An update on citrus black spot trials

By Pamela Roberts and Megan Dewdney

Citrus black spot (CBS), caused by the fungus *Phyllosticta citricarpa* (*Guignardia citricarpa*), was discovered in a commercial grove near Immokalee in March 2010 when the first CBS symptomatic fruit were found (Figure 1). Since then, the number of blocks identified with CBS-positive trees has increased each season in the Southwest Florida production region with nearly 46,000 acres in quarantine as of February 2015. Maps and current information about the quarantine areas are available as links through the citrus black spot website (www.citrusblackspot.org).

Figure 1. This Valencia fruit shows symptoms of citrus black spot.

SUSCEPTIBILITY

Currently, the majority of CBS-affected blocks are Valencia oranges (the most common citrus cultivar in Southwest Florida). Lemon is the most CBS-susceptible species, but sweet oranges, especially mid- to late-maturing cultivars, are also highly susceptible to this disease. Valencia oranges are the most susceptible of the commercially grown cultivars in Florida, but nearly all cultivars are susceptible.

Hamlin sweet orange and tangerine/mandarin types are moderately susceptible, in part because there is less overlap of young and mature fruit on the trees. From our limited experience in Florida, grapefruit appears moderately susceptible.

Tahiti limes are asymptomatic, but *P. citricarpa* can form spores in the leaves, allowing the fungus to complete its life cycle. Sour oranges and sour orange hybrids are also asymptomatic, but whether spores can be formed in the leaves is still unknown.

INFECTION

CBS can cause many different lesion types on the fruit, making it unsuitable for the fresh market. Fruit intended for the juice market becomes blemished, but the internal quality of the fruit remains unaffected. However, fruit infection can lead to premature fruit drop, which is of serious concern for those producing for processing (Figure 2). In our trials, there was a 30 percent increase of fruit drop from trees with severely affected fruit compared to trees with lower incidence and severity of CBS-infected fruit. This is a very serious consequence when other diseases like huanglongbing are contributing to increased fruit drop.

Leaf symptoms are uncommon in groves managed for CBS. Despite the scarcity of leaf symptoms, the most important spores — ascospores — for spreading the disease come from the leaf litter as it decomposes. The infections that produce these spores are not visible to the eye and are often termed latent infections as no visible

Figure 2. Fruit drop under this Valencia tree was caused by citrus black spot.

symptoms are formed. The majority of airborne spores are released between mid-March and late-August.

Fruit are susceptible for five to six months after petal fall and must be moist to be infected. Fruit maturation, along with warm weather and sunlight, stimulate symptom production. When scouting trees for symptomatic fruit in a grove, a good rule of thumb is to look for symptoms on the sunny side of a declining tree (where the symptoms are most likely to appear first), search for extensive fruit drop under a tree and then examine hanging fruit. Symptoms are visible on fallen fruit.

CONTROL

Like most diseases and pests, application timing for CBS control is important. The beginning of May is the recommended time to apply the first treatments. If rains occur earlier, as they did this year in April — usually a dry month — an application should be considered. Applications should continue at monthly intervals until late-August/early September.

Currently, we have four fungicide groups that are registered and found to be efficacious in Florida for CBS control. These include the copper-based fungicides (FRAC Group M1; various copper compounds), the strobilurins (FRAC Group 11; Abound, Gem and Headline), the demethylation

CRDF Efforts to Address Huanglongbing Over 6 Years

By Harold Browning

The Citrus Research and Development Foundation (CRDF) was formed in April 2009 in response to the Florida citrus industry's need for a single organization to coordinate research in finding solutions to huanglongbing (HLB). The first responsibility for CRDF was to assume oversight of the funded projects begun in 2008 to address this disease. The contracts for more than 100 projects were transferred from the Florida Citrus Production Research Advisory Council and Florida Department of Citrus to this new organization. The founding board and staff established processes and procedures for managing this unprecedented effort. As we recognize the completion of six years of effort, the mission remains the same: to discover and deliver solutions to HLB.

