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2023–2024 Florida Citrus Production Guide: Citrus Black Spot[1]

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Citrus black spot is caused by the fungus *Phyllosticta citricarpa* (formerly known as *Guignardia citricarpa*). 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. In Florida, sweet oranges, especially mid- to late maturing types such as 'Valencia', are highly susceptible to this disease, although lemons are reported to be even more susceptible in other regions. 'Hamlin' sweet oranges and tangerine/mandarin types are moderately susceptible. Based on symptoms in Florida, grapefruit is thought to be moderately susceptible, but little information is available on relative susceptibility. Management is required in groves intended for processing and fresh-market fruit in quarantine and surrounding areas. Need for citrus black spot management should be evaluated annually in all other locations.

Black spot fruit symptoms are wide-ranging and have many different names (see PP-274, *Citrus Black Spot*, https://edis.ifas.ufl.edu/publication/PP274). Hard spot is the most diagnostic symptom of black spot. The 0.1 inch–0.4 inch (3 mm–10 mm) diameter lesions are nearly circular and 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 lesions appear 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 0.04–0.1 inch (1 mm–3 mm) 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 spots are a symptom that has only been observed in the Americas and is reported to be an interaction between rust mites and *P. 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 early virulent spot lesions coalesce to form virulent spot, 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 postharvest on apparently symptomless fruit, sometimes in transit to markets. Despite the unsightliness of black spot lesions, they rarely cause internal fruit rot, so those

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fruit that remain on the tree until ripe are still suitable for processing. Significant fruit drop is a common symptom in heavily infected groves.

Only one type of spore from *P. 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 remain susceptible most of the growing season. An exact figure on how long leaves remain susceptible is unknown but is thought to be approximately 10 months.

Despite having only one type of spore, monthly applications of fungicides such as copper, strobilurins (Abound, Gem, or Headline), or other labeled fungicides (Amistar Top, Enable, 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 are now based on efficacy data collected from field trials in Florida. Field tests in Florida of fungicides including Abound, Amistar Top, copper-based products, Enable, Gem, Headline, and Pristine indicate that all of these fungicides can be useful in a black-spot management program. Only four strobilurin fungicide applications, including the premixes Pristine and Amistar Top, can be used in a season for any purpose. Therefore, for fresh fruit it is recommended to reserve the strobilurin-containing 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 with those for greasy spot and melanose. To manage pathogen resistance, it is recommended that fungicides containing strobilurins not be applied in two consecutive sprays but instead 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 publication 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 leaf litter inoculum may be beneficial. Enhancing leaf litter degradation should commence in mid-March. There are three methods that have reduced the ascospore inoculum of *Zasmidium citri-griseum* (formerly *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 half 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 *Z. citri-griseum*, 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 *Z. citri-griseum*, 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, because they have opposite methods of action.

Several cultural practices can 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 main inoculum is formed within the fallen leaves. As leaf litter decomposes, the spores form and are splashed into the canopy. 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 (https://edis.ifas.ufl.edu/publication/SS478) 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, the 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 within the geographical citrus black spot quarantine zones; 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, because 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 US 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 fungal pathogen *P. 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 have been quarantined since that date in Collier, Hendry and Polk Counties. To see the details of current regulations and the current quarantined areas of record for CBS, along with other relevant compliance information, visit the State's Citrus Health Response Program (CHRP) website at https://www.fdacs.gov/Agriculture-Industry/Pests-and-Diseases/Plant-Pests-and-Diseases/Citrus-Health-Response-Program/Citrus-Pests-and-Diseases/Citrus-Black-Spot-Information.

Growers, Caretakers, Harvesters, and Haulers

Citrus growers, caretakers, 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 ½ inch, with the exception of bulk loads with side and rear walls constructed of expanded metal, with openings not to exceed ¾ × 1-11/16 inches. Tarpaulins (tarps) used as fruit covers may be of any fabric with a weave of less than ½ 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, Multi-block ID number, 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 as "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 to an approved site. 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 with a limited permit or completed trip ticket 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 a 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 (PPA) solution at 85 ppm.

