PP-182

UF UNIVERSITY of FLORIDA
IFAS Extension

2007 Florida Citrus Pest Management Guide: Citrus Canker[1]

L.W. Timmer, J.H. Graham, H.L. Chamberlain, K.R. Chung and T.S. Schubert[2]

Citrus canker, caused by the bacterium *Xanthomonas axonopodis* pv. *citri*, is a leaf, fruit, and stem spotting disease that affects numerous species, cultivars, and hybrids of citrus and citrus relatives. Grapefruit, Mexican lime, and some early oranges are highly susceptible to canker; Navel, Pineapple, and Hamlin sweet oranges, lemons and limes are moderately susceptible; Valencia orange, tangors, tangelos, and other mandarin hybrids are susceptible; and tangerines are moderately tolerant.

Symptoms. Young lesions are raised on both surfaces of the leaf, but particularly on the lower leaf surface. The pustules later become corky and crater-like with a raised margin, sunken center and are surrounded by a yellow halo. Fruit lesions vary in size because the rind is susceptible for a longer time, and more than one infection cycle can occur on the fruit. Stem lesions can support long-term survival of the bacterium. Older lesions can become colonized by saprophytic fungi such as *Colletotrichum* spp.

Major outbreaks of citrus canker occur when new shoots are emerging or when fruit are in the early stages of development. Frequent rainfall in warm weather, especially during storms, contributes to disease development. Citrus canker is mostly a leaf-spotting and fruit rind-blemishing disease, but when conditions are highly favorable for infection, it causes defoliation, shoot die-back, and fruit drop. When feeding galleries of Asian leafminer on leaves, stems, and fruit become contaminated with the bacterium, the number and size of individual lesions greatly increases and results in tremendous inoculum production.

Biology. The bacterium reproduces in lesions on leaves, stems, and fruit. When there is free moisture on the lesions, the bacteria ooze out and can spread to new growth and other trees. Wind-driven rain is the main dispersal agent, and wind speeds >18 mph aid in the penetration of bacteria through the stomatal pores or wounds made by thorns, insects, and blowing sand.

1. This document is PP-182, one of a series of the Plant Pathology Department, Florida Cooperative Exension Service, Institute of Food and Agricultural Sciences, University of Florida. Date printed: September 1999. Date revised: September 2006. This publication is included in SP-43, 2007 Florida Citrus Pest Management Guide. For a copy of this handbook, request information on its purchase at your county Extension office. Please visit the EDIS Web site at **http://edis.ifas.ufl.edu**.

2. L.W. Timmer, professor, Plant Pathology Department, Citrus REC, Lake Alfred, Florida; J.H. Graham, professor, Soil and Water Science Department, Citrus REC, Lake Alfred, Florida; H.L. Chamberlain, coordinator extension education, canker, greening and exotic diseases, Plant Pathology Department, Citrus REC, Lake Alfred, Florida; K.R. Chung, assistant professor, Plant Pathology Department, Citrus REC, Lake Alfred, Florida; T.S. Schubert, FDACS, Division of Plant Industry, Gainesville, Florida; Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL 32611.

Leaves, stems, and fruit become resistant to infection as they mature. Almost all infections occur on leaves and stems within the first 6 weeks after initiation of growth. The most critical period for fruit infection is during the first 90 days after petal fall. Infection after this time results in the formation of only small and inconspicuous pustules.

Most spread of canker bacteria by wind and rain is for short distances, i.e., within trees or to neighboring trees. Canker is more severe on the side of the tree exposed to wind-driven rain. Spread over longer distances, up to miles, can occur during severe tropical storms, hurricanes, and tornadoes. Long-distance spread occurs more commonly with the movement of diseased plant material, such as budwood, rootstock seedlings, or budded trees, or less commonly on fruit and leaves. Workers can carry bacteria from one location to another on hands, clothes, and equipment. Grove equipment spreads the bacteria within and among plantings, especially when trees are wet.

Management. The 1900-ft rule has been suspended and eradication of citrus canker-affected trees has been ended. The Citrus Health Response Plan (CHRP) is being developed, but removal of affected trees will not be obligatory. Thus, growers probably have to use their best judgment in management of citrus canker. Canker has been found in most citrus areas of the state except the northwestern production areas. Currently, 75% of the citrus acreage is within 5 miles of a canker find. The entire state of Florida is now under quarantine, and fruit movement is subject to specific regulations based on market destination.

