CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Avocado sunblotch viroid

Current Pest Rating: C

Proposed Pest Rating: C

Domain: Virus, Group: Viroids
Family: Avsunviroidae, Genus: Avsunviroid

Comment Period: 07/12/2021 through 08/26/2021

Initiating Event:

This pathogen has not been through the pest rating process. The risk to California from Avocado sunblotch viroid (ASBVd) is described herein and a permanent pest rating is proposed.

History & Status:

Background: Sunblotch symptoms on avocados were observed and documented first in Southern California in 1914 and then in Palestine in 1924 (Coit, 1928; Whitsell, 1952). The symptoms were initially thought to have physiological causes, like high solar irradiation, or be the result of a genetic disorder. They were proven to be caused by a graft-transmissible agent that was hypothesized to be a virus (Wallace, 1958). When further research with electron microscopy failed to identify viral particles, a viroid was suggested (Desjardin et al., 1980). Researchers in Australia were the first to purify a viroid from avocado leaves with symptoms of sunblotch disease, and they named it Avocado sunblotch viroid (ASBVd) (Dale and Allen, 1979; Allen et al., 1981).

Viroids are the smallest known plant pathogens and are composed of only a short, circular, single stranded RNA. Although viroids are composed of nucleic acid, they do not encode any protein and have no protein coats. All viroids are inhabitants of higher plants, and some cause diseases while others are asymptomatic. Members of viroid family Avsunviroidae, including ASBVd, replicate by single-unit nuclear-encoded polymerase in plant chloroplasts using "rolling circle" synthesis to make new positive sense RNA from the negative sense viroid RNA (Giguère et al., 2014).

Mesoamerica is considered the center of origin of the avocado, principally the highlands of Mexico and Guatemala. The origin of ASBVd has not been confirmed, but considering the dependence of this pathogen on its host, it has been postulated that the viroid evolved together with the avocado. The

avocado industry in Southern California began with trees and seeds from Mexico and Guatemala, and germplasm could have been infected with ASBVd at that time (Saucedo et al., 2019).

Today ASVBd is widely distributed in most avocado-producing countries around the world and causes significant reductions in yield and fruit quality. Infected but asymptomatic trees play an important role in the epidemiology of this disease when they are used for budwood or pollen leads to infected seeds and seedlings used as rootstocks. There are no curative treatments, but sanitation practices that protect trees from infection may have a significant impact on disease spread (CABI-ISC, 2021).

Hosts: ASBVd has a very narrow host range and all hosts are in the family Lauraceae. *Persea americana* (avocado) is the only natural host. *Cinnamomum zeylanicum* (Ceylon cinnamon), *C. camphora* (camphor tree), *Persea schiedeana* (coyo), and *Ocotea bullata* (cape walnut) are experimental hosts (Da Graca and Van Vuuren, 1980; 1981).

Symptoms: Symptoms can be variable depending on the avocado cultivar, environment, and variants of the viroid present. The most typical symptom is sunken crevices on the fruit that can be white, yellow, or reddish in color. The sunken areas can become necrotic. Shoots and young branches can show discolored streaks or stripes. Some leaves are distorted and variegated with light and dark areas developing from the central vein, with deformation of the leaf blade. The bark of some trunks and older branches develop a cracked appearance called “alligator skin”. The distribution of symptoms is irregular, and trees may have all the symptoms or only one. Trees can be stunted and fruitless, or completely asymptomatic. Symptoms can be more pronounced when the trees are under environmental stress (Eskalen and Adaskaveg, 2016; Rios, 2017).

Transmission: ASBVd can move systemically within the avocado. Trees that show no symptoms even though the viroid is present are known as "symptomless carriers”, and cuttings and seed from symptomless carriers can transmit the viroid (Eskalen and Faber, 2016). One of the main ways ASBVd spreads is by grafting of infected budwood (Wallace, 1958), or by growing rootstock seedlings from infected seeds. Mechanical transmission through wounds caused by contaminated grafting or pruning tools and injection equipment causes disease spread inside and between grove (Desjardins et al., 1980). Root grafts can transmit sunblotch tree-to-tree inside groves (Whitsell, 1952). Pollen transmission of ASBVd has been demonstrated where pollen from an infected tree moves to the flower ovule of a noninfected tree, resulting in infected seed only (the mother tree does not become infected this way) (Desjardins et al., 1979). Transmission through seed collected from symptomatic trees is low (less than 5%) but is reported to be high (80 to 100%) from symptomless carriers (Desjardins, 1987). There is no evidence of conventional insect vectoring, however, experiments have shown that honeybees in cages are able to move infected pollen (Desjardins et al., 1979; Eskalen and Faber, 2016).

Damage Potential: ASBVd reduces fruit quality and fruit yield. Even asymptomatic “Hass” trees have reductions of avocado yield in the range of 15–30% from ASBVd, while symptomatic trees are more severely affected with a reduction of 75% (Saucedo-Carabez et al., 2014). Infected trees are reduced in size and vigor. Infected trees should be removed from the orchards, and disease-free material should always be used for planting. Continuous disinfection of pruning, harvesting and grafting tools is needed to stop disease spread.

Worldwide Distribution: Australia, Ghana, Greece, Guatemala, Israel, Mexico, Peru, South Africa, Spain, United States (*California, Florida*) and Venezuela (CABI-ISC, 2021).

Official Control: ASBVd is on the EPPO's A1 list for Bahrain, Chile, and Jordan, and is a quarantine pest in Morocco (EPPO, 2021). It is on the USDA's Harmful Organism list for: Antigua and Barbuda, Australia, Chile, China, Ecuador, Georgia, Grenada, Guatemala, Indonesia, Japan, Nauru, New Caledonia, Panama, and Thailand (USDA-PCIT, 2021).

California Distribution: Official records are available for Santa Barbara, Santa Clara and Ventura counties. University of California specialists report that sunblotch is widespread in California, and likely to be found in all districts where avocados are grown (Rios, 2017).

California Interceptions: None

The risk Avocado sunblotch viroid would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:**
Avocados are frost-sensitive, and are grown mostly along the southern coast, primarily in San Diego and Ventura counties, but also in Santa Barbara, Riverside and San Luis Obispo counties. ASBVd can occur everywhere avocados can grow, including the San Francisco Bay area.

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 natural host range of ASBVd 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 viroid can only reproduce inside of a host. It spreads with infected propagative material including pollen, budwood, through root grafts, and with some types of wounding

Evaluate the natural and artificial dispersal potential of the pest.

Score: 1
- 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 disease can have a large impact on fruit production, and there is considerable cost to removing diseased trees and practicing orchard management in ways that prevent spread.

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

Economic Impact: A, B, C, D
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:** With a host range limited to avocados, no direct environmental impacts are expected. However, it could impact urban gardening as there is no treatment for infected trees

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 Avocado sunblotch viroid*:* Medium

Add up the total score and include it here. **9**
-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.

   ASBVd has been in California for over 100 years. It is now widespread in the avocado growing areas.

   Evaluation is 'high'.

   Score: -3
   -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* ***= 6***

Uncertainty:

None.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for **Avocado sunblotch viroid** is **C**.

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***Comment Period: 07/12/2021 through 08/26/2021**

***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: C