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

B1. Heat-treated to a minimum of 180°F for at least one hour; or

B2. Incinerated; or

B3. 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. In addition, 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: https://www.aphis.usda.gov/plant_health/plant_pest_info/citrus/citrus-downloads/citrus-black-spot/cbs-packing-house-procedures.pdf.

C1. Sodium hypochlorite solution at 200 PPM for at least 2 minutes; or

C2. Sodium o-phenylphenate (SOPP) solution at 1.86% to 2.0% total solution; or

C3. Peroxyacetic acid (PAA) solution at 85 PPM for at least 1 minute.

Export Shipment of Fruit

Rules for Grove Operations outside Citrus Black Spot Quarantines

Growers planning to ship fresh citrus fruit to the European Union (EU) must comply with the following provisions to meet 2017 amendments to EU Annexes of Council Directive 2000/29/EC on plant protective measures. These amendments affect growers planning to ship fruit from areas of Florida outside of counties quarantined for citrus black spot (CBS), under statewide citrus canker quarantine (refer to chapter 30, Citrus Canker, for recommended cultural practices and guidance in pest and disease management):

Cultural Practices—Citrus growers and caretakers must implement cultural practices to minimize the incident and spread of citrus canker disease in each production unit and buffer area under caretaker's supervision. These practices could include, for example, the planting and maintenance of windbreaks such as eucalyptus trees.

- Please note that production unit freedom (from citrus canker) is no longer required.
- Appropriate Treatment—Copper (for example) should be applied to a grove to prevent disease damage to fruit, leaves, and stems caused by citrus canker, along with maintaining an appropriate pest management program as recommended by the UF/IFAS *Florida Citrus Production Guide*.
- The packinghouse must also treat the fruit with sodium o-phenylphenate (SOPP) or equivalent.
- Fruit harvested from source block(s) must be found free of citrus canker symptoms during an official packinghouse inspection of a representative sample defined in accordance with international standards.
  - All packed citrus fruit must be traceable back to the grove block (production unit) as provided on the Federal Phytosanitary Certificate, and trip tickets must include the Grower C/A Number.
  - CHRP regulatory staff will conduct random inspections to determine grower compliance with appropriate cultural practices, treatments, and decontamination.
  - In addition, trip tickets for fresh fruit destined for the EU must include the notation "CC" to indicate that the grower is following the recommended practices in the UF/IFAS *Florida Citrus Production Guide* to mitigate the incidence of citrus canker disease.

Growers planning to ship fresh citrus fruit to the European Union (EU) must also comply with the following provisions to meet 2017 amendments to EU Annexes with respect to citrus black spot (CBS) in areas outside the EU observed countywide quarantines in Florida:

- Inspection of the fruit is required in the packinghouse with no symptoms of citrus black spot observed.
- Proof of area freedom from citrus black spot (CBS) is required and must be validated by Citrus Black Spot Survey, Multi-Pest Survey, both Grove and Residential, statewide.

Rules for Grove Operations in Citrus Black Spot Quarantine Areas

Florida growers planning to ship fresh citrus fruit to the European Union (EU) must comply with the following provisions to meet 2017 amendments to EU Annexes of Council Directive 2000/29/EC on protective measures with respect to citrus black spot (CBS) in areas within the EU-observed countywide CBS Quarantines. Refer to the UF/IFAS *Florida Citrus Production Guide* for recommended cultural practices and instructions in pest and disease management.

Cultural Practices—Citrus growers and caretakers must implement cultural practices as recommended by UF/IFAS to minimize the incidence and spread of citrus black spot disease in each production unit (with no buffer area required). As an example, leaves may be raked from under trees or be treated in place with an approved material. Additionally, dead wood should be removed from the trees and any diseased and declining trees removed from the groves.

