CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Phyllosticta citricarpa (McAlpine) Van der Aa 1973

(teleomorph *Guignardia citricarpa* Kiely 1948)

Citrus black spot

Current Pest Rating: None

Proposed Pest Rating: A

Kingdom Fungi, Phylum: Ascomycota,
Subphylum: Pezizomycotina, Class: Dothideomycetes,
Order: Botryosphaeriales, Family: Phyllostictaceae

Comment Period: 05/19/2021 through 07/03/2021

Initiating Event:

This pathogen has not been through the pest rating process. The risk to California from citrus black spot (CBS) caused by *Phyllosticta citricarpa* is described herein and a permanent pest rating is proposed.

History & Status:

Background: Citrus black spot disease was first described in Australia by Kiely in 1950. By the late 1970s it was established in Southern Africa and described by Kotze (1981) as an "epidemic and a major crop destroyer" in the humid coastal regions of the Southern Hemisphere. He predicted that should the disease become established in the United States, Florida would be vulnerable to similar epidemics because of its climate.

While the entire plant can be asymptomatically infected, symptom development primarily occurs on the fruit. Infected fruit develops unsightly dark lesions on the rind, which reduce the fresh market crop value. Severe infection may cause fruit drop, but rarely does it cause internal post-harvest decay, even if the rind becomes necrotized. Fruit can asymptomatic at harvest, but latent infections may cause rind symptoms to appear during transport or storage (Kotzé, 2000). The majority of commercially grown citrus such as lemons, grapefruit, and oranges are susceptible to citrus black spot. International spread

is assumed to have taken place mainly through the movement of infected plants for planting, rather than with infected fruit (Baayen et al., 2009).

Kiely (1948) described CBS with its perfect, teleomorph stage, *Guignardia citricarpa*, and matched it with the imperfect anamorph *Phoma citricarpa*. Subsequently, the *Phoma* stage was moved to *Phyllostictina citricarpa* by Petrack, then to *Phyllosticta citricarpa* by Van der Aa in 1973. Following the guidance of Wingfield et al., 2011, pathologists are using one name for ascomycete fungi with pleomorphism, and the anamorph *Phyllosticta citricarpa* (published as *Phoma* by McAlpine in 1899) has seniority and thus is the preferred name. In many parts of the world, both ascospores and conidia contribute to epidemic disease development (Tran et al., 2018).

In 2010, the first North American detection of CBS occurred in Florida (Schubert et al., 2010). Prior to 2010, the nearest known established infestations were in Brazil and Argentina, although infected fruit had been intercepted with travelers from Cuba (Smith, 2006). The USDA maintains a Federal domestic quarantine against six infested counties in Florida. Under USDA compliance, all quarantined citrus fruit, and leaves, sourced from these counties, can only be moved once containment is secured by properly enclosing the materials. Additionally, movement is restricted to a packing house or processing plant. In Florida, only the *Phyllosticta* form (not the *Guignardia* form) has been detected (Dewdney et al., 2020).

Hosts: Aegle marmelos (golden-apple), *Camellia sinensis* (tea), *Cassia emarginata, Cedrela mexicana* (Mexican-cedar), *Cedrela odorata* (Spanish-cedar), *Citrus aurantium* (bitter orange), *Citrus aurantifolia* (key lime)*, Citrus decumana* (pomelo), *Citrus deliciosa* (mandarin), *Citrus grandis* (pomelo), *Citrus ×grandis-reticulata* (mandarin orange), *Citrus junos* (yuzu), *Citrus limon* (lemon), *Citrus limonia* (lemon), *Citrus maxima* (pomelo), *Citrus medica* (citron), *Citrus medica* var. *limonum* (lemon), *Citrus macrocarpa*, *Citrus natsudaidai* (amanatsu), *Citrus nobilis*, *Citrus nobilis* var. *deliciosa* (mandarin), *Citrus ×paradisi* (grapefruit), *Citrus reticulata* (mandarin), *Citrus reticulata* var. *poonensis*, *Citrus reticulata var. suhoiensis* (mandarin orange), *Citrus reticulata* var. *sunki*, *Citrus reticulata* var. *tankan*, *Citrus ×tangelo* (tangelo), *Citrus sinensis* (orange), *Citrus sinensis* var. *sekhan*, *Citrus* sp., *Citrus tankan*, *Citrus tankan f. koshotankan*, *Citrus tankan* var. *koshotankan*, *Citrus unshiu* (mandarin), *Diospyros halesioides*, *Elaeis guineensis* (oil palm), *Elettaria cardamomum* (cardamom), *Eucalyptus grandis* (rose gum), *Fortunella crassifolia* (kumquat), *Jatropha podagrica* (Budda belly), *Mangifera indica* (mango), *Psidium guajava* (guava), and *Senna bicapsularis* (Christmas bush).

