CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal for

Polystigma amygdalinum Cannon, 1996
almond red leaf blotch

Current Pest Rating: Q

Proposed Pest Rating: B

Kingdom: Fungi, Phylum: Ascomycota,
Subphylum: Pezizomycotina, Class: Sordariomycetes,
Subclass: Sordariomycetidae, Order: Phyllachorales,
Family: Phyllachoraceae

Comment Period: 09/30/2024 through 11/14/2024

Initiating Event:

In early June 2024, University of California Co-operative Extension Specialist, Fruit and Nut Crop Plant Pathologist Florent Trouillas contacted Senior Diagnostician Suzanne Rooney-Latham at CDFA's Plant Pest Diagnostics Lab to report he had recently diagnosed red leaf blotch (RLB) disease of almond, caused by the fungus *Polystigma amygdalinum*, from multiple commercial almond orchards in the San Joaquin Valley. CDFA staff collected an official sample from a symptomatic orchard close to the Merced-Madera County line. The leaves were dissected, and spores that matched the descriptions of *P. amygdalium* were seen in the tissues. This fungus cannot be grown in culture, so PCR amplification of the ITS region was used to generate DNA sequence data. Sequences obtained from multiple samples matched published sequences for *P. amygdalium* and it was assigned a temporary Q-rating. Almond leaf samples and CDFA-generated sequence data were sent to Megan Romberg, USDA National Mycologist/Plant Pathologist, who confirmed the diagnosis as a first observation of this fungus in the U.S. This pathogen has not been through the pest rating process. The risk to California from *Polystigma amygdalinum* is described herein and a permanent rating is proposed.

History & Status:

Background:

California grows 80% of the global almond crop and 100% of the commercial supply for the U.S. Our hot, dry, Mediterranean climate and the well-developed water infrastructure in the Central Valley provide ideal growing conditions for almonds. In 2022, almonds were California's 5th most valuable commodity and the highest-value export crop. Approximately 1.25M acres yielded 2.8B pounds of nuts that were valued at $3.53B (https://www.cdfa.ca.gov/Statistics/). The largest almond-growing counties are Fresno, Kern, Stanislaus, Merced, and Madera, and they account for 75% of the total bearing acreage (https://www.almonds.com/sites/default/files/2023-04/2022_NASS_Acreage.pdf).

Red leaf blotch is an important foliar fungal disease in some of the major almond production regions of the Mediterranean basin and the Middle East including Iran, Israel, Italy, Morocco, Spain and Turkey. Cultivated almonds, *Prunus dulcis*, and wild almonds, *P. webbii*, are the only hosts. *Polystigma* is a biotrophic ascomycete and the type genus of the family Polystigmataceae, established by Lamarck and de Candolle in 1815. *Polystigma amygdalinum* was first described in Italy in 1845 as a pathogen of almonds as *Septora rubra* var *amygdalina*. *Polystigma* was formally monographed by Cannon (1996); it is a small genus, and most of the species are reported to have both asexual and sexual morphs. The genus is characterized principally by its brightly colored stromata, occurring on living leaves of *Prunus* spp. in the Euro-Asiatic areas. Five species are accepted by Cannon. A study in 2016 by Habibi and Banihashemi indicated that it may not fit best in the Phyllachorales and would be better matched to

the Xylariomycedidae subclass of the Sordariomyces. Because of its host specificity, limited distribution, and because it cannot be grown on artificial media, published research is limited.

Hosts: Cultivated almond (*Amygdalus communis*, syn. *Prunus amygdalus*, syn. *P. dulcis*), wild almond (*Amygdalus webbii*) (Farr and Rossman, 2024).

Symptoms: The earliest disease symptoms appear in mid-May and continue to develop during the summer months. Symptoms begin as pale green to yellowish spots on both leaf surfaces, and first turn yellow orange, later to dark red and dark brown. The size of the spots increases through the spring and summer, and they will cover almost the whole leaf surface. The spots are associated with hypertrophy and deformation of the leaves, which is caused by the development of the fungal stroma inside the leaves. Infected leaves roll inward, and there is premature defoliation (Zúñiga et al., 2020).

