Foliar disease management in 2016

By Megan Dewdney and Jim Graham

While HLB is everyone's priority, foliar diseases are still able to significantly damage yields. Fungal diseases and canker can either directly cause fruit drop or reduce yields via leaf loss or other damage. For diseases like postbloom fruit drop (PFD) and canker, it is very important to be proactive because they can reach damaging levels very quickly.

GREASY SPOT

The fungal disease greasy spot is caused by *Mycosphaerella citri* and affects all Florida citrus. Ascospores, the spores responsible for infection, form in the leaf litter beneath the trees. If greasy spot symptoms were common in the previous year, it is advisable to increase control efforts by potentially adding a fungicide application in August. Additionally, if leaf drop has been sizable, an enhanced greasy spot program should be considered as more greasy spot inoculum will be formed.

M. citri is most vulnerable to chemical control in the early summer because it is in the phase when it grows on the surface of the leaves and fruit. The fungus does not actually infect plant tissues until late summer, and symptoms are most often seen from November to February. Symptoms develop most rapidly when it is warm. Severe greasy spot outbreaks cause major defoliation on non-treated trees, leading to small, marred fruit and fruit drop.

For greasy spot control, copper remains effective and economical, especially for rind blotch and groves with canker. However, with high temperatures (>94°F) and dry conditions, copper phytotoxicity on the fruit can occur. When copper is combined with petroleum oil, rind defects can occur during the summer months, which is most problematic for fresh fruit production. Copper is best applied on moderately warm days without any additives, especially petroleum oil, at 2 pounds per acre or less. On processing oranges, where fruit blemishes are not as important, petroleum oils are a good alternative or additive to copper for controlling greasy spot on leaves.

If phytotoxicity is of particular concern, strobilurin-containing fungicides (Fungicide Resistance Action Committee 11; see Table 1) or Enable are also effective control options. The strobilurin-containing fungicides are most appropriate in late May to early June because they also control melanose. To avoid resistance in *M. citri*, no more than one application of a strobilurin — alone or in a mixture — should be made within a season. Enable is especially effective for mid- to late-season control of rind blotch, but should not be followed by Quadris Top because of resistance management, as they share a mode of action (Table 1).

MELANOSE

Diaporthe citri, the melanose-causing fungus, rapidly colonizes and sporulates on small twigs (<0.25 inch) that die from freeze damage and other causes of shoot dieback, including HLB. The fungus also infects live twigs that produce inoculum after twig death. The fungus is able to produce much more inoculum when there are large numbers of dead twigs. Dead wood removal via hedging will reduce disease pressure, even though it is impossible to remove all dead twigs.

Normally, groves under 10 years old have lower melanose levels since there are not many dead twigs in the canopy, but a freeze can cause young blocks to be affected earlier. Fortunately, inoculum levels do not

Table 1. Fungicides with modes of action to aid rotation for resistance management

Fungicide	Mode of Action[a]
Abound (azoxystrobin)	11
Copper	M1
Enable 2F (fenbuconazole)	3
Ferbam (ferbam)	M3
Gem 500 SC (trifloxystrobin)	11
Headline SC (pyraclostrobin)	11
Petroleum oil	—
Pristine (pyraclostrobin + boscalid)	11 + 7
Quadris Top (azoxystrobin+ difenoconazole)	11 + 3

[a]Mode of action class from the Fungicide Resistance Action Committee Code List 2015.

remain high from year to year, so if there is not a significant freeze event, melanose inoculum should return to normal levels. Melanose is not usually severe unless there are extended leaf wetness periods. Only 10 to 12 hours of leaf wetness are needed for infection if temperatures are between 70°F and 80°F. If temperatures are cool, longer leaf wetness periods of up to 24 hours are needed. No spores are produced from leaf and fruit lesions to continue infections.

Copper is still the most economical melanose control because of its long residual activity, but residues decline with fruit expansion and rainfall. The Citrus Copper Application Scheduler (www.agroclimate.org/tools/cudecay) estimates the copper residue on the fruit surface and assists the timing of copper applications for optimal coverage for better melanose and canker control.

Without the Scheduler, copper applications should be made every three weeks to the whole tree from early May until fruit become resistant in early July. This is especially important for grapefruit, which are the most susceptible to melanose. If copper is applied in early June, it can also serve as the first greasy spot application and a canker application. In hot weather when copper phytotoxicity is problematic, strobilurin-containing fungicides give good control, but should never be used more than twice in a row because of possible development of fungicide resistance (Table 1). Strobilurins do not have as long a residual activity as copper, so applications need to be more frequent than every 21 days.

BLACK SPOT

Black spot is still concentrated in Collier and Hendry counties, and the area affected continues to expand. Most citrus cultivars and species are susceptible to the disease. Like greasy spot, the ascospores are formed in the leaf litter under the trees and are spread by wind. The conidia are formed on dead twigs and on certain fruit symptom types, and are spread

Time to Start Removing Abandoned Groves

By Harold Browning

One of plant pathology's fundamental tenets is that unmanaged reservoirs of disease inoculum and vector population are a primary driver for disease spread. Clearly, getting rid of infected plants is an important tool to stave off diseases such as huanglongbing (HLB).

