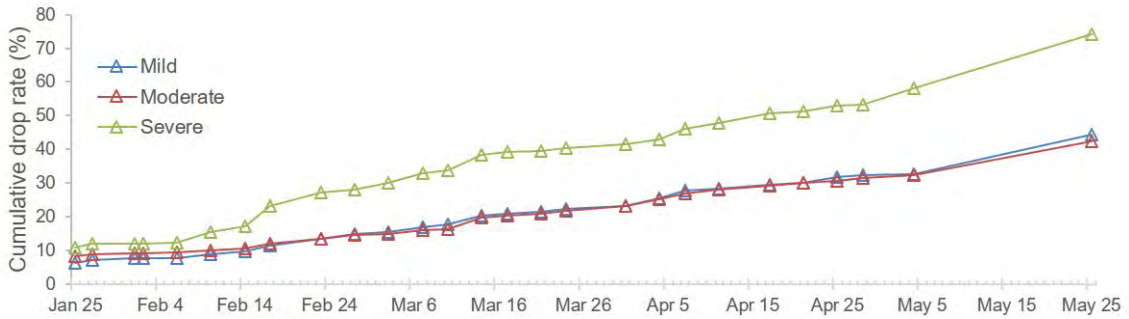

Figure 2. Cumulative mature fruit drop rate for Valencia trees at three HLB symptom levels

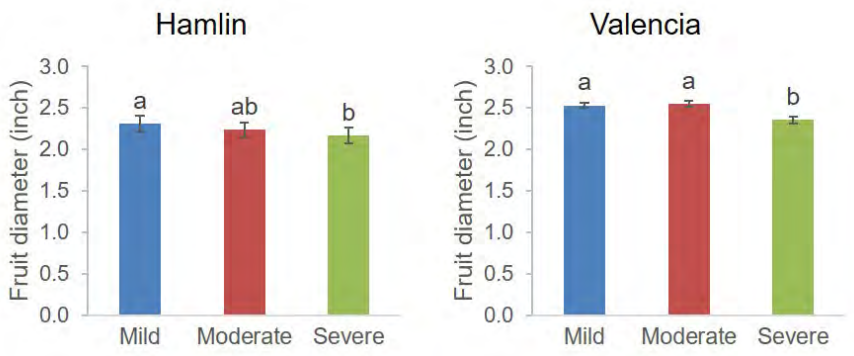

Figure 3. Fruit size of Hamlin and Valencia from trees at three HLB sympotom levels; different letters (a, ab, and b) indicate a significant difference

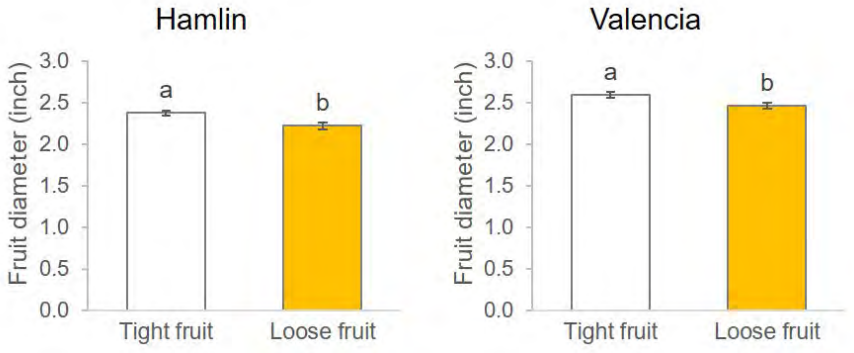

Figure 4. Size of tight fruit (fruit detachment force > 6 kilogram-force) and loose fruit (fruit detachment force < 6 kilogram-force) from Hamlin and Valencia trees

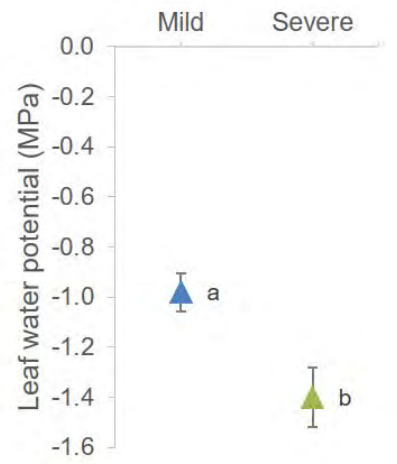

Figure 5. Midday leaf water potential for mild and severe HLB Valencia trees in March; different letters (a and b) indicate a significant difference. MPa = megapascals (units of pressure)

and size of cells, respectively, during the first two months following the beginning of fruit set (stage I of fruit development) and about four to six months thereafter (stage II). Given that severe trees produced small fruit and that small fruit had a high tendency to drop, it is likely that HLB restrains fruit growth during early developmental stages, which leads to a high inclination for fruit drop at maturity.

For citrus, fruit size increases rapidly as a result of water accumulation in cells at stage II of fruit development. Therefore, adequate water supply during this period is critical to ensure uninterrupted fruit development and growth for better fruit retention.

Interestingly, in another preliminary experiment, lower midday leaf water potential was observed for severe Valencia trees in comparison with mild trees in March (Figure 5). Although the value of water potential for severe trees was not in the range of water-deficit stress, and fruit were mature at the time of measurement, results imply that the internal water requirement or usage is different for trees with different HLB severity. Therefore, it is recommended to avoid any stress conditions, including drought, in order to prevent exacerbating preharvest fruit drop in the presence of HLB.

THE ROLE OF CARBOHYDRATES

It has been hypothesized that HLB results in the disruption of carbohydrate flow in the phloem, which leads to a carbohydrate shortage in fruit. This could increase preharvest fruit drop in a manner similar to the cause of fruitlet abscission during drop that occurs in summer months after fruit set.

Nevertheless, the results of recent analysis demonstrate that carbohydrate levels in fruit are independent

of HLB severity or the tendency of fruit drop. For Valencia, there was no difference in the concentration of sucrose, fructose or glucose in juice of fruit from mild, moderate and severe trees. Carbohydrate levels were not different between attached and dropped fruit either.

In summary, research results demonstrate a clear relationship between HLB severity, fruit size and preharvest fruit drop.

Moreover, between attached and dropped fruit, no difference in the callose (a carbohydrate component of plant cell walls) accumulation in the peduncle phloem was observed, suggesting that phloem plugging is not related to HLB-associated fruit drop.

TREE HEALTH MANAGEMENT

In summary, research results demonstrate a clear relationship between HLB severity, fruit size and preharvest fruit drop. Fruit of severely symptomatic trees are smaller and have a higher tendency to drop prior to harvest compared to those of trees displaying less symptoms. This strongly suggests that maintaining tree health is a key to control preharvest fruit drop in HLB-affected trees.

Since there is no cure for HLB, an adequate nutritional program in combination with an optimal irrigation regime is important to sustain normal tree physiology, especially during early fruit development and growth phases. Prevention of any stress condition — drought, in particular — to citrus trees also benefits fruit retention until harvest.

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