

2017-2018 FLORIDA CITRUS PRODUCTION GUIDE:

Citrus Black Spot¹

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Citrus black spot is caused by the fungus *Guignardia citri-carpa*. The disease causes fruit blemishes and significant yield losses, especially on sweet oranges. Black spot can affect all commercial citrus species and cultivars commonly grown in Florida. Lemons are the most susceptible but sweet oranges, especially mid to late maturing types such as ‘Valencia’, are highly susceptible to this disease. ‘Hamlin’ sweet oranges and tangerine/mandarin types are moderately susceptible. Grapefruit is thought to be moderately susceptible and symptoms have been seen in Florida, but there is little information available on relative susceptibility. Management is required in groves intended for processing and fresh market fruit in quarantine and surrounding areas and should be considered in all others.

Black spot fruit symptoms are wide ranging and have many different names. Hard spot is the most diagnostic symptom of black spot. The 0.1-.4 inch (3-10 mm) diameter lesions are nearly circular, depressed with gray necrotic tissue at the middle with a brick-red to black margin that can be cracked around the edges. Fruiting structures (pycnidia) that produce the asexual spores (conidia) are often present in the center of lesions and resemble slightly elevated black dots. Hard spot appears as the fruit begin to color before harvest. They 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 (0.04 – 0.1 inch) in diameter and can vary in color from tan to chocolate brown. Under favorable infection conditions, false melanose can resemble the mud cake symptoms of authentic 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. Hard spots can form in the center of these lesions. The most concerning 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 proportion of the fruit surface or become hard spot. When spots coalesce, they turn brown to black and the older lesion 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. Virulent spot symptoms can appear in post-harvest on apparently symptomless fruit, sometimes in transit to markets. Despite the unsightliness of black spot lesions, they rarely cause internal fruit rot so those fruit that remain on the tree until ripe are still suitable for processing. Significant fruit drop is a common symptom in heavily infected groves.

It was recently discovered that only one type of spore from *G. citricarpa* is present in Florida. These spores are the asexual spores (conidia) which are formed in fruit lesions, leaf litter, and twigs. The conidia are spread by rain splash and can infect fruit and leaves. 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, usually not 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. Conidia are present in the leaf litter most of the year but the most favorable infection conditions occur from May through September. Fruit remains susceptible most of the growing season. An exact figure on how long leaves remain susceptible is unknown but it is thought to be approximately 10 months.

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Despite having only one type of spore, monthly applications of fungicides such as copper, strobilurins (Abound, Gem, or Headline), or another labeled fungicide (Enable, Quadris Top, Pristine) will be needed from early May to mid-September to control black spot. If there is substantial rain in April, starting fungicide applications in April is advised. Our fungicide recommendations have been based on efficacy data from trials in other countries with black spot and products registered for use on citrus in Florida with preliminary field testing in Florida. Field tests in Florida of fungicides including Abound, copper-based products, Enable, Gem, Headline, Pristine, and Quadris Top indicate that all of these fungicides can be useful in a fungicide program. Since only four strobilurin fungicides, including the premixes Pristine and Quadris Top, can be used in a season for any purpose, it is recommended for fresh fruit to reserve strobilurin fungicides for times when phytotoxicity from copper applications is a concern (temperatures >94°F). For processing fruit, fungicides containing strobilurins can be used earlier in the season and applications combined for greasy spot and melanose. It is recommended that fungicides containing strobilurins not be applied in two consecutive sprays to manage pathogen resistance and rotated with a fungicide containing another mode of action.

It is important to remember that copper residues are reduced with fruit expansion and as a result of rainfall. A model, <http://agroclimate.org/tools/citrus-copper-application-scheduler/>, is available to determine whether residues remaining on fruit are sufficient to control the disease. It is based on fruit growth models, the copper rate and time of the last application, and rainfall since the last spray. It has proven helpful for timing of sprays for black spot control. Further information about the model is available in EDIS PP289 'A Web-based tool for timing copper applications in Florida citrus'.

In addition to chemical control measures, practices to accelerate leaf litter decomposition beneath the trees to reduce the ascospore inoculum may be beneficial. Enhancing leaf litter degradation should commence in mid-March. There are three methods that have reduced the ascospore inoculum of *Mycosphaerella citri*, the fungus that causes greasy spot. The first is to increase the microsprinkler irrigations to at least 5 times a week for approximately a ½ hour per irrigation period for 1.5 months. The leaf litter decomposition will be greater compared to that with the traditional irrigation frequency. A 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, make sure you monitor your soil pH to ensure that it does not become too low. 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. Nitrate-based fertilizers are ineffective. The

final method is to apply dolomitic lime or calcium carbonate (2226 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 plant trash movement among groves and even among blocks within groves. While there are generally few symptoms on leaves, the ascospores, the main inoculum, are formed within the fallen 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 symptomless leaves and other trash. This is the basis of the tarping requirement from quarantine 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 regardless of the cause. 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. This problem is especially troublesome on Valencia when new and old fruit crops overlap. Fruit do not appear to become resistant to infection as they age. In addition, nutritionally stressed trees will often express black spot symptoms first. A good nutritional program (<http://edis.ifas.ufl.edu/pdf/files/SS/SS47800.pdf>) helps 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. 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 we gain a better understanding of the distribution of the disease.