In this 6-year history, the CRDF has engaged in the following efforts to support its mission to provide solutions to HLB.

- Provided a quality funding program to support the best research and delivery efforts
  - 149 completed multi-year research projects
  - 112 active multi-year research projects
  - 52 Commercial Project Delivery projects in place
  - A total of 313 projects each spanning up to three years involving hundreds of scientists
- Projects balanced across the components of the disease system:
  - Asian citrus psyllid vector
  - *Candidatus Liberibacter asiaticus* bacterial pathogen
  - Host citrus trees, both rootstocks and scions
  - Interactions between all of the above components
  - The soils, geography and hydrology associated with growing regions
  - Influence of other pests and diseases on health of trees infected with HLB
- Engaged with industry leaders in securing and coordinating funding support from:
  - State legislative appropriation
  - Federal research program support [U.S. Department of Agriculture (USDA), National Institute of Food and Agriculture Specialty Crop Research Initiative, Citrus Disease Research & Extension Program]
  - USDA, Animal Plant Health Inspection Service Multi-Agency Coordination Group funding for field-ready testing of solutions to HLB
  - Award of a competitive grant (nuPsyllid) project to USDA
  - Donations from the broader citrus industry community
  - Co-funding projects with the California Citrus Research Board
- Participated in and sponsored efforts to communicate results of HLB research
  - Three International HLB conferences in Orlando to bring HLB researchers together
  - Annual Citrus Expo educational seminars
  - Annual Florida Citrus Industry Conference educational seminars
  - Annual Florida Citrus Growers' Institutes
  - Hosted and sponsored field days and other grower educational events

These are but a few of the activities that have benefited from the growers' vision to establish an organization to lead the fight against HLB. CRDF has been and remains the primary entity for HLB research and delivery efforts across the world, and continues to find solutions for this very difficult challenge.

CRDF Grower Dollars at work for you

Column sponsored by the Citrus Research and Development Foundation

An aggressive canker suppression program may help to control, but not eliminate, CBS on grapefruit.

inhibitor fungicides (DMIs; FRAC Group 3; Enable) and the mixtures Quadris Top (FRAC groups 11/3) and Pristine (FRAC groups 11/7).

Fortunately, many of the fungicide applications for other diseases will also control CBS. An aggressive canker suppression program may help to control, but not eliminate, CBS on grapefruit. For other cultivars, canker applications would need to continue into late summer. Applications for greasy spot and melanose will also help, but again, the applications will need to continue to August. Many alternaria and most scab applications will be too early for CBS control, but may serve as a first application in April/early May.

Non-copper fungicides are recommended for improved control over copper alone and also for fresh fruit production, but should be rotated with each other and with copper for resistance management. Because of copper phytotoxicity concerns, non-copper fungicides should be used when temperatures are greater than 94°F.

Since modern, single-site fungicides have had many problems with resistance historically, applications are restricted by label to a certain number per year for all uses. Resistance has already become a problem with Alternaria brown spot, and we do not want to lose these valuable tools for CBS control. Be careful to stay within label rates.

FUNGICIDE TESTS

We now have several seasons of testing fungicides and various timing regimes to manage this disease under Florida conditions, and the use of effective, timely fungicide applications will undoubtedly continue to be part of the integrated approach. The evaluation of fungicide products and timing regimes was initiated in a commercial block in 2011 and will continue. Fungicides currently labeled for use on citrus were used in every field trial; however, the trials in 2013 and 2014 included products not currently labeled on citrus, but selected for potential efficacy against this disease.

Fungicides labeled for use on citrus that were included in the recently completed trials were: Gem 500SC (trifloxystrobin; FRAC 11), Enable 2F (fenbuconazole; FRAC 3), Quadris Top 2.71SC (azoxystrobin and difenoconazole; FRAC 11 and 3), Pristine 38WG (pyraclostrobin and boscalid; FRAC 11 and 7) and Kocide 3000 (copper hydroxide). The FRAC grouping indicates mode of action; for example, FRAC 11 includes the strobilurins, and can be found for every fungicide in the last table of the Florida Citrus Pest Management Guide.

