# Gibberellic acid: Increase fruit size and yield, reduce drop

By Tripti Vashisth and Megan Dewdney

This article discusses the use of gibberellic acid (GA), the naturally occurring plant hormone, on huanglongbing (HLB)-affected trees. The results were generated from a 3-year trial in which Valencia trees were treated with GA in the fall. The outcomes suggest that GA can be effectively used for synchronizing and suppressing profuse flowering without negatively affecting yield in Valencia. In addition, GA treatment has potential to improve yield and fruit size while reducing fruit drop.

For years, GA has been known to influence flowering and fruit development in citrus but is not commonly used in commercial production. GA also is involved in many aspects of citrus growth and development such as peel senescence, fruit drop, juice quality, etc. In healthy citrus, GA is used commercially to minimize fruit drop, to expand the harvest window by delaying maturation and to delay peel breakdown.

## TREE STRESS

HLB and psyllid infestation add stress to the trees. Off-season and prolonged flowering is a well-known response of trees when undergoing various stress conditions. Navel and Valencia trees stressed by HLB are known to have prolonged flowering periods with sporadic flowering during the fall, resulting in unharvestable off-season fruit.

Generally, off-season and prolonged flowering is not a great concern, but when combined with heavy rainfall and warm weather in the spring, this can increase the threat of postbloom fruit drop (PFD). Therefore, the ability to synchronize and suppress off-season flowering can be beneficial for the following reasons:

1. A compressed and synchronized flowering period can be efficiently targeted with fungicides, and fungicide use can be reduced.
2. PFD inoculum build-up in the tree during the off-season can be reduced.
3. Synchronized flowering with no off-season flowering will yield uniform fruit set and more profit for growers.

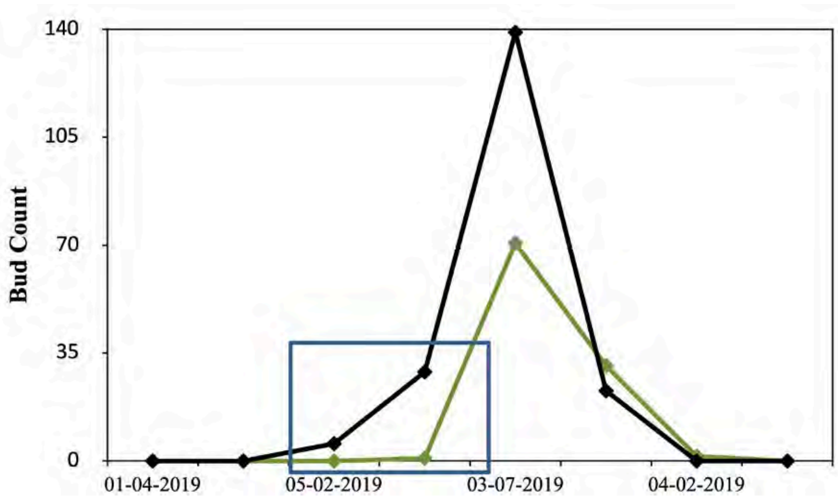


**Figure 1.** Number of buds and their distribution in spring of 2019 per 0.25 $m^2$ of canopy in Valencia treated with gibberellic acid (GA)-100 (green line) and the control (black line). The blue box highlights the early-season suppression of flowering in GA treatments.

A further consideration is that only approximately 2 percent of flowers are harvested as fruit. Thus, a large quantity of tree resources is invested in flowering and fruit set, which eventually end up on the ground. The ability to conserve these resources for harvestable fruit can be highly beneficial for HLB-affected trees.

Recent research on HLB-associated fruit drop has shown that fruit drop is related to fruit size. Small fruit are highly likely to drop. Also, fruit size decreases and fruit drop increases with greater HLB severity of trees (low canopy density). In other words, a highly HLB-symptomatic tree produces significantly small fruit and undergoes significant fruit drop (in some cases up to 70 percent).

Flower thinning to improve fruit set and growth is a common practice in fruit crops such as apples and peaches. Use of GA offers the additional potential advantage of improving fruit size, lessening crop-load stress from the tree and reducing fruit drop in HLB-affected trees.