Symptoms: Symptoms on fruit are known as black spot, hard spot, shot hole spot, false melanose, speckled blotch, freckle spot, and virulent spot. The most common symptoms are hard spot or shot-hole spot. When fruit starts maturing, before the rind develops color, these symptoms appear as shallow lesions with a small, grey to tan crater with a dark brown rim, 3–10 mm in diameter (Kotzé 2000). Pycnidia can often be seen inside the spots as tiny and slightly elevated black dots in the grey to tan background. Freckle spot develops on mature fruits, usually after harvest. These are small, slightly depressed spots that can be grey to tan, or reddish, or brownish, or just spots without discoloration. Often, but not always, they have a dark red or brown rim, 1–3 mm in diameter. Pycnidia are less common in freckle spot lesions. Freckle spots often occur at the perimeter of hard-spot lesions (Kotzé, 2000).

False melanose or speckled blotch appears as small, raised, dark brown to black lesions often surrounded by dark specks on green fruit. These lesions may coalesce. This symptom is observed in citrus-growing areas where the *Guignardia* stage is present. Spots may coalesce to form 'virulent' spots towards the end of the season. This is the most damaging form because it extends deeply into the peel causing premature fruit drop and serious post-harvest losses. Spots turn brown to black, develop a leathery texture, and may cover the entire fruit. Pycnidia may be present in these spots (Kotzé, 1981).

Two additional types of symptoms have also been reported. These symptoms are lacey spot and cracked spot. Lacey spot, a variant of false melanose is defined by superficial yellow to brown lesions with a smooth texture, and no definite edges on green fruit. Cracked spot is defined by superficial, slightly raised, cracked spots. Lesions resulting from this disease have irregular margins, lack pycnidia, and appear on fruit older than six months (De Goes et al., 2000).

Symptoms on mature leaves and petioles are circular red to red-brown spots, visible on both leaf surfaces. Small spots (< 3 mm) darken with a brown to black ring. Leaf lesions can have yellow halos. CBS produces similar symptoms to those caused by *Phyllosticta citriasisana*, *Alternaria alternata* pv. *citri*, *Colletotrichum* spp., *Diaporthe citri*, *Mycosphaerella citri*, *Septoria* spp., and mechanical and insect damage. Diagnosis should not be made on field symptoms alone (Dewdney et al., 2020). Most symptoms do not appear for several months, usually not until the fruit begins to ripen.

Transmission: Perithecia with ascospores of *Guignardia,* formed in a pseudothecia and produced exclusively on leaf litter, are a primary source of inoculum in many areas. Ascospores are released during rainfall or irrigation, are carried by wind throughout the canopy (Fourie et al., 2013). The conidia of the *Phyllosticta* anamorph are important secondary inoculum sources, in areas where rainfall is frequent during the time that citrus flowers are producing new leaves in multiple flushes. These asexual spores form in fruit lesions, leaf litter, and twigs. The conidia are spread by rain splash and can infect fruit and leaves. Spores germinate and directly infect the leaves and fruit (Dewdney et al., 2020).

The disease is favored by warm humid weather during the summer. In order to infect, the fungus requires a long wetting period of 24–48 hours, The critical period for infection for both ascospores and conidia begins at fruit set and lasts for 4–5 months until the fruit becomes resistant, with leaves and twigs susceptible for as long as 10 months (Kotzé, 2000; Trute et al., 2004). After infection, the pathogen remains in a quiescent state, with symptoms not developing until the fruit becomes fully grown (Kotzé, 2000).

Damage Potential: Fruit can be infected up to 6 months after fruit set. After this period the pathogen can remain latent for another 4 to 6 months until fruit are mature, and symptoms appear. The appearance of CBS lesions reduces the value of fresh fruit and substantially reduces yield when heavily infected fruits drop prematurely (Dewdney et al., 2020). CBS is a domestic and international quarantine pest.

Worldwide Distribution: Africa: *Angola, Ghana, Kenya, Mozambique, Namibia, South Africa, Tunisia, Uganda, Zambia, Zimbabwe*. America: *Argentina, Brazil, Cuba, United States* (Florida), *Uruguay.* Asia: *Bhutan, China, India, Indonesia, Philippines, Taiwan*. Oceania: *Australia* (EPPO, 2021).

Official Control: *Phyllosticta citricarpa* is on the EPPO's A1 list for Bahrain, Chile, Egypt, Georgia, Jordan, Paraguay, Turkey, Uruguay, European Union, and Caribbean Agricultural Health and Food Safety Agency. It is on the A2 list for Asia-Pacific Plant Protection Commission, Inter-African Phytosanitary Council, and Pacific Plant Protection Organisation. It is a quarantine pest for Israel, Morocco, New Zealand, Tunisia, and the United States (EPPO, 2021).