Although it is difficult to predict exactly how severe canker will be under Florida conditions, indications from outbreaks in the state are that it will be difficult to control. Areas that are currently canker-free should be protected to the extent possible.

Protecting Canker-Free Areas.

Decontamination. Rules for decontamination are still in place and should be followed. With more canker around the state, the possibility of spread is greater than ever. In moving equipment and personnel from grove to grove, every effort should be made to make sure that plant material is not moved inadvertently and that all equipment has been thoroughly decontaminated. Decontamination is especially important in harvesting operations, hedging and topping, and in any other practices involving extensive contact with foliage. Obviously, when equipment is moved from blocks where canker is endemic to other infected blocks, decontamination serves little purpose.

Tree removal. If canker is detected in areas previously free of the disease, removal and burning of trees on site can slow the establishment of the disease. For tree removal to be effective, canker has to be localized and limited to a small number of trees. Tree removal is not likely to be effective if canker is already present within a mile of the grove. Before tree removal is attempted as a control measure, blocks should be thoroughly inspected to be sure that canker is not more widespread than initially thought. All infected trees as well as a few apparently healthy trees surrounding the infested area should be removed. More trees should be removed if the focus is large, but if it is very large, tree removal may need to be reconsidered. This measure is unlikely to eradicate the disease, but can substantially slow disease development. Tree removal must be followed by monthly inspections and removal of any more trees found positive for the disease. At some point, tree removal will no longer be economically sustainable and should be discontinued.

Defoliation. There are currently no registered defoliants, but it is possible to defoliate trees using high concentrations of legal copper or fertilizer products. However, no rates or spray volumes have been established for this practice. Chemical defoliants may be available at some point in the near future. Defoliation should only be used during dry times of the year and in conjunction with an intense inspection program.

Defoliation or even buckhorning of known canker-infected trees is not likely to eliminate the disease. A strong flush of highly susceptible leaves follow defoliation and is likely to become infected from residual inoculum in the tree or nearby. Defoliation can be useful in areas surrounding foci of infected trees that have been removed. These trees may appear healthy, but are likely to harbor

undetectable canker lesions. Defoliation can eliminate this inoculum and still save many trees. Following defoliation or buckhorning, the new growth flush should be treated with copper products once the growth is half expanded to protect it from new infections.

Endemic Canker. Where canker is already endemic, the primary means of control are: 1) planting of windbreaks, 2) protection of fruit and leaves with copper sprays, and 3) control of leafminer.

Windbreaks. Windbreaks are highly effective in reducing the spread of canker, but more importantly, they reduce the severity of the infection in endemic situations. When canker lesions are wetted, millions of bacteria ooze onto the leaf surface. While bacteria can swim very short distances, they have no active means to penetrate the fruit, leaves, or twigs. The vast majority of the infection occurs by wind-blown rains. Winds of 18 to 20 mph are needed to actually force bacteria into the stomates on leaves and fruit.

Windbreaks are the single most effective means of dealing with canker. In our observations in Argentina, the number of canker lesions was ten times greater on the side of the tree exposed to the prevailing winds than on the protected side of the same tree. In tests in nursery situations, artificial windbreaks greatly diminished the distance of spread of canker down the nursery row and reduced disease to only a few scattered lesions.

Windbreaks reduce wind speed for a distance ten times the height of the windbreak. That is, a 30-ft tall windbreak will exert an effect for about 300 ft. To be effective for canker control, windbreaks need not to be dense. All that is required is to reduce wind speed to less than 20 mph. The need for and the distance required between windbreak rows will depend on the destination of the fruit, fresh or processed, and the susceptibility of the variety. With grapefruit for the fresh market in Florida, it is likely that each 5- to 10-acre block will need to be surrounded by a windbreak. In many groves of less susceptible varieties, a windbreak down the row about every 300 ft may be sufficient. In some situations where some protection exists and tolerant varieties are grown for processing, additional windbreaks may be unnecessary. Additionally, not topping outside rows of citrus will also serve as a viable, harvestable windbreak. Currently, we recommend that growers plant windbreaks along fence lines, ditches, around wetlands, or wherever they can plant without removing citrus trees. If it becomes obvious that more windbreak protection is needed, rows of citrus or end trees can be removed to accommodate windbreaks.