## WHAT THE RESEARCH SHOWS

In 2016, a 3-year GA trial was initiated to evaluate its effect on flowering, yield, fruit size and fruit drop on Valencia oranges at a commercial grove in Fort Meade. The

**Table 1.** Different gibberellic acid (GA) treatments with rate and number of foliar applications

| Treatment name | GA rate (grams active ingredient per acre) | Number of applications | Months of application |
|---|---|---|---|
| Control | 0 | – | – |
| GA-30 | 10 | 3 | September–November |
| GA-40 | 10 | 4 | September–December |
| GA-50 | 10 | 5 | September–January |
| GA-60 | 20 | 3 | September–November |
| GA-80 | 20 | 4 | September–December |
| GA-100 | 20 | 5 | September–January |

**Table 2.** Yield of Valencia with different gibberellic acid (GA) treatments for 2016–17, 2017–18 and 2018–19.

| Treatment | Fruit yield (lb/tree) per year | | |
|---|---|---|---|
| | 2016–17 | 2017–18 | 2018–19 |
| Control | 99 | 214 | 209 b |
| GA-30 | 172 | 216 | 190 b |
| GA-40 | 183 | 222 | 253 ab |
| GA-50 | 187 | 254 | 254 ab |
| GA-60 | 148 | 218 | 255 ab |
| GA-80 | 179 | 220 | 257 ab |
| GA-100 | 172 | 256 | 282 a |
| *P*-value | 0.13 | 0.82 | 0.04 |

GA treatments were applied in the fall, from September to January, at two different rates. Table 1 shows the seven treatments (including control) evaluated in this trial. Since the GA applications were made in the fall, the existing fruit (the fruit that were harvested following spring) also received the GA treatment. The fruit yield was collected in 2017, 2018 and 2019. The fruit size and fruit drop was collected for the harvest season of 2018 and 2019 (only on the control and GA-100 treatment).

In all the three years, the effect of GA treatment on flowering was similar. In the higher GA rate treatments, the flower buds and number of flowers were reduced by 50 percent (Figure 1, page 21). In addition, GA-40 to GA-100 treatments resulted in complete suppression of early floral bud emergence (and flowering consequently) and a single sharp, narrow base flowering peak.

The flowering (open flowers) was more synchronized in cases of the GA treatments where open flowers were observed for approximately three weeks and control trees had a 4-week flowering period. This suggests that with GA, flowering can be suppressed and synchronized on HLB-affected trees, leading to better PFD management.

As an example, see the blue highlighted box on page 21. Since there were no floral buds in GA-treated trees until early March, a fungicide application will not be needed. However, untreated control trees have a significant number of elongated buds. This warrants an early fungicide spray, if weather is conducive for PFD. Also, prolonged flowering activity can affect psyllid spray scheduling. Therefore, GA treatment may improve psyllid spray management in the spring.

Because flowering was significantly reduced (by 50 percent), a major concern was whether the use of GA reduced fruit yield. Interestingly, the use of GA did not decrease the yield in any of the treatments (Table 2, page 22). In 2017 and 2019, a positive correlation was observed between total amount of GA applied and yield. In other words, the data shows that there was a tendency of increase in yield with increase in total GA applied.

In 2019, the GA-100 treatment showed a significant increase in yield compared to the control. However, all the other treatments were not significantly different from the control. In GA-100-treated trees, yield consistently increased from 2017 to 2019, from 172 pounds per tree to 282 pounds per tree with the repeated application of GA. No such increase was observed for untreated control trees. The 3-year cumulative yield of GA-100 trees was significantly higher than the control.

When the fruit size was compared between the control and GA-100 trees, the fruit from GA-100 trees were consistently larger than the control trees. GA-treated trees had significantly higher fruit detachment force than untreated trees, indicating that GA-treated fruit were less likely to drop.

In summary, this field study demonstrates that GA application resulted in synchronized flowering with no negative effect on yield. Moreover, repeated application of GA has potential to improve yield. It is hypothesized that reduction in total flowering and increase in fruit size resulted in reduced fruit drop and improved yield.

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*Tripti Vashisth is an assistant professor and Megan Dewdney is an associate professor, both at the University of Florida Institute of Food and Agricultural Sciences Citrus Research and Education Center in Lake Alfred.*