

2011 Florida Citrus Pest Management Guide: Citrus Black Spot¹

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Citrus black spot, a disease caused by the fungus *Guignardia citricarpa*, causes fruit blemishes and significant yield losses and can affect all commercial citrus species and cultivars commonly grown in Florida. Lemons are the most susceptible, but sweet oranges—especially mid-late maturing types such as 'Valencia'—are also highly susceptible to this disease. 'Hamlin' sweet oranges and tangerine/mandarin types are moderately susceptible. Grapefruit is thought to be moderately susceptible, but there is little information available. Management must be considered in groves intended for processing and fresh market fruit.

Fruit symptoms are wide ranging and have many different names. Hard spot is the most diagnostic symptom of black spot. The 3–10 mm diameter lesions are depressed and nearly circular, with gray necrotic tissue at the middle that has a brick-red to black margin that can be cracked around the edges. Structures that produce the asexual spores (pycnidia) are often present in the center of lesions and resemble slightly elevated black dots. Hard spot appears as the

fruit begins to color before harvest. Lesions first occur on the side of the fruit with the greatest light exposure. False melanose symptoms appear on green fruit early in the season and do not contain pycnidia. The slightly raised lesions are 1–3 mm in diameter and can vary in color from tan to chocolate brown. Under favorable conditions for infection, false melanose can resemble the mudcake symptoms of melanose, but are very dark brown rather than rust red. False melanose symptoms can develop into hard spot as the season progresses. Cracked spot is a symptom that has only been observed in the Americas and is reported to be an interaction between rust mites and *G. citricarpa*. Cracked spots are large, diffuse, smooth lesions that form raised cracks around the center. Hard spots can form in the center of these lesions. The most serious black spot symptom is virulent spot. Early virulent spot (freckle spot) lesions start as irregularly shaped, sunken lesions with a reddish color. Early virulent spot can either coalesce to cover a large portion of the fruit surface or become hard spot. When spots coalesce, they turn from brown to black, and the older lesion

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surface becomes leathery. Many pycnidia can be found in early and expanded lesions. Virulent spot occurs on mature, severely infected fruit at the end of the season. Despite the unsightliness of black spot lesions, they rarely cause internal fruit rot so those fruit that have not fallen off the tree are still suitable for processing.

Airborne ascospores produced in decomposing leaf litter on the grove floor and blown into the canopy by the wind are the primary inoculum for black spot. These spores germinate and directly infect the leaves and fruit. There is a long latent period for this disease, which means that most symptoms do not appear for several months until the fruit begins to ripen. The fungus requires a long wetting period of 24–48 hours to infect, and the disease is favored by warm, humid weather such as occurs during the summer months. Major ascospore release usually occurs from April to early September, with favorable infection conditions from May through September. Fruit remains susceptible most of the growing season. It is unknown how long leaves may remain susceptible. The asexual spores are formed in fruit lesions, leaf litter and twigs. They are spread by rain splash and can infect fruit and leaves.

Monthly fungicide applications of copper and/or strobilurins (Abound, Gem, or Headline) will be needed from early May to mid-September to control black spot. Fungicide applications in April are advised if there is substantial rainfall that month. Our fungicide recommendations are based on efficacy data from trials in other countries with black spot and products registered for use on citrus in Florida. Since only four strobilurin fungicide applications can be used in a season for any purpose, it is recommended to reserve strobilurin fungicides for times when phytotoxicity from copper applications is a concern (temperatures >94°F). This is especially important for fresh fruit. It is recommended that strobilurin fungicides not be applied in two consecutive sprays to manage resistance. Currently, there are no other rotational fungicides for resistance management.

