CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Colletotrichum alienum B. Weir & P.R. Johnst. 2012

Current Pest Rating: Q

Proposed Pest Rating: B

Kingdom: Fungi, Division: Ascomycota,
Class: Sordariomycetes, Order: Glomerellales,
Family: Glomerellaceae

Comment Period: 06/10/2021 through 07/25/2021

Initiating Event:

On February 17, 2021, San Luis Obispo County agricultural inspectors submitted a sample of leaves from *Clivia* spp., with necrotic leaf spots collected during a regulatory nursery inspection. On March 9, 2021, CDFA plant pathologist Albre Brown diagnosed anthracnose disease, caused by a fungal pathogen in the genus *Colletotrichum*. With PCR and multigene sequence analysis, she identified the species as *alienum*. This is the first detection of *C. alienum* in California and the first detection anywhere on *Clivia* spp. It was assigned a temporary Q-rating. The risk to California from *C. alienum* is described herein and a permanent rating is proposed.

History & Status:

Background:

The genus *Colletotrichum* contains many species which cause destructive diseases on a wide variety of agricultural crops, often causing leaf spots and postharvest fruit rots. Species of *Colletotrichum* are also important because of their use as model organisms (Dean et al. 2012). Species level identification of this genus is complex and challenging. In the past, species were often named for the host they were first identified from, but many Colletotrichum species are now known to have wide host ranges. For an individual species, distinct morphological traits are typically uncharacteristic, and they can have tremendous variation in pathogenicity, depending on the host. Some hosts may be parasitized by multiple species of *Colletotrichum,* and some species of *Colletotrichum* are known to have dozens of hosts (Cannon et al., 2012). While they can act as endophytes, saprophytes, and necrotrophs, they most commonly act as hemi-biotrophs, which cause disease under select conditions.

Historically, many isolates were classified as either *C. acutatum* Simmonds ex Simmonds or *C. gloeosporioides* (Penzig) Penzig & Saccardo. Both are now known to be species complexes made up of numerous genetically diverse and distinct species. The *gloeosporioides* species complex has approximately 40 closely related species, mainly consisting of plant pathogens, but some species act primarily as endophytes (Liu et al. 2015). Based on a multigene phylogenetic analysis, Weir et al. (2012) recognized two subclades within the species complex, naming them Kahawae and Musae. In 2013, Liu et al. performed phylogenetic analyses which revealed that strains of the *C. gloeosporioides* complex inside the subclade Musae, associated with the plant family Proteaceae, comprise at least six species. These include *C. alienum*, *C. aotearoa, C. kahawae*, (subsp. *ciggaro*), *C. siamense*, *C. proteae* and *C. grevilleae.* Most isolations of *C. alienum* have been made from members of the family Proteacae, but also from *Malus domstica* (apple) and *Persea americana* (avocado) in New Zealand and Australia, respectively. The etymology of the name *alienum* is based on this species' first detection on non-native, exotic hosts (in New Zealand) and presumed to be a recent introduction to Australasia. Prior to the detection in San Luis Obispo County from *Clivia* spp., the only other U.S. detections of *C. alienum* have made in Hawaii from members of the family Proteacea including *Banksia, Leucadendron, Leucospermum, Protea,* and *Telopea* (Crous et al., 2013; Farr and Rossman, 2021).

Hosts: Aquilaria sinensis (agarwood), *Banksia dryandroides*, *Camellia sinensis* (tea), *Clivia* sp., *Diospyros kaki* (persimmon), *Fragaria ×ananassa* (strawberry), *Grevillea sp*., *Leucadendron laureolum, Leucadendron sp*., *Leucospermum cordifolium* (pincushion), *L. cordifolium-glabrum*, *L. cordifolium-patersonii*, *L. glabrum*, *Leucospermum sp*., *L. ×cordifolium-lineare*, *Malus domestica* (apple), *Mangifera indica* (mango), *Nerium oleander* (oleander), *Persea americana* (avocado), *Platostoma palustre* (mesona), *Protea compacta* (Bot River protea), *P. coronate*, *P. cynaroides* (king protea), *P. eximia*, *P. grandiceps* (peach protea), *P. lacticolor*, *P. laurifolia*, *P. lepidocarpodendron*, *P. longifolia*, *P. magnifica* (bearded protea), *P. mundii*, *P. nana* (mountain-rose), *P. neriifolia* (oleander-leaf protea), *P. obtusifolia*, *P. pudens*, *P. repens* (sugarbush), *P. scolymocephala* (small green protea), *Protea sp*., *P. speciosa*, *P. stokoei*, *P. susannae*, *P. ×compacta-neriifolia*, *P. ×magnifica-susannae*, *Serruria sp*., *Telopea sp.* (Farr and Rossman, 2021; CDFA PDR database).

Symptoms: On proteas, *C. alienum* causes seedling damping off, shepherd's crook, anthracnose leaf lesions, pruning wound dieback and stem dieback (Crous et al., 2011). On *Aquilaria sinensis* (agarwood), anthracnose leaf spots were small and brown initially, then developed into various shapes, including oval or irregular circles, 15 mm in diameter on the mature leaves (Liu et al., 2020). Mangos will develop twig and leaf anthracnose, but symptoms are most dramatic on the fruit. On post-harvest mangos, *C. alienum* causes brown to black lesions of different sizes up to 2 cm, with an identified border on the fruit surface. Over time the lesions coalesce and extensively cover the surface area of the fruit. The pathogen invades the peel and the fruit pulp. Bitter rot of apples is characterized as a sunken zone on the fruit surface with concentric rings of conidial masses (Munir et al., 2016). Avocado fruit anthracnose is characterized by the appearance of sunken necrotic black lesions along with the formation of orange conidial masses.