Sprays were initiated in May and continued at approximately monthly intervals through early fall. Results from a few selected fungicide regimes are presented. These include: 1) Kocide 3000 at first application rotated with Quadris Top 2.71SC, 2) Enable 2F plus 5 percent citrus oil alternated with Kocide 3000 and 3) Pristine 38WG at the first application rotated with Kocide 3000. All the applications were made with an airblast sprayer calibrated to deliver 126 gallons per acre operating at 200 psi and 3 miles per hour. The trial was a randomized block design with four replications of each treatment containing at least three trees from which the data were collected.

Fruit from test plots were evaluated for CBS lesions beginning

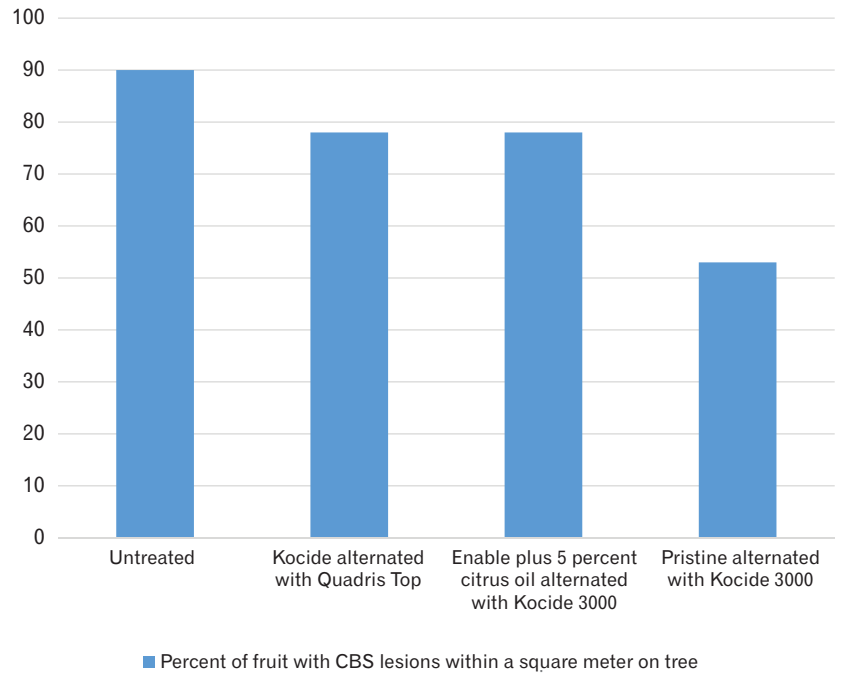

Figure 3. The percentage of Valencia fruit on a tree with symptoms of citrus black spot calculated from the total number of fruit counted within a square meter, March 2015. Significant differences were not detected among treatments for this rating.

in December and continued through March. As expected, Valencia fruit exhibiting symptoms and fruit drop increased as the season progressed. For the purposes of this trial, fruit were considered to be diseased if a single CBS lesion was seen. Fruit drop was assessed twice, once in February and at the end of March, by counting all of the fruit under the treatment trees. The number of dropped fruit with CBS lesions and without visible symptoms was counted. On the tree, the percentage of total fruit with CBS within a square meter of canopy was calculated (Figure 3).

Preliminary results for selected fungicide regimes are presented in Figure 3. As expected, these fungicide applications were effective in reducing the number of fruit dropped and the number of fruit with symptoms of CBS; however, the data shown from March 2015 fruit drop were not highly significant.

Since fruit are thought to be susceptible for five to six months post-bloom, the current University of Florida/IFAS recommendations are to initiate sprays in the early spring and continue through fall to protect fruit and coincide with the peak release of inoculum. A rotation of copper and another labeled fungicide, such as one of the strobilurins (Headline SC, Gem 500SC or Abound 2.08SC), Enable 2F, Pristine 38WG or Quadris Top 2.71SC, is recommended. Remember to use the FRAC codes to alternate the modes of action and that the label is the law for the number of applications that can be made for a particular product.

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