CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Diplodia corticola A.J.L. Phillips, A. Alves & J. Luque 2004 (*Botryosphaeria corticola*)

Current Pest Rating: Z

Proposed Pest Rating: C

Domain: Eukaryota, Kingdom: Fungi,
Phylum: Ascomycota, Subphylum: Pezizomycotina,
Class: Dothideomycetes, Order: Botryosphaeriales,
Family: Botryosphaeriaceae

Comment Period: 11/05/2021 through 12/20/2021

Initiating Event:

In 2009, a Plumas County Agricultural Inspector submitted a sample of canyon live oak, *Quercus chrysolepis*, from a homeowner, to CDFA's Plant Pest Diagnostics Center at Meadowview. The inspector recorded the symptoms on the tree as "tissue death and girdling of trunk at soil line". CDFA Plant Pathologist Suzanne Rooney-Latham detected *Dipoldia corticola* (syn *Botryosphaeria corticola*) from the trunk canker in culture and confirmed her diagnosis with molecular sequencing. This was the first report of this fungus in the Western United States. A sample was sent to the USDA's National Mycology Lab in Beltsville MD, and the identity of the pathogen was confirmed. *Diplodia corticola* is a known trunk canker pathogen in Europe. Suzanne Rooney-Latham assigned a temporary Q rating. An additional twenty official samples have been submitted to date, from multiple hosts in multiple counties, in addition to an interception on an incoming shipment from Iowa. Urbez-Torres et al. (2010), described this pathogen on the canyon live oak and on grapevines with cankers from Sonoma County. The current rating is a temporary Z. The risk to California from *Diplodia corticola* is described herein and a permanent rating is proposed.

History & Status:

Background:

The fungal family of Botryosphaeriaceae includes common and widespread pathogens of woody hosts, most of which belong to the genera *Lasiodiplodia, Neofusicoccum, Dothiorella, Diplodia*, and

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Botryosphaeria (Slippers et al., 2017). Members of the Botryosphaeriaceae are often described as latent or opportunistic pathogens, with most of the species able to live endophytically and asymptomatically in plant tissues for long periods of time. They will switch to pathogenic behavior following a period of host stress (i.e., drought, cold damage, wounding) resulting in various symptoms, such as leaf spots, fruit and root rot, dieback, and cankers (Slippers and Wingfield 2007). They often co-occur in pathogen complexes with other species with similar lifestyles. There are increasing reports of Botryosphaeriaceae fungi damaging woody hosts, along with new species and pathogen–host associations being described in California (Aćimović et al., 2018; Moral et al., 2019; Chen et al., 2014; Lynch et al., 2013).

Diplodia corticola is a cosmopolitan pathogen, native to both Europe and the United states. Although it has been detected in many places, it is not the only cause of oak declines, and probably is acting opportunistically when environmental conditions predispose woody plants to disease (Ferreira et al., 2021). In 1998, Jacobs and Rehner reported isolation of *D. corticola* from oak in California but did not report the oak species from which the isolate was obtained, or if they tested its virulence. *Diplodia corticola* has been shown to be the most prevalent canker and dieback pathogen in cork oaks (*Quercus suber*) in the Iberian Peninsula in Spain and to be causing a regional oak decline in Portugal, France, and Italy in Europe and in the mid-Atlantic region of the United States (Alves et al., 2004; Ferreira et al., 2021). *Diplodia corticola* is somewhat unique as it apparently lacks host specificity, attacking both red and white oaks plus other trees and grapevines. Other species of *Diplodia* such as *D. quercivora* (which is in a monophyletic sister clade), are more specialized with a narrower host range.

Hosts: Cercis canadensis (eastern redbud), *Eucalyptus globulus* (blue gum), *Pinus pinaster* (maritime pine), *Quercus afares* (African oak), *Q. agrifolia* (coast live oak), *Q. alba* (white oak), *Q. canariensis* (zean oak), *Q. cerris* (turkey oak), *Q. chrysolepis* (canyon live oak), *Q. coccifera* (kermes oak), *Q. ilex* (holly oak), *Q. macrocarpa* (bur oak), *Q. petraea* (sessile oak), *Q. rubra* (red oak), *Q. suber* (cork oak), *Q. velutina* (black oak), *Q. virginiana* (southern live oak), *Vitis* sp., *Vitis vinifera* (grapevine) (Farr and Rossman, 2021).

Symptoms: Symptoms on oak trees can be acute wilt, blighting of leaves, external trunk or branch cankers, necrotic lesions under the bark, severe dieback, and even tree mortality. Pre-disposing abiotic factors such as drought, flooding, mechanical damage, and insect attack often increase the probability of symptom development with *D. corticola* (Lynch et al., 2010, 2012).

