Impact of HLB on fruit growth and retention

By Tripti Vashisth and Mary Sutton

Citrus trees affected by huanglongbing (HLB) consistently have small fruit and low fruit numbers at harvest. The low fruit numbers are largely attributed to the increased rates of preharvest fruit drop that accompany HLB. Small fruit is more likely to drop during this preharvest period, suggesting a link between fruit size and retention.

To develop effective fruit drop mitigation strategies, it is critical to identify when such differences in fruit size arise. Furthermore, it is unknown how HLB affects fruit retention through periods other than preharvest drop, such as flowering and fruit set. Therefore, a study that followed mildly and severely HLB-affected Valencia trees from flowering through harvest was conducted to determine how HLB affects fruit growth and retention throughout the season.

1A

1B

Figure 1. Counting methods included tagged inflorescences following flowering at the inflorescence scale (A) and flowering frames following flowering at the whole tree scale (B).

Trees were selected based on visual symptoms and canopy density. HLB-affected trees undergo a significant amount of canopy dieback. Therefore, more severely affected trees typically have a thinner canopy or lower canopy density. Photosynthetically active radiation (PAR) readings were used to determine the amount of sunlight that passed through the canopy. A higher PAR reading means more light passes through the canopy, suggesting a thinner canopy. Trees mildly affected by HLB were those with a PAR reading lower than 150. Severely affected trees had a PAR reading greater than 300.

FLOWERING

Thirty early (before peak flowering) and late (after peak flowering) emerging inflorescences were tagged to monitor floral intensity and fruit set rates at an inflorescence scale (Figure 1A). Inflorescences from mild and severe trees produced a similar number of flowers, suggesting HLB does not affect inflorescence productivity. Tagging inflorescences at two different times revealed that severe trees produced more flowers during the latter half of the flowering period. Mild trees produced a similar number of flowers regardless of when the inflorescence emerged (Figure 2A, page 20). This suggests flowering in severely affected trees lags behind mildly affected trees.

A square frame was held up to the canopy in four random places to count the number of flowers that fell within its borders (Figure 1B). This allowed researchers to estimate the flowering rate on a whole tree scale. The mild trees produced significantly more flowers than the severe trees (Figure 2B, page 20). Because there was no difference in flower production at the inflorescence scale, this suggests differences in flowering come from differences in canopy densities.

The denser the canopy, the more flower-producing branches, resulting in more flowers overall. Therefore, the focus should be on