In addition to chemical control measures, practices to accelerate leaf litter decomposition beneath the trees to reduce the ascospore inoculum may be beneficial. Leaf litter degradation should be

started in mid-March. Three methods have been reported to be helpful and have reduced the ascospore inoculum of *Mycosphaerella citri*, the fungus that causes greasy spot. The first is to increase microsprinkler irrigation to at least 5 times a week for approximately a 1/2 hour per irrigation period for 1.5 months. The leaf litter will be reduced compared to the traditional irrigation frequency. One drawback is that leaf litter reduction will be confined to the areas where the microsprinklers reach. A second method is to apply urea (187 lb/treated acre) or ammonium sulfate (561 lb/acre) to the leaf litter. If using ammonium sulfate as a method to control leaf litter inoculum, monitor the soil pH to ensure that it does not become too low. Nitrate-based fertilizers are ineffective. The leaf litter decay will be less than without urea but when tested with *M. citri*, the number of spore-producing structures was reduced and fewer spores were produced. The third method is to apply dolomitic lime or calcium carbonate (2,226 lb/treated acre) to the leaf litter. The decay rate is greater for litter treated with lime, and inoculum production is reduced. All treatments worked equally well with *M. citri*, and there is no indication that one method is better than another. Lime or irrigation methods should not be used in conjunction with the high N treatments since they have opposite methods of action.

There are several cultural practices that will aid control and help restrict further spread of black spot. It is essential to minimize trash movement among groves and even among blocks within groves. While there are generally few symptoms on leaves, the ascospores, which are the main inoculum, are formed within the leaves. As leaf litter decomposes, the spores form and are forcibly ejected. It is very easy to inadvertently move the fungus from one site to another with leaves and other trash. This is the basis of the tarping requirement from quarantine and regulated areas, but any grove equipment or vehicle can move leaf litter or trash from one location to another.

Declining trees should be removed from a grove. Trees that are declining will often have off-season bloom as a symptom of stress. Where there is more than one age of fruit present on the tree, the asexual spores on the fruit can be transferred to new fruit,

amplifying the disease. Fruit do not appear to become resistant to infection as they age. Nutritionally stressed trees will often express black spot symptoms first. A good nutritional program (<http://edis.ifas.ufl.edu/pdffiles/SS/SS47800.pdf>) should be followed to minimize symptoms and maintain yields.

Where possible, open the tree canopy by skirting to reduce the leaf wetness periods. The fungus requires between 24-48 hours of leaf wetness to infect. It is also important to minimize dead wood in the canopy. Like the melanose pathogen, black spot fungus can colonize and reproduce in dead twigs. It is expected that canopies with significant numbers of dead twigs will have more problems with black spot than those without.

Finally, as with all fungal diseases, it is important to use clean nursery stock. Currently, there are no nurseries near known infected groves; however, this may change as disease distribution becomes better understood.

Regulatory Considerations

Care must be exercised in handling and moving citrus fruit, leaves, twigs and debris from CBS Quarantined and Regulated (buffer) Areas since the disease may be easily and unwittingly spread to other citrus trees, nurseries, or groves. The following rules are in addition to stipulations imposed as a result of the statewide citrus canker quarantine:

The U.S. Department of Agriculture issued a Federal Order effective October 14, 2010, to help prevent the spread of the plant pathogen *Guignardia citricarpa* Kiely, the causal agent of citrus black spot (CBS). The initial CBS Quarantined Areas and Regulated Areas are located in Collier and Hendry counties and have been announced and delineated in the Federal Order (DA-2010-47). Details of the new regulations and quarantined areas for CBS may be accessed through the state's Citrus Health Response Program (CHRP) website, along with other relevant compliance information, at the following address: <http://www.doacs.state.fl.us/pi/enpp/pathology/citrus-black-spot.html>.

Growers, Harvesters and Haulers

Prior to departing any citrus grove, all personnel are required to inspect all vehicles and equipment for plant material and debris and clean all vehicles, equipment, picking sacks and clothing so that they are free of fruit, limbs, leaves, soil and debris prior to microbial decontamination. Said plant material and debris is to be left on that property or, if moved, must be transported away from citrus production areas (both nursery and grove) and treated in accordance with the terms set forth in the Federal Order (DA-2010-47).

Equipment must be decontaminated using one of the following materials:

- a. 200 ppm solution of sodium hypochlorite with a pH of 6.0–7.5;
- b. 0.2% solution of a quaternary ammonium chloride (QAC) cleaner/disinfectant compound; or
- c. Peroxyacetic acid-based sanitizer at labeled rates.