- Appropriate Treatment—Fungicides, such as copper, strobilurins, or other labeled fungicides, should be applied to the trees at intervals as recommended by UF/IFAS to help prevent the damage and spread of citrus black spot disease. Leaf litter should also be controlled by various methods and treatments as recommended by UF/IFAS.
- Growers seeking a Citrus Fruit Harvesting Permit (FDACS 08123) to ship fresh fruit to the European Union (EU) or to other restricted markets must request and fill out an Application for Participation (FDACS 08415) and

send to the local FDACS CHRP field office in order to receive a field inspection of the proposed source grove block(s) for symptoms of citrus black spot and citrus canker diseases.

- Upon receipt of a grower's Application for Participation, the FDACS field office will schedule a field inspection of the grove block(s) requested. The fruit will be field-inspected by the department in the production unit by Multi-Block(s), with no buffer required; if no symptoms of citrus black spot are observed on the fruit, the grower will be issued a Citrus Fruit Harvesting Permit.
- Fruit harvested for fresh-fruit shipment must be packed in an APHIS-compliant packinghouse, washed, brushed, surface disinfested with sodium o-phenylphenate or equivalent, treated at labeled rates with imazalil and/or thiabendazole at the time of packing, and waxed.
- Fruit harvested from source block(s) must be found free of CBS and citrus canker symptoms during an official packinghouse inspection of a representative sample defined in accordance with international standards.
- All packed citrus fruit must be traceable back to the grove block (production unit) of origin as provided on the Federal Phytosanitary Certificate. Trip tickets must include the Grower C/A Number.
- CHRP regulatory staff will conduct random inspections to determine grower compliance with appropriate cultural practices, treatments, and decontamination.
- Each load of fruit must be identified by issuing a clearly written, serially numbered trip ticket with the following information: Grove Name, Multi-Block ID #, 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. In addition, trip tickets must include the following information near the bottom of the ticket: "TARP-Q" & "CC," to indicate that the fruit is moving from a Citrus Black Spot Quarantine Area, under statewide citrus canker quarantine, that the fruit is destined for the EU, and that the grower is following the recommended practices in the UF/IFAS *Florida Citrus Production Guide* for pest and disease management. If using a computer-generated trip ticket, the grower/harvester must make sure that all of the above information is on the ticket and that it highlights whether the load is tarped and from a citrus black spot quarantine area.
- CHRP regulatory staff will conduct random inspections to determine grower compliance with appropriate cultural practices, treatments, and decontamination.

Regulated fruit from groves in a CBS Quarantined Area that is not eligible for interstate movement under the conditions stated for consumption in the United States 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 transloading 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 nonquarantine 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: https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/pests-and-diseases/citrus.

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[1]	Mature Trees Rate/Acre[2]
copper fungicide	M 01	Use label rate.
Abound Flowable[3]	11	9.0–15.5 fl oz. Do not apply more than 90 fl oz (1.5 lb a.i.)/acre/season for all uses. Best applied with petroleum oil.
Amistar Top[3,4]	11/3	15.4 fl oz. Do not apply more than 61.5 fl oz/acre/year. Do not apply more than 0.5 lb a.i./ acre/season of difenoconazole. Do not apply more than 1.5 lb a.i./acre/season of azoxystrobin.
Enable 2F[4]	3	8.0 fl oz. Do not apply more than 3 applications or 24 fl oz (0.38 lb a.i.)/acre/season.
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 (0.88 lb a.i.)/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 which is equivalent to 1.17 lb a.i./ acre/season of boscalid and 0.592 lb a.i./acre/season of pyraclostrobin. Up to 0.88 lb a.i./acre/season of pyraclostrobin can be used.

[1] Mode of action class for citrus pesticides from the Fungicide Resistance Action Committee (FRAC) 2022. Refer to chapter 4, *Pesticide Resistance and Resistance Management*, for more details.
[2] Lower rates can be used on smaller trees. Do not use less than minimum label rate.
[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 Amistar Top/season. Do not make more than 2 sequential applications of Pristine or Amistar Top before alternating to a non-strobilurin, non-SDHI (FRAC MOA 7), non-DMI (FRAC MOA 3) fungicide.