Transmission: RLB is a monocyclic disease, and the inoculum comes from the stromata of affected leaves that have fallen to the ground the preceding autumn. Ascospores are believed to be the only inoculum of this pathogen. The ascospores are spread by air and infect new almond leaves (Banihashemi, 1990). Ascospores are discharged from early February, just before flowering, until mid-May, after fruit set. The filiform spores visible in the intact leaves during the summer are spermatia essential to the sexual process and are not asexual spores that can infect leaves. It is likely to be homothallic, not requiring separate mating types to form ascostromata (Habibi and Banihashemi, 2016). Long-distance spread can occur with the movement of infected nursery stock. The pathogen has not been found associated with hulls and nuts.

Damage Potential: Polystigma is one of the few genera of Phyllachoraceae that can cause economic damage to its host plants, causing infected leaves to become necrotic and curl, dropping from the trees prematurely. This pathogen does not infect wood or kill trees. It also does not directly affect the nuts. Occasionally, severe infections under hot and dry conditions can induce an early leaf fall in summer, thus reducing the photosynthetic activity of trees, and can diminish crop yields in the current year and the next (Zúñiga et al., 2020). Specific crop loss estimates are not found in the literature.

Worldwide Distribution: Afghanistan, Cyprus, Greece, India, Iran, Israel, Italy, Kazakhstan, Lebanon, Libya, Morocco, Portugal, Romania, Tajikistan, Turkey, Ukraine, United States (California) (Cannon, 1996; CDFA PDR database, 2024).

Official Control: This pathogen is not listed by the EPPO and is not on the USDA's harmful organism list for any country. It is not a U.S.-regulated pest.

California Distribution: Official samples have been confirmed from Fresno, Madera, Merced, San Joaquin, and Stanislaus counties. Despite a first report just in the spring of 2024, it seems to be already widespread in the Northern San Joaquin Valley (Dr. F. Trouillas, UCCE, Pers. Comm.).

California Interceptions: none

The risk that *Polystigma amygdalinum* would pose to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** This pathogen is likely to survive wherever its hosts can grow.

   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 limited to almonds.

   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:** As a monocyclic pathogen with only one type of spore, it has spread very rapidly in the San Joaquin Valley, showing its potential is high.

   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:** There is limited direct economic data available – e.g. measurement of yield in symptomatic vs. healthy orchards. However, reducing the number of leaves will slow tree growth and hurt nut production. If fallen leaves are left in the orchard, they will release ascospores and perpetuate the infection cycle.

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

   Economic Impact: A, D
   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: **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:** Fungicide treatments may be necessary to control this disease.

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

Environmental Impact: D

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 *P. amygdalinum:* Medium

Add up the total score and include it here. **10**
-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'.

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 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* ***= 9***

Uncertainty:

As this disease has only been known in California for a very short time, we have very limited information on its distribution and impacts.

Conclusion and Rating Justification:

Based on the evidence provided above the proposed rating for ***Polystigma amygdalinum*** **is B.**

References:

Banihashemi, Z. 1990. Biology and control of *Polystigma ochraceum*, the cause of almond red leaf blotch. Plant Pathology. 39:309-315.

Cannon, P.F., 1996. Systematics and diversity of the Phyllachoraceae associated with Rosaceae, with a monograph of *Polystigma*. Mycological research, 100(12), pp.1409-1427.

Farr, D.F., and Rossman, A.Y. Fungal Databases, U.S. National Fungus Collections, ARS, USDA. Retrieved 9/11/2024, from https://nt.ars-grin.gov/fungaldatabases/

Habibi, A. and Banihashemi, Z., 2016. Mating system and role of pycnidiospores in biology of *Polystigma amygdalinum*, the causal agent of almond red leaf blotch. Phytopathologia Mediterranea, pp.98-108.

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USDA Phytosanitary Certificate Issuance and Tracking System, Phytosanitary Export Database (PExD) Harmful Organisms Database Report. *Polystigma amygdalinum*. Accessed 9/11/2024.

Zúñiga, E., Romero, J., Ollero-Lara, A., Lovera, M., Arquero, O., Miarnau, X., Torguet, L., Trapero, A. and Luque, J., 2020. Inoculum and infection dynamics of *Polystigma amygdalinum* in almond orchards in Spain. Plant disease, 104(4), pp.1239-1246.

Responsible Party:

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***Comment Period: 09/30/2024 through 11/14/2024**

***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.

Proposed Pest Rating: B