CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Profile for

Plenodomus tracheiphilus comb. nov (Petri) Gruyter, Aveskamp & Verkley 2013

Syn. *Phoma tracheiphila* (Petri) L.A. Kantsch. & Gikaschvili 1948

mal secco disease of citrus

Pest Rating: A

Kingdom: Fungi, Phylum: Ascomycota,
Subphylum: Pezizomycotina, Class: Dothideomycetes,
Subclass: Pleosporomycetidae, Order: Pleosporales,
Family: Leptosphaeriaceae

Comment Period: 09/04/2024 through 10/19/2024

Initiating Event:

This fungus is of concern to many international plant protection organizations and there is a risk of it spreading in infected propagative material. This pathogen has not been through the pest rating process. The risk to California from *Plenodomus tracheiphilus* is described herein and a permanent rating is proposed.

History & Status:

Background:

California produces the highest quality citrus in the world, supplying over 90% of the nation's fresh fruit, and sending exports to foreign countries. Grapefruit, lemons, oranges, and mandarins are grown on 270,000 acres with a 2021/22 value of $2.2B (https://www.cdfa.ca.gov/Statistics/PDFs/2022-2023_california_agricultural_statistics_review.pdf). There are three distinct growing regions in California: the coastal region where most of the state's lemons are grown; the desert region producing primarily grapefruit and lemons; and the San Joaquin Valley where 75 percent of the state's citrus acreage is located, primarily producing oranges, mandarins, and lemons.

'Mal secco', is an Italian term meaning 'dry disease'. This disease, which severely affects the xylem of citrus and elms, was first described in 1894 in the Greek Aegean Islands (Nigro et al., 2011). In Italy, the disease was found in Eastern Sicily in 1918, with infected plants brought from Greece. During the early part of the 20th century, it spread quickly through Italy (Nigro et al., 2011). Despite phytosanitary efforts to limit its spread, it is found in most citrus-growing countries around the Mediterranean and Black Sea, except Portugal and Morocco (EPPO, 2024). It has also spread to parts of the Middle East and there is a recent report from Canada (Zeng et al., 2024). Field observations suggest that the most susceptible citrus species are lemon (*Citrus lemon*), citron (*Citrus medica*), and lime (*Citrus aurantifolia*), but most all citrus species have some level of susceptibility (EPPO 2024; CABI 2024). On elms in Canada, symptoms of wilt and dieback previously attributed to *Dothiorella* sp. were found to be caused by *Plenodomus tracheiphilus* instead (Yang et al., 2024).

Plenodomus tracheiphilus is a conidial, necrotrophic fungus that colonizes the vascular system of its host. Originally, the pathogen was described as *Deuterophoma tracheiphila* by Petri (Nigro et al., 2011). Later, it was transferred to the genus *Phoma* (Ciccarone and Russo, 1969). Boerema et al., 1994 described section *Plenodomus* inside *Phoma* whose members are characterized by their ability to produce scleroplectenchyma (a thick tissue formed by hyphae that become twisted and fused), a phialophora-like synanamorph, and often also pseudothecia. Detailed molecular phylogenetic studies on *Phoma* and related anamorph genera recognized that *Phoma* is a polyphyletic group (de Gruyter et al., 2009). As a result, the section *Plenodomus* was moved up to become a genus and this fungus was named *Plenodomus tracheiphilus* (de Gruyter et al., 2013). Even though the sexual stage of *P. tracheiphilus* has not been produced *in vitro* nor found in orchards, molecular evidence suggests that this species is phylogenetically related to *Leptosphaeria*, the teleomorphic stage of numerous *Phoma* species. Sequences of *P. tracheiphila* retrieved in BLAST searches reveal a close relationship between *P. tracheiphila* and *Leptosphaeria congesta* (Balmas et al., 2005).

Hosts: The main host is lemon, but the pathogen has also been reported on other species of the genera *Citrus, Fortunella, Poncirus,* and *Severinia* and their hybrids, plus *Ulmus*.