The simplest example of this general rule is the mandatory destruction of crop residues following harvest of annual crops as a method of disease or pest prevention. The process eliminates the host reservoir before the next crop is planted. Disease organisms and the vector insects have no bridge from one season to the next.

The complexity of managing HLB in Florida has been influenced by disease and vector reservoirs, and the accumulation of abandoned groves. The National Agricultural Statistics Service of the U.S. Department of Agriculture (USDA) has estimated that throughout the state's citrus-growing regions, there are 130,000 acres of these havens for psyllids and inoculum.

It is apparent to many that inoculum removal is an important step in planning for the future, along with Asian citrus psyllid (ACP) suppression tools, horticultural practices and disease management treatments.

And while wholesale destruction of all infected trees has proven a difficult challenge, a step in the right direction is on the way. At publication of this column, a measure to ramp up the Florida Department of Agriculture and Consumer Services' (FDACS) abandoned grove initiative was moving through the Florida Legislature and headed for approval. This initiative will provide incentives for removal of unmanaged groves, building on the continuing demonstration of benefit that has been conducted by FDACS with support from the USDA's Multi-Agency Coordinating Group.

We cannot remove all 130,000 acres at once, so a prioritization system could be employed to assist in identifying groves of greatest threat to neighboring managed groves. Residual nutrients in the soil following the discontinuation of management allow continued flushing, providing a resource for ACP. Thus, those groves most actively flushing are the greatest threat. The distance from managed citrus groves also is a factor that can be used to prioritize groves for removal. Nearest neighboring groves that have recently been removed from management may represent the greatest threat to adjacent groves. The Citrus Research and Development Foundation has been actively involved in communicating the importance of this effort to growers, legislators and other interested parties.

An alternative strategy to disable ACP and bacterial reservoirs is simply killing the trees, which might be less expensive and, therefore, more acceptable. Preliminary work on candidate herbicides has been conducted, requiring additional effort to include this option in tree-removal efforts.

The beauty of eliminating highest-risk, unmanaged groves is that the process will boost the effectiveness of HLB management, including bactericides, heat treatment and other practices. It also will be an important step in encouraging new plantings. Short of complete eradication of host citrus trees and related host plants for HLB, eliminating reservoirs of bacteria and the vector populations is the next best thing. A concerted effort by the industry to address this challenge will have dividends that will accrue with each grove removed.

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.

by rain splash similarly to melanose. Fruit infection is mainly from May to September; however, applications are advised in April if conditions are wet.

Black spot infection requires long wetting periods of at least 18 hours, but with the heavy dews that occur in Florida, such prolonged periods are not unusual. In addition to the strobilurin-containing fungicides, copper and Enable are options for black spot management, and it is recommended to rotate modes of action (Table 1). If canker is problematic in a grove, the copper applications used for canker control will also control black spot. However, in most processing oranges, especially Valencia, additional applications will be needed for black spot. Any of the other fungicides are recommended where phytotoxicity is a concern or where there was severe disease the previous season.

POSTBLOOM FRUIT DROP

Postbloom fruit drop was a problem in 2014 and 2015, especially on Navels. The most susceptible cultivars are Valencia and Navel. Hamlin, grapefruit and tangerines are less susceptible to the disease. The fungus *Colletotrichum acutatum* is stimulated to grow and produce spores by flower exudates, so off-season or prolonged bloom periods favor the disease and make control more difficult. Many blocks have multiple bloom periods because of HLB, so applications should be concentrated on the bloom that you feel is most likely to provide your major crop. It is vital in this El Niño year that growers scout their flowers for the reddish, brown discoloration that is indicative of infection, so that applications can be made as soon as possible, particularly if there are persistent calyxes from the previous year (Figure 1).

Currently, there are few recommended fungicides. The strobilurins, tank-mixed with Ferbam, are currently the best option (Table 1), but these products have very limited usages. In initial trials in 2015, all of the treatments recommended in the Florida Citrus Pest Management Guide, as well as Quadris Top and Pristine, performed well. Copper is generally considered ineffective.

Figure 1. Brown postbloom fruit drop lesions on petals in a flower cluster (top) and buttons (bottom) resulting from infection by *Colletotrichum acutatum*.

CITRUS CANKER

In 2015, crop losses from citrus canker were due to premature fruit drop in Hamlins and from fruit lesions in grapefruit that restrict market access for fresh fruit growers. Disease levels were highly variable depending on whether rains were coincident with susceptible stages of foliage or fruit development. Below is a brief review of how HLB interacts with canker, as well as the latest research on improvement of integrated canker management.

