CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Elsinoë perseae (Jenkins) Rossman & W.C. Allen

Avocado scab

Current Pest Rating: none

Proposed Pest Rating: A

Kingdom: Fungi, Phylum: Ascomycota,
Subphylum: Pezizomycotina, Class: Dothideomycetes,
Subclass: Dothideomycetidae, Order: Myriangiales,
Family: Elsinoaceae

Comment Period: 08/01/2023 through 09/15/2023

Initiating Event:

This pathogen has not been through the pest rating process. The risk to California from *Elsinoë perseae* is described herein and a permanent rating is proposed.

History & Status:

Background: California leads the nation in avocado (*Persea americana*) production, accounting for 95.7% of the total. Trees are grown on 47,000 acres with a gross value over $407M in 2021 (CDFA Agricultural statistics https://www.cdfa.ca.gov/Statistics/PDFs/2022Ag_Stats_Review.pdf). This is approximately 10% of total global production. Nearly all fruit is consumed within the United States; very little is exported out of the country. The top avocado producing county is Ventura, followed by San Diego, Riverside, San Luis Obispo, and Santa Barbara. Most production occurs in areas tempered by coastal climates. Commercial production of avocado in California primarily utilizes three "races": Guatemalan, Mexican, and West Indian. All are susceptible to avocado scab, caused by *Elsinoë perseae*, which is not known to be in California.

Economically important fruit diseases caused by *Elsinoë* include avocado scab caused by *E. perseae*, and citrus scab caused by *E. fawcettii* and *E. australis*. Avocado scab was first reported from Cuba in

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1915 and in Florida in 1916. It was described and named by Jenkins (1934). Since that time, it has spread throughout the Florida avocado industry and is described as a destructive pathogen (Palmateer et al., 2006). The disease occurs on young fruit, shoots, and leaves of susceptible varieties. Incidence and severity of avocado scab varies depending on local climate, cultural practices, and the susceptibility of the avocado cultivar. In regions with high humidity, frequent rainfall, or extended periods of leaf wetness, the risk of avocado scab development and spread is typically higher. Severe avocado scab infections can reduce the overall yield of avocado trees. Infected fruit may drop prematurely or be reduced in size, affecting the quantity of marketable produce. The decrease in yield directly translates to decreased revenue for growers (Marais, 2004; Palmateer et al., 2006; Pernezny and Marlatt, 2000).

Examining samples collected in the field is often frustrating because of the lack of visible fungal structures. Isolation of *Elsinoë* in pure culture can be challenging because of its very slow growth, with cultures easily becoming overgrown by contaminants. Diagnosis is often made with molecular methods that rely on DNA sequencing. The classification and taxonomy of the anamorphic and teleomorphic stages of *Elsinoë* species has evolved over time. The genus name *Sphaceloma* was traditionally used for the anamorph stage. *Sphaceloma perseae* produces asexual spores for this fungus, which are known as conidia. Conidia are usually single-celled and are formed in structures called conidiomata. Conidia play a crucial role in the disease development of *Elsinoë*. They are largely responsible for initiating infections by landing on susceptible host surfaces, germinating, and penetrating the plant's tissues. Once inside the host, the fungus can establish and develop the characteristic scab lesions associated with *Elsinoë* diseases (Fan et al., 2017).

This pathogen is one of the main phytosanitary concerns in avocado-producing countries (Avila-Quezada et al., 2003; Everett and Siebert, 2018; Fan et al., 2017). Disease incidence can be as high as 97% (Avila-Quezada et al., 2003) causing huge yield losses when infected fruit drop from the tree prematurely or are rejected by the packer (Marais, 2004). The fungus forms lesions on the fruit and can rupture the epidermis and release conidia, allowing the disease to spread (Everett et al., 2011). Moving scabby fruit poses a high risk for disease spread to new areas (CABI, 2023).

Hosts: Persea americana (avocado) is considered the only host but there is a single report of *E. perseae* (as its synonym: *Sphaceloma perseae*) infecting *Ananas comosus* (pineapple) (Farr and Rossman, 2023).

Symptoms: Avocado scab weakens the overall health and vigor of avocado trees. Weakened trees are more susceptible to other diseases, pests, and environmental stresses. The life cycle of *Elsinoë* species involves the production of ascomata and ascospores. Ascospores are released and dispersed by wind or rain, landing on susceptible plant tissues. Infection occurs when spores germinate and penetrate the host's cuticle or other entry points. The pathogen then colonizes the tissues, leading to the development of characteristic scab lesions. Secondary infection can occur with conidia by splashing of spores from infected tissues. Disease typically manifests as scab-like lesions on plant surfaces. These lesions can vary in appearance but often have a raised, corky, or scaly texture. The disease begins on leaves as small, discrete lesions. The lesions are slightly raised and elongated on leaf veins, petioles, and twigs. These lesions may coalesce into star-like patterns and eventually cause the leaves to

become distorted and stunted. Lesions may also occur on leaf petioles, twigs, and fruit pedicels (Marais, 2004; CABI, 2023; EPPO, 2023).

