# Management recommendations for citrus canker

# By Jim Graham and Megan Dewdney

ast year, two publications in scientific journals reported results from separate international research groups showing that citrus fruit are highly unlikely to spread canker to other regions, even when fruit exhibit canker symptoms. Consequently, a new rule was published in the Federal Register in October that discontinues APHIS inspections for canker on fresh fruit and opens up shipments to all states in the United States, even if symptoms of canker are present. As before, fruit surfaces are required to be treated with one of the currently approved disinfectants.

About one-third of Florida's exported citrus was sent to countries of the European Union (EU) during the 2007-08 season. Shipments to EU still require pre-harvest grove inspections as well as postharvest fruit inspection for canker before shipping. If a single canker lesion is found on a single piece of fruit, the entire production block is disqualified for EU shipment. Adoption of the new domestic canker rule allows diverting such fruit to domestic markets without the costly need to regrade the fruit. Hopefully, the new canker research findings will encourage EU to re-evaluate its current citrus import regulations.

Despite acceptance of canker-blemished fruit in the packing box for U.S. shipment, the goal is still to reduce inoculum potential in fresh grapefruit groves as much as possible to ensure that an economically viable pack-out with low incidence of unsightly blemishes is obtained.

Without windbreaks in place,



production of canker-free grapefruit proved difficult to achieve under the typically rainy Florida conditions of 2009, especially on younger fruiting trees. Even with successful copper spray programs, production of fresh grapefruit remains in jeopardy from late-season infections from thunderstorms, tropical storms and hurricanes. Fortunately the 2009 season was marked by the absence of severe weather which resulted in moderately effective disease control on fruit with copper formulations in our field trials of young red grapefruit.

Highly susceptible grapefruit must be protected with copper from the one-half to three-quarter inch fruit diameter to full expansion stage in late September to mid-October. Grapefruit disease incidence was held to about 15 percent to 20 percent with 21-day-interval sprays with copper formulations compared to nearly 60 percent on fruit from the untreated trees. The majority of fruit infection occurred after July because most lesions were less than one-quarter inch in diameter.

The effectiveness of the protective film of copper on fruit did not vary greatly among copper formulations at 1.5 to 3 lbs. of product or 0.6 to 1.1 lbs. of metallic copper per acre per application. Residual activity of copper

## Figure 1.

Two-year-old windbreak of Eucalyptus grandis in a grapefruit grove In Indian River County, December 2009

on the fruit surface declined due to an increase in fruit growth over 21-day periods, supporting the recommendation to apply sprays at 21-day intervals. Copper efficacy was not enhanced by adjuvants because they did not affect residual activity of copper. An application in July and August of Firewall, a formulation of the antibiotic streptomycin, was effective either in combination with a reduced rate of copper or when substituted for copper in the spray program. Thus, the product manufacturer, Agrosource, Inc., continues to develop the fruit residue studies required by EPA for

Section 18 registration for use against canker on fresh grapefruit.

# ADOPTION OF WINDBREAKS

When canker is well established in a grove, the primary means of disease management are: 1) planting of windbreaks, 2) leafminer control, and 3) protection of fruit and leaves with copper sprays. Windbreaks are the single most effective means for reducing canker infection. Windbreaks serve to reduce wind speed for a distance of five to 10 times the height of the windbreak. Windbreaks are used to reduce windblown rain infection of fruit by the bacterium because, without windbreaks to reduce wind speed below 20 mph, the surface film of copper is not protective.

Fresh grapefruit growers well recognized the loss of canker control due to windblown rain after the tropical storm Fay in August 2008 and a number are in the process of establishing windbreaks (Figure 1). A recent *Citrus Industry* article (October, 2009) updates the progress in the selection and availability of plant species, grove designs and establishment requirements for windbreaks in Florida. For more information, also see www.crec. ifas.ufl.edu/extension/windbreaks/ index.htm.



Figure 2. Hamlin fruit drop due to early season canker infection promoted by several rain events in May, Desoto County, December 2009

# COPPER SPRAYS PROTECT FRUIT

Young leaves are protected by a copper film for only a few days because the surface area rapidly increases. Because fruit grow more slowly, the copper film protects for weeks after spray application. Orange fruit are susceptible to infection from the point when the stomates open at about one-quarter to one-half inch in diameter until they develop fruit rind resistance in mid- to late-July.