Personnel must be decontaminated by an appropriate sanitizing method in accordance with *Approved Decontamination Products & Methods* (see FDACS/ CHRP *Grower/ Caretaker Compliance Agreement*, "Schedule 11," available on the Division of Plant Industry website at <http://www.doacs.state.fl.us/pi/chrp>).

Harvesters and Haulers

Each load of fruit must be identified by issuing a serially numbered trip ticket containing the following information:

Name of grove, Land owner or agent, Lessee, Harvester; License tag number; Number of boxes contained in the load; Grove block from which fruit was harvested, and Grower C/A Number written clearly; Processing plant or Packinghouse to which fruit is destined; Date of harvest. Loads from quarantined areas must have "TARP" and a big letter, "Q," written near the bottom of the ticket; Loads from Regulated Areas must have "REGULATED" written at the bottom. In addition, the CBS Fruit Harvesting Permit No. must be included on the trip ticket when issued, indicating CBS was not found in a preharvest

grove inspection or associated leaf testing analysis for the specified block.

Processing and Packing Facilities and Haulers

Each load of fruit harvested from a quarantined area is required to be covered by a tarpaulin in accordance with federal regulations to preclude the loss of leaves, fruit and debris in transit to a packing or processing facility. The load must arrive tarped at the receiving facility, and all quarantined fruit, leaves and debris in the truck or trailer must be unloaded and handled in compliance with Federal Order DA-2010-47. The vehicle must be thoroughly cleaned out and decontaminated prior to departing the receiving facility. If any citrus leaves or other citrus waste material is to be moved from a receiving facility (or from a grove), it must be placed in bags or be covered in transit in order to prevent the loss of leaves, fruit or debris. Once emptied and cleaned of plant debris, all trailers, truck beds, field boxes or bins must be disinfected by using one of the decontaminant materials listed above.

All leaves, unwholesome fruit, and other plant debris originating from a CBS Quarantined or Regulated (buffer) Area, or cleaned from trailers, tarpaulins, field boxes or field bins hauled from a CBS Quarantined or Regulated Area, must be handled or treated by one of the following methods subject to monitoring by an inspector:

- a. Heat treated to a minimum of 180°F for at least one hour;
- b. Incinerated; or
- c. Buried at a landfill or other APHIS- or state-approved disposal site, and covered with dirt at the end of every day that dumping occurs.

All citrus fruit harvested from a Citrus Black Spot Quarantined Area or Regulated Area must move intrastate either directly to a processor who is operating under a state compliance agreement for processing into a product other than fresh fruit, or to a packinghouse that is operating under a state or federal compliance agreement. Distribution of fresh citrus fruit from a CBS Quarantined Area or a CBS Regulated Area to markets within Florida is prohibited.

Although there is currently no requirement for covering loads of fruit prior to movement and in transit from Citrus Black Spot Regulated Areas or non-regulated areas to receiving facilities, covering this fruit is highly recommended as a precautionary measure for the protection of citrus groves in non-quarantine areas of Florida.

Additional Rules for Fresh Citrus Packers and Shippers

Fresh fruit from groves within a CBS

Quarantined Area is eligible for interstate movement only to non commercial citrus-producing states east of the Mississippi River, provided the fruit originates from a grove operating with a valid compliance agreement, is packed in a packinghouse operating under a valid compliance agreement, is found to be free of CBS symptoms based on packinghouse inspection by a trained inspector, and is treated and handled as follows:

The fruit must be disinfected at the packinghouse using one of the following methods:

- a. Wet thoroughly for at least 2 minutes with a solution containing 200 ppm sodium hypochlorite, with pH maintained from 6.0 to 7.5;
- b. Wet thoroughly with a solution of sodium o-phenyl phenate (SOPP) with concentration of 1.86–2.0 percent of total solution for 45 seconds if it has sufficient detergent to cause visible foaming, or for 1 minute if the solution is non-sudsing; or
- c. Wet thoroughly for at least 1 minute with a solution of 85 ppm peroxyacetic acid.

