Postbloom fruit drop: spring is coming

By Megan M. Dewdney

In the 2014 and 2015 seasons, postbloom fruit drop (PFD) has been a problem in certain groves throughout the citrus-growing areas of Florida. Prior to the 2014 season, the last major PFD outbreak occurred in the 1997–1998 season, more than 15 years ago. This was the last strong El Niño season. After the outbreak of PFD in the spring of 2014, growers were looking for the signs of PFD in their groves earlier in 2015. This allowed for better timed applications in some cases.

SURVIVAL, SPREAD AND SYMPTOMS

PFD is caused by the fungus *Colletotrichum acutatum*. The inoculum survives as dormant infections between flowering periods on the buttons, leaves and twigs. When flowers first open on a tree, fungal survival structures start to germinate and form spores. These spores are moved via rain to the flowers, where they are able to germinate, infect flowers and produce many more spores. These spores are then moved to the next flowers by subsequent rainfall events. The fungus is highly dependent on rainfall, especially frequent rain events when flowers are present in the grove.

Infection usually happens within 24 hours of a weather event, and symptoms occur in approximately four to five days. Flower symptoms of PFD start with water-soaked lesions on petals that turn from peach to orange-brown as they age (Figure 1). The fungus continues this cycle for as long as there are susceptible flowers available.

While windblown rain is the main means of disease spread, human activity contributes to long-distance spread through equipment movement. Workers with petals in their picking bags can also contribute to spreading the disease, especially if work is done while the canopy is wet.

Trees, groves or cultivars that have extended blooms, multiple blooms or off-season blooms tend to have more problems than groves where the bloom is restricted to a short period. At the end of bloom, the fungus causes the young fruitlets to abscise, leaving calyxes (also called buttons) (Figure 2). Fruit in a cluster with late flowers can also abscise if those flowers become infected. The fungal population will diminish with the end of bloom, but *C. acutatum* will survive on the tree until more flowers are present.

One frequently asked question is: Where did the disease come from so suddenly? Since the late 1990s, *C. acutatum*, has been present in groves at very low levels. The weather during bloom and general tree condition had been unfavorable for the fungus to cause disease. Over this time, low numbers of the persistent calyxes or buttons could be observed, indicating the fungus was around but not thriving. In the last few years, almost unobserved, the number of buttons present in the groves has been slowly increasing, which shows that the conditions were becoming more favorable. The wet weather of 2014 and 2015 was just the trigger the fungus needed to cause a full-fledged PFD outbreak.

EL NIÑO AND EXTENDED BLOOM

There are two factors likely to make next spring a season for another outbreak of PFD. The El Niño climate phase is expected to continue over the winter of 2015–2016. There is a greater than 90 percent chance El Niño will last through the winter and an 85 percent chance that it will continue into the

Figure 1. Young lesions on citrus petals have an orange circular pattern caused by masses of spores produced by the fungus *Colletotrichum acutatum*.

Figure 2. Persistent calyxes or buttons caused by PFD infection of flowers and the abortion of fruitlets from the calyxes. There are few other causes of this symptom.