For more information on selection of plant species and design, see the CREC website (www.crec.ifas.ufl.edu).

Copper sprays. Over the last 30 years, IFAS has evaluated dozens of products for canker control in several projects in Argentina and Brazil. Products such as antibiotics, compounds that induce resistance in plants, and disinfectants often provide limited canker control, but no material has proven more effective than copper products.

Copper products are quite effective in preventing infection of fruit, less effective for reducing leaf infection, and have limited value in reducing spread of the disease. Application of copper to young leaves protects against infection, but protection is soon lost due to rapid expansion of the surface area. Fruit grows more slowly and is easier to protect. Fruit is susceptible to infection after the stomates open when the fruit is about 1/2- to 1-inch in diameter until they develop resistance in mid to late July. Infection through wounds can occur at any stage.

Programs needed for effective control of canker in Florida have not been determined. However, we believe that most of the infection will occur during June and July here. With endemic canker, we suggest that three copper sprays be used for early oranges grown for processing, one in mid-May, a second in early to mid-June, and the final one in early July. Two applications should be sufficient for Valencias, in early June and in early July.

Programs for fresh fruit are more complex, but many copper sprays are already used on these varieties. For fresh market grapefruit, a low rate of copper should be added to the spray of spring flush for scab. Subsequently, the copper spray program used for melanose control should also control canker, but additional applications may be needed in late June

and July. Copper may need to be added to applications of fungicides or petroleum oil.

Most tangerines are fairly tolerant to canker. Programs used for control of Alternaria should also protect against canker, but copper will have to be used in each spray. Navel oranges are highly susceptible to canker and will probably need to be sprayed every 3 weeks from late April to mid-July. Fallglo is more tolerant and probably three sprays in May, June, and July should suffice.

Spray programs will have to be adjusted as we develop experience. The rates needed depend on the length of protection expected and the weather. As little as 0.5 to 1.0 lb of metallic copper will protect spring flush growth or fruit during the dry spring season. However, in the rainy season, up to 1-1/2 to 2 lb of metallic copper will be required to protect fruit for 3 to 4 weeks.

To the extent possible, copper usage should be minimized since this metal accumulates in soil and may cause phytotoxicity and creates environmental concerns.

Leafminer control. Leafminers do not spread canker, but extensive invasion of leafminer tunnels by the bacterium greatly increases inoculum levels making the disease difficult to control. Leafminers are not usually a problem on the spring flush and no control is needed at that time. Leafminer control on the first summer flush can reduce disease pressure considerably. If properly timed, applications of petroleum oil, Agri-mek, Micromite, Spintor, or Assail will reduce damage by leafminer. Late summer flushes tend to be erratic and effective control at that time will probably be difficult. (See ENY-604 section of this Guide on Soft-Bodied Insects Attacking Foliage and Fruit.)

The citrus canker situation and the rules and regulations involving canker are changing rapidly. For current information on disease status and regulations, see the website of the Florida Department of Agriculture and Consumer Services:

http://www.doacs.state.fl.us/pi/canker

or the CREC website:

http://www.lal.ufl.edu/extension/canker/

Contact your county agent for additional information, training materials, and programs.

Recommended Chemical Controls

READ THE LABEL.

See Table 1.

Rates for pesticides are given as the maximum amount required to treat mature citrus trees unless otherwise noted. To treat smaller trees with commercial application equipment including handguns, mix the per acre rate for mature trees in 125 gallons of water. Calibrate and arrange nozzles to deliver thorough distribution and treat as many acres as this volume of spray allows.

Table 1. Recommended Chemical Controls for Citrus Canker

Pesticide	FRAC MOA[1]	Mature Trees Rate/Acre[2]
copper fungicide	M9	Use label rate.

[1]Mode of action class for citrus pesticides from the Fungicide Resistance Action Committee (FRAC) 2003. Refer to ENY-624, Pesticide Resistance and Resistance Management, in the 2007 Florida Citrus Pest Management Guide for more details.
[2]Lower rates can be used on smaller trees. Do not use less than the minimum label rate.