REGULATORY CONSIDERATIONS

Care must be exercised in handling and moving citrus fruit with leaves, twigs and debris from citrus black spot (CBS) Quarantined 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 Florida's statewide citrus canker quarantine.

The U.S. Department of Agriculture Animal and Plant Health Inspection Service (APHIS) issued a Federal Order effective October 14, 2010 to help prevent the spread of the plant pathogen *G. citricarpa*. The initial CBS Quarantined Areas and Regulated Areas were located in Collier and Hendry Counties, and were announced and delineated in the Federal Order (DA-2010-47). An updated Federal Order (DA-2012-09) was released on March 16, 2012 expanding existing quarantines in Collier and Hendry Counties. Additional sections were quarantined since that date in Collier, Hendry and Polk Counties, as specified in APHIS Information and Action notice DA-2013-08 issued March 22, 2013. Six sections were subsequently added in Lee County along with additional sections in both Collier and Hendry counties by APHIS Information and Action notice DA-2015-16 issued on March 31, 2015. (Note that no positive detections were made in Lee County; the six sections serve as portions of buffer zones extending from adjacent counties.). The latest CBS Information and Action notice of quarantine expansion as of this publication is DA-2016-69, issued November 22, 2016 by APHIS. Details of current regulations and quarantined areas of record 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.freshfromflorida.com/Divisions-Offices/Plant-Industry/Agriculture-Industry/Citrus-Health-Response-Program/Citrus-Diseases/Citrus-Black-Spot>.

GROWERS, HARVESTERS AND HAULERS

Citrus growers, harvesters, and haulers must operate under compliance agreements with regulations that serve to protect the citrus industries of Florida, the United States and international trade partners. When harvesting citrus in groves, vehicles used to transport fruit from CBS Quarantined Areas must meet the following minimum standards: All conveyances, whether bulk filled with fruit or loaded in pallet boxes or field bins and stacked on trucks or trailers, must be completely covered with no openings greater than 1/2 inch, with the exception of bulk loads with side and rear walls constructed of expanded metal, with openings not to exceed 3/4 x 1-11/16 inches. Tarpaulins (tarps) used as fruit covers may be of any fabric with a weave of less than 1/2 inch. Details of transport vehicle regulations may be found in CBS Federal Order DA-2012-09.

Each load of fruit must be identified by issuing a clearly written, serially numbered trip ticket with the following information: Grove name, Block or sub-block of Origin, Land owner or agent, Lessee, Harvester; Number of boxes, Variety; Tag number; Grower C/A Number; Destination (receiving facility or Disposal Site ID); Date of Harvest; and Harvesting Permit

Number if issued; “TARP” and “Q” must be written clearly on the ticket, “TARP-Q,” preferably near the bottom.

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 to ensure that they are free of fruit, limbs, leaves, soil and debris prior to applying a microbial decontaminant. All plant material and debris cleaned from said vehicles and equipment is to be left on the grove property, or if moved, must be transported under a limited permit away from citrus production areas to a location that will not pose a risk to citrus nurseries or groves. Once cleaned, citrus waste hauling equipment and grove caretaking and harvesting equipment must be decontaminated using one of the materials from List A (under, “Disposal of Citrus Debris”).

PROCESSING AND PACKING FACILITIES AND HAULERS

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

Each load of fruit harvested from a quarantined area is required to be covered by a tarp 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 completely. 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 all leaves and plant debris, all trailers, truck beds, field boxes, and bins must be disinfected by using one of the decontaminant materials in List A (below).

DISPOSAL OF CITRUS DEBRIS

All leaves, culled or eliminated fruit, and other plant debris originating from a CBS Quarantined Area, cleaned from trailers, tarpaulins, field boxes, or field bins at a receiving facility, or hauled from a CBS Quarantined Area, must be moved under limited permit in an enclosed or covered conveyance as stipulated in the Federal Order that will prevent the loss of fruit, leaves, or debris while in transit. When citrus plant material

comes in contact with vehicle, the vehicle must be decontaminated following movement with a sanitizer in List A (below).

List A – Equipment Decontaminants

- A1. 200 ppm solution of sodium hypochlorite with a pH of 6.0 to 7.5; or
- A2. 0.2% solution of a quaternary ammonium chloride (QAC) cleaner/disinfectant compound; or
- A3. Peroxyacetic acid-based sanitizer at labeled rates.

Citrus waste in the form of culls, peel, pulp, leaves, limbs or plant debris originating from a CBS quarantined area must be handled or treated by one of the following methods subject to monitoring by an authorized CHRP inspector:

List B – Waste Treatments

- B.1. Heat treated to a minimum of 180°F for at least one hour; or
- B.2. Incinerated; or
- B.3. Buried at a landfill or other FDACS or APHIS approved disposal site and covered with dirt at the end of each day that dumping occurs.

