

## California Pest Rating Proposal for

### *Diplodia malorum* Fuckel 1870

Current Pest Rating: Q

Proposed Pest Rating: B

Kingdom: Fungi, Class: Dothideomycetes

Order: Botryosphaeriales, Family: Botryosphaeriaceae

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Comment Period: **2/7/2020 through 3/23/2020**

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#### Initiating Event:

On March 31, 2018, the CDFA Plant Pest Diagnostics Center received samples of apple cankers from a high-density demonstration orchard in San Jose, Santa Clara County. On June 8, 2018, plant pathologists Suzanne Rooney-Latham and Cheryl Blomquist visited the garden with staff from the University of California Cooperative Extension who manage the orchard. They observed cankers and dieback on approximately 33 apple (*Malus pumila*) trees of the 35 inspected and on numerous other fruit trees as well. In addition to apple, samples from Asian pear (*Pyrus pyrifolia*) and cherries were also collected during the follow up visit. *Diplodia malorum* was detected in culture from both apple and Asian pear samples. Morphological identification was confirmed by amplification of DNA extracts, sequencing, and comparing the sequences to published DNA sequences of *D. malorum*. There were no records of this pathogen in the United States, and Suzanne Rooney-Latham sent a culture of the fungus to the USDA National Identification Services in Beltsville Maryland. On October 23, 2018, USDA Mycologist Aaron Kennedy confirmed her identification was correct. On November 15, 2019 USDA National Policy Manager Paul Ijams notified CDFA that this was a first detection of *Diplodia malorum* in the United States and that this pathogen has been designated as a federal quarantine pest. The pathogen received a temporary Q rating. The risk to California is assessed herein and a permanent rating is proposed.

#### History & Status:

##### Background:

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The genus *Diplodia* is a member of the family Botryosphaeriaceae, which contains a range of morphologically diverse fungi that are either pathogens, endophytes, or saprobes, mainly on woody hosts. They are found in all geographical and climatic areas of the world. They are frequently considered significant plant pathogens and much of the research is focused on the systematics of the genera and species (Phillips et al., 2013).

*Diplodia* is a large genus with more than 1200 species currently recognized. They can cause “soft rots” of wood that affect the surface layers of branches and trunks where they are maintained with an environment of a more or less continuously high moisture substrates. Soft-rot fungi utilize both polysaccharides and lignin for pathogenesis. They invade wood preferably through rays or vessels, from where they grow into the adjacent tracheids and invade their cell walls. Within the cell wall they produce conical or cylindrical cavities parallel to the orientation of the microfibrils, with progressing decay. (Agrios, 2005). The most severe infections of this disease follow environmental stresses to the trees such as drought or cold injury (Hanifeh et al., 2013). In addition to causing wood rots, *Diplodia* sp. can also cause black rot on apple fruit (Crespo et al., 2018).

Since the time that it was introduced by Fuckel in 1870, the name *D. malorum* has been used infrequently. The names *D. mutila* or *D. seriata* were more often applied to the *Diplodia* pathogens isolated from apples with black rot and wood cankers. At times, all three were considered synonymous (Slippers et al., 2007; Phillips et al., 2007). However, Phillips et al. (2012) showed that *D. malorum* has cladistic support as a distinct species from *D. mutilata* and *D. seriata*, in addition to the morphological differences. One morphological characteristic of *D. malorum* is that the conidia of this species are larger, and they frequently become brown and 1-septate soon after discharge from the pycnidia.

**Hosts:** *Cotoneaster franchetii* (orange cotoneaster), *C. henryana*, *C. insignis*, *Crataegus monogyna* (common hawthorn), *Eriobotrya japonica* (loquat), *Malus* sp. (apple), *M. niedzwetzkyana*, *M. sylvestris* (European crab apple), *Mespilus germanica* (common medlar), *Populus alba* (silverleaf poplar), *Prunus vulgaris* (heal-all), *Pyrus communis* (pear) (Farr and Rossman, 2019).

**Symptoms:** In Iran, apple trees infected by *D. malorum* were observed by Hanifeh et al. (2013). The bark and vascular system of the tree were darkened at the site of infection and cankers were scaling on main trunk and branches. *Diplodia* cankers typically affect a single branch and then gradually move to other branches, weakening and reducing vigor of the tree over time.

**Transmission:** Like *Diplodia* cankers on other hosts, the fungi enter branches through wounds and possibly natural openings. Asexual fruiting bodies (pycnidia) are produced within 24 weeks and will continue to produce spores for about two years. On branches, pycnidia are in black masses of fungal tissue (stromata) on and embedded in the bark. Spore production and germination are favored by moisture. During winter rainfall, spores are released, and wounds made by winter pruning provide infection sites (Smith et al., 2014).

**Damage Potential:** After a pruning wound is infected, the pathogen establishes a permanent, localized wood infection that cannot be eradicated by fungicide applications. Branches rot and fruit production declines.

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**Worldwide Distribution:** Asia: *Uzbekistan, Iran*; Europe: *Armenia, Bulgaria, Germany, Italy, Portugal, Spain, and Ukraine* (Farr and Rossman, 2019; Hanifeh et al., 2013).

**Official Control:** None.

**California Distribution:** *Diplodia malorum* was found infecting apple and pear trees in one orchard in Santa Clara County (see 'Initiating event').

**California Interceptions:** None.

The risk *Diplodia malorum* would pose to California is evaluated below.

### Consequences of Introduction:

- 1) Climate/Host Interaction:** *Diplodia* spp. require rain and wet conditions for spore production, dissemination, and infection. California weather conditions are generally favorable for only short periods in the winter and spring, but commonly occur in the parts of the state where apples and pears are produced.

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

**Score: 3**

- 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 members of the rose family, including ornamentals and some widely planted tree fruit species including apples, pears, and loquats.

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:** *Diplodia* spp. produce large numbers of conidia but they require wet weather to spread and infect. They also require a wound or natural opening and are unable to directly infect intact bark.

Evaluate the natural and artificial dispersal potential of the pest.

**Score: 2**

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

#### 4) **Economic Impact:**

Epidemics are often associated with pre-existing or concurrent environmental stresses and wounding from pruning. During times of environmental stress, branch cankers and dieback can have a significant impact on tree health and yield. Its likely there will be differences in susceptibility between varieties of apples, pears, and loquats. It is likely that it will be able to infect apple fruit, similar to closely related species.

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

##### **Economic Impact: A, B**

- 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: 2**

- 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:** Infections can be reduced but not eliminated by using delayed pruning techniques and avoiding tree work during wet weather (Smith et al., 2014).

##### **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.
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- **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 *Diplodia malorum* is 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.

*Evaluation is 'low'*. *Diplodia malorum* has been detected in one location in Santa Clara County.

**Score: -1**

-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:

**Final Score:** *Score of Consequences of Introduction – Score of Post Entry Distribution and Survey Information = 10*

**Uncertainty:**

None

**Conclusion and Rating Justification:**

Based on the evidence provided above **the proposed rating for *Diplodia malorum* is B.**

**References:**

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### Responsible Party:

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**\*Comment Period: 2/7/2020 through 3/23/2020**

### \*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](mailto:permits[@]cdfa.ca.gov).

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**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.

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**Proposed Pest Rating: B**

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