In 2009, programs for canker control on oranges were further evaluated in our spray trials and by growers. Those who adopted the IFAS recommendation had satisfactory control with four to five copper sprays applied at 21-day intervals beginning when fruit reached one-quarter to one-half inch diameter until mid-July or when fruit reached about 1½ to 2 inches in diameter.

In our trial, copper sprays, initiated in early April before several May rain events, resulted in an estimated 50 percent reduction from 5 percent to 2.5 percent in premature fruit drop due to canker by the end of season. Continuing sprays past mid-July did not further reduce fruit drop because lateseason lesions do not grow to a large size or produce sufficient ethylene to induce premature fruit abscission.

Growers who started copper applications during or after the May rains had compromised disease control on fruit for the remainder of the season (Figure 2). The 2009 season confirmed that prevention of early-season fruit infection is crucial for subsequent control of fruit infection and risk of canker-induced drop. Although early orange varieties grown for higher color score (Early Gold, Westin, Ruby, Itaborai) were again more susceptible than Hamlins, an aggressive program of copper sprays, starting with spring flush and ending in early August, was effective for canker control on Early Gold. However, this spray schedule required additional applications that may not be sustainable based on processed fruit prices for these varieties.

## INOCULUM MANAGEMENT FOR FRESH GRAPEFRUIT

Reduction of inoculum on spring flush is critical for protection of grapefruit throughout the season because of its greater susceptibility. We have been following the development of Cooperative Producers, Inc., Felda protocol for reducing inoculum in grapefruit trees with endemic canker infection. The strategy depends on performing operations to reduce inoculum after picking the fruit crop and during the coolest and driest time of the year when environmental conditions are least conducive for canker re-infection. This is intended to minimize the risk of any new flush produced by inoculum removal from being infected as susceptible new leaves emerge.

Inoculum reduction is initially accomplished by mechanically hedging off the canker-infected summer and fall growth. Upon inspection, additional infected foliage is identified and those trees with excessive infection are spot- treated with a defoliant. The trees are then sprayed with copper bactericide spray when the spring flush reaches one-half to three quarter leaf expansion stage. Applying this protocol in Fall 2008, a Ruby red grapefruit block went from 459 infected trees to 19 infected trees as of April 2009. The protocol appears to have minimized the impact of canker blemished fruit on pack-out for domestic shipment this 2009 harvest season.

### LEAFMINER CONTROL IS CRUCIAL

Leafminer galleries are very susceptible to invasion by citrus canker. Extensive invasion of leafminer galleries by the canker bacterium greatly increases inoculum levels, making the disease explosive, particularly on flushes from July to the end of the season. Leafminer control on the first summer flushes is problematic since the susceptibility of the flushes to attack exceeds the residual activity of most insecticide sprays. On younger trees, loss of control on late summer flushes is accentuated by tendency of flushes to be erratic, making the timing of sprays for effective control difficult to achieve. However, controlling leafminer damage is essential to lowering canker severity in groves.

#### CANKER CONTROL ON NON-BEARING AND YOUNG FRUITING TREES

More susceptible flush per canopy volume occurs on younger trees. Repeated vigorous flushes are also extremely prone to leafminer damage. Infection of this susceptible, wounded tissue promotes explosive increase in leaf inoculum and subsequent cankerinduced defoliation. The rapid buildup of canker on leaves puts developing fruit at high risk for infection.

Copper is somewhat effective at 21-day intervals for canker control on foliage, but newly planted trees represent a small spray target for copper application so sprays must be applied with a hand gun or hoop-boom sprayer. Intervals between copper sprays of longer than 21 days or ineffective foliage coverage compromises control of canker-induced defoliation. More consistent reduction of foliar symptoms and canker-induced defoliation on young trees has been achieved with Admire and Platinum soil drenches applied at the beginning and middle of the growing season. The control is not only due to more effective leafminer control, but also due to the neo-nicotinoid breakdown product in the tree

that induces systemic acquired resistance (SAR). The SAR produced by these insecticides is long-lasting and therefore effective for reducing disease on foliage all season. Non-bearing grapefruit and early oranges that are more susceptible still require copper to protect each flush (21-day interval, metallic copper rate from 0.5-1.0 lb./ acre per application) in addition to the full season allowance of soil applied Admire or Platinum.

For more details regarding insect and disease management recommen-

dations, consult the Florida Citrus Pest Management Guide (http://www.crec. ifas.ufl.edu/extension/pest/index.htm)

Jim Graham is a professor and Megan Dewdney is an assistant professor, both at the University of Florida's Citrus Research and Education Center, Lake Alfred.