INTERSTATE SHIPMENT OF FRUIT

Fresh fruit from groves within a CBS Quarantined Area is eligible for movement interstate under federal certificate to all states under the following conditions:

The fruit must be washed and brushed, disinfested, and sanitized with a product from List C (below), then treated at labeled rates with imazalil or thiabendazole (TBZ) and waxed at the time of packing in a packinghouse operating under an APHIS approved packinghouse procedure prior to shipment. The fruit must be free of leaves and other plant material, and attached stems must be less than 1 inch in length. The fruit must be packed in a packinghouse with a signed APHIS compliance agreement. The fruit must be accompanied by a federal certificate issued by a person or inspector operating under compliance with APHIS. And, the certificate must be present on the packed cartons or containers of fruit and the accompanying paperwork.

Fresh fruit from groves within a CBS Quarantined Area is eligible for movement interstate under federal limited permit to noncommercial citrus-producing states under the following conditions:

The fruit must be washed, brushed, and surface disinfested with a treatment from List C (below) or an organic disinfectant, such as hydrogen dioxide or PAA at labeled rates in a packinghouse operating under an APHIS approved packinghouse procedure prior to shipment. The fruit must be free of leaves

and other plant material, and attached stems must be less than 1 inch in length. The fruit must be packed in a packinghouse with a signed APHIS compliance agreement. The fruit must be accompanied by a limited permit issued by a person or inspector operating under compliance with APHIS. And, the limited permit must be present on the packed cartons or containers of fruit and the accompanying paperwork.

List C – Fruit Treatments

Must be applied in accordance with APHIS approved Packinghouse procedures for CBS: http://www.aphis.usda.gov/plant_health/plant_pest_info/citrus/downloads/black_spot/CBS_PackingHouseProcedures-2012-09.pdf

- C.1. Sodium hypochlorite solution at 200 PPM for at least 2 minutes; or
- C.2. Sodium o-phenyl phenate (SOPP) solution at 1.86 to 2.0% total solution; or
- C.3. Peroxyacetic acid (PAA) solution at 85 PPM for at least 1 minute.

EXPORT SHIPMENT OF FRUIT

Since a Harvesting Permit is required statewide for shipments of quarantine fruit to the European Union (EU) with respect to citrus canker, a grove in any county that has a CBS quarantine must also be inspected for symptoms of CBS, in accordance with EU Import requirements as of July 1, 2013. In each county with a CBS quarantine, the Harvesting Permit may serve as a single instrument in declaring the grove as visually free of both canker and CBS. In addition, fruit from said grove must be inspected and found free of CBS and canker in the packinghouse. As an option, however, the EU will allow a statement from the grower that the source grove has been, “subjected to appropriate treatments against CBS,” (in place of a pre-harvest survey of the grove) and the harvested fruit must also be inspected and found free of CBS in the packinghouse.

Regulated fruit from groves in a CBS Quarantined Area that is not eligible for interstate movement under the conditions stated for consumption in the US may be moved through Florida or interstate only for immediate export. Regulated fruit for export must be accompanied by a “Limited Permit for Export” issued by an inspector or a trained individual operating under a compliance agreement and must be moved in a container under APHIS seal directly to the port of export. No trans-loading will be allowed at ports located in citrus producing states.

REGULATORY REMARKS

Although truckloads of citrus fruit harvested from perimeter areas of CBS Quarantines have not been required to be covered

by tarpaulins destined to receiving facilities, covering this fruit is highly recommended as a precautionary measure for the protection of citrus groves in non-quarantine areas of our state.

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 MOA ²	Mature Trees Rate/Acre ¹
copper fungicide	M1	Use label rate.
Enable 2F ⁴	3	8.0 fl/oz. Do not apply more than 24 oz/acre/season
Abound ³	11	9.0-15.5 fl oz. Do not apply more than 92.3 fl oz/acre/season for all uses. Best applied with petroleum oil.
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. Do not apply within 7 days of harvest.
Headline SC ³	11	12-15 fl oz. Do not apply more than 54 fl oz/acre/season for all uses. Best applied with petroleum oil.
Pristine ^{3,4}	11 + 7	16-18.5 oz. No more than 74 oz/acre/season
Quadris Top ^{3,4}	11 + 3	15.4 fl oz. Do not apply more than 61.5 fl oz/acre/year

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) 2017. Refer to ENY624, Pesticide Resistance and Resistance Management, in the 2017-18 Florida Citrus Production 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 (FRAC MOA 11).

⁴ Do not make more than 4 applications of Pristine or Quadris Top/season. Do not make more than 2 sequential applications of Pristine or Quadris Top before alternating to a non-strobilurin, SDHI (FRAC MOA 7) or DMI (FRAC MOA 3)