Atalantia buxifolia (Chinese box-orange), *Citrofortunella macrocarpa, Citrus* spp., *Citrus* hybrids, *C. jambhiri, C. karna, C. latifolia*, *C. latipes, C.* x *limon, C. limonia, C. limonimedica, C. macrophylla*, *C. medica, C. myrtifolia, C. nobilis, C. pennivesiculata, C. reshni, C. reticulata, C. taiwanica, C. trifoliata, C. C. unshiu*, *webberi, C.* x *aurantiifolia, C.* x *aurantiifolia* var. *macrophylla, C.* x *aurantium, C.* x *aurantium* var. *clementina, C.* x *aurantium* var. *deliciosa, C.* x *aurantium* var. *paradisi, C.* x *aurantium* var. *sinensis, C.* x *junos, C.* x *limonia, C.* x *limonia* var. *jambhiri, C.* x *limonia* var. *volkameriana, C.* x *limon* var. *bergamia, C.* x *limon* var. *limettioides, C.* x *limon* var. *meyerii, C.* x *tangelo, Eremocitrus spp., Fortunella japonica, Fortunella* sp., *Poncirus, Poncirus trifoliata*, *Ulmus* sp. (EPPO, 2024; Zeng et al., 2024)

Symptoms: On citrus, the disease is characterized by the desiccation of twigs, branches, or the whole plant, as suggested by its name 'mal secco' (Sicilia et al., 2022). Individual branches or sectors may be infected initially (Solel and Salerno, 2000), but over time, the pathogen affects the entire tree, which eventually dies. Symptoms begin in spring as shoot and veinal and interveinal leaf chlorosis, shoot chlorosis, and epinasty of young leaves followed by both shedding of leaves wilt and dieback of twigs

and branches. Pycnidia can be seen as raised black points in ash-grey areas of withered twigs. Suckers commonly form at the base of branches and from the rootstock (Nigro et al., 2011).

When the wood of infected twigs, branches, or trunks is cut or stripped of bark, a salmon pink or brown-reddish wood discoloration under the bark of withered twigs, infected branches, and the trunk is seen. This is due to gum production within the xylem vessels (Magnano et al., 1992; Sicilia et al., 2022; Perrotta and Graniti, 1988). The growth of sprouts from the base of the affected branches and suckers from the rootstock is a common response of the host to the disease. Gradually the pathogen affects the entire tree, which eventually dies. In addition to the more common form of mal secco, two other forms of the disease can be distinguished. Root infections have been characterized by a chronic, slowly developing disease leading to a browning of the heartwood called 'mal nero' ('black disease') and a sudden death syndrome called 'mal fulminante' which is a rapid form of the disease apparently due to root infection (Nigro et al., 2011; Dimaria et al., 2023).

Transmission: Plants for planting are the main pathway for the introduction and spread of this disease. The pathogen can spread over long distances via the movement of infected rootstocks, grafted plants, scions, or budwood. Additionally, fruit peduncles and leaves, including latently infected, asymptomatic material, can carry the fungus. Once in an orchard, conidia produced on diseased plant parts such as twigs, branches, peduncles, leaves, etc. can spread over relatively short distances with rain-splash, overhead irrigation, water surface flow, or wind-driven rain (Migheli et al., 2009; Nigro et al., 2011). Birds and insects have been suspected to be vectors (Perrotta and Graniti, 1988). The pathogen can survive on pruned material or in soil containing infected plant debris (particularly twigs or branches) for up to four months (De Cicco et al., 1987).