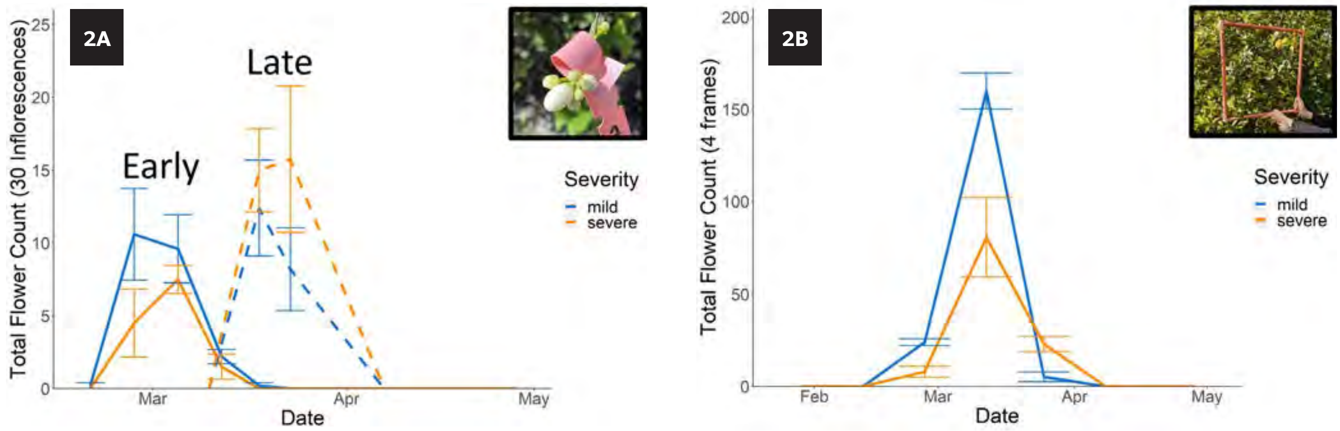

Figure 2. Flower production in early- vs. late-emerging inflorescences following flowering at the inflorescence scale (A) and flower production on the whole tree scale estimated using the flowering frames (B)

improving tree canopy density and not increasing the flower number. It is strongly recommended to not use flower-enhancing chemicals on trees with low canopy density.

FRUIT SET

Following the early- and late-emerging inflorescences (30 of each) through fruit set revealed that late-emerging inflorescences set more fruit. Early-emerging inflorescences in mild and severe trees on average set 14 and 10 fruit, respectively, by 26 days after full bloom. The late-emerging inflorescences in mild and severe trees set 36 and 27 fruit, respectively. This is consistent with previous studies that showed that late-emerging inflorescences typically emerge with new leaves.

The new leaves provide resources for the young fruitlet, which gives it a competitive advantage during initial growth. Mild trees generally set more fruit than severe trees. This was only significant in the late-emerging inflorescences. This is consistent with a preliminary trial conducted in 2020 where 100 tagged flowers were followed through a fruit set. In this preliminary trial, a larger proportion of the tagged flowers set fruit in the mild trees compared to the severe trees (15 vs. nine fruit, respectively). Together, this suggests worsening HLB symptoms do negatively affect fruit set rates.

A similar trend was seen at the whole tree scale using the flowering frames. The mild trees set significantly more fruit than the severe trees. Differences were seen at both the inflorescence and whole tree scale, which suggests that both canopy density and HLB severity affect fruit set rates. In other words, fruit set is not only limited by the number of flowering branches present but also by the productivity of individual inflorescences.

EARLY FRUIT GROWTH

Fruit sizes were initially similar between mild and severe trees in the 2020 preliminary trial but slowly diverged during the latter half of the season. For the current trial, 50 random fruit diameters were taken periodically throughout the season to monitor fruit growth. Fruit sizes in mild and severe trees initially differed, but these differences were largely lost as the fruit continued to grow. This contrasts with the preliminary trial.

While differences in fruit size do exist between mild and severe HLB trees, it varies when they arise. This may suggest that HLB indirectly affects fruit sizes and may be dependent on other factors that vary from season to season such as temperature or rainfall.

For example, fruit growth is dependent on water accumulation in fruit cells. Water deficits can limit this accumulation, which limits fruit size. HLB-affected trees have smaller root systems with limited uptake capacity. Such limitations may prove detrimental under prolonged hot and dry conditions. Unfortunately, the dry season in Florida is October to May and overlaps with flowering, fruit set, initial fruit growth and preharvest drop.

Mid-afternoon leaf water potentials measured in May were significantly lower in severely affected trees compared to mild trees. As this corresponds with the differences seen in initial fruit sizes in mild and severe, it's possible the lower water uptake capacity in severely HLB-affected trees limits growth. These differences are slowly resolved once the dry season is over and well-watered conditions return.

With worsening HLB symptoms, trees become more susceptible to stressors. These stressors may further limit fruit growth. Therefore, it is imperative to avoid such stress conditions through proper irrigation and nutrition management.

SUMMARY

In summary, this research suggests flowering and fruit set are largely limited by canopy density. However, HLB does appear to affect fruit set rates at the inflorescence scale. Strategies to maintain or improve canopy health will be key to improving flowering and fruit set rates. Similarly, optimal irrigation and nutrition practices will be necessary to avoid stress conditions, such as drought, and will help maintain fruit growth. While such practices are important throughout the season, they are imperative during flowering, fruit set and early fruit growth and development.

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