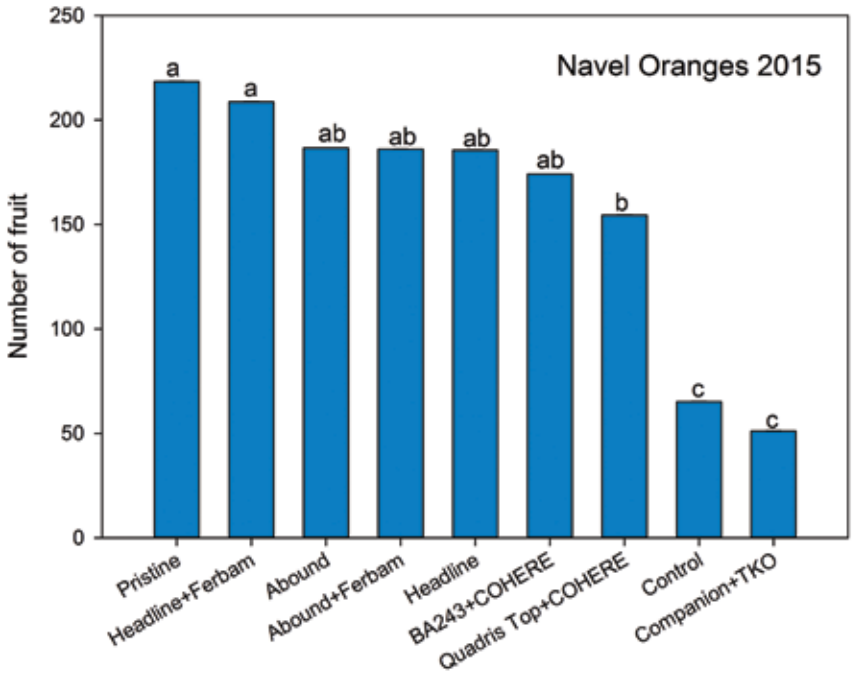

Figure 3. The average number of fruit per tree for each fungicide treatment in the 2015 postbloom fruit drop trial. The effects of the fungicides with the same letter are not significantly different at the 95 percent confidence level.

early spring (www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/ensodisc.html). This means that there is probably going to be more rain on average during the winter and into spring, when the majority of citrus flowering occurs.

Additionally, many groves have off-season bloom or an extended bloom for several reasons. Some cultivars, such as Navels, are prone to off-season or extended bloom. Trees that are stressed by other factors — like diseases such as huanglongbing, blight or phytophthora — can bloom off-season. Whatever the reason for extended bloom in a grove, it allows the fungus to multiply and increase the inoculum load. If the anticipated wet spring occurs, PFD will be difficult to manage in groves with extended bloom, and a great deal of care will be needed to apply fungicide in a timely manner. Since there have been substantial PFD outbreaks in 2014 and 2015, even groves that have not been affected may have some disease.

PROTECTIVE MEASURES

Since another PFD outbreak is likely in 2016, what can be done to protect groves? If possible, remove severely declining trees, especially if they have consistent off-season bloom and limited yield. These trees will probably cost more to protect than is profitable. Vulnerable grove blocks should be scouted regularly. If the first indication of a problem is this year's buttons, then it will be too late for management. It is important to know when trees start to flower and whether there was inoculum present from last year. If inoculum (buttons) is present, plan for PFD management.

If you are considering fungicide applications for PFD, timing of those applications is critical. This has become more complicated in the last few years because many trees with HLB have several waves of flowers. Therefore, applications need to be targeted toward the most profitable waves. The optimal timing for the first application is around 10 percent bloom, if you are judging by the phenological stage. If further applications are needed, full bloom and then 90 percent bloom would be good targets. However, the best way to time applications is by the use of the PFD-FAD (Fungicide Application Decision) system (http://pfd.ifas.ufl.edu). Timing is highly specific to the grove situation, including flowering stage and local weather conditions.

While timing is very important for PFD control, it is necessary to know which product to put in the sprayer tank. Currently, the Florida Citrus Pest Management Guide recommends any of the three strobilurin fungicides: Abound, Gem, or Headline with or without Ferbam. These provide moderately good PFD control. Keep in mind that products like copper have no demonstrated efficacy on PFD and are not recommended.

FUNGICIDE FIELD TRIAL

Until 2015, there had been no work with the more recently registered fungicides because there had not been enough disease to conduct a trial. A trial was conducted in a Polk City Navel block that was highly affected by HLB, had significant off-season bloom and a major outbreak of PFD in 2014. Prior to applications, the number of buttons and open flowers was measured, and there were no differences among treatments. There were significantly more infected flowers in some randomly assigned treatments prior to treatment, but that did not appear to affect the outcome.

Applications were made on the recommendation of the PFD-FAD system. The application dates were February 25, March 4, 16 and 24, 2015. The treatments and rates per acre used in this field trial are listed in Table 1. Eight treatments were tested along with an untreated control.

Table 1. Treatments per acre used in the 2015 postbloom fruit drop trial on Navel oranges.