Grapevines develop dieback symptoms including dead cordons and spurs. Lack of spring growth development was the most characteristic symptom observed on infected vines in Texas (Úrbez-Torres, et al., 2009). Stunted shoots and bleaching of canes can occur on grapevines showing dieback. Cross sections of infected grapevine tissue will show perennial cankers and/or brown-black streaking of the wood. Both cankers and wood streaking were always associated with old wounds caused by pruning or by mechanical damage (Smith et al., 2014).

Transmission: Diplodia spores germinate and enter the host through existing wounds or scars, such as those from pruning, leaf and fruit drop, or bud scars. The fungi spread primarily in splashing water during rain. Infections may develop slowly for many months before symptoms become visible. Much

more is known about the transmission of this type of fungi to grapevine than to other hosts. Pycnidia are the overwintering structures that produce spores, and they are embedded in diseased woody tissues. During winter rainfall, spores are released, and wounds made by winter pruning provide infection sites. Under California conditions, pruning as late as possible in the dormant period has been shown to be very effective in reducing the risk of infection. Delayed pruning takes advantage of reduced susceptibility of pruning wounds to infection and avoids the period of highest spore release during winter rain events. After a pruning wound is infected, the pathogen establishes a permanent, localized wood infection, which cannot be eradicated by fungicide applications (Smith et al., 2014). Long distance spread is possible through movement of infected planting material, which can be asymptomatic.

Damage Potential: In San Diego County, *Quercus agrifolia* with decline and mortality generally attributed to the goldspotted oak borer also had pycnidia of *D. corticola*. Staining was observed around the inoculation points from the insects on trees and trees exhibited bleeding. Necrotic tissue was observed in the phloem and xylem tissue that was symptomatic of *D. corticola* infection. Trees showed crown thinning, bark cracking and/or peeling, patches of stain (1 to 10 cm in diameter), bleeding on the bole, and tree death was common from the combination of these pests (Lynch et al., 2010). Oak branch canker and dieback is caused by *D. corticola* and *D. quercina* in California. They can completely kill branches, leaving them with all brown, dead leaves. In Europe, on *Q. suber*, *D. corticola* was the most prevalent canker and dieback pathogen causing a general decline because of canker formation in the trunks (Alves et al., 2014).

Wood infecting fungi in in the groups that include *D. corticola* cause the death of spurs, arms, cordons, canes, and sometimes the upper section of grapevine trunks, depending on the location of the wood canker. Leaves on a shoot originating from an infected spur or cane will wilt and the shoot will die back completely during the growing season. This will reduce vine growth and fruit yield (Smith et al., 2014).

Worldwide Distribution: Algeria, France, Italy, Greece, Hungary, Mexico, Morocco, Portugal, Spain, Tunisia, United States (*California, District of Columbia, Florida, Maine, Massachusetts, Missouri, Texas, West Virginia, Wisconsin*) (CABI-CPC, 2021).

Official Control: *Diplodia* spp. are on the USDA PCIT's harmful organism list for Egypt, El Salvador, and Honduras (USDA, 2021).

California Distribution: Alameda, Humboldt, Los Angeles, Mendocino, Plumas, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Sonoma, and Yolo counties (PDR Database, 2021), with additional reports from San Diego County by UC Riverside pathologists (Lynch et al., 2010).

California Interceptions: There has been one interception in Alameda County on chestnut (*Castanea sativa*) nuts from Iowa.

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

Consequences of Introduction:

1) **Climate/Host Interaction:** This pathogen occurs with its hosts across a range of environments in temperate and tropical locations. Abundant rainfall increases disease severity.

   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 includes multiple trees and grapevines. Oaks are the most important host.

   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. spread with spores that are moved 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:** The occurrence of *Diplodia* spp. in asymptomatic plants has allowed their worldwide dissemination through nursery trades. There is often no barrier to disease transmission between native and nonnative plant species or cultivated/urban and natural settings i.e., between cultivated oaks and native oaks in California.

   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: *Diplodia corticola* has a host range that includes native California oaks. Although often occurring as mixed infections with other pathogens and insects, losses of branches and some whole trees have been reported.

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

Environmental Impact: A
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 *Diplodia corticola:* 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.

Diplodia corticola has been identified in northern, central, and southern California.

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* ***= 9***

Uncertainty:

It is very common for multiple genera of related fungi causing mixed infections to be isolated from wounds and cankers on declining oak trees and grapevines. Multiple species of *Diplodia* have been found on oaks (Lynch et al., 2013). Assessing the role of each species in the decline, and their interactions with each other, is difficult. Climate change is likely to be a major factor linked to increasing epidemics of Botryosphaeriaceae fungi, because it increases the intensity and frequency of stress on trees.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for *Diplodia coricola* is C.

References:

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Responsible Party:

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***Comment Period: 11/05/2021 through 12/20/2021**

***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