



As HLB has increased, so has fruit drop, resulting in fruit losses worth more than \$150 million annually.

## Status of citrus fruit drop in relationship to HLB

By L. G. Albrigo and J. P. Syvertsen

**S**ince huanglongbing (HLB) became an endemic problem in Florida three years ago, current estimates indicate that 80 percent to 90 percent of Florida citrus trees have HLB. Along with tree decline, preharvest fruit drop of citrus (Figure 1) has become more severe.

The National Agricultural Statistics Service (NASS) had average

estimates of preharvest fruit drop at 18 percent and 23 percent of the total crop for early-midseason varieties, and 22 percent and 31 percent for Valencia oranges for the 2012–13 and 2013–14 seasons, respectively. Over the three seasons previous to 2012–13 and 2013–14 when HLB was not a general problem, average preharvest drop estimates varied from 9 percent to 11 percent for both early-midseason and Valencias.

The recent 10 percent to 20 percent increase in preharvest drop rates associated with HLB increases translates into fruit losses worth more than \$150 million annually. Figure 2 (page 16) shows the general increase in drop percentage as tree health declines from HLB infection. Even the healthier trees in this example are still infected with HLB, typical of almost all Florida citrus trees.

### DROP TIMING

In 2012–13 and 2013–14, significant drop of Hamlin fruit started about September 20, but in the current 2014–15 harvest season, the drop did not start until the second or third week of October. This harvest season, the summer rainy period extended later in the fall, and temperatures were slightly lower in October and December than in previous years. It is possible that a delay in fall water stress accounted for the delay in the start of fruit drop this past fall.

Drop percentages as of May 2015 for the 2014–15 season were 22 percent for early-mid and 25 percent for late oranges, representing 1 percent and 6 percent reductions from 2013–14. Again, this may reflect better moisture conditions than previous years and more growers shifting to irrigation schedules with more frequent applications. Even as this article goes to press, however, current crop estimates are falling as the spring rains decreased in April.

### STRESS FACTORS

Normal fruit drop is related to the formation of a natural abscission zone that causes fruit to drop from the stem. This abscission zone is stimulated to develop by ethylene as fruit mature, which causes up-regulation of cell wall-dissolving enzymes in the abscission zone. Stress factors (like drought and HLB) can also lead to ethylene production in plants, including citrus. This premature ethylene production can lead to unusual preharvest fruit drop from stress. The auxin substitute, 2, 4-D, has been shown to inhibit up-regulation of these cell wall enzymes and can reduce preharvest fruit drop in healthy citrus trees.

Water stress from drought is one of the most common stress factors. It has been shown to cause the production of the ethylene precursor ACC in roots, which converts to ethylene in leaves and fruit. Gibberellic acid (GA) inhibits this process (Iglesias et al, 2007) and has been used commercially to extend the harvest season by

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retaining fruit on the tree. Thus, auxins and other plant hormones such as GA affect citrus physiology, and the effects of some can be mimicked by plant growth regulators (PGRs).

## PGR STUDIES

Studies funded by the U.S. Department of Agriculture's Specialty Crop Research Initiative (SCRI) program through the Florida Department of Agriculture and Consumer Services, the Citrus Research and Development Foundation (CRDF) and agricultural chemical companies were intended to provide information about citrus physiological and horticultural changes in response to HLB that could help determine ways to reduce preharvest fruit drop. One possibility was that these studies could be used to determine if some PGRs or other production practices could reduce preharvest fruit drop that has been associated with HLB.

We have demonstrated that declining, HLB-affected trees have more water stress than healthy-appearing trees. Further, more affected trees tend to have higher percentage drop rates than healthy-appearing trees, which supports the idea that GA along with 2, 4-D would be good candidates to reduce preharvest fruit drop.

Initially, PGR studies were started in 2013 with support from an agricultural chemical company. Additional tests were initiated in early 2014 with funding support from the SCRI and CRDF funds and were continued in the 2014–15 season. Significant support for these tests also was provided by several growers with the use of their groves and application of some materials with their commercial equipment.

A total of 16 tests were carried out in 2013–14 and another 30 tests in 2014–15. These trials were representative of citrus blocks in the two years as the untreated Valencia control trees had drop rates of 39.4 percent in 2013–14 and 16.2 percent

## Integrating Investments in HLB and Other Disease Research

By Harold Browning



Almost one year has passed since the two federal funding sources were announced. Projects are now underway in both the U.S. Department of Agriculture (USDA), National Institute of Food and Agriculture (NIFA), Specialty Crop Research Initiative, and the USDA, Animal and Plant Health Inspection Service Multi-Agency Coordinating (MAC) Group programs for citrus disease. At the same time, the Citrus Research and Development Foundation (CRDF) is adjusting its programs to focus grower resources on near-term solutions and to continue to deliver results as soon as they are available.

The table below summarizes current investments (total project costs) of CRDF's research- and product-delivery portfolios, organized by some of the major topics of intervention in managing HLB and other challenges. Along with the CRDF investment, latest commitments from the two federal programs have been inserted to show the complementarity of the efforts and the focus on these important management elements.

While these numbers are not inclusive of all investments from the CRDF or the federal programs, they depict a significant portion of the investment at this time. CRDF and the federal programs are engaging in evaluation of new projects, and additional updates will highlight how this funding picture continues to change.