Damage Potential: Mal secco disease causes major yield losses when the death of twigs reduces the volume of the citrus tree canopy. A substantial reduction in crop yield, resulting in an economic impact to lemon production happens where the pathogen occurs (Migheli et al., 2009). The disease can also lead to the death of citrus trees (Nigro et al., 2011). In the Mediterranean area, it is the most destructive fungal disease of lemons with a highly significant impact on the citrus industry (Migheli et al., 2009; Nigro et al., 2011; EFSA, 2014). Any injury to the tree, specifically from freezing, may predispose it to fungal attack. Outbreaks of *P. tracheiphilus* may occur after frost spells and hailstorms in spring (Perrotta and Graniti, 1988). The disease reduces the quantity and quality of lemon production in the areas where the pathogen is present and limits the use of susceptible species and cultivars. Losses in lemons are documented. In 1991, the incidence of mal secco in Greece was roughly 30 to 40%, with yield decreases of 20 to 30% (Thanassoulopoulos and Manos 1992). It was estimated that in Sicily in years with a high disease incidence, mal secco disease may have caused losses of up to 50% (Cutuli, 1982).

Worldwide Distribution: Africa: *Algeria, Egypt, Libya, Tunisia*. Americas: *Canada*. Asia: *Albania, Armenia, Georgia, Iraq, Israel, Lebanon, Syria, Yemen. Europe: Cyprus, France, Georgia, Greece, Italy, Russia, Spain, Türkiye* (EPPO, 2024; CABI 2024).

Official Control*: Plenodomus tracheiphilus* is of quarantine concern to many regional plant protection organizations and the United States. It is on the EPPO's A1 list for Argentina, Azerbaijan, Brazil, Chile, Iran, Paraguay, the Asia and Pacific Plant Protection Commission (APPPC), the Comité de Sanidad Vegetal del Cono Sur (COSAVE), and the Pacific Plant Protection Organisation (PPPO). It is on the A2 list for Bahrain, the European Plant Protection Organization (EPPO), the Inter-African Phytosanitary Council (AU-IAPSC), Jordan, and The Republic of Türkiye. It is a regulated quarantine pest in Mexico, U.S.A., and China, and a regulated non-quarantine pest in Switzerland (EPPO, 2024). It is on the USDA PCIT's harmful organisms list for Albania, Argentina, Bangladesh, Brazil, Chile, China, European Union, French Polynesia, Holy See (Vatican City State), Honduras, Indonesia, Jordan, Mexico, Monaco, New Caledonia, Paraguay, Peru, Republic of North Macedonia, San Marino, Taiwan, Thailand, The Republic of Türkiye, Timor-Leste, United Kingdom, Uruguay, and Viet Nam (USDA-PCIT 2024).

California Distribution: none

California Interceptions: none

The risk that *Plenodomus tracheiphilus* would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** Citrus is widely planted in all areas with mild winters. Elms are commonly planted in landscapes

   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 be established 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 citrus and related genera, plus elm.

   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:** This pathogen has only one type of spore, asexual conidia. Spores can be airborne. It can be spread with nursery stock.

   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 economic impact of *P. tracheiphilus* includes expenses related to pruning branches and twigs, removing dead trees, lowered yields, and the added cost of applying extra fungicide sprays (Migheli et al., 2009; Nigro et al., 2011). It is a quarantine pest in many countries.

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

Economic Impact: A, B, C

A. The pest could lower crop yield.
B. The pest could lower crop value (including increasing crop production costs).
C. The pest could trigger the loss of markets (including 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:** There are no native citrus or elms, but citrus is extensively planted in home gardens and elms are used as street trees. The city of Sacramento has nearly 1,800 elms, some have been infected with Dutch Elm disease, caused by another exotic fungal pathogen, *Ophiostoma novo-ulmi.*

Evaluate the environmental impact of the pest on 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 *Plenodomus tracheiphilus:* 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 '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 the 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* ***= 11***

Uncertainty:

The pathogenicity of isolates collected from *Ulmus* sp. in Canada has not been confirmed on *Citrus* sp. (Y. Yang, Alberta Plant Health Lab, Pers. Comm). If isolates from *Ulmus* are pathogenic on citrus, *Ulmus* trees or wood products from Canada could be a pathway for the pathogen into the United States.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for ***Plenodomus tracheiphilus*** **is A.**

References:

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Responsible Party:

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*Comment Period: 09/04/2024 through 10/19/2024

*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.

Pest Rating: A