As *Guignardia citricarpa*, it is on the USDA PCIT's Harmful organisms list for Albania, Brazil, Cambodia, Chile, Colombia, Dominican Republic, Egypt, French Polynesia, Holy See (Vatican City State), Israel, Jamaica, Japan, Jordan, Monaco, Morocco, New Zealand, Oman, Peru, Qatar, San Marino, Serbia, Syrian Arab Republic, Turkey, United Arab Emirates; and as *Phyllosticta citricarpa* for Brazil, Costa Rica, Ecuador, the European Union, and the United Kingdom.

In 2010, the USDA put up a Federal Domestic Quarantine order against parts of South Florida where CBS had been detected (https://www.aphis.usda.gov/plant_health/plant_pest_info/citrus/citrus-downloads/spro/DA-2019-16.pdf). This was updated in 2019 with an expansion of the quarantine area. California maintains a state exterior quarantine against citrus pests that includes CBS (http://pi.cdfa.ca.gov/pqm/manual/pdf/301.pdf).

California Distribution: None

California Interceptions: None

The risk *Phyllosticta citricarpa* would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** Epidemics of CBS occur in areas with warm temperatures and summer rainfall. California summer temperatures are similar or higher to areas where CBS occurs, but are much drier with little to no summer precipitation. CBS is not known in the Mediterranean area of Europe.

   Evaluate if the pest would have suitable hosts and climate to establish in California.

   Score: **1**

   - Low (1) Not likely to establish in California; or likely to establish in very limited areas.

   - Medium (2) may be able to establish in a larger but limited part of California.

   - High (3) likely to establish a widespread distribution in California.

2) **Known Pest Host Range:** The host range is primarily citrus, and most commercially produced species are susceptible.

Evaluate the host range of the pest.

Score: 2

- Low (1) has a very limited host range.
- **Medium (2) has a moderate host range.**
- High (3) has a wide host range.

3) **Pest Reproductive Potential:** The pathogen is usually heterothallic, producing two types of infectious spores. Spores are spread by wind and rain.

Evaluate the natural and artificial dispersal potential of the pest.

Score: 2

- Low (1) does not have high reproductive or dispersal potential.
- **Medium (2) has either high reproductive or dispersal potential.**
- High (3) has both high reproduction and dispersal potential.

4) **Economic Impact:** CBS greatly reduces the value of table fruit with blemishes on the rind. In orchards with high levels of infection, fruit can drop. There are domestic and international quarantines

Evaluate the economic impact of the pest to California using the criteria below.

Economic Impact: A, B, C

A. **The pest could lower crop yield.**
B. **The pest could lower crop value (includes increasing crop production costs).**
C. **The pest could trigger the loss of markets (includes quarantines).**
D. The pest could negatively change normal cultural practices.
E. The pest can vector, or is vectored, by another pestiferous organism.
F. The organism is injurious or poisonous to agriculturally important animals.
G. The organism can interfere with the delivery or supply of water for agricultural uses.

Economic Impact Score: **3**

- Low (1) causes 0 or 1 of these impacts.
- Medium (2) causes 2 of these impacts.
- **High (3) causes 3 or more of these impacts.**

5) **Environmental Impact:** In Florida, monthly applications of fungicides are needed to protect fruit from CBS from early May to mid- September to control black spot. If there is substantial rain in April, starting fungicide applications in April is advised. If fruit are moved interstate out of Florida, they must be washed, brushed and surface disinfested, treated with fungicide, and waxed at a packing house with a Federal compliance agreement.

Evaluate the environmental impact of the pest to California using the criteria below

Environmental Impact: D, E

A. The pest could have a significant environmental impact such as lowering biodiversity, disrupting natural communities, or changing ecosystem processes.
B. The pest could directly affect threatened or endangered species.
C. The pest could impact threatened or endangered species by disrupting critical habitats.
D. The pest could trigger additional official or private treatment programs.
E. The pest significantly impacts cultural practices, home/urban gardening or ornamental plantings.

Environmental Impact Score: 3

- Low (1) causes none of the above to occur.
- Medium (2) causes one of the above to occur.
- High (3) causes two or more of the above to occur.

Consequences of Introduction to California for *Phyllosticta citricarpa:* Medium

Add up the total score and include it here. **11**
-Low = 5-8 points
-Medium = 9-12 points
-High = 13-15 points

6) **Post Entry Distribution and Survey Information**: Evaluate the known distribution in California. Only official records identified by a taxonomic expert and supported by voucher specimens deposited in natural history collections should be considered. Pest incursions that have been eradicated, are under eradication, or have been delimited with no further detections should not be included.

There are no records of *Phyllosticta citricarpa* in California

Evaluation is 'not established'.

Score: 0
-Not established (0) Pest never detected in California or known only from incursions.
-Low (-1) Pest has a localized distribution in California or is established in one suitable climate/host area (region).
-Medium (-2) Pest is widespread in California but not fully established in the endangered area, or pest established in two contiguous suitable climate/host areas.
-High (-3) Pest has fully established in the endangered area, or pest is reported in more than two contiguous or non-contiguous suitable climate/host areas.

7) **The final score is** the consequences of introduction score minus the post entry distribution and survey information score: (Score)

Final Score: *Score of Consequences of Introduction – Score of Post Entry Distribution and Survey Information* ***= 11***

Uncertainty:

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for *Phyllosticta citricarpa* is A.

References:

Baayen, R.P., Bonants, P.J.M., Carroll, G.C., Meffert, J.P. and Kox, L.F.F., 2009. Normes OEPP/EPPO Standards: Diagnostic/Diagnostics PM 7/17 2. *Guignardia citricarpa*. Bulletin OEPP: EPPO B, 39(3), pp.318-327.

Dewdney, M.M., Walker, C., Roberts, P.D., Peres, N.A., Schubert, T.S. and Estes, M.R., 2020. 2020–2021 Florida Citrus Production Guide: Citrus Black Spot. EDIS.

De Goes, A., Baldassari, R.B., Feichtenberger, E., Spósito, M.B. and Aguilar-Vildoso, C.I., 2000. Cracked spot, a new symptom of citrus black spot (*Guignardia citricarpa*) in Brazil. Proc. of the Intl. Soc. of Citriculture, p.145.

EPPO Global Database. 2021. *Guignardia citricarpa* https://gd.eppo.int/taxon/GUIGCI

Fourie, P., Schutte, T., Serfontein, S. and Swart, F., 2013. Modeling the effect of temperature and wetness on *Guignardia* pseudothecium maturation and ascospore release in citrus orchards. Phytopathology, 103(3), pp.281-292.

Kiely, T.B., 1950. Control and epiphytology of black spot of Citrus on the central coast of New South Wales. Science Bulletin, Department of Agriculture New South Wales, (71).

Kotzé, J.M., 1981. Epidemiology and Control of Citrus Black Spot in South Africa. Plant Dis. 65 (12):945-950. DOI: 10.1094/PD-65-945.

Kotzé, J. M. 2000. Black spot. In: Compendium of Citrus Diseases, 2nd edn (Ed. Timmer LW, Garnsey SM & Graham JH), pp. 23–25. APS Press, St Paul (US)

Schubert, T., Sutton, B. and Jeyaprakash, A., 2010. Citrus black spot (*Guignardia citricarpa*) discovered in Florida. Pest Alert.

Smith, M.C. 2006. USDA-APHIS-PPQ Report of a Significant Agricultural Inspection Incident at Miami Service Port, Passenger Processing: Citrus black spot. *Phyllosticta citricarpa*, intercepted on oranges from Cuba. Date: November 26, 2006

Tran, N.T., Miles, A.K., Smith, M.W., Dietzgen, R.G. and Drenth, A., 2018. Pathogenicity of *Phyllosticta citricarpa* Ascospores on *Citrus* spp. Plant disease, 102(7), pp.1386-1393.

Truter, M., Kotzé, J.M., van Rensberg, T.J. and Korsten, L., 2004. A sampler to determine available *Guignardia citricarpa* inoculum on citrus leaf litter. Biosystems engineering, 89(4), pp.515-519.

Wingfield, M.J., De Beer, Z.W., Slippers, B., Wingfield, B.D., Groenewald, J.Z., Lombard, L. and Crous, P.W., 2012. One fungus, one name promotes progressive plant pathology. Molecular plant pathology, 13(6), pp.604-613.

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*Comment Period: 05/19/2021 through 07/03/2021

*NOTE:

You must be registered and logged in to post a comment. If you have registered and have not received the registration confirmation, please contact us at permits[@]cdfa.ca.gov.

Comment Format:

- Comments should refer to the appropriate California Pest Rating Proposal Form subsection(s) being commented on, as shown below.

  Example Comment:

  Consequences of Introduction: 1. Climate/Host Interaction: [Your comment that relates to "Climate/Host Interaction" here.]

- Posted comments will not be able to be viewed immediately.
- Comments may not be posted if they:

Contain inappropriate language which is not germane to the pest rating proposal;

Contains defamatory, false, inaccurate, abusive, obscene, pornographic, sexually oriented, threatening, racially offensive, discriminatory or illegal material;

Violates agency regulations prohibiting sexual harassment or other forms of discrimination;

Violates agency regulations prohibiting workplace violence, including threats.

- Comments may be edited prior to posting to ensure they are entirely germane.
- Posted comments shall be those which have been approved in content and posted to the website to be viewed, not just submitted.

Proposed Pest Rating: A