Product	Rate/Acre
Control	—
Quadris Top and Cohere	15.4 fl oz + 16 fl oz
Abound	15.5 fl oz
Pristine	18.5 oz
BA243 and Cohere	6 fl oz
Headline	15 fl oz
Abound and Ferbam	15.5 fl oz + 6 lb
Headline and Ferbam	15 fl oz + 6 lb
Companion and TKO	32 oz + 64 fl oz

The number of fruit per tree was counted between June 12 and 23, 2015, and the averages are presented in Figure 3 (page 14). The number of fruit was counted at that time to give those fruit that were going to be dropped during the June drop an opportunity to fall, but not in time for the HLB-induced fruit drop to occur. Most treatments produced significantly more fruit per tree than the untreated control ($P < 0.05$).

Pristine and Headline + Ferbam had the greatest number of fruit, but the number of fruit was not significantly greater than most other treatments. From the 2015 results, it appears that Pristine, Headline with or without Ferbam, or Abound with or without Ferbam would be the best choices currently, although Quadris Top gave significantly more fruit than the untreated control and is a reasonable choice.

These results are only from a 1-year study, but a repeated trial is planned to determine if the trends are consistent among years. Results from a 1-year study are very likely to change. Although we have several reasonably effective fungicides, at the moment, there is no product that would equal the effectiveness of benomyl or other benzimidazole fungicides.

CONCLUSION

PFD is likely to be a problem again in 2016 because of the El Niño climate pattern and the extended bloom from HLB-infected trees. There are fungicides that show promise for improved control, but if the applications are not well timed, no fungicidal treatment will be effective. Growers should be proactively scouting their groves for buttons and deteriorating trees. Observe the number of flowers that are available and whether it is likely to be the major bloom. These are the flowers where protection should be aimed.

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Moving HLB Tolerance and Resistance to the Field

By Harold Browning

The balance of efforts to deliver solutions to huanglongbing (HLB) in Florida includes a major focus on the development of tolerance and/or resistance to the disease in commercial scions and rootstocks that are important to the industry. The appropriate combination of rootstock and scion provides the foundation in citrus for cultivation in the presence of diverse soils and conditions, and ultimately defines the characteristics and quality of fruit produced, whether it is for fresh or processed markets.

HLB has disrupted normal citrus production in Florida, and the community of citrus breeders and biotechnologists has been hard at work to develop and test new plant material that could provide the resistance or tolerance needed to allow sustained production in the presence of this disease. The long-term existence of citrus breeding programs in Florida and elsewhere in the United States and the world provides the basis for this work, and significant progress has been made in creation of a broad germplasm collection that has traits which may confer tolerance or resistance.

The only way to demonstrate the level of benefit that this might provide is through testing of candidate material under field HLB pressure. Numerous tests are underway across the state in research plots and grower field trials, and observations indicate emergence of good candidates. Commercial-scale field trials were planted on three sites in 2015 to demonstrate the benefit of tolerant rootstocks, and there are many more candidates that can be evaluated.

Recently, CRDF partnered with PepsiCo/Tropicana to organize a knowledge-sharing activity that brought 20 citrus breeders and biotechnologists together to discuss how best to move strong candidates to the field. Over a two-day period, the group — representing Florida, Texas and California citrus breeding programs, HLB researchers from across the country, and a few plant breeders involved in other crops — discussed and planned for a common evaluation stream that can be employed to accelerate the testing, licensing, deregulation and scale-up of citrus material that may deliver tolerance or resistance to HLB. Recognizing the need to integrate various program products and to facilitate side-by-side comparisons of the elite materials coming from research, the group discussed and suggested field trial design, data collection needs and how to remove time from the lengthy period of step-wise evaluation of rootstocks and scions.

The results of this very productive workshop are being summarized, and over the next two months, a plan for implementation of an aggressive statewide evaluation program for tolerance and resistance will be discussed and approved. The goal will be to gather information on the best class of rootstock candidates and in parallel, best scion candidates from all sources available. A committee of growers and researchers then can make determinations of which candidates should go forward into the compressed field evaluation.

A critical parallel set of activities also was discussed and inserted into the process. Along with the field evaluation, separate processes for addressing the intellectual property and licensing, regulatory considerations and scale-up will be initiated so that appropriate steps in these areas can be pursued in tandem with the field trials.

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.

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