On fruit, the symptoms initially appear as corky, raised, oval or irregular shaped brown to purplish-brown spots. These spots enlarge and coalesce to form large rough areas over the fruit surface. Cracking of these rough areas may allow secondary organisms, such as anthracnose fungi, to penetrate and rot the fruit. The scabbing does not affect the internal quality of the fruit. Brownish scars can also develop on fruits from rubbing, producing symptoms that are called carapace spot (named for the resemblance to the hard upper shell of a turtle). The symptoms of abiotic carapace spot can be confused with the symptoms of scab (Dreistadt, 2007).

Transmission: The conidia of avocado scab can be carried by wind over short distances. These spores are released from infected plant debris, such as fallen leaves or infected fruit, and move to new parts of the same tree, or to nearby avocado trees, where they can initiate new infections. Water plays a significant role in the spread of avocado scab. Rainfall, irrigation, or overhead watering can splash the fungal spores from infected plant parts onto healthy avocado foliage and fruit, leading to new infections. Humid environments with long rainy seasons are the conditions most conducive to disease development (Ávila-Quezada et al., 2003).

Movement of infected plant material, such as infected nursery plants or pruned branches, can introduce the disease to new areas. Additionally, tools or equipment used in avocado orchards that encounter infected plant material can act as carriers, spreading the fungus to healthy trees if not properly cleaned and disinfected. Some studies suggest that certain insects, such as beetles and thrips, may act as potential vectors for avocado scab. These insects can inadvertently pick up fungal spores from infected avocado trees and transfer them to healthy trees while feeding or moving between plants. However, the role of insects in the transmission of avocado scab is not yet fully understood and requires further research (Everett, 2020).

Damage Potential: Avocado scab can cause cosmetic damage to the fruit, making it unattractive and potentially unmarketable. Scab appears on the first stages of fruit, causing crop losses up to 53% (Vidales, 1996). Growers experience reduced market value or even face rejection of scab-scarred fruit lots. This can lead to lower prices for the affected fruit or the need to sell it at discounted rates, resulting in financial losses. Severe avocado scab infections can reduce the overall yield of avocado trees. Infected fruit may drop prematurely or have reduced size, affecting the quantity of marketable produce. Fungicides are often used as part of scab management, and their application adds to the overall expenses of orchard management. Additionally, monitoring, scouting, and implementing disease management practices demand additional labor and time. Avocado scab weakens the overall health and vigor of avocado trees. Weakened trees are more susceptible to other diseases, pests, and environmental stresses, which may necessitate additional treatments and incur additional costs. In Mexico, avocado scab disease incidence was high correlated with thrips damage incidence (Ávila-Quezada et al., 2003).

Worldwide Distribution: Avocado scab occurs in most regions where avocado trees are cultivated, particularly in areas with warm and humid climates. Africa: *Guinea, Morocco, South Africa, Zambia,*

Zimbabwe. America: *Argentina, Barbados, Bermuda, Brazil, Costa Rica, Cuba, Dominican Republic, El Salvador, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Peru, Puerto Rico, United States of America* (Florida, Texas), *Venezuela*. Asia: *Philippines, Taiwan* (EPPO, 2023).

Official Control: *Elsinoë perseae* is on the EPPO's A1 list for Chile and Egypt, and the USDA PCIT's harmful organism list for Ecuador.

California Distribution: none

California Interceptions: none

The risk *Elsinoë perseae* would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:**
   Avocado scab is likely to be found wherever avocados can grow in the state but may only be severe when rainfall and humidity is higher.

   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 host range is limited to avocado.

   Evaluate the host range of the pest.
   Score: 1
   - 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:** This pathogen reproduces with multiple types of spores on multiple plant parts. Spores are spread with wind and rain, possibly with insects.

   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:

This is a very significant disease in the parts of the world where it is found. It causes large yield losses and fruit are disfigured, dropping off the tree pre-harvest. It is a quarantine pest for 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 damage that scab causes to the fruit is unacceptable in many markets, leading to significant fungicide use as protectants. Urban gardeners may not be able to keep their trees scab-free.

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 *Elsinoë perseae:* 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.

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* ***= 12***

Uncertainty:

Elsinoë diseases are often correlated with climates with high humidity and rainfall such as are found in Florida and Texas, and humidity is thought to be a limiting factor for disease incidence and severity. However, this has not been the California experience with sweet orange scab, cause by *Elsinoë australis*, which has been found sporadically in the desert near the Arizona border and in Southern California. It's possible that *E. perseae* poses a similar risk to California, where coastal growing areas will provide adequate humidity for disease establishment.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for ***Elsinoë perseae*** **is A.**

References:

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***Comment Period: 08/01/2023 through 09/15/2023**

***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