Inspected and treated fruit must be accompanied by a limited permit issued by an inspector or by a trained individual operating under a compliance agreement. Distribution of fresh citrus fruit from a CBS Quarantined Area to markets within Florida is prohibited.

Fresh fruit from groves within a CBS

Regulated Area is eligible for movement interstate to all states other than commercial citrus-producing states, provided the fruit originates from a grove operating with a valid compliance agreement, is packed in a packinghouse operating under a valid

compliance agreement, is found to be free of symptoms of CBS based on packinghouse inspection by a trained inspector, and is handled and treated as follows:

- The source grove or grove block of fruit to be packed must be visually surveyed by an inspector no more than 30 days prior to harvest and found to be free of CBS. Groves with additional harvest cycles require that inspectors conduct a preharvest survey no more than 45 days before each subsequent harvest. A field inspector must also collect leaves from the surveyed groves in accordance with an APHIS-approved protocol. These leaves must be submitted to a lab for PCR testing for CBS in compliance with an APHIS-approved testing protocol and be found to be free of CBS.
- The fruit must be disinfected at the packinghouse using one of the following methods:
 - a. Wet thoroughly for at least 2 minutes with a solution containing 200 ppm sodium hypochlorite, with pH maintained from 6.0 to 7.5;
 - b. Wet thoroughly with a solution of sodium o-phenyl phenate (SOPP), with concentration of 1.86–2.0% of total solution for 45 seconds if it has sufficient detergent to cause visible foaming, or for 1 minute if the solution is non-sudsing; or
 - c. Wet thoroughly for at least 1 minute with a solution of 85 ppm peroxyacetic acid.
- Inspected and treated fruit must be accompanied by a limited permit issued by an inspector or by a trained individual operating under a compliance agreement. Distribution of fresh citrus fruit from a CBS Regulated Area to markets within Florida is prohibited.
- Fruit from a grove that fails a visual preharvest survey or PCR testing for CBS, or fruit that has not undergone a visual preharvest survey or PCR testing, can be shipped to non commercial citrus-producing states east of the Mississippi River provided that no symptoms of CBS are found during a packinghouse inspection.

- Regulated fruit from groves in a CBS Quarantined Area or in a CBS Regulated Area that is not eligible for interstate movement under the conditions stated for consumption in the United States may be moved interstate only for immediate export. Regulated fruit for export must be accompanied by a limited permit issued by an inspector or a trained individual operating under a compliance agreement. It must be moved in a container that has been sealed by an inspector directly to the port of export according to the conditions of the limited permit.
- Please check for updates and information on federal quarantines, regulations, and the interstate movement of citrus at the APHIS Citrus Health Response Program website: http://www.aphis.usda.gov/plant_health/plant_pest_info/citrus/index.shtml.

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 250 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 Black Spot

Pesticide	FRAC MOA²	Mature Trees Rate/Acre¹
copper fungicide	M1	Use label rate.
Abound 2.08F ³	11	12.4-15.4 fl oz. Do not apply more than 92.3 fl oz/acre/season for all uses. Best applied with petroleum oil.
Gem 25WG ³	11	4.0-8.0 oz. Do not apply more than 32 oz/acre/season for all uses.
Gem 500 SC ³	11	1.9-3.8 fl oz. Do not apply more than 15.2 fl oz/acre/season for all uses. Best applied with petroleum oil.
Headline ³	11	9-12 fl oz. Do not apply more than 54 fl oz/acre/season for all uses. Best applied with petroleum oil.
¹ Lower rates can be used on smaller trees. Do not use less than minimum label rate.		
² Mode of action class for citrus pesticides from the Fungicide Resistance Action Committee (FRAC), 2010. Refer to ENY-624, "Pesticide Resistance and Resistance Management," in the 2011 Florida Citrus Pest Management Guide for more details.		
³ Do not use more than 4 applications of strobilurin fungicides/season. Do not make more than 2 sequential applications of strobilurin fungicides.		