PREVENTING HLB SPREAD	Research		Delivery	
	CRDF	NIFA	CRDF	MAC
Asian Citrus Psyllid (ACP) Movement	814,674		211,681	
ACP Management and Citrus Health Management Areas	4,100,103	4,500,000	1,426,265	2,998,000
New Plantings Systems			936,705	2,998,000
Tolerance in Rootstocks and Scions	1,424,649		4,916,042	1,000,003
Engineering Resistance	3,550,894			
REDUCING HLB DISEASE IN TREES	Research		Delivery	
	CRDF	NIFA	CRDF	MAC
Bactericides	1,155,142	6,700,000	1,753,245	1,326,000
Thermal Therapy		3,500,000	927,455	1,266,000
Inoculum Removal				1,000,000
SUSTAINING TREE HEALTH	Research		Delivery	
	CRDF	NIFA	CRDF	MAC
Nutrition			407,500	
Soil/Water Conditions and Treatments	477,576		385,193	173,000
Compost, Microbe Products	187,296		782,078	216,000
Integrating Approaches to Health				1,543,000
FRUIT DROP AND FRUIT QUALITY	Research		Delivery	
	CRDF	NIFA	CRDF	MAC
Influence of Plant Growth Regulators on Infected Trees	470,849		814,144	
Impact of HLB on Fruit Quality			110,000	
REDUCE IMPACT OF OTHER DISEASES	Research		Delivery	
	CRDF	NIFA	CRDF	MAC
Citrus Canker	3,043,544		834,133	
Citrus Black Spot			909,302	
Phytophthora	336,714			
Diaprepes Root Weevil	80,000		134,500	
Citrus Blight	400,000			

Harold Browning is Chief Operations Officer of CRDF. The foundation is charged with funding citrus research and getting the results of that research to use in the grove.

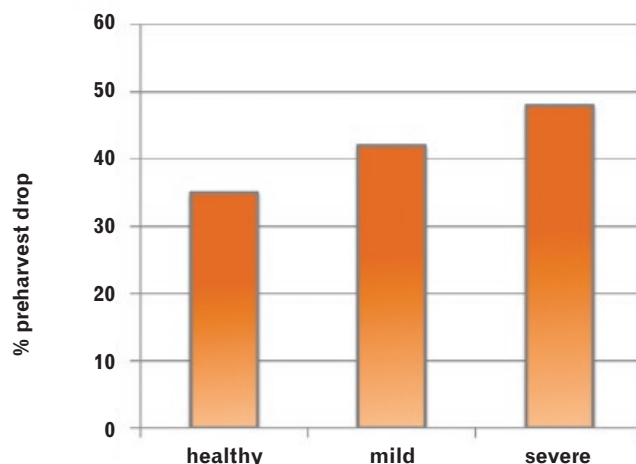


Column sponsored by the Citrus Research and Development Foundation

in 2014–15. These compare to 31 and 25 percent for statewide averages. For Hamlins in 2014–15, our seven test sites averaged 29.5 percent preharvest drop for the untreated controls, while statewide the NASS data was 22 percent.

Of 16 tests in 2013–14, 13 sites had no effect from the PGR treatments on fruit drop. Three sites had a positive result where a PGR treatment resulted in a significantly lower percentage of preharvest drop rate than the untreated control trees. Two of these three included ProGibb (GA), and all three of the significant treatments included Citrus Fix (2, 4-D), one of which had Citrus Fix applied alone.

Of 30 tests in 2014–15, 23 tests had no effect from the PGR treatments on fruit drop. Seven tests had a significant reduction in preharvest fruit drop from a test material. Of these seven, five tests included Pro-Gibb (GA3) and six included Citrus Fix (2, 4-D). Four of these positive tests included both



**Figure 2:** Average percentage of fruit drop in non-treated Valencia trees from three groves, in relationship to tree health.

ProGibb and Citrus Fix. Of eight tests that included Headline, the product numerically reduced preharvest drop in three locations, but only significantly in one. Ascend, a product containing three PGRs, reduced fruit drop in one of three tests. Most of the significant reductions in drop in 2014–15 were in Hamlin and a grapefruit trial, but control drop rates

were nearly twice as high in Hamlin compared to Valencia trials.

Overall, PGRs did reduce preharvest fruit drop about 23 percent of the time, although treatments were numerically lower about another 25 percent of the time. ProGibb and Citrus Fix were the most consistent, accounting for five and six, respectively,



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of the seven tests that had significant reductions in fruit drop. In fact, when all the tests on Hamlin were pooled, there was a 5 percent significant reduction in fruit drop. Still, no positive response was observed in many of the test sites.

There were no apparent relationships between observed tree condition nor other grove characteristics, that we could see, and whether a product would work or not. At this time, PGRs cannot be recommended as a consistent way to reduce fruit drop related to HLB. Good nutrition and irrigation with frequent applications (perhaps daily through the fall for Hamlins, and also spring for Valencias) appear to be better ways to reduce preharvest fruit drop. 🍊

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## Citrus Pickins

### CITRUS GROWERS RE-ELECTED AS FARM CREDIT OF CENTRAL FLORIDA DIRECTORS

Farm Credit of Central Florida announced that directors Jenny Black and John Langford have been re-elected by the cooperative's membership to serve 3-year terms expiring in 2018.

Langford, a board member since 2005, is a citrus grower, citrus fruit dealer and real estate agent from Bartow and serves as the designated financial expert for Farm Credit of Central Florida. He was recently elected vice chairman of the AgFirst Farm Credit Bank board in Columbia, S.C.

Black is a Florida native and citrus grower residing in Lakeland. She started her own IT consulting practice in 2008 and serves multiple clients in the transportation and agricultural industries. Black was appointed to the board in September 2014. 🍊

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