Canker epidemics in Hamlins. Hamlin fruit are most susceptible from 0.25- to 0.5-inch diameter. In Hamlin groves less than 5 years old, fruit infected before July drop prematurely due to ethylene produced from canker lesions. After midsummer, fruit protection is unnecessary because lesions do not become sufficiently large enough to trigger fruit drop. Based on a rainfall comparison in the Sebring area in 2014 and 2015, April was the most important month for fruit protection to prevent drop due to canker in 2015. Over 5 inches of rain in April 2015 resulted in early fruit infection and three times more fruit drop than in April 2014 when less than 1 inch of rain fell (figures 2A and 2B). In 2015, copper sprays reduced fruit drop by 50 percent, whereas copper sprays provided little benefit in the

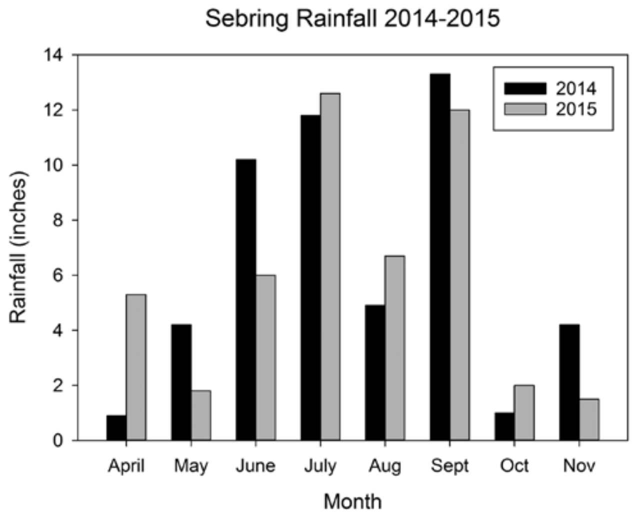

Figure 2A

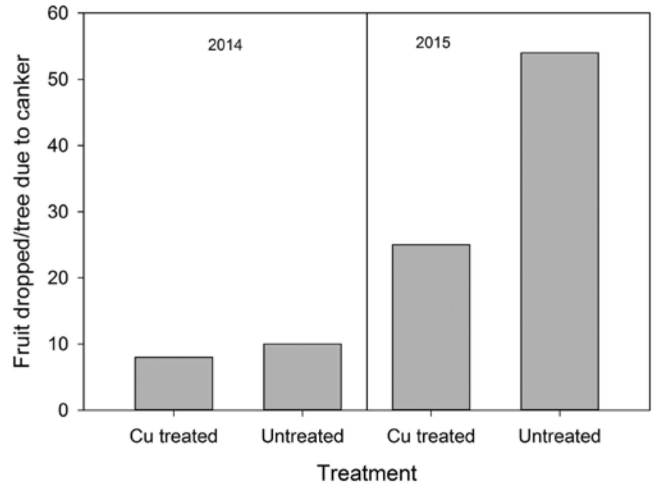

Figure 2B

Figure 2A. Rainfall in Sebring (Florida Agricultural Weather Network). **Figure 2B.** The effect of four applications of copper at 21-day intervals from April to July on the number of canker fruit dropped from 3- and 4-year-old Hamlin trees in 2014 and 2015, respectively. In 2015, 5 inches of rain in April was conducive for fruit infection at the most susceptible size of development (0.25- to 0.5-inch diameter), resulting in premature fruit drop. Copper applications reduced fruit drop by 50 percent.

2014 season with minimal fruit drop.

Interaction with HLB and its management. Where HLB disrupts cycles of flowering, fruit set and foliar flushing, canker can be either reduced or promoted, depending on the amount of inoculum present in the spring and horticultural practices in the grove. Canker inoculum fails to build up on young trees with reduced shoot flushes. In contrast, aggressive foliar nutritional programs may promote constant flushing and canker buildup on foliage and fruit. In addition, foliar nutrients increase the risk of rind burn on grapefruit, especially when tank-mixed with copper. Well-targeted foliar sprays of micronutrients balanced with fertigation of macronutrients produce more regular shoot flushes of shorter duration that are less susceptible to bacterial infection. This practice also lowers the probability of deleterious interactions with copper that is in the tank mix season long.

Integrated management with systemic acquired resistance (SAR). Soil-applied neonicotinoids are crucial for psyllid and leafminer control. They also provide protection of foliage against canker infection. In 2014, we confirmed the limitation of SAR inducers for control of foliar infection and fruit canker on grapefruit trees that exceed 8 feet in height. Canker control on grapefruit became no longer effective because of early-season inoculum buildup despite season-long soil applications of Admire Pro (imidacloprid), Platinum (thiamethoxam) and Belay (clothianidin).

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From 2013 through 2015, soil applications of the commercial SAR elicitor Actigard (acibenzolar-S-methyl) were evaluated by Syngenta and the University of Florida's Institute of Food and Agricultural Sciences in conjunction with grower standard copper spray programs in two commercial grapefruit operations. In each grove, four drenches of Actigard at 60-day intervals between April and October produced higher control of foliar and fruit disease than the copper spray program alone. This efficacy data has been used to support Syngenta's pending registration of Actigard in the spring of 2016 for integrated canker management on all varieties of bearing and non-bearing citrus.

Further information on the control and biology of foliar diseases is available under the Extension tab of the Citrus Research and Education Center website, in the Florida Citrus Pest Management Guide (www.crec.ifas.ufl.edu/extension/pest) and on the Electronic Data Information Source (http://edis.ifas.ufl.edu).

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