Transmission: It is likely that *C. alienum* has a similar life cycle to that of other *Colletotrichum* species and survives between crops during winter as mycelium on plant residue in soil, on infected plants, and

on seeds. During active growth, the pathogen produces masses of hyphae (stromata) that bear conidiophores on the plant surface. Conidia (spores) are produced at the tips of the conidiophores and disseminated by wind, rain, cultivation tools, equipment, and field workers. Conidia are transmitted to host plants. Humid, wet, rainy weather is necessary for infection to occur. These requirements may limit the occurrence of the pathogen in California fields and subsequently, the pathogen may be more of a problem under the controlled environments of greenhouses. Conidia germinate, penetrate host tissue by means of specialized hyphae (appressoria), and invade host tissue. Wind, wind-driven rain, cultivation tools, and human contact can move the pathogen. Long distance spread is with the movement of infected plant material and fruit. For avocado anthracnose, source of conidia quiescently affecting fruit during the wet winters may originate from leaves or branches (dry or fresh). In tropical regions, it has been reported that the fungus survives between fruiting cycles on dried avocado leaves and twigs, either in the plant canopy or on the ground (Sharma et al., 2017)

Damage Potential: Postharvest mango anthracnose, which reduces the shelf-life of mature fruit, caused by *Colletotrichum* sp. is the most significant disease of mango in almost all production areas around the world (Wu et al., 2020; Tovar-Pedraza et al., 2020). About 30% of mango fruits were affected by anthracnose disease in Taiwan in a study by Ahmed et al., 2021. Mango anthracnose in Mexico is caused by multiple *Colletotrichum* species. Among these, *C. siamense* and *C. asianum* were rated as the most virulent, whereas *C. alienum* was classified as a less virulent species. (Tovar-Pedraza et al., 2020).

Anthracnose diseases caused by *Colletotrichum* sp. are also a major constraint for the shelf-life and marketability of avocado fruits (Sharma et al., 2017). Infections of avocado occur from conidia in the orchard, but remain quiescent until fruit ripening after harvest, during transport or storage. Bitter rot, caused by multiple fungi in the genus *Colletotrichum,* is one of the most common post-harvest diseases of apple fruit and causes significant yield loss worldwide (Munir et al., 2016).

Agarwood is used as high-quality incense and in traditional Chinese medicine. Liu et al. (2020) observed that about 35% of trees in their study area were affected by anthracnose symptoms on the leaves and twigs. Proteas are a high value plant in landscapes and some species are used for cut flowers. Anthracnose infection damages the branches, shoots, and leaves (Liu et al., 2013). Some countries regulate *Colletotrichum* at the species level, making any visible infections subject to rejection at the borders.

Nursery production of potted host plants such as *Clivia* in greenhouses are particularly at risk as nursery conditions are often conducive to infection by *Colletotrichum* species. In cultivated fields, disease development may be sporadic as it is affected by levels of pathogen inoculum and environmental conditions.

Worldwide Distribution: Africa: *South Africa, Zimbabwe*. America: *Mexico, United States* (California, Hawaii). Asia: *China, Israel, Taiwan*. Europe: *Portugal, Spain*. Oceania: *Australia, New Zealand.*

Official Control: In California, *C. alienum* is an actionable, Q-rated pathogen, and infected plant material is subject to destruction or rejection. *Colletotrichum* sp. are on the USDA's harmful organism list for French Polynesia, Israel, Mexico, Qatar, and Uruguay (USDA PCIT 2021).

California Distribution: There has been one detection in a nursery in San Luis Obispo County (see 'initiating event').

California Interceptions: None.

The risk *Colletotrichum alienum* would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:**
Similar to other species of *Colletotrichum*, *C. alienum* requires humid, wet, rainy weather for conidia to infect host plants. This environmental requirement may limit the ability of the pathogen to fully establish and spread under dry field conditions in California. Limited regions with conducive climates within California could enable the pathogen to establish. In particular, *C. alienum* can effectively infect and spread to host plants grown under conducive climate conditions in nurseries.

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

Score: **2**

- 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 most often identified hosts of *C. alienum* are members of the family Proteaceae, but there are also important fruit crops including apple, avocado, and mango.

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 has high reproductive potential and conidia are produced successively. They are transmitted by wind, wind-driven rain, cultivation tools, and human contact however conidial germination and plant infection require long, wet periods.

Evaluate the natural and artificial dispersal potential of the pest.

Score: 3

- 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: Under suitable climates, the pathogen can lower plant growth and value. Fruit can be quiescently infested, developing symptoms on the rinds and in the pulp post-harvest. It is also subject to quarantine regulation in some countries.

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: The pathogen could significantly impact cultural practices, home gardening, or ornamental plantings.

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

Environmental Impact: 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: 2

- 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 *Colletotrichum alienum:* Medium

Add up the total score and include it here. **12**
-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.

   Colletotrichum alienum has only been found in one nursery and is under state quarantine control.

   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* ***=***

Uncertainty:

As this is a species that has been separated out from a larger species complex, it is likely that more hosts will be described in the future.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for *Colletotrichum alienum* is B.

References:

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Responsible Party:

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***Comment Period: 06/10/2021 through 07